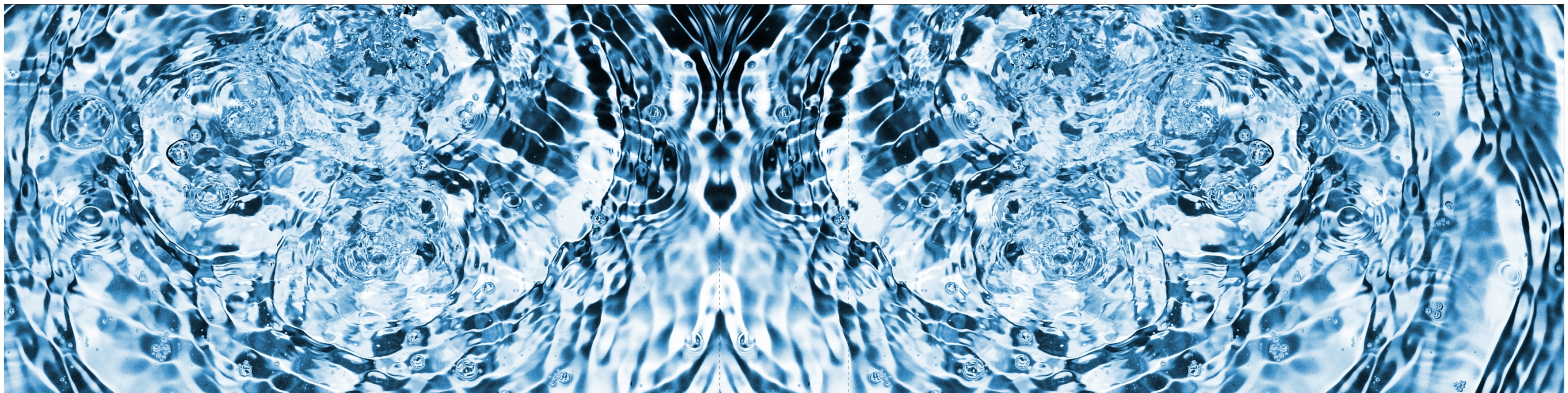

Council on Energy, Environment & Water

CEEW Report September 2011

Thapar House, 124, Janpath, New Delhi 110001, India
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National Water Resources Framework Study

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2030 WATER RESOURCES GROUP

Research Report Submitted to the Planning Commission for the 12th Five Year Plan

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A report on a national water resources framework study for the Planning Commission, Government of India.

This report was prepared by the Council on Energy, Environment and Water with a research team comprising independent experts. The report was commissioned on the request of the Planning Commission of India to the 2030 Water Resources Group, via the International Finance Corporation.

The Council on Energy, Environment and Water (CEEW) is an independent, not-for-profit, policy research institution. CEEW works to promote dialogue and common understanding on energy, environment and water issues in India, its region and the wider world, through high quality research, partnerships with public and private institutions, and engagement with and outreach to the wider public. For more information, visit http://www.ceew.in.

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FOREWORD

For India's economic growth and human development to become sustainable, the holistic management of the nation's water resources is critical. Two underlying trends underscore this imperative. First, looking forward over the next two decades, India's growing demand for water will fall short of available and planned increases in supply by a significant percentage. Secondly, while agriculture is the lifeblood for a large share of our population, trends in urbanisation and industrialisation will put pressure on the sectoral allocation of water. How do we manage these pressures in a fair and equitable way while also ensuring that the institutions mandated with different water management tasks operate with a strategic vision and in a coordinated manner? How, in other words, can we develop a framework for the sustainable management of India's national water resources?

This is the premise of the report that you now hold in your hands. The primary purpose of the report was to find the evidentiary basis for proposing reforms in the water sector. It was also important to answer questions that had direct relevance to policymakers. Through the 2030 Water Resources Group, the Council on Energy, Environment Water engaged with Dr Mihir Shah, Member, Planning Commission, to write a report that could serve as an input into the deliberations for the 12th Five Year Plan. We are deeply grateful for Dr Shah's guidance during this project, starting with the comprehensive list of questions that he posed to the research team and, subsequently, for his stewardship of the process of consultation with the Working Groups convened by the Planning Commission.

The National Water Resources Framework Study covers the full range of water-related issues: from effective participatory management of medium and large scale irrigation to the sustainable management of groundwater resources; from reform and capacity building of irrigation and drainage departments to the role of water regulators; from water utility management to regulating the entrepreneurial sector providing water services; from promoting water conservation in industry to exploring legal, regulatory and institutional reforms. Only such integrated analysis can offer solutions to improve governance across all levels of government. Working Paper 1 highlights how the success of interventions in one area is contingent of action in others. The twelve remaining working papers provide detailed diagnosis of the problems, analysis of reform initiatives underway in different parts of the country and internationally, and propose reforms that would be applicable within the 12th Five Year Plan and in the long term.

I congratulate the team comprising senior and independent international and national water experts: Dr Martin Anthony Burton, Mr Simon Gordon-Walker, Mr Rahul Sen and Mr Anand Jalakam. The team's work was led and coordinated by CEEW's CEO, Dr Arunabha Ghosh, who also provided overall sector policy guidance. CEEW thanks the International Finance Corporation, which supported the project on behalf of the 2030 Water Resources Group and made the resources available to produce this comprehensive document in a short span of time. I hope that this report can trigger a nationwide debate on the sustainable management of our water resources.

Suresh P. Prabhu
Chairperson, Council on Energy, Environment and Water

New Delhi
12 September 2011

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National Water Resources Framework Study

Working Paper No.1:

Overview of Working Papers

The Working Papers have been structured in response to the questions posed to the National Water Resources Framework (NWRF) study by the National Planning Commission. These questions are presented in Table 1. Table 2 presents the title of each Working Paper. Table 3 presents broad answers and possible solutions to the questions posed.

Table 1: Questions posed by the National Planning Commission

Theme	Questions	Working Paper
Large Scale Irrigation Reform	1. Can we say that PIM/IMT has failed?	WP 2
	2. Under what conditions does PIM work?	WP 2
	3. Under what conditions does PIM fail?	WP 2
	4. What is the way we need to define PIM such that it delivers on the ground (its essential constituent elements)?	WP 2
	5. What is the best way forward to ensure volumetric pricing of water?	WP3; WP2; WP4
	6. Detailed case-study of Andhra	WP 2
	7. Detailed case-study of Gujarat	WP 2
	8. In what ways should/can the irrigation bureaucracies be reformed?	WP 3; WP4
	9. Can we suggest a new set of conditionalities/reforms to make AIBP more effective?	WP2;WP3;WP4; WP6
	10. How do we reintegrate AIBP and CADP?	WP2;WP3;WP4; WP6
Groundwater Management	11. What does the international experience on groundwater management teach us (especially Spain, Mexico)?	WP5
	12. What does the APFMGS experience on groundwater management teach us?	WP5
	13. Detailed case-study of APFMGS	WP5
	14. Is metering/licensing of groundwater an option?	WP5
	15. What does the Gujarat experience in the first decade of the 21st century teach us? Is the Gujarat turnaround (on groundwater levels) mainly attributable to separation of feeders? What was the contribution of the larger power sector reforms in this?	WP5
	16. What is the best way to break the “energy-groundwater” nexus?	WP5
	17. Can we develop a State-specific road-map of reforms in breaking the “energy-groundwater” nexus?	WP5
	18. What conclusions should we draw from the work of Aditi Mukherji on West Bengal in this respect?	WP5
	19. Do we know enough about arsenic in groundwater? Is it true that we still do not understand what triggers the occurrence of arsenic in groundwater as scientists from Bangladesh recently told me? What is the state of knowledge on this internationally?	WP5
	20. If we are to take the required steps in the direction of sustainable groundwater management, what kinds of changes are required in the CGWB, CGWA and the SGWBs?	WP5
	21. What are the kinds of partnerships these institutions would need to develop with other agencies?	WP5
	22. What would be the best institutional design for Aquifer Management Associations (AMAs)?	WP5
	23. What would be their interface with the statutory groundwater bodies?	WP5
	24. How best could the AMAs be part of river basin planning?	WP5
River Basin Planning	25. How can we visualise river basin planning happening in India?	WP6
	26. What are the institutional requirements for this to become possible?	WP6

	27. What are the data requirements for this to become possible?	WP6
	28. What are the human resource capacity requirements for this to become possible?	WP6
	29. What is the process through which this can happen?	WP6
	30. What kind of road-map can we propose for river basin planning in India given the dismal experience so far?	WP6
	31. Is it better to begin with sub-river basin planning?	WP6
Regulatory Framework	32. Should there be a regulator at a national level or a separate one in each State?	WP7
	33. What should be the functions of a regulator?	WP7; WP11
	34. What should be the degree of independence of the regulator from government or rather what should be the precise nature of the relationship between regulator and government?	WP7; WP11
	35. What should be the human resource profile of a regulator?	WP7
	36. What can be learnt from the experience of the MWRRA so far?	WP7
	37. Case study of MWRRA	WP7
Legal Framework	38. Does India need a National Water Framework Law akin e.g. to or different from the EU Water Framework Directive?	WP8
	39. Does India need new groundwater legislation in line with the PTD enunciated by the Supreme Court?	WP8
	40. Are there international legislations that could help India? South Africa, for instance, legally protects basic requirements of domestic water and of the environment "reserve"?	WP8
Urban and Industrial Water	41. Apparently the Chinese 12th Plan targets a 30% reduction in water consumption per unit of value added in industrial consumption? Is this or something like this, a realistic target for India? If so, what would be the instruments that could help achieve it?	WP9
	42. Could we set a target for the proportion of water to be mandatorily recycled by Indian industry? If so, what would be the instruments that could help achieve it?	WP9
	43. How can international experience in this regard help in moving Indian industry in this direction, both in terms of technologies and in terms of instruments of reform (incentives, disincentives etc)	WP9
	44. What are the main lessons that emerge from the Indian experience with PPP in urban water supply?	WP10
	45. Can we specify the way concession agreements need to be drawn up, outlining precisely what should never be done, what the positive non-negotiables are and what the desirables might be?	WP10
	46. Is it possible to spell out a road map for urban water supply reform in India?	WP10
	47. What are the best examples of this that we may adopt practices from (could be specified in terms of what we may adopt from which city/town)?	WP10
National Water Commission	48. Does India need a National Water Commission on the lines specified in my presentation?	WP13
	49. If so, what should be the functions of such a Commission?	WP13
	50. What legal changes would be required for such an NWC to be constituted?	WP13
	51. What precise functions should the NWC perform?	WP13
	52. What should be its human resource profile?	WP13
	53. Can the CWC be conceivably modified to play these roles?	WP13

Table 2: Titles of Working Papers

No.	Title
WP1	Overview of Working Papers
WP2	Re-engaging with Participatory Irrigation Management
WP3	Reforming Management in the Irrigation and Drainage Sector
WP4	Performance Management in the I&D Sector
WP5	Managing Ground Water for Multiple Uses
WP6	Water Resources Management
WP7	The Role of the Water Regulator in Water Resource Management
WP8	Perspectives on Legal Frameworks for Water Resources Management
WP9	Developing a Water Conservation Strategy for Industry
WP10	Water Utility Management: Urban Water Supply Reform and Use of Public Private Partnerships
WP11	Regulation of Water Supply and Wastewater
WP12	Governing the Entrepreneurial Sector Providing Water Services
WP13	National Water Commission

Table 3: Summary of answers and proposed solutions to the questions

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
Large Scale Irrigation Reform					
<u>*Diagnosing PIM*</u> • Can we say that PIM/IMT has failed? • Under what conditions does PIM work? • Under what conditions does PIM fail? <u>*Redefining PIM*</u> • What is the way we need to define PIM such that it delivers on the ground (its essential constituent elements)?	• PIM/IMT has not failed, but is not working well in many cases. The concept is correct; the implementation of the process by government organisations has been poor. • PIM/IMT succeeds where government and irrigation agencies are fully committed to the principles and process. It fails where this support is lacking. • To succeed PIM/IMT requires long-term commitment and	• PIM established without sufficient support services. • PIM often not accepted and supported by ID. • Limited resources committed to WUA formation and establishment. • Little or no training and capacity building provided to WUAs. • WUAs not given sufficient rights, such as setting, collection and utilisation of service fees. • Too much interference and control of the WUA	**Short-term (12th FYP):** • Gain acceptance at all levels in ID for PIM, no exceptions. • Establish WUA Support Units • Provide training and support for WUAs • Change WUA laws to allow for WUA charter, fee setting and collection, etc. • Change water tax to a service fee set and collected by WUAs. **Long-term (10-20 years):** • Maintain support to WUAs over 10-15 year transition period until fully institutionalised.	• Analysis and evidence provided in WP2. • PIM succeeding in schemes in Gujarat, Maharashtra, MP and AP where adequate support provided. • AP has established I&CAD funded WUA Support Units at Circle Level. Similar approach proposed by World Bank funded MP Water Resources Sector Restructuring Project (MPWRSRP). • IMT has succeeded elsewhere (USA, Spain, Mexico,	• Reform the ID from construction focus to a MOM focus. • ID must be focussed on service delivery and performance management. • Change of attitude by ID staff to water users and PIM concept.

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	support. • To succeed water users (through WUAs) need to be given more responsibility with associated rights (such as being able to set, collect and utilize service fees independent of the ID). • Investment of time and resources is required in the short term to build WUA capacity. • There are relevant examples worldwide and in India of successful PIM/IMT.	by the ID (as the Competent Authority).		Turkey, Kyrgyzstan). • IMT succeeding in Kyrgyzstan with small landholdings and subsistence farmers comparable to India.	
<u>Measurement</u> • What is the best way forward to ensure volumetric	• Firstly have to appreciate that this is a difficult task, moving from an operational culture	• Little or no measurement of volume of water delivered to farmers at present.	**Short-term (12th FYP):** • Build on existing experience in schemes such as Dharoi (Gujarat) and	• Analysis and evidence provided in WP2, WP3 and WP4. • Dharoi (Gujarat) and	• Change of culture within ID and farming community to paying by volume delivered.

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
pricing of water?	with little flow measurement to one with full or partial measurement. • Secondly, have to appreciate that volumetric measurement may not be appropriate or feasible for all schemes. • Requires technical and institutional measures. Technical – installation of measuring structures. Institutional – procedures for daily measurement, recording and processing. • Form WUAs and get water users on board with the concept, then install measuring structures at intake to WUA command areas.	• Few measuring structures and little or no organisational culture of discharge measurement. • Transparency and accountability of water allocations not always considered beneficial to all.	Waghab (Maharashtra). Identify key features in success of these schemes. • Choose suitable schemes where water saving and better water sharing can produce measurable benefits. • Provide funds under AIBP/CAD to install measuring structures, create awareness of process amongst water users and train personnel **Long-term (10-20 years):** • Train all ID staff in principles and practices of discharge measurement. • Incorporate measurement into all	Waghad (Maharashtra) provide good examples of volumetric measurement. Has been accompanied by significant institution building of WUAs. • Measurement widely used in other countries, USA, France, Italy, Spain, Australia, but also former Soviet Union countries such as Kyrgyzstan with large number of smallholders. • Case studies provided of Dharoi, Waghad, Albania and Kyrgyzstan.	• Development of a service delivery and performance management culture with the ID.

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	• Have joint measurement of discharges daily by WUA and ID and delivery point. • Charge WUA on volumetric basis but allow WUA to set and collect fee from water users on simplified basis (area, crop type, flow duration, charge per irrigation, etc.)		rehabilitation projects. • Continue to support gradual adoption of volumetric measurement on suitable schemes.		
Case studies • Detailed case-study of Andhra • Detailed case-study of Gujarat	• See discussion above. Case studies and examples provided in WP2 and WP3.			Case studies and examples provided in WP2 and WP3.	
Management reform - I • In what ways should/can the irrigation	• Significant reform of the ID required in order to address	• ID currently focussed on construction rather	**Short-term (12th FYP):** • Each State to carry out a review of	• Analysis and evidence provided in WP3 and WP4.	• Reduce interference and pressure from politicians to

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
bureaucracies be reformed?	current and upcoming issues. • Culture of ID needs to change from construction focus to management, operation and maintenance (MOM) focus. • ID needs to focus on service delivery and enhanced performance of I&D schemes. • Staffing profile within the ID needs to change with increase in cadres such as water resources, irrigation and agricultural engineers. • Human Resource Development (HRD) in ID has to change with more professional approach. • WALMIs need to be	than MOM (management, operation and maintenance) • Some senior personnel in some IDs unwilling to modernize the organisation. • ID staffed with civil engineers rather than water management engineers. • Lack of understanding/ interest in water users and irrigated agriculture. • Very poor standard of training and HRD in ID.	current and future role of the ID and make proposals for reform. State IDs to formulate a vision for the future. • Support States with implementation of agreed reforms. • Reform charters of ID to allow employment of wider range of professionals. • Reform WALMIs to enable them to provide training to convert civil engineers into irrigation engineers and water management engineers. **Long-term (10-20 years):** • Support university education of irrigation engineers	• In all major irrigation states the area actually irrigated and under ID management greatly exceeds new areas for development. Construction should be the minor, not the major, concern of the ID. • World Bank funded Sustainable Development of WUAs study in 2010 identified ID reform as major requirement for successful PIM/IMT. • Several reports on WALMIs have highlighted major concerns and need for reform.	develop new irrigation areas. • Reduce funding for construction of new I&D schemes in developed States and increase funding for MOM related initiatives. • Support and reward States for converting ID from construction focus to water management/MOM focus. • National and State government focus on increasing production and productivity of water use on existing schemes

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12^{th} FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	revitalised and staffing significantly improved.		and other water management professionals • Promote change of ID culture from construction to management.		
<u>Management reform -II</u> • Can we suggest a new set of condition-alities/ reforms to make AIBP more effective? • How do we reintegrate AIBP and CADP?	• AIBP to prioritize its mission and goals for achieving targets of new IP and stabilization of existing IP and not allow accommodation of any demands made by the states. • AIBP to prioritize projects in each state that can be completed in a time bound manner and not spread its resources so thin that project completion becomes a casualty.	• Net and gross irrigated area in the country is not showing significant increase despite implementation of AIBP. • Many states instead of completing the last mile projects under AIBP are taking up new projects, which would require longer completion period. • Major irrigation DPRs needs various clearances from central government agencies/ ministries.	**Short-term (12^{th} FYP):** • Review and refocus the mission objectives of AIBP to achieve programme objectives. • Create a priority list of projects in each state to be completed within 12 Plan and make available the resources for achieving it. • Co-ordinate sanction between AIBP and CAD&WM scheme to ensure the short listed projects	• Analysis and evidence provided in WP2, WP3, WP4 & WP6.	• Acceptance by state politicians and senior ID managers of the role for management initiatives to increase agricultural production and water use productivity.

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	• Streamlining of various sanctions required to facilitate faster clearance of projects. • Sanction of CAD works under CAD&WM scheme may be made along with sanction of project under AIBP. • Planning and survey for CAD work should commence with construction of minors. • WUAs in new projects should be formed during system construction itself and not after delimitation of ayacut as is the practice now. This will assist in co-jointly completing CAD works in the ayacut with the completion of the	All such agencies/ministries examine the DPRs in sequential order and take considerable amount of time in granting requisite clearances. • CAD works is taken up in new major irrigation projects only after completion of the storage and distribution system to the minor level. This delays irrigation services by a further few years after canal system completion. • Currently, CAD works is planned from the head to the tail reach. While the tail reach CAD works are in progress it is usually the practice of the	completed including CAD works within the 12 Plan period. • Offer to support states with management reforms focused in increasing agricultural and water use productivity. **Long-term (10-20 years):** • Strengthen the project MOM capacity of state IDs to ensure that ayacut once created is not lost due to inadequate O&M. • Provide grants to form WUA Support Units in IDs. • Adoption by State IDs of benchmarking scheme performance.		

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12^{th} FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	canal system. • AIBP to support management initiatives to enhance agricultural production and water use productivity. Support performance based management of I&D schemes.	ID to start releasing water to the head reaches. This establishes bad practices as the head reach users get used to greater than designed water supplies in the first few years. Later tail reach farmers find it difficult to obtain rightful water supplies. • MoWR sanctions new projects under CAD&WM scheme only after completion of works in currently sanctioned projects. This invariably leads to newly completed projects to be brought under CA&WM scheme after a delay of a few years during which time	• Grants for adoption by IDs of modern approaches to irrigation management (remote sensing, GIS, measurement, etc.)		

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
		managing irrigation becomes a problem.			
Groundwater Management					
International experience • What does the international experience on groundwater management teach us (especially Spain, Mexico)?	• Many countries are experiencing problems with overdraft of groundwater (Mexico, USA, Spain, Turkey). Few countries have been able to adequately manage and control this overdraft. • Spain has serious problems and has formed aquifer management groups. These have not yet been successful (despite very successful surface water management groups). • In Mexico aquifer management	*International experience:* • Large numbers of spatially dispersed abstractors. • Difficulty in regulating and controlling drilling of new wells. • Difficulty in getting abstractors to work together. • Increase in cropping of high value crops means farmers very reluctant to reduce gw use. • Mixed messages from government. Providing subsidised electricity for agriculture at the same time as trying to regulate and	**Short-term (12th FYP):** • Learn from experience of other countries, even though in some cases it has not been successful. **Long-term (10-20 years):** • Continue to monitor and learn from experience in other countries.	• Evidence in WP5 from Spain and USA	

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	councils (COTAS) have been formed since 1996. They too have not been successful to date. There is adequate legislation in place for gw management, but this is not enforced.	restrict gw abstraction.			
<u>*Case study: Andhra Pradesh*</u> • What does the APFMGS experience on groundwater management teach us? • Detailed case-study of APFMGS	• Participatory hydrological monitoring, environmental viability assessment, crop water budgeting and farmers water schools are workable simplified scientific methods and tools for participatory groundwater monitoring and sustainable use of groundwater.	• Unregulated expansion of groundwater irrigation is leading to rapid depletion of groundwater. • Groundwater irrigation based agriculture is becoming unsustainable. • Farmers are investing more and more into deepening their bore wells getting indebted and even losing their	**Short-term (12th FYP):** • Formulate and implement participatory groundwater management (PGM) projects in endemic groundwater depletion areas • Allocated adequate resources and trained personals in implementation of these projects. • **Long-term (10-20**	• Analysis and evidence provided in WP5 • APWELL & APFMAGS projects have successfully implemented PGM in 650 villages in 7 districts of Andhra Pradesh.	• Implement groundwater recharge works. • Provide agricultural extension support to farmers to adopt water saving agronomic practices. • Provide incentives for use of micro irrigation wherever possible.

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	• Community awareness and training on participatory monitoring of groundwater can lead to better collective decision making on improving groundwater management and sustainable groundwater use.	investments.	**years):** • Maintain support for PGM projects for an extended period to facilitate adequate training and capacity building of community to make project sustainable. • Develop capacity in groundwater and agriculture departments to support PGM projects.		
Case study: Gujarat • What does the Gujarat experience in the first decade of the 21st century teach us? Is the Gujarat turnaround (on groundwater	• Separation of feeder led to improvement in quality of power supplied to agriculture and rural domestic connections in Gujarat. • Separation of feeder assisted in effective rationing of power	• Unified feeders for agricultural and rural domestic supply limits the possibility of rationing power supply to agriculture as farmers can use phase-splitting capacitors to run pump sets even on	**Short-term (12th FYP):** • Separation of feeders to be implemented in all states with high agricultural power consumption. • Formulate special programme for small and marginal farmers to mitigate	• Analysis and evidence provided in WP5. • Separation of feeders implemented in Gujarat under Jyotirgram Yojana. • Separation of feeders implemented in Andhra Pradesh and Punjab.	• Conversion of agricultural feeders to HVDS. • Replace inefficient pump sets with BEE certified pump sets to reduce per pump efficiency. • Implement PGM and community based artificial

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
levels) mainly attributable to separation of (power) feeders? What was the contribution of the larger power sector reforms in this?	supply for agriculture thereby reducing agricultural power consumption in Gujarat. • Reduction in agricultural power consumption improved the financial health of the power utilities and reduced the subsidy burden for agricultural power on the government in Gujarat. • Turnabout of groundwater levels in parts of Gujarat is only partially attributable to separation of feeders. Other influencing factors were good monsoon for a few continuous years, recharge of groundwater through widespread	2-phase power supply. • Overload of feeder lines and poor power supply leads to pump burn out and low reliability of irrigation services, which make farmers unwilling to pay increased tariff. • Separation of feeder adversely impacts groundwater markets as reduction in hours of agricultural power supply shrinks the amount of water sold by pump owners. • Shrinking of water markets directly affects poor small and marginal farmers who are the most common water buyers.	the adverse impact of shrinking groundwater market on them – targeted credit for pump investment, collective groundwater irrigation facility. • Provide technical advice and credit for interventions to conserve water (e.g. buried distribution pipes) **Long-term (10-20 years):** • Rationalize agricultural power tariff levels to make power utilities financially viable and reduce state subsidies on agricultural power supply – metered tariff if politically feasible or rational flat tariff with	• APWELL project implemented in Andhra Pradesh under which small and marginal farmers collectives managed groundwater irrigation facility.	groundwater recharge works. • Improve irrigation water distribution and application efficiencies through micro irrigation and appropriate agronomic practices.

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	community based watershed and artificial recharge programmes.		synchronized power supply to agriculture as per moisture stress and irrigation needs. • Develop the capacity of the power utilities to diagnose and manage power supply to agricultural as per the specific needs of an area.		
Energy-groundwater nexus • Is metering / licensing of groundwater an option?	• Metering of pump sets and volumetric charging for powers is the solution propagated by the protagonists of power sector reforms for the solution to the "energy-power nexus" in the country. • Due to the distances	• Metering of pump sets was abandoned by most SEBs during the 1970s and 1980s as the cost of metering, raising tariff on consumption and then collecting the tariff from such large number of dispersed consumers had become a	**Short-term (12th FYP):** • It may be a better option to make states to adopt a rational flat tariff system with the associated actions of separation of feeders, conversion to HVDS, replacement of inefficient pumps with BEE certified	• Analysis and evidence provided in WP5. • Separation of feeders carried out in Gujarat, Andhra Pradesh and Punjab. • Conversion of agricultural feeder lines to HVDS on going in Andhra Pradesh. • Detailed project	• Participatory Groundwater Management (PGM) • Agriculture Extension and Marketing Services (AES) • Artificial groundwater recharge works.

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	over which power will have to be transmitted and distributed and the low consumer load on the feeders the cost of services for agriculture could become high making groundwater irrigation unviable for many farmers. • Licensing of groundwater is already provisioned for under the groundwater control and regulation legislation of a number of states. • However, it is more implemented in the breach with many users extracting groundwater without securing license. This has resulted in practically no groundwater	logistic and monitoring problem for them. • This problem will be even more now as the number of agricultural connections is many times more that it was in 1970s and 1980s. • Power utilities ability to install, monitor and protect the meters from tampering is logistically limited and utilities may not effectively be able to meter and charge the consumers. • While for electric pump sets licensing of groundwater can be done at the time of sanctioning power connection, experience in Andhra Pradesh and	pumps, improving on-farm water application efficiency – micro irrigation & agronomic practices. • Get all remaining states to enact groundwater (regulation) legislation. **Long-term (10-20 years):** • Enforcement of groundwater regulation legislations may be tightened using remote sensing and IT enabled monitoring systems to track location of extraction devices and volume of water pumped through pre-installed electronic chips in the pump sets	reports for replacement of pump sets prepared for 7 states. • Micro irrigation projects being implemented in number states with subsidy from the National Horticulture Mission of GoI.	

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	regulation due to licensing.	many other states show that farmers hook up unauthorized connections, which the licensing authority find difficult to monitor and control due to logistic and political reasons. • In the case of diesel pump sets even this option is not there and only field verification can facilitate licensing. • Licensing in itself will not lead to groundwater regulation. For that the license will have to fix a particular volume as entitlement, which again the licensing authority may find impossible to monitor as the	programmed to monitor duration of pump operation.		

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
		extraction is so local and time specific.			
Energy-groundwater nexus • What is the best way to break the “energy-groundwater” nexus? • Can we develop a State-specific road-map of reforms in breaking the “energy-groundwater” nexus?	• The best way to break the “energy-groundwater nexus” is to develop comprehensive agricultural demand side management strategy for each state covering the following components: • Separation of Feeders and conversion to HVDS • Rational flat tariff strategy • Replacement of pumps and improving efficiency and management of pumping system • Participatory Groundwater	• Unregulated expansion of groundwater irrigation is leading to rapid depletion of groundwater. • Rapid growth in electric pump based groundwater irrigation in west-central and southern India leading to massive agricultural power consumption. • Low agricultural flat tariff result in financial losses for power utilities. • The utilities lack the capacity to invest in improving rural power infrastructure leading to poor voltage and frequency power	**Short-term (12th FYP):** • Implement separation of feeders and convert agricultural feeder line to High Voltage Distribution System lines • Introduce rational flat tariff system. • Implement replacement of old inefficient pumps with BEE certified efficient pumps. • Scale up implementation of micro irrigation under the National Horticulture Mission of GoI. • Formulate area specific PGM programmes in all endemic	• Analysis and evidence provided in WP5. • Separation of feeders carried out in Gujarat, Andhra Pradesh and Punjab. • Conversion of agricultural feeder lines to HVDS on going in Andhra Pradesh. • Detailed project reports for replacement of pump sets prepared for 7 states. • Micro irrigation projects being implemented in number states with subsidy from the National Horticulture Mission of GoI.	• Artificial groundwater recharge works.

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	Management (PGM) • Agriculture Extension and Marketing Services (AES) • Improving Water Application Efficiency – micro irrigation & agronomic practices	supply creating a vicious cycle of poor services and low willingness of farmers to pay higher tariff. • Low Voltage rural supply lines allow power theft and use of unauthorized pump sets resulting in huge T&D losses. • Use of poor quality pumps by farmers primarily because of the risk of efficient but expensive pump sets burning out due to poor voltage and frequency power supply.	groundwater deficient areas. • Provide agriculture extension services to marketing infrastructure to assist farmers in moving from water intensive to other equally remunerative but less water intensive crops. **Long-term (10-20 years):** • Maintain extended support for the comprehensive agricultural demand side management strategy through appropriate policies and programmes. • BEE has commissioned preparation of DPRs for pump replacement in 7 states. Based on		

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			these studies GoI could lay down recommendations for appropriate legal framework and conducive policy environment for the implementation of the comprehensive Ag DSM strategy in the country. • GoI notify pump sets as 'an appliance" under section 14 of Energy Conservation Act 2001 that would permit manufacture of pumps having the certified standards as under the BEE standards and labelling programme for energy efficient agriculture pumps already announced. • Power Finance Corporation/Rural Electrification		

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			Corporation could include the comprehensive Ag DSM strategy under its Accelerated Power Development and Reforms Programme, especially for states that have already implemented feeder separation and conversion to HVDS.		
Energy-groundwater nexus • What conclusions should we draw from the work of Aditi Mukherji on West Bengal in this respect?	• In heavy rainfall areas with shallow and abundant groundwater rapid expansion of irrigation can be supported with the right incentives without the fear of groundwater depletion. • High flat tariff for agricultural power	• Shift from flat rate tariff to pro-rota metering tariff will lead to shrinking of groundwater markets. • Escalating diesel prices affects groundwater market by contracting pump operation and shrink the market; shift cropping pattern	**Short-term (12th FYP):** • Promote use of electric pump sets instead of diesel pump sets with proper incentives such as rational flat tariff strategy. • Provide backward and forward linkages to farmers to shift to less water intensive but	• Analysis and evidence provided in WP5. • Studies carried out in West Bengal, Bihar and eastern Uttar Pradesh support the findings and recommended actions.	• Implement separation of feeders and convert agricultural feeder line to High Voltage Distribution System lines. • Implement replacement of old inefficient pumps with BEE certified efficient pumps.

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	promotes groundwater markets due to near zero marginal cost of pumping. • Large water markets are beneficial for poor small and marginal farmers as they can avail irrigation services even without owning pump sets. • Groundwater markets allow small and marginal farmers who buy water similar level of cropping intensity, productivity and profitability as pump set owners. • Diesel pump set owners do not enjoy benefit of near zero marginal cost of pumping as the amount of diesel	from the irrigated crops to dry or rain fed crops; leads farmers to restore to dubious innovations like mixing kerosene with diesel, using LPG cylinders as alternate fuel, etc. • Shrinking groundwater markets adversely impact most on small and marginal farmers who bought water reverting them back to rain fed cropping reducing their cropping intensity, productivity and profitability.	remunerative crops. **Long-term (10-20 years):** •		

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	consumed is proportionate to the hours for which the pump set is operated. • Consequently, diesel pump sets do not promote groundwater markets to the extent that electric pump sets do.				
<u>*Groundwater quality*</u> • Do we know enough about arsenic in groundwater? Is it true that we still do not understand what triggers the occurrence of arsenic in groundwater as scientists from	• Almost. There has been extensive research on arsenic in groundwater and the mechanisms are relatively well understood.	• Better understanding is required to explain the vertical and lateral heterogeneous distribution of arsenic. • Pumping relatively large volumes of water from deep aquifers that are low on arsenic may compromise these	**Short-term (12^{th} FYP):** • In locations with high risk of arsenic contamination in groundwater limit pumping from deep aquifers with low arsenic levels to drinking water only	• Analysis and evidence provided in WP5.	• Legislation (and its enforcement) to restrict groundwater pumping in areas at risk from arsenic contamination.

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Bangladesh recently told me? What is the state of knowledge on this internationally ?		aquifers. These resources should be reserved for drinking water.	**Long-term (10-20 years):** • Maintain a programme of periodic monitoring of groundwater wells.		
__Institutional reforms A__ • If we are to take the required steps in the direction of sustainable groundwater management, what kinds of changes are required in the CGWB, CGWA and the SGWBs? • What are the kinds of partnerships these institutions	• CGWB & SGWB will need to develop the technical and institutional capacity and human resources to support implementation of Participatory Groundwater Management and Aquifer Management Association projects. • CGWB & SGWB will need to establish partnership with NGOs to support mobilization and organization of	• At present CGWB & SGWB are mostly functioning as groundwater exploration and monitoring agencies staffed primarily with geo-hydrologists. • In no state groundwater monitoring data is available in the public domain at such frequencies as to facilitate scientifically informed groundwater	**Short-term (12^{th} FYP):** • MoWR, GoI and CGWB should issue national guidelines and initiate a National Pilot Project on PGM and AMAs (in line with the RRR Project for MI tank restoration it did under the 10th Plan) • SGWB formulate projects in with partnership with NGOs and other technical agencies to pilot PGM and AMA in their states.	• Analysis and evidence provided in WP5.	• Artificial groundwater recharge works. • The comprehensive Ag DSM model.

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would need to develop with other agencies?	farmers. • CGWB & SGWB will need to establish partnership with research institutions on groundwater research. • CGWB & SGWB will need to establish a information and data servicing centre to make available regular and up dated groundwater monitoring data to GWUGs and AMAs to facilitate decision making at their level.	utilization on a daily or weekly basis. • There is very little involvement of CGWB & SGWB in projects like APFMAGS, which are primarily NGO driven.	• CGWB & SGWB should develop information and data management systems and capacity so service the groundwater information requirements of PGM and AMA projects. • CGWB & SGWB should develop its technical and institutional capacity and human resources to support implementation of PGM and AMA projects by hiring the required skilled personals on contractual basis. • CGWB & SGWB should carry out scientifically designed studies on the process and impact of PGM and		

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			AMA pilot projects to identify the policy, legislative and programme support required to scale up the pilots. **Long-term (10-20 years):** • GoI support a national programme on PGM and AMA (such as CAD&WM scheme) to scale up PGM and AMA activities to larger areas to have region wide impacts. • CGWB & SGWB initiate the required policy, legislative and programme support to incentives PGM and AMA projects. • CGWB & SGWB should develop its technical and institutional capacity and human		

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			resources to support implementation of PGM and AMA projects by appropriately re-structuring itself and its staff composition.		
<u>Institutional Reforms B: AMAs</u> • What would be the best institutional design for Aquifer Management Associations (AMAs)? • What would be their interface with the statutory groundwater bodies? • How best could the AMAs be part of river basin planning?	• Establish village or micro catchment based Primary Groundwater Users Groups for supply and demand side management of groundwater. • Federate the PGUGs at the larger aquifer level into Aquifer Management Association with a comprehensive powers for issuing permits; aquifer management; research and data collection; enforcement;	• There is no experience of aquifer level management associations in India. • Projects adopting community groundwater management invariable adopt a micro-catchment (watershed) or stream basin (APFMAGS) approach.	**Short-term (12th FYP):** • Pilot aquifer management associations based groundwater projects in various states. • Develop the capacity and resources of concerned government departments, NGOs, technical support agencies to facilitate implementation of pilot aquifer management association based projects.	• Analysis and evidence provided in WP5. • APFMAGS projects have successfully implemented tertiary basin level groundwater management in 650 villages in 7 districts of Andhra Pradesh. • Under the APCBTMP in AP Groundwater Users Groups are being formed at the level of groundwater influence zones of minor irrigation tanks for community	• Artificial groundwater recharge works. • The comprehensive Ag DSM model.

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	administration ; critical period management; and groundwater conservation plan. • Create the capacity and resources in the concerned groundwater statutory bodies, NGOs and technical support agencies to facilitate and support such a aquifer management programme.		• Carry out scientifically designed studies on the process and impact of such pilot projects to identify the policy, legislative and programme support required to scale up the pilots. **Long-term (10-20 years):** • Scale up the aquifer management association based project to larger areas to have region wide impacts. • Initiate the required policy, legislative and programme support to incentives successful aquifer management association based project.	groundwater management.	

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Legal reforms • Does India need new groundwater legislation in line with the PTD enunciated by the Supreme Court?	• A number of states have enacted groundwater (regulation) legislations which are adequately provisioned for controlling and regulating groundwater extraction. • Indian Easement Act, 1882 also appears to put limits to an individual's right to exploit groundwater by makes a distinction between water flowing in 'defined channels' underground and percolating water. • The applicability of PTD to groundwater remains unclear due to the two contrary	• Most states have been reluctant to enact groundwater (regulation) legislations. • Even in those states where groundwater (regulation) legislations have been enacted they are enforced more in the breach. • Even if groundwater legislation in line with PDT is enacted allowing the government to intervene to control groundwater extraction, without clear volumetric entitlement for individual groundwater user it would be impossible to monitor and control over	**Short-term (12th FYP):** • Get all remaining states to enact groundwater (regulation) legislation. • Develop the capacity and resources of the authority designated under the groundwater legislation to regulate groundwater. **Long-term (10-20 years):** • Enforcement of groundwater regulation legislations may be tightened using remote sensing and IT enabled monitoring systems to track location of	• Analysis and evidence provided in WP5 and WP8.	

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	orders pronounced by the Kerala High Court. The on going petition on the issue in the Supreme Court may settle the issue. • Supreme Court, however, through various judgements has included the public trust doctrine as part of India's jurisprudence, which then can be interpreted to apply also to groundwater. • The problem with groundwater regulation through legislation is not of enactment but of enforcement.	extraction.	extraction devices and volume of water pumped through pre-installed electronic chips in the pump sets programmed to monitor duration of pump operation.		

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River Basin Planning					
Institutional reforms • How can we visualise river basin planning happening in India? • What are the institutional requirements for this to become possible? • What are the data requirements for this to become possible? • What are the human resource capacity requirements for this to become possible?	• The concept of river basin planning and management needs to be accepted as the way forward for effective water resources management. • Senior personnel in the Irrigation Department need to accept the concept of separating water resources management from irrigation (and drainage) service delivery. • Water resources management needs to be clearly separated from irrigation development and management.	• Water resources management is not differentiated from irrigation (and drainage) service delivery in India. • The basic river basin planning and management functions are currently being carried out by a range of organizations in each state mostly under the provisions of the Irrigation Act and under the mandate of the ID.	**Short-term (12^{th} FYP):** • Essential river basin management functions can be carried out within the Irrigation / Water Resources Department by creating three divisions: (i) water resources planning and management; (ii) I&D system management and (iii) planning, design and construction of new schemes. • Legislative Action should be taken to facilitate this reorganisation • Permit the ID/WRD to employ suitable cadres of staff (water resource	• Analysis and evidence provided in WP6.	• Political willingness to take action to resolve the growing water resources crisis. • Political willingness to accept a technically rationale solution to the management process. • Willingness amongst some government agencies to relinquish control to the proposed State Water Council and the State Water Administration.

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<u>Roadmap for reform</u> • What kind of roadmap can we propose for river basin planning in India given the dismal experience so far? • What is the process through which this can happen? • Is it better to begin with sub-river basin planning?	• A Water Resources Management Act needs to be promulgated. • The State Water Administration needs to be established and adequate numbers of staff employed and trained.		planners, hydrologists, geologists, hydro-geologists, social scientists, etc.) • Once there is a functioning water resources planning and management unit at the state level River Basin Councils can be formed and Basin Plans prepared. **Long-term (10-20 years):** • The separate SWA can be formally established under a State Water Resources Management Act and water resources planning and management division moved under it. • State Water		

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			Councils can be established for water resources management and use.		
Regulatory Framework					
Role of regulator • Should there be a regulator at a national level or a separate one in each State? • What should be the functions of a regulator? • What should be the human resource profile of a regulator? *Independence* • What should be the degree	• There appears to be differing perceptions of what are the purpose and functions of a regulator. • It is arguable that water regulators may not be necessary. • Tariffs could (and should) be set by the water service provider (whether for irrigation, water supply or industry). A regulator may then be required to monitor that (i) the tariff is fair and reasonable, and (ii)	• Excessive withdrawals of groundwater • Increasing urban demands for safe and reliable sources of drinking water; an increase from 350 to 600 million people • Ambiguity over roles in the reform process. • Widespread lack of human and resources capacity. • Less acceptance of the need to "pay for water": there is a need to set service fees (tariffs) at a level sufficient to	**Short-term (12th FYP):** • Review the role of the regulator in the light of the proposals made above regarding establishment of State Water Councils, State Water Administrations and (sub-) Basin Councils. • Establish a resource centre whose aim is to promulgate to the states and local governments the principles and vision of the national water	• Analysis and evidence provided in WP7 and WP11. • Good examples in Germany and the United States where municipalities have this responsibility but where the national governments set norms of technical and service standards expected by the consumers. • German states (Länder) play a key role in the sector by setting the legal framework for tariff approval.	• See above

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of independence of the regulator from government or rather what should be the precise nature of the relationship between regulator and government? *Case study: MWRRA* • What can be learnt from the experience of the MWRRA so far?	that the service provider is providing an adequate level of service, and sustaining the physical infrastructure. • There is no national irrigation/bulk water supply market. Leaving aside the constitutional settlement in terms of irrigation, it is clear that the sector takes place entirely at the State level. For this reason alone a national water regulator is neither necessary nor desirable.	sustain the physical infrastructure over time. • There is a need to provide water users with rights or entitlements to water. Such rights facilitate river basin planning and management and provide security to water users. • There is a pressing need to plan and manage water resources in a rationale, transparent and accountable manner to sustain social and economic development and avert disputes and conflicts over water.	reform strategy. • Resource centre will train and support local decision makers. • Role of the regulator as an "enabler" for sound PPP; to deliver the three core values that the private sector can bring are 1) technology, 2) systems, and 3) capital. • Performance reporting system will be transparent, covering both public and private operators. • Skills required include technical, financial/economic, legal, and communications. • Establish a national advisory service to assist municipalities	Municipalities play a direct role in influencing policy positions through their influential municipal associations.	

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			in their regulatory responsibilities. Example: Service Public 2000 in France provides support services to local authorities in: preparing contracts, organising fair competition, negotiating with bidders, estimating costs of services, ensuring respect for legal procedures and monitoring services and contracts. **Long-term (10-20 years):** • Move to a rationale framework for water resources planning and management based on river (sub-)basin and groundwater aquifer boundaries. • Develop a		

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			professional cadre of water resource planners, managers and technicians. • Regulatory rules can be set out in terms of a set of (i) precise rules and (ii) principles of the kind typically encountered in ordinary commercial contracts.		
Urban and Industrial Water					
Recycling by industry • Apparently the Chinese 12th Plan targets a 30% reduction in water consumption per unit of value added in industrial consumption? Is this or something like		• It may be that in a highly centralised command and control social and economic context that China may be able to deliver the ambitious reduction in water consumption mentioned; but how likely is it in a much more decentralised	**Short-term (12th FYP):** • State government agencies in the areas of health, environment and water resource management need to review and develop policy in the next 12 months to support water recycling. • Sector by sector approach: target	• See WP9 • Jordan: National Water Demand Management Policy created a Water Demand Management Unit and Performance Management Unit. • Sydney Water’s ‘Every drop counts’ programme: detailed best practice	

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this, a realistic target for India? If so, what would be the instruments that could help achieve it? • Could we set a target for the proportion of water to be mandatorily recycled by Indian industry? If so, what would be the instruments that could help achieve it? • How can international experience in this regard help in moving Indian		nation such as India?	high water industrial users and provide incentives and information to encourage a switch to technologies that curtail demand for water from the natural sources. • Licensing regime developed for abstraction would include measures that took account of a company's progress to recycle water; harvest rainwater and use water efficiently. • Government's own institutions can lead by example. • Political leadership must be considered a critical aspect of a water saving strategy.	information to encourage businesses to be water efficient, covering cooling towers, sub-metering, plant watering, urinals, toilets, commercial clothes washers, dishwashers, and hotel water audits. • USA: Cases in Water Conservation – how water efficiency programmes help water utilities save water and avoid costs (by US-EPA)	

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industry in this direction, both in terms of technologies and in terms of instruments of reform (incentives, disincentives etc)?					
<u>Experience on PPPs</u> • What are the main lessons that emerge from the Indian experience with PPP in urban water supply? • What are the best examples of this that we may adopt practices from (could be specified in		• No national level guidance authority for the sector similar to Central Electricity Authority or National Highway Authority. • Complex institutional structure with multi point overlapping responsibilities between state governments and local authorities in policy setting,	**Short-term (12th FYP):** • Government of India to take lead policy setting role and provide guiding tools to state governments and local authorities for institutional reform. • Roll out the National Service Level Benchmarking Program linked to fiscal incentives. • Develop and provide template service	• Evidence and cases in WP10. • Success in North Karnataka and Nagpur • Ongoing concession contracts in Alandur (Tamilnadu), Khandwa (Madhya Pradesh) • Problems with not so well prepared or high risk PPP contracts detailed for Mysore Delegated	

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terms of what we may adopt from which city/town)?		regulation, capital asset development, operations and maintenance and service delivery. • Lack of ownership and inadequate stakeholder support. • Historically low tariffs resulting in weak financial capacity. • Lack of legal and regulatory framework of leveraging public finance with private management. • Lack of basic asset and service delivery data. • Lack of awareness among local authorities in understanding best endeavour outcome based contracting framework when compared to	contracting framework for selective outsourcing of operations. • Planning Commission to develop and provide model concession agreements for management, lease and concession contracts. • Planning Commission to take a lead role in progressively developing regulatory mechanisms and provide guidance tools to the state governments and local authorities based on the founding principles of (i) separation of policy and service delivery; (ii)	Management Contract and Aurangabad Water Supply Improvement Project	

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		traditional LBD measurement contracts. • Limited local capacity of transaction advice and no model concession documents from Planning Commission as practiced in other infrastructure sectors. • Serious dearth of skills in water utility management.	democratic accountability and (iii) federal principle. • State governments to institute and promote state level performance monitoring units. • GOI in partnership with Chambers of Commerce and Industry to promote 'vendor development programme'. • GOI and State Governments to develop skills development plans. **Long-term (10-20 years):** • GOI and Planning Commission to develop National Water Commission as the premier body for providing policy		

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			support, implementation oversight, single window for promotion of best practices in demand and resource management and provide national coordinating role between different sector stakeholders. • State Governments to assist local authorities in improving the accountability of different actors. • Link reform via NWC to financial resources required to guide and support that reform by giving local authorities more autonomy and permitting sub-national commercial borrowing.		

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Roadmap for reform • Is it possible to spell out a road map for urban water supply reform in India? • Can we specify the way concession agreements need to be drawn up, outlining precisely what should never be done, what the positive non-negotiables are and what the desirables might be?	• Increased PPP in water supply has better chances to succeed if (a) it is part of a comprehensive programme of reforms; (b) political commitment at all levels of government is ensured; (c) consensus has been reached among the many stakeholders; and (d) the public authority has defined clear objectives and put in place a clear decision making process. • All options for private participation must be analysed; risks of all types (political, economic,	• Few cases so far of PPP efforts to attract financing of water supply projects by ULBs • Inadequate management capacity • Emergence of new enterprise and organisations from around India who are willing to develop new forms of private public partnerships between water utilities	**Short-term (12th FYP):** • PPP should not be considered as policy objective in itself and must be understood primarily as a means to achieve certain objectives within the wider water and sanitation strategy. • One of the main principles of the PC's strategy is to highlight that there is no single model of what an effective PPP system should look like. • Classic "regulation-by-contract", augmented by a decentralised system of checks and balances based on supportive procedural and	• Evidence and cases in WP10. • In Jordan, PPP and its different forms have been integrated with a clear set of objectives for policy in the whole sector.	

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	commercial, technical and legal) must be assessed and appropriate mechanisms to mitigate them should be adopted.		institutional mechanisms, is an alternate form of regulation to the conventional independent regulatory agency. **Long-term (10-20 years):** • Ensure that water and wastewater sector PPP arrangements are consistent with clear national objectives for PPP. • Ensure the pro poor and community participation in the development of the PPP objectives. • Ensure that the PPP partner company possesses sufficient financial strength so it can sustain the investment over a 10 to 20 year period and endure.		

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			• Enterprise-based approach promises many benefits: transfer of appropriate risks to private sector management; avoidance of time and cost overruns; adoption of best practice technologies and innovative practices. • Strategic clarity is achieved by focusing government resources on contract design and management of contract outcomes. • Local enterprise and entrepreneurship promotion. • Access to local and foreign private finance.		

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National Water Commission					
<u>*Purpose of an NWC*</u> • Does India need a National Water Commission on the lines specified in my presentation? • If so, what should be the functions of such a Commission? • What legal changes would be required for such an NWC to be constituted? • Does India need a National Water Framework	• Constituted as statutory agency and with independent authority • The National Water Commission is not envisaged as a regulator; rather it will exist to provide vigorous leadership in the pursuit of solutions to counter the challenges that India has in its water sector, with regulation taking place with the States or Local Authorities. • NWC would serve as a proactive overseer of the country's water resources to ensure their sustainability. It would assess water resources	Despite the extensive list of activities at the CWC, there remain at least four gaps in the planning and management of water in the country as a whole: • <u>Technical assessment of projects</u> - current guidelines do not give the mandate for assessing the state of water resources; no obligation to continue assessments *after* clearances have been awarded • <u>Treating water as a national resource</u>: no institution is currently mandated with the responsibility of	**Short-term (12th FYP):** • The NWC could evolve incrementally with a gradual broadening of its mandate, resources and capacity <u>Year 1</u> • Empowered Working Group (EWG) to develop a National Water Strategy (NWS) regularly reporting to the National Development Council (NDC) • Collating up-to-date data • Reviewing and revising the guidelines and assessment methodologies	• Analysis of CWC activities available in WP13, section 2.1 and Appendix 1. • Deficiencies and gaps in water management in WP13, section 2.2 • Details on phased evolution of the NWC in WP13, section 6.1 and table 1	• Reform of state-level and basin-wide water resource management institutions; see discussion of State Water Councils in WP6, section 4.2

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Law akin e.g. to or different from the EU Water Framework Directive?	across sectors, promote a national water strategy, deliver timely information to the public, and develop a broad base of skills for water management at different levels of government	planning for shifts in the sectoral demand for water, the response to closed or overexploited river basins, or more efficient conjunctive use of surface and groundwater • <u>Timely and usable information</u> is not made available readily and, most importantly, in a usable format • <u>Capacity for management</u>: no countrywide institution that has the responsibility to assess gaps in skills other than civil engineering (hydrology, hydrogeology, agricultural practices, ecosystem management, energy experts, social	<u>Years 2-3</u> • 25-year Perspective Plan on Water discussed by NDC before being adopted as NWS • EWG publicly communicates information about the country's water resources <u>Years 4-5</u> • On invitation of state and municipal governments, EWG supports capacity development • Growing public and political acceptance of the NWS • NWC created by an act of Parliament and with autonomy from the central		

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
		scientists, etc.)	government; the provisions of the act are accepted and legislated upon by state governments		
Functions of an NWC • What precise functions should the NWC perform? • What should be its human resource profile? • Can the CWC be conceivably modified to play these roles?	• NWC would operate as: (1) an independent **technical assessor** to offer more refined analysis to support the Planning Commission and the Ministry of Environment and Forests *before* project clearances are issued, monitor progress *during* construction, and continuously assess project management *after* completion; (2) the **guardian or watchdog of national water resources**, states' rights and	• In contrast to the institutional framework in India, Australia's National Water Commission was created as an independent, expert body with a national – rather than state of Commonwealth – perspective on water reform • Its role is to advise on national water issues, assess progress on reform efforts, and support the implementation of the National Water Initiative • Its functions	**Short-term (12th FYP):** • Development of revised technical guidelines to continuously monitor projects and undertake dynamic assessments • Coordination and networking across sectors and levels of government • Information collection and dissemination on successes and failures at the individual project level • Capacity-building	• Analysis of Australia's National Water Commission available in WP13, section 3 and Appendix 2. • Details of functions over the short and long-term in WP13, sections 6.2 and 6.3	• Financial support for at least ten years to allow the NWC to evolve • Institutional coordination with State Water Councils

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12th FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	individual entitlements, a promoter of the Government's principles for water sector reform, and an independent monitor of a long-term National Water Strategy; (3) an **aggregator and public communicator of data and information**, so that water authorities at the central and state levels have an objective basis to organise and implement a nationwide and continuous water and wastewater performance benchmarking programme; (4) a **facilitator and capacity developer** in order to support states (if requested) with	include: assessing the state of the country's water resources as a whole; benchmarking water use across states; ecological integrity; competition in urban water provision; and developing nationwide water management skills	activities: a comprehensive web portal; and periodic advanced practitioner workshops; facilitate involvement of public and private service providers in water utilities • Engagement with potential local and foreign investors as well as all other stakeholders; full transparency concerning all contract details **Long-term (10-20 years):** • Guardian of the National Water Strategy • Offering technical advice to central and state water administrations, including State		

Questions	Broad answer	Key pressing issues (diagnosing the problem)	Proposed solutions (12^{th} FYP and longer term perspective)	Data/Info in WPs as supporting evidence for solutions	Minimum other complementary interventions
	advice on institutional design, capacity and skills development, and to offer technical advice, if sought, to resolve disputes.		Water Councils • Watchdog of the rights of all water stakeholders by "naming and shaming". • Continuous benchmarking of best institutional practices • Information dissemination, transparency, capacity building and public education and advocacy.		

National Water Resources Framework Study

Large Scale Irrigation Reform

Working Paper No.2:

Re-engaging with Participatory Irrigation Management

Rahul Sen and Martin A. Burton

Contents

Questions raised

The following questions were raised by the Planning Commission with regard to the Participatory Irrigation Management in India:

Diagnosing PIM

- Can we say that PIM/IMT has failed?
- Under what conditions does PIM work?
- Under what conditions does PIM fail?

Redefining PIM

- What is the way we need to define PIM such that it delivers on the ground (its essential constituent elements)?

Case studies

- Detailed case-study of Andhra
- Detailed case-study of Gujarat

Brief answers to questions raised

Brief answers to these questions are provided in the sections below, with supporting information and evidence provided in the subsequent sections of the paper.

a. Can we say that PIM/IMT has failed?

Participatory irrigation management in India has not been successful to date on the large scale. There are, however, good examples of successful implementation of PIM on schemes in some states, including, amongst others, Gujarat (Dharoi Irrigation Project), Madhya Pradesh (Mann and Jobat Irrigation Schemes), and Maharashtra (Minor Irrigation Programme and Waghad Irrigation Project).

b. Under what conditions does PIM work?

PIM/IMT works where:

- There is committed high level political support;
- The government I&D agency and its personnel are strongly supportive of the programme;
- Politicians are aware of the programme and if not actively supportive, not resisting changes;
- Specific legislation is enacted related to establishment of water users associations, with complimentary changes made in associated legislation (water law, civil code, tax code, etc.);
- WUAs are given the legal right to set, collect and use service charges related to their service area;
- WUAs are given a legal entitlement to irrigation water with clear definition of associated conditions;
- The I&D systems function adequately;
- There are clearly defined roles and responsibilities of the various stakeholders, including water users, WUA management and I&D agency personnel;

- There is provision for a sufficient length of time for specialist personnel to raise awareness, train and support WUAs and water users;
- There is a clearly thought through policy and programme for restructuring of the I&D agency, including training in WUA principles, practices and support functions;
- Adequate time and resources are provided to complete management transfer.

During the process of PIM/IMT the following issues need to be recognized and addressed:

- Recognition that this is a change management process. There needs to be acceptance and use of proven change management understandings and techniques;
- The strength of the potential resistance to change from parties with vested interests, including I&D agency personnel and politicians;
- Recognition of the need to raise awareness, understanding and support for the programme amongst I&D agency staff;
- Whilst management transfer might reduce government expenditure over time it requires additional resources in the short-term until WUAs are established and functioning.

It is also important to understand the drivers for change, the objectives and desired end points for PIM/IMT:

- Clearly identifying the factors that are driving the move towards PIM/IMT (need to reduce government expenditure, need to improve water use efficiency and productivity, need to address societal changes);
- Setting clear objectives and end points;
- Being clear on the desired end points of the process (greater fee recovery, more efficient and productive use of water, more sustainable systems);
- Structuring transfer programmes to address these drivers whilst ensuring that some of the basic requirement are recognized, principally that water users need to be given rights as well as responsibilities.

c. Under what conditions does PIM fail?

PIM/IMT programmes can fail where there is:

- Lack of high-level support;
- Sabotage of the process by vested interests resisting change;
- Adverse political interference (e.g. politicians advocating the non-payment of service fees);
- Lack of adequate explanation and support for the transfer process (i.e. failure to provide specialist support to form and guide WUAs and water users over a sufficient length of time);
- An inadequate or weak legal framework;
- Failure to devolve adequate levels of responsibility to water users (vis. ability to set, collect and utilize the service fee);
- Perpetuation of the top-down approach to farmers and water users;

- A failure to respect the expertise and capability of the farming community to organise and manage themselves;
- Failure to reform and restructure the I&D agency.

d. What is the way we need to define PIM such that it delivers on the ground (its essential constituent elements)?

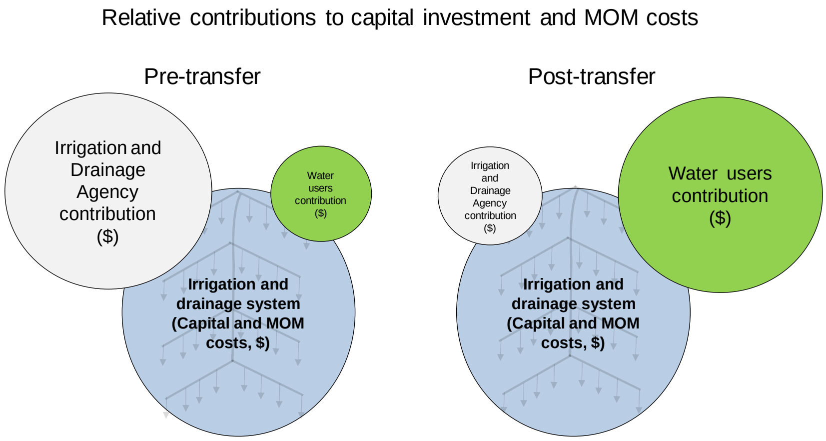
Proposed measures to improve participatory irrigation management in India include:

- **Move from a PIM approach towards an IMT approach**. The current PIM approach leaves too much responsibility in the hands of the ID. More rights and responsibility should be transferred to WUAs.
- **Allow WUAs to set and collect the service fee.** WUAs should be able to set, collect and spend their own service fee (as agreed by the General Assembly of members), though a portion may be passed on to the ID for MOM of the main system.
- **Separate governance and management of the WUA.** Governance and management should be separated, with elections to appoint 10-12 WUA Committee members who in turn elect a WUA Chairman. The WUA Committee then appoints paid staff to carry out the day-to-day management of the I&D system[1].
- **Grant each WUA an entitlement to water.** There should be an entitlement to water, from both surface water and groundwater[2]. This entitlement can be allocated to the WUA rather than individual members, and can be based on allocation of a fair share of the available water supplies in the basin.
- **Create WUA support units.** WUA Support Units should be formed, trained and resourced to train and provide support to WUAs over a minimum 10-year time frame.
- **Increased awareness and training.** A significant awareness raising and training program should be carried out, followed by ongoing support and hand-holding from WUA Support Units.
- **Change attitude and role of the Irrigation Department.** The ID was established over 100 years ago for a very different environment to that encountered today in modern India. The ID needs to reform and restructure itself to benefit from the opportunities offered by participatory irrigation management, and work in partnership with WUAs and water users to enhance the productivity of irrigated agriculture in India. An important factor in the changing role of the ID and the water users is their respective contributions to the management of the I&D system. As the funding from the ID decreases and that from the water users increases (Figure 1), so the role and importance of the two players will change, with the water users assuming a far greater role than in the past. At the heart of the discussion here is the ID attitude that government has financed and built the I&D systems therefore it is government property. This attitude has been prevalent in many other countries (USA, Mexico, Australia, Chile) but governments are now taking the view that they have made their contribution and it is now time for the beneficiaries to take on the MOM of the systems.

[1] The issue here will be of meeting the cost of hiring WUA staff. This can either be met by correspondingly increasing the water charges or the government transferring the salary cost to the WUAs.

[2] There are several issues with the licensing of abstraction from groundwater which are discussed in the Working Paper on groundwater management.

Figure 1: Changing financial contribution of the I&D agency and water users over time



e. Detailed case-studies of Gujarat and Andhra

A detailed case study of the Dharoi Irrigation Scheme is provided in Appendix A4. The approach by the I&CAD Department in Andhra Pradesh of providing state-wide support to WUAs is detailed in Appendix A5, whilst a description of the Waghad Irrigation Project is provided in Appendix A6.

1 Introduction

Despite various initiatives participatory irrigation management (PIM) has not, to date, been successful in India, save for a few examples in Gujarat, Maharashtra, Andhra Pradesh and Madhya Pradesh. Though over 50,000 water users associations (WUAs) have been formed on paper, the vast majority of them are not functioning effectively.

This paper investigates the origins of PIM in India and looks at the current issues being faced. The paper provides background information on experience with PIM and irrigation management transfer (IMT) internationally, and makes proposals for changes to improve the situation in India.

The paper commences with brief answers to the questions posed by the National Planning Commission, with more detailed supporting information provided in the subsequent sections of the paper. Case studies are provided in the appendices from Mexico, Turkey, Kyrgyzstan, Gujarat, Maharashtra and Andhra Pradesh.

2 Background to participatory irrigation management in India

Experimentation with participatory irrigation management began in India around the mid-1970s with the Ministry of Water Resources, supported by a number of NGOs encouraging farmer participation in management at the tertiary level. From the mid-1980s Command Area Development projects supported with funds from the Government of India (GoI) encouraged farmer participation in the planning, design and construction of on-farm systems. In 1987 the concept of greater farmer participation was adopted as official Government of India (GoI) policy and incorporated in the National Water Policy:

> *"Efforts should be made to involve farmers progressively in various aspects of management of irrigation systems, particularly in water distribution and collection of water rates. Assistance of voluntary agencies should be enlisted in educating farmers in efficient water-use and water management"*

Though pilot projects had been initiated in several states in India during the 1980s Andhra Pradesh was the first Indian state to adopt participatory irrigation management state-wide through the enactment of the Andhra Pradesh Farmers' Management of Irrigation Systems (APFMIS) Act in 1997. Based on this Act some 10,000 WUAs were formed through elections conducted by the I&CAD Department under the provisions of the Act.. The Act was revised in 2003 and formed the basis for much of the legislation adopted in other Indian states. By March 2010 over 56,000 water users associations had been formed in 28 states, serving an area of some 13.5 million hectares (Table 1).

Table 1: Number of WUAs formed in each State (2010)

Name of State	Area covered (thousand ha.)	Number of WUAs formed
Andhra Pradesh	4,169.00	10,800
Arunachal Pradesh	9.02	39
Assam	47.04	720
Bihar	182.36	67
Chattisgarh	1,244.56	1,324
Goa	7.01	57
Gujarat	96.68	576
Haryana	200.00	2,800
Himachal Pradesh	35.00	876
J&K	2.76	39
Jharkhand	0.00	0
Karnataka	1,318.93	2,557
Kerala	174.89	4,163
Madhya Pradesh	1,691.88	1,687
Maharashtra	667.00	1,539
Manipur	49.27	73
Meghalaya	16.45	123
Mizoram	14.00	110
Nagaland	3.15	23
Orissa	1,537.92	16,196
Punjab	116.95	957
Rajasthan	619.65	506
Sikkim	0.00	0
Tamil Nadu	1,176.21	1,457
Tripura	0.00	0
Uttar Pradesh	121.21	245
Uttarakhand	0.00	0
West Bengal	37.00	10,000
Total	**13,537.94**	**56,934**

Source: Data provided by Command Area Development and Water Management (CADWM), Ministry of Water Resources, New Delhi, March 2010

Many of the PIM initiatives have been instigated by the state governments without external support, in other cases the World Bank and other funding agencies have been incorporating measures to increase farmer participation in their water resources and I&D projects. In 1997 the World Bank commenced a study in collaboration with the Ministry of Water Resources, GoI on water resources management. The Report on the Irrigation Sector[3] report (World Bank, 1998) recognised the important role of water users in I&D system management, operation and maintenance (MOM) and recommended the promotion of irrigation management transfer:

> *"At the heart of the reform agenda is irrigation management transfer to farmers. As found in countries such as Mexico, Turkey, Chile, and Australia, etc. farmers can better manage and maintain systems than government, and have the direct incentive to do so....."*

[3] This report was one of five under the "India – Water Resources Management (WRM) Sector Review". The other reports covered (i) Inter-Sectoral Water Allocation, Planning and Management; (ii) Groundwater Regulation and Management; (iii) Urban Water Supply and Sanitation; and (iv) Rural Water Supply and Sanitation.

The report identified the following features as elements for successful IMT in India:

- **A democratic grassroots base.** WUAs need to be established through a grassroots and democratic process. Elections should start at the minor level. WUAs should then be represented at a higher level (distributary canal for large major, or at the scheme level for medium schemes). For major systems a third and final tier can be formed from the Presidents of the distributary organizations.
- **A demand and client-led approach.** WUA formation and management needs to be demand-led by the water users in order to be successful. It is essential to create a sense of ownership of the WUA by water users.
- **Financial viability.** WUAs need to be financially self-sufficient from the outset. They should be able to collect service fees sufficient to cover the MOM costs at their level of operation.
- **A clear legal framework.** Though WUAs can be formed under existing legislation, for instance the Societies Act, specific legislation is required.
- **A hydrology and whole command area approach.** WUAs should be formed on hydrological units: minors, distributaries, branch canals and whole systems. Generally WUAs should be distinct from other social organizations, such as Panchayats, as hydrological boundaries seldom coincide with administrative boundaries.
- **Investment and technical support.** Formation of WUAs should be accompanied by improvement of the physical infrastructure and provision of technical, managerial and motivational support.
- **"Big Bang" versus gradualism approach.** The report concluded that the "big bang" approach (as in Mexico and Turkey) may be better in comparison to the gradual "pilot project" approach adopted in some countries.
- **Ensuring participation of women and minorities.** Whilst democratic elections can provide a sound base to the WUA more is likely to be needed to ensure full and fair participation by women and minorities (scheduled castes and tribes).
- **Establishing water rights.** Each WUA should be granted a legal water right and have full freedom to use this water and decide on the crops to be grown. The report also recommends that within each WUA member should have water rights proportionate to their area and be able to sell, buy, lease of rent their water (as is done in Chile, Western USA and Australia).
- **Possible wider functions for WUAs.** Though the primary function of a WUA should be water management and maintenance of the I&D system the report suggests that WUAs be allowed to take on other activities. This may include acting as a contact point of agricultural extension, marketing of inputs and products and possibly provision of credit. They also provide ideal stakeholder groupings for participation in river basin organizations and other management and policy entities.

As a result of the findings in the Water Resources Management Sector Review the above and other principles were incorporated into Water Sector Restructuring Projects (WSRPs) in Tamil Nadu (TN), Rajasthan, Maharashtra, Andhra Pradesh (AP), Madhya Pradesh (MP) and Uttar Pradesh (UP). These projects have typically included components on:

- *Water Resources Management – Institutions and Instruments,* covering the establishment of a state water resources agency, a tariff regulatory commission and pilot river basin organisations.
- *Service Delivery – Irrigation and Drainage Institutions,* covering reform of the Irrigation Department and involvement of the private sector in the I&D sector, including the formation and support of WUAs.
- *Improving productivity,* covering rehabilitation and modernization of physical infrastructure, improvement of system MOM, agricultural intensification and diversification and fisheries development.

In some states NGOs are actively promoting and supporting participatory irrigation management, with particularly successful models in Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu and Madhya Pradesh. In Gujarat the Development Support Centre (DSC) NGO has established over 200 well-functioning WUAs serving an area of over 60,000 ha. Similarly, SOPPECOM in Maharashtra, JalaSpandana in Karnataka and Andhra Pradesh and Dhan in Tamil Nadu have successfully collaborated with their respective state WR&I Departments in supporting PIM in selected irrigation projects. The difficulty now being encountered with these models is how to scale them up to cover the whole state.

3 Issues with participatory irrigation management

In India most state governments practice a PIM approach defined by a system of participation of the farmers as beneficiaries with at best a joint role in management of the irrigation system. It is not envisaged to fully transfer the assets and management responsibility to the WUAs. Hence, the ID deputes what is called Competent Authorities (usually AEE rank staff) to the WUAs to do the actual management and book keeping works. Other work charge staff such as laskars, gate operators, etc. are expected to support the WUAs in implementation of O&M works. In AP in fact, appointment of laskars on temporary contract basis has now been transferred to WUAs while only the laskars permanently employed as I&CAD staff remain with the department. Interestingly, this is the participatory approach followed by the governments in India in all sectors whether watershed management, forestry, rural water supply, etc.

Two reviews of progress with WUA development in India were carried out by the World Bank, one in 2009 and further more detailed studies in 2010 under the Sustainable Development of Water Users Association (SDWUAs) project. The first study was carried out by an international specialist to review the status of WUA development in selected World Bank funded projects. The second study had a broader focus and covered not only WUAs but the wider issues of water legislation, reform and modernisation of the Irrigation Department and education and training related to the water resources and irrigation sectors. The two studies identified a number of issues related to the participation of water users in the management of irrigation and drainage systems. Table 1 summarises these issues for the three states visited under the first study, whilst Table 2 summarises the general issues related to participatory irrigation management which were identified during both studies.

The 2009 study visited WUAs in Uttar Pradesh (UP), Andhra Pradesh (AP) and Maharashtra. The study found that although the Central Government established a policy of encouraging participation by water users in the planning and management of I&D schemes it was not until 1997 when AP approved the Farmers’ Management of Irrigation Systems (APFMIS) that the a large number of WUAs were formed under a tailor-made legal framework. The 2002 National Water Policy added further to the call to involve water users in various aspects of the planning, design and management of I&D schemes following which Maharashtra initiated the Maharashtra Management of Irrigation Systems by Farmers (MMISF) Ordinance in 2004, which was passed into law in 2005 to become the MMISF Act. Some time later Uttar Pradesh passed the Participatory Irrigation Management (PIM) Ordinance in 2008, which was upgraded to become law in 2009. In many cases the formulation and enactment of these acts has been brought about through donor-funded projects, despite varying degrees of reticence from the Irrigation Department.

Involvement of water users in irrigation management commenced in UP around 1976 with the formation of Chak Committees. These were followed by a number of different entities, including the Water Co-operative Committees formed under CAD in 1998. Under an executive order issued in 2001 some 9,500 WUAs were formed on minors and distributaries, but relatively little support was provided by the UPID. The UP Participatory Irrigation Management (UPPIM) Ordinance was issued in 2008, and subsequently enacted in 2009. The Act is written in a way such that it can be implemented over time, as and when funds might become available (such as under the UP Water Sector Restructuring Project, UPWSRP).

In Andhra Pradesh Pipe Committees were formed under the 1984 AP Irrigation and Command Area Development Act. Unfortunately these Committees proved unsustainable once the CAD program had withdrawn from the scheme, and a number of pilot schemes were established to demonstrate the value of farmers' organisations at the minor level. Lessons emerging from these pilot schemes included:

- The need for WUAs to have proper legal status;
- The need for WUAs to have a proper legal entitlement to water;
- The importance of making WUAs accountable (to the ID) for the water used and area irrigated;
- The need for WUAs to build up their financial resources;
- Clear delineation of the role, rights and responsibilities for WUAs in taking over the management of the irrigation system.

In 1997 the AP Government took a policy decision to promote and support PIM and enacted the AP Farmer's Management of Irrigation Systems (APFMIS) Act. As a result of this Act over 10,000 WUAs were formed, almost overnight, closely followed by the formation of 174 Distributary Committees. Under the Act elections for the WUA President and Managing Committees were to be held each 5 years. In April 2003 the Act was amended to make the WUA Managing Committee a permanent elected body, with a rotating membership, thus providing a far greater degree of permanency to the Committee. In addition other changes were made to the Act to enable greater participation, accountability and transparency and elections held under the new Act which resulted in the formation of 10,755 WUAs (2,239 in major projects, 432 in medium projects and 8,094 in minor projects), 323 Distributory Committees (all major projects) and 83 Project Committees(23 major projects and 60 medium projects.

The Maharashtra Water and Irrigation Commission recommended in 1999 that Water Users Associations should be provided with volumetric supplies of water from public canal systems. As a measure to try to encourage greater participation by water users to close the gap between the potential irrigated area created and actual the government passed the Maharashtra Management of Irrigation Systems by Farmers (MMISF) Ordinance in August 2004, which then became the MMISF Act in 2005. The Act had a number of interesting features in that it: permitted greater involvement by farmers and WUAs project planning and system management; allowed for greater involvement of women in both the General Body and WUA Management Committees; and allowed specifically for representation in the WUA from tail, middle and head-end water users. Under the MMISF Act, unlike other similar acts, the members of the elected Management Committee elect a Chairperson[4] and Deputy Chairperson and employ a paid secretary with a salary determined by the WUA.

The MMISF Act was followed in 2005 by the Maharashtra Water Resources Regulatory Authority (MWRRA) Act which provided WUAs with a volumetric entitlement to water (termed an Aggregate Bulk Water Entitlement under the Act), measured at the point of delivery to the WUA. Allied to this volumetric entitlement the MWRRA was empowered to establish a tariff for different uses of water and to fix the criteria for making water charges at sub-basin, river basin and State level. Under the Act these charges are required to reflect the true cost of management, operation and maintenance of water resources projects. The WUA General Body is then empowered to set the water charge for its members to cover the fees charged for the bulk water supply plus an additional fee to cover the WUA's management, operation and maintenance costs.

As can be seen from Tables 1 and 2 there are a number of issues with the uptake of PIM in India. These can be divided in broad domains of: legal; formation and support; management/organisational; operation and maintenance (O&M); and finance. The main issues in these different domains include:

Legal

- Lack of water rights or entitlement to water (except in Maharashtra and to some extent in AP[5]);
- WUAs are not independent of government;
- Insufficient belief by government of water users' capabilities, and lack of delegation of sufficient rights and responsibilities to water users.

Formation and support

- In general WUAs have been formed without adequate institutional support. Some of the World Bank funded Water Sector Restructuring Projects (WSRPs) have provided support through consultants or NGOs, with mixed success;
- Central Government has articulated the need for greater involvement of water users in water management. Unfortunately this objective does not appear to have yet been put into practice on the ground;
- In general the ID appears not to be supportive of the PIM process, and therefore not providing adequate support and guidance to WUAs and water users;
- In some locations the ID retains a top-down approach to working with water users;

[4] This is also the case in AP and Orissa. In other States the water users directly elect a WUA President. The WUA Management Committee is then made up of the elected Territorial Constituency (TC) representatives and the elected President.

[5] In AP at the time of delimitation of the command area a cropping pattern is recommended. Based on this a quantity of water is allocated to the various zones of the command. This is clearly mentioned in the WUA Memoire when it is established. However, actual water allocated each cropping season depends on the actual crop being grown and the water available in the reservoir

Management/organisational

- Except in Maharashtra, AP and Orissa the WUA President is elected directly by the water users, rather than a WUA Chairperson being elected from amongst the by the elected representatives on the Management Committee. This leads to presidential style rather than committee/community style management of the WUA;
- There is a need to separate governance of the WUA from management. Elected representatives to the Management Committee should be responsible to the General Body for governance – setting policy, setting service fee levels, appointing staff, etc. whilst staff should be appointed to manage the I&D system. These staff would comprise a WUA Director, accountant and water masters, who would be responsible to the Management Committee and the General Body;
- Many WUAs do not employ staff to carry out the basic functions of water management, maintenance and record keeping. Service delivery by the WUA is subsequently generally poor;
- Many WUAs do not have offices, and thus are not seen as a permanent institution by farmers and other stakeholders.

Operation and Maintenance

- Except in Maharashtra, lack of staff to properly manage, operate and maintain the I&D systems in order to provide a reliable, timely an adequate level of service to water users;
- As there are often no permanent WUA staff it is difficult to carry out any targeted training related to system MOM;
- Standards of operation and maintenance are low as a result of lack of trained WUA staff.

Finance

- Except in Maharashtra WUAs cannot set, collect and utilize service fees[6]. This is a key function of any organisation, denying this responsibility to WUAs removes one of their major roles;

[6] There are three systems of irrigation water revenue administration operating in India.

Sl. No.	Department Responsible for Assessment / Collection of Water Charges	Adopted in States
1	Irrigation Department does assessment and collection	Maharashtra, Gujarat, Madhya Pradesh, Chhattisgarh, Rajasthan, Goa, West Bengal, Bihar, Jharkhand, Jammu & Kashmir, Assam, Manipur,
2	Irrigation Department does assessment but collection is entrusted to Revenue Department	Haryana, Himachal Pradesh, Punjab, Uttar Pradesh, Uttaranchal
3	Revenue Department does both assessment and collection	Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Orissa

In Maharashtra the first system (Marathwada System) operates where the water is the property of the ID until it reaches the farmer's field. So the ID assesses and levies the water charges and also collects it, a responsibility which has now been delegated to the WUAs. In Andhra Pradesh the third system (Madras System) is followed where the water once in the canal is the property of the Revenue Department, which is then responsible for assessing and levying the water tax and also collecting it. Since it is a tax, only the government can levy and collect it. In AP the I&CAD Department proposed that the WUA be made responsible for collection of the water tax and retain it to cover their MOM costs. However, the Finance Department disallowed this approach on the

- Water charges levied by the ID and the Revenue Department are seen as a tax by water users;
- Water charges collected by the Revenue Department are not generally used for MOM of the systems from which they were collected. There is a lack of connection between charges paid and level of service delivered;
- In states where there is "flowback" of funds the payment-to-repayment route is lengthy, time and resources consuming, and controlled by the ID and Revenue Department, not the WUAs;
- There are too many staff involved in the water charge collection process. This is not cost-effective and wasteful of time and resources which could be better spent on system MOM;
- Water charges are too low to cover the real costs of system MOM;
- Regulatory Authorities should not set water charges within I&D systems, this should be done using recognised technical procedures (such as asset management planning) by the service providers (the ID at the main system level and the WUAs at the on-farm level);
- The water charges should be set for each system based on the quantified needs. They should not be a general average rate set at the State level.
- The water tax is charged based on crop area, not measured volume of water supplied[7].

grounds that this could not be done unless the GoAP changed the relevant revenue code and abolished the Water Tax Act and designated the levy as water charges. So while in AP 100% of the water tax collected is ploughed back to the WUAs, it has to follow a circuitous route from the farmer to the Revenue Department, on to the Finance Department further to the I&CAD Department and then back to the WUA.

[7] In AP, for example, while the tax is not charged on the actual volume supplied it is based on a calculation of the water requirement for a crop (based on crop water requirement) multiplied by the area actually cropped. In fact, the rate is also adjusted seasonally to reflect the crop water requirement. One of the reasons this system is followed is because the ID finds it practically impossible to volumetrically measure the water supplied to individual WUAs and farmers for lack of measuring devices in the irrigation system and the administrative cost of recording the volumetric data. In Maharashtra volumetric assessment may have become possible as the water charge collection has been delegated to the WUAs who can both maintain the measuring devices and maintain regular records to allow charging based on volume delivered.

Table 2: Summary of findings from three States of study of WUA development (adapted from Johnson, 2009)

Domain	State	Feature/Issue	Consequence/Remarks
Legal	UP	• UPPIM Act (2009) written such that it can be implemented over time as project or other funds become available.	• PIM movement is project-focussed, not state-wide. WUA establishment in non-project areas not seen as a priority.
	AP	• Government decision in 1997 to promote PIM state-wide. • Management Committees (MCs) initially elected throughout the State for a 5-year term under APFMIS Act (1997). • 2003 Act revision allows two Panchayat members to be nominated to the WUA MC, plus co-option of other water users (fishers, potters, etc.).	• Demonstrates strong political support for PIM. • Causes problems if the elections are delayed (as in 2002). Changed in 2003 Act revisions to a system of rolling elections of WUA Management Committee members. • Increases representation and engagement.
	M'stra	• MMISF Act (2005) allows for election of a Chairperson by the elected members of the WUA MC. • MMISF Act engages water users in all parts of the project cycle (planning, design, construction, management). • MWRRA Act provides WUAs with a volumetric entitlement to water. • MWRRA sets tariffs for water uses/users.	• WUA Chairman more responsive to WUA MC. • Greater sense of ownership created for water users. • Entitlement to water quantifies water to be provided, makes irrigation water supply more secure and reliable, farmers can match cropping accordingly. • Difficult for the MWRRA to set tariffs for each I&D system. In-system tariff best left to service provider to determine. Regulator can then check.
Formation and support	UP	• Initial top-down approach to WUA formation. • Focus at the outlet level, with Outlet WUAs. • UPWSRP-funded Community Organisers (COs) involved with WUAs since 2004. • WUAs do not play an active role in system rehabilitation.	• Lack of engagement and ownership by water users. • WUA set at too low a level in the system, not big enough to function properly. • WUAs become dependent on the project-funded COs. When project ends the COs will be gone. • No sense of ownership created and thus no responsibility for maintenance of the physical works.
	AP	• Tanks visited have sluice gate operators paid by Gram Panchayat for which fees are collected from farmers. • AP policy is that tanks should get 90 percent refund of water fees. • Social Organisers paid by project to work with tank users. • On major irrigation system water taxes collected by the Revenue Department with assistance from the I&CAD Department, WUAs should get a 60 percent refund of fees. • Refunds are paid into PNO account. WUA MC with ID and CADA decide on works and request money from PNO Revenue Office.	• Farmers used to paying for staff. • Preferable to allow WUAs to collect and use fees for tank MOM. No staff needed then for fee collection. • Have to take care that water users do not become dependent on SOs. • WUA not involved in setting and collecting water fees. WUA President doesn't know which farmers have/have not paid. • WUAs are not able to decide the allocation of the funds, diminishes their sense of ownership, responsibility and confidence.
	M'stra	• On the Waghab scheme 24 WUAs have been formed by water users themselves with the help of a motivated engineer within the ID.	• The Waghab scheme has been held up as best practice, both for WUA formation and system management.
Management, Operation and Maintenance	UP	• Focus on outlet-level WUAs appears to be too low down in the system.	• WUAs not big enough to function properly. Too many WUAs to be formed and to provide training and support to.
	AP	• Originally Management Committees and Presidents elected state-wide for 5 years. • Act revised in 2003 to make the WUA Management Committee a permanent body with rotating membership, with one-third of the MC members retiring/standing down each two years after a term of six years.	• Involved a massive effort every 5 years to organise elections. Also created serious disruption and discontinuity in the management of the WUA. • Far better arrangement, allows continuity of management experience in the MC. • Direct election of the WUA President creates a presidential and potentially autocratic style of management by one person. Preferable to have the WUA Chairperson elected

		• Initially the WUA President was elected directly by the water users. Since revision of the Act in 2003 the WUA Chairman is elected by the (elected) members of the TC on the WUA Management Committee.	from amongst the elected WUA Management Committee members.
	M'stra	• Elected MC which represents the head, middle and tail of the I&D system. MC elects a Chairperson and Deputy Chairperson. • MC recruits a paid Secretary. • The PLA determines the annual and seasonal water entitlements for each WUA based on available resources in the reservoir. • Water is allocated on the scheme by volume. The ID and WUAs jointly measure flows twice per day. • Farmers grow high value crops, use drip irrigation and conjunctive use of surface and ground water .	• WUA Chairperson more representative of the MC • Concept of paid staff is accepted. • The Waghab system is relatively fortunate in having a dedicated reservoir. • The volumetric water entitlement allows farmers flexibility in cropping. • Good example of conjunctive use of surface and ground water.
Finance	UP	• WUAs not allowed to set and collect service fees, responsibility of Revenue Department and ID. • Additional service charge for MOM of WUA system not set or collected.	• The water charge is a seen as a tax, not a service fee. • No funds available for system maintenance post-rehabilitation.
	AP	• Water taxes are set by government and collected by the Revenue Department with assistance from the I&CAD Department. . WUAs should receive 60 percent "flowback", but not directly. The money collected goes into PNO account and is then drawn down by WUA with agreement of ID and CADA. The remaining 40percent is also ploughed back, with 15 percent to the Distributary Committee, 20 percent to Project Committee and 5 percent to the GP.	• Good that some of the water tax is coming back to the WUA, but a very bureaucratic and time-intensive process. Far easier for the WUA to collect and retain the service fees for their system and pass on ID main system charges to the ID.
	M'stra	• WUAs collect the water fees and pay to the Project Level Authority (PLA) who then transfer fees to the ID. ID return 78 percent of collected funds. WUAs charge an additional sum over the ID rate for their own MOM costs.	• Before formation of WUAs and the PLA only 60 percent (Rs 0.3 million) of fees collected. Afterwards recovery was 100 percent (Rs 2.2 million), about US$ 5/ha (still low).

Table 3: Summary of key issues identified with participatory irrigation management in India

Domain	Feature/Issue	Consequence/Remarks	International/National best practice
Legal	• WUAs do not formulate their own Charter or by-laws.	• One size fits all approach does not allow farmers to formulate their own ideas and create their rules. No sense of ownership created, rather a feeling that the WUA is state-imposed.	• Water users are provided with a model charter as an example and allowed to modify it to suit their own needs. The Charter is then registered along with other WUA documents with the local court.
	• In most states, other than Maharashtra, water users do not have a right/entitlement to water	• No security of supply for water users. • Water users at risk of upstream users taking their water. • No basis for planning and allocation of available water supplies between different water uses and users	• Water rights are a key feature of water management in Mexico, Australia, Europe and the USA.
Formation and support	• Training is carried out by WALMI and NGOs.	• WALMI are not well qualified or adequately staffed to train WUAs. Similarly some NGOs are often not sufficiently qualified to train WUAs.	• Specialist WUA Support Units are established to form, train and support WUAs (Mexico, Kyrgyzstan)
	• Social Organisers are employed by NGOs to form and support WUAs.	• Water users can become too dependent on the SOs and the NGOs	• Support is provided by WUA Support Units (SUs) based at District or Regional level. WUA SU staff travel to WUAs rather than being based within the WUA.
	• WUA support is generally project-based and short-term, rather than long-term.	• WUAs take time to become established. Without long-term support and hand-holding they may fail.	• Specialist WUA Support Units are established within the irrigation agency (Kyrgyzstan, Azerbaijan). Alternatively the irrigation agency staff are trained to support water users. • In AP Farmer Training Centres (FTCs) with roving trainers have recently been established within the I&CAD. FTCs are funded from the I&CAD budget.
	• ID staff are often not supportive of the PIM concept and WUAs.	• If the ID is not fully supportive of the PIM concept then the ID staff will not support WUAs and participation of water users in system MOM. A fundamental change in attitude is required.	• In Mexico and Turkey support for PIM/IMT came right from the top and all irrigation agency were required to support WUAs at all stages. Not supporting the process was not an option.
Management/ Organisational	• Under various State Acts in India there is no separation between governance by the General Body and management.	• This is a major problem, governance should be separate from management. The General Body (GB), through the Management Committee (MC), should make policies and decide how the WUA should operate. A separate group, overseen by the General Body (GB) through the MC, should be charged with the day-to-day management of the WUA (water distribution, maintenance, liaison with water users on water issues, etc.)	• Most WUAs internationally separate out governance and management. Water users elect a WUA Management Committee who then elect a Chairperson from amongst their number. The MC then appoints paid staff, generally including a WUA Director, accountant and O&M field staff. • In majority of best practice cases the Chairperson is elected from amongst the elected members of the WUA Management Committee.
	• WUAs not formed state-wide, only formed or supported on a pilot or project basis.	• Mixed messages given as to the importance of PIM/IMT.	• Best practice found where PIM/IMT programmes are implemented nation-wide (Mexico, Turkey, Kyrgyzstan).

Domain	Feature/Issue	Consequence/Remarks	International/National best practice
	• Lack of clear support for PIM/IMT from politicians and senior ID management.	• No clear message given to ID staff on PIM/ IMT. Lack of support for PIM/IMT from lower levels in the ID, fearing loss of jobs.	• Strong political support a key feature of best practice PIM/IMT programmes.
	• Under various State Acts in India a WUA President is directly elected by the water users, whilst a Management Committee is formed from elected representatives for Territorial Constituencies.	• There is a disjoint between the WUA President and the MC, it is not clear who has the responsibility for running the WUA. This approach concentrates too much power in the hands of the WUA President. In some cases these elections are now based on political lines, which is not good.	• In most international cases the members of the MC are elected first, and then they elect a Chairperson from amongst themselves. Thus the Chairperson is accountable to the MC, and the MC to the members through the General Body.
	• An ID Engineer is the Secretary to the WUA Management Committee	• As a result the WUA are not independent of the ID. They will not develop as an organisation.	• This is very unusual and is not practiced in other countries. Under the law the WUA is established as a separate independent body from the irrigation agency.
	• Often WUAs do not have offices	• If WUAs are to be a permanent feature they require offices, in the same way that the ID requires offices.	• In best practice locations WUAs have their own offices as a base for the WUA staff and contact point for water users. Offices also create a sense of identity and permanency.
	• Some WUAs are too small to be able to hire staff.	• Without staff the job of managing, operating and maintaining the I&D system falls to the WUA President, the TCs and volunteers. As these personnel are not paid and not full time on the job, the quality of the service suffers.	• The minimum size for a WUA varies from country to country, but a WUA command area in the range of 2-3,000 ha enables a manager, accountant and O&M field staff to be employed.
	• Elections for WUA President and Management Committee are organised by government and held every 5 years	• Laborious process for government to organise the WUA elections. • Continuity of WUA Management Committee broken by electing new MC every 5 years.	• Allow WUAs to organise their own elections, according to their Charter. WUA Regulatory Authority created to be responsible for oversight of the process. • Members of Management Committees elected on a rolling basis. Term usually 2-3 years.
Operation and Maintenance	• Water distribution not measured volumetrically.	• No incentive for WUAs or water users to use water efficiently	• Volumetric allocation and measurement of water is used in other countries as a basic management process.
	• No paid staff to operate and maintain the I&D system.	• Difficult to hold voluntary labour for O&M to account. Paid labour can be given clear job descriptions and can be held to account by the MC and the General Body.	• Most successful WUAs and farmer-managed irrigation systems have paid, not voluntary labour. Benefits far outweigh the costs.
	• No systematic process for assessing the maintenance and repair costs for the I&D system.	• Failure to properly ascertain maintenance and repair costs results in lower than required investment in maintenance and repair, and gradual loss of serviceability of the system.	• Successful WUAs recognise the importance of maintaining the I&D system, and make realistic assessments of maintenance and repair costs. Asset management planning a useful tool in this context.
Finance	• The water charge is seen as a tax, not a service fee.	• There is a big difference in perception amongst farmers between a water tax and a service fee.	• Fee recovery is higher where it is seen as a service fee, for which a specific level of service will be provided.
	• In general water charges are low and insufficient to cover the MOM costs of I&D systems.	• Due to low fee collection I&D systems cannot be adequately maintained.	• Fees are set by the WUA based on identified needs. Asset management planning (AMP) is a valuable approach to identifying, quantifying and costing maintenance needs.

Domain	Feature/Issue	Consequence/Remarks	International/National best practice
	• Water charges are generally collected by government (ID or Revenue Dept) and sent to a central exchequer. They are not retained for use on the scheme from which they are collected.	• Water users do not see a link between the water charge they pay and the level of service they receive.	• Fee recovery is higher where the service fee is retained for use at the scheme level. In best practice countries WUAs collect and use the service fee, passing on the fee for the higher-order systems. This is the system used in Maharashtra.
	• Water charges are set centrally for the whole State, they are not set for individual systems.	• For budgeting purposes the water charge is set for the State, and is not based on the needs of individual systems. • Water tax rates are fixed crop-wise and season-wise (Kharif and Rabi) per acre and are applicable across the state.	• In successful cases internationally the service fee is established based on the needs of individual systems, and if set by the WUA is collected and used by them and not sent to a central exchequer. There is then a direct link between the service fee paid and the service delivered on a farmer's system.
	• The cost of water charge collection can be a significant part of the charges collected.	• Money that could be used for maintenance work is spent on salaries of collection staff.	• In Mexico, Turkey and Kyrgyzstan service fees are paid by water users directly to WUAs in their offices. Collection costs are thus zero. In the Philippines National Irrigation Agency staff spend around 40 percent of their time trying to collect service fees.
	• Water charge made based on area rather than volume of water supplied to the WUA.	• No encouragement of the WUA or water users to be economical with irrigation water supplies.	• Water measured and accounted for volumetrically.
	• Water charges set at the State level.	• The water charge becomes a political issue that can be manipulated by politicians.	• Service fees are set by WUAs and irrigation agencies based on identified needs. Fees are independent of political influence.
	• Funds collected for I&D system MOM are insufficient.	• Up to the 1960s the water tax used to be sufficient to cover the MOM costs of the I&D systems. This is not now the case, the water charges are well below levels required for sustainable MOM. Setting the level of the water charge has, in some cases, become a political rather than a technical decision.	• The problem of low service fees contributing to I&D system deterioration has been recognized in many countries. Formation of WUAs has resulted in the service fee being raised to sustainable levels in: Colombia (US$54/ha); China (US$ 42-80/ha); Turkey (US$ 35-96/ha); Armenia (US$ 53-65/ha). Note that there is a range of fees, the fee is set based on the needs of each system.
	• In some states Regulatory Authorities (RA) are being established to set the tariff for water use and users.	• Difficult for the RA to set the water tariff within each irrigation system, they do not have the staff or the relevant data.	• Tariffs usually set by the service provider (ID, WUA or WUA Federation) based on each system's needs. • RA usually responsible for licensing water allocations and overseeing tariffs set by service providers to ensure that they are appropriate and fair.
	• Water taxes are determined based on crop type and area, not volume of water delivered (except in Maharashtra)	• Water delivered to each WUA should be measured and service fees charged based on volume of water delivered.	• Most best practice countries measure water delivered and charge based on volume delivered. • In Australia on some systems a basic water entitlement volume is guaranteed, at a relatively low charge rate. Additional supplies can be obtained, but at a higher price.

4 Innovative provisions in PIM Acts

While most of the provisions of the PIM Acts of the different States are quiet similar, some even being clones of others there are some innovative provisions included in some of the PIM Acts that could be considered as progressive in nature. These include provisions related to:

1. Delineation of WUA area
   - i. Provision for the farmers to register their opinions before final notification of delineation of the WUA area
2. Constitution of WUA
   - i. Wife of land holder who do not hold land deemed to be the landholders and made members of WUA
   - ii. WUA constituted and responsibility of irrigation system handed over to them only after restoring it to its prescribed performance standard
   - iii. Representation of Scheduled Caste, Scheduled Tribe, Gram Panchayat and Women
3. Constitution of WUA Managing Committee
   - i. Three representatives elected at territorial constituency level off which one is elected as members of WUA managing committee
   - ii. WUA managing committee constituted as a continuous body with six year term and with one third members replaced every two years
4. Functions of Farmers Organization
   - i. Develop irrigation infrastructure by availing institutional finance
   - ii. Supply seeds, fertilizers and other inputs
   - iii. Market agricultural products
   - iv. Undertake enterprise for value addition to agriculture products
   - v. Establish Agro Service Centre for providing agricultural services
   - vi. Act as Self-help Group for providing credit
   - vii. Promote micro irrigation - drip and sprinkler systems
   - viii. Develop farm ponds and community projects for exploiting groundwater
   - ix. Supplementary business like dairy and fisheries
5. WUA Agreement
   - i. Signing of agreement between WUA and Irrigation Department for the supply of bulk water to the WUA and related issues:
   - ii. Water use entitlement
   - iii. Water rate and assessment on volumetric basis
   - iv. Rights of member of WUA
   - v. Rights of WUA
   - vi. Standards for maintenance and repairs of canal system;
   - vii. Standards for maintenance and repairs of field channels and field drains

viii. Provisions for resolution of conflicts

6. WUA staff
    i. A secretary
    ii. A minor canal operator
7. WUA Records
    i. WUA annual report
    ii. The books of accounts and other records are open for information to all members
8. Volumetric supply of water to WUAs
9. Installation of measuring devices on minor canal
10. Training of WUAs
11. Protection of local government and tribal rights under 73 and 74 Constitutional Amendment and 5th Schedule of Constitution

The detailed state wise innovative provisions from the PIM Acts are given in Appendix A2.4.

5 Related international experience

Related international experience is summarised in Appendices A1 to A3 for Mexico, Turkey and Kyrgyzstan, whilst Appendix A4 provides a best practice example from the Dharoi Irrigation Scheme in Gujarat. From the case studies described in the appendices and studies carried out by others (Kloezen and Samad, 1995; Geijer et al, 1996; Vermillion, 1997, Vermillion and Sagardoy, 1999) the following are the major factors influencing the success of programmes to increase the participation of water users in the management of I&D systems:

i) Understanding drivers for change, objectives and desired end points

- Clearly identifying the factors that are driving the move towards participatory irrigation management (need to reduce government expenditure, need to improve water use efficiency and productivity, need to address societal changes);
- Setting clear objectives and end points;
- Being clear on the desired end points of the process (greater fee recovery, more efficient and productive use of water, more sustainable systems);
- Structuring transfer programmes to address these drivers whilst ensuring that some of the basic requirement are recognized, principally that water users need to be given rights as well as responsibilities.

ii) Essential conditions

- Committed high level political support;
- Government I&D agency supportive of the programme;
- Politicians aware of the programme and if not actively supportive, not resisting changes;
- Specific legislation enacted related to establishment of water users associations, with complimentary changes made in associated legislation (water law, civil code, tax code, etc.);

- Legal right of WUAs to set, collect and use service charges related to their service area;
- Legal entitlement to irrigation water with clear definition of associated conditions;
- Adequately functioning I&D systems;
- Clearly defined roles and responsibilities of the various stakeholders, including water users, WUA management and I&D agency personnel;
- Provision for a sufficient length of time of specialist personnel to raise awareness, train and support WUAs and water users;
- Clearly thought through policy and programme for restructuring of the I&D agency, including training in WUA principles, practices and support functions;
- Adequate time and resources to complete management transfer.

iii) Issues to be recognized and addressed

- Recognition that this is a change management process. Acceptance and use of proven change management approaches and techniques;
- Strength of the potential resistance to change from parties with vested interests, including I&D agency personnel and politicians;
- Recognition of the need to raise awareness and understanding of the role and benefits of management transfer amongst politicians;
- Recognition of the need to raise awareness, understanding and support for the programme amongst I&D agency staff;
- Whilst management transfer might reduce government expenditure over time it requires additional resources in the short-term until WUAs are established and functioning.

iv) Factors contributing to failure of management transfer programmes

- Lack of high-level support;
- Sabotage of the process by vested interests resisting change;
- Adverse political interference (e.g. politicians advocating the non-payment of service fees);
- Lack of adequate explanation and support for the transfer process (i.e. failure to provide specialist support to form and guide WUAs and water users over a sufficient length of time);
- Inadequate/weak legal framework;
- Failure to devolve adequate levels of responsibility to water users (vis. ability to set, collect and utilize the service fee);
- Perpetuation of the top-down approach to farmers and water users. Failure to respect the expertise and capabilities of the farming community;
- Failure to reform and restructure the I&D agency.

6 Proposals

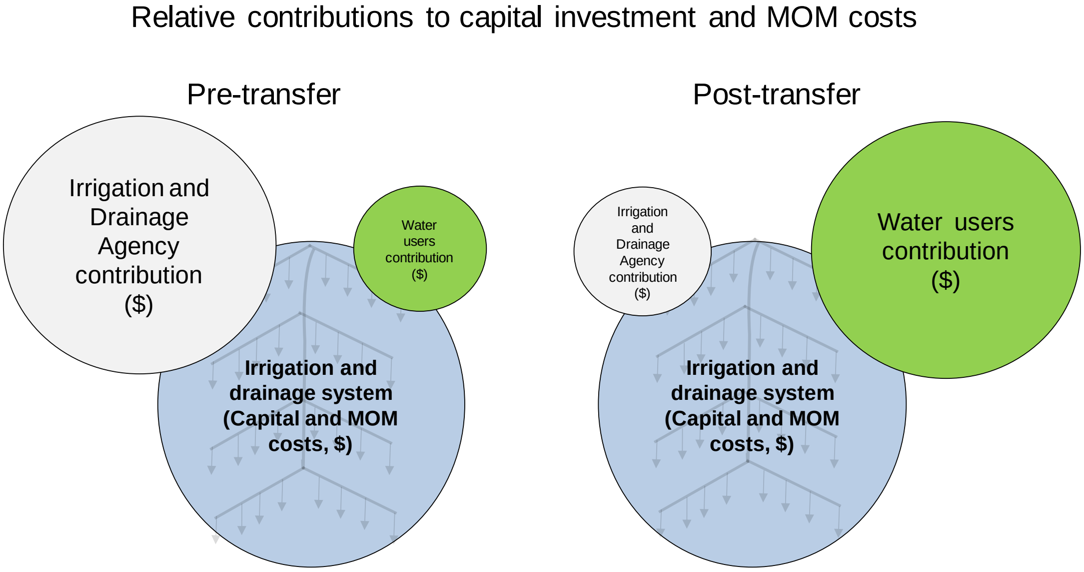
Proposed measures to improve participatory irrigation management in India include:

- **Move from a PIM approach towards an IMT approach**. The current PIM approach leaves too much responsibility in the hands of the ID. More rights and responsibility should be transferred to WUAs.
- **Allow WUAs to set and collect the service fee.** WUAs should be able to set, collect and spend their own service fee (as agreed by the General Assembly of members), though a portion may be passed on to the ID for MOM of the main system.
- **Separate governance and management of the WUA.** Governance and management should be separated, with elections to appoint 10-12 WUA Committee members who in turn elect a WUA Chairman. The WUA Committee then appoints paid staff to carry out the day-to-day management of the I&D system[8].
- **Grant each WUA an entitlement to water.** There should be an entitlement to water, from both surface water and groundwater[9]. This entitlement can be allocated to the WUA rather than individual members, and can be based on allocation of a fair share of the available water supplies in the basin.
- **Create WUA support units.** WUA Support Units should be formed, trained and resourced to train and provide support to WUAs over a minimum 10-year time frame.
- **Increased awareness and training.** A significant awareness raising and training program should be carried out, followed by ongoing support and hand-holding from WUA Support Units.
- **Change attitude and role of the Irrigation Department.** The ID was established over 100 years ago for a very different environment to that encountered today in modern India. The ID needs to reform and restructure itself to benefit from the opportunities offered by participatory irrigation management, and work in partnership with WUAs and water users to enhance the productivity of irrigated agriculture in India. An important factor in the changing role of the ID and the water users is their respective contributions to the management of the I&D system. As the funding from the ID decreases and that from the water users increases (Figure 2), so the role and importance of the two players will change, with the water users assuming a far greater role than in the past. At the heart of the discussion here is the ID attitude that government has financed and built the I&D systems therefore it is government property. This attitude has been prevalent in many other countries (USA, Mexico, Australia, Chile) but governments are now taking the view that they have made their contribution and it is time for the beneficiaries to take on the MOM of the systems.

[8] The issue here will be of meeting the cost of hiring WUA staff. This can either be met by correspondingly increasing the water charges or the government transferring the salary cost to the WUAs.

[9] There are several issues with the licensing of abstraction from groundwater which are discussed in the Working Paper on groundwater management.

Figure 2: Changing financial contribution of the I&D agency and water users over time



7 Conclusions and Proposals for reforms

This Working Paper has endeavoured to summarise some of the key issues facing participatory irrigation management in India, and sought to provide some suggestions for approaches to improve the situation based on international experience.

Much has been done. Tailor-made legislation for WUA formation has been prepared, WUAs have been established and support has been provided in some instances for these fledgling organisations. Crucial to the changing situation in India is the recognition by the national and state governments that water users need to be given an increasing say in the management of their irrigation systems, coupled with an increasing appreciation of the valuable contribution that water users and their associations can make to the management, operation and maintenance of these systems, not only in financial terms but also in terms of their motivation and commitment to productive agriculture.

However, as much as has already been done, there is more to do. Crucial amongst these are changes in attitudes, understandings and knowledge amongst the Irrigation Department staff. The days of construction of new schemes is over, the era of productive management of the already developed irrigation and drainage schemes has dawned. Civil engineers with a primary interest in design and construction need to give way to irrigation and agricultural engineers with an interest, appreciation, knowledge and understanding of water management, agriculture, agricultural economics and community engagement and participation.

A formal review of participatory irrigation management in India needs to be carried out, supported by the national and state governments, and a close look taken at best practices in India and elsewhere with PIM and IMT. Evidence exists in India of best practice, the question is how to scale this up and how to transform the existing bureaucracy to suit the current and future needs.

The vision is of sustainable water users associations, democratically managed by and for water users for efficient and productive irrigated agriculture, working in partnership with an Irrigation Department in which managers measure their own performance by that of the outputs of the schemes they manage and the efficiency, reliability and timeliness of water delivery.

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Appendix A1: International Experience

A1.1 Case Study 1: Mexico

The irrigation management transfer program in Mexico commenced in 1989 with the formation of the National Water Commission (CNA) following a decision made by the Office of the President. The CNA was charged with developing a national water resources management program, involving water users (through water users associations) in order to improve water use efficiency and productivity, and ensure financial self-sufficiency.

The I&D system in Mexico had been developed in the 1930s to provide food security and food-self-sufficiency. Large irrigation districts were created ranging from 20-300,000 ha, which were operated until 1990 by the government irrigation agency. By this time Mexico had some 6 million hectares irrigated, with 3.3. million hectares in 81 public irrigation districts.

Initially the public-run I&D systems were nearly self-financing, with 85 percent of the MOM costs being recovered from water users. However, the fee recovery rate gradually declined such that by the 1989 the recovery rate was only 20 percent. With a major financial crisis in Mexico in the late 1980s drastic measures were required to return the I&D systems to financial self-sufficiency.

The transfer program was initiated in two phases. Under Phase I the MOM of government-run I&D systems was shifted to water users associations (WUAs), whilst under Phase II the Limited Responsibility Societies (SLRs) were created to enable federations of WUAs within a District to manage the main system. By 2000 some 3.2 million ha of had been transferred to 420 WUAs comprising 470,000 members, and 10 SLRs had been formed. This massive change had been brought about though a well organised transfer program coordinated by the CNA involving significant amounts of awareness raising amongst water users and training of both WUA management and water users. Water tariffs were increased and by 2000 the transferred irrigation districts were recovering 80 percent of their MOM costs direct from water users, up from under 30 percent in 1991. At the same time the CNA O&M staff were reduced from some 8,000 staff to under 2,000.

An important aspect of the transfer program was the formulation of a new water law in 1992, followed by supporting regulations for implementation in 1994. Though the initial reform was initiated under the 1972 law it was realised that more targeted legislation was required, resulting in the 1992 law and associated regulations. The new law set out the principal of water rights and water concessions to WUAs to provide equal water allocation each season to WUAs within a district. The concessions for a proportional right to the available water in the district are granted to WUAs, not individual water users, and are for a period of up to 50 years. When a SLR is formed these concessions remain with the WUAs, the SLR only has the responsibility to manage these concessions. As the WUAs have gained in experience so their involvement in water resources management outside their boundaries has increased, both with the formation of SLRs and with their engagement though river basin councils to ensure that they get a fair share of the available water resource.

During this period the role of the irrigation agency (CNA) has changed from one of being responsible for management of water resources and irrigation water delivery to that of being responsible for management and regulation of water resources. There has been increased focus on the establishment of river basin authorities and the engagement and coordination of stakeholders in management of the available water resources. Recognising this changed role, the CNA has been moved from the Ministry of Agriculture to the newly formed Ministry of Environment and Natural Resources. In time, as the river basin councils become established, it is intended that they will become self-managing, leaving the CNA to become a national water resources management authority, responsible for setting policy and regulation of the available water resources.

Mexico is held up as one of the most successful examples of irrigation management transfer. Key factors which contributed to this success include:

- **Support from the top.** Very strong support from the top, the move was initiated through the Prime Minister's Office.
- **Solution to a tangible crisis.** There was a major financial crisis in Mexico in the late 1980s. The government and water users did not have many alternatives if the I&D systems were to continue to function.
- **Enabling legal framework.** Sound legal framework based on allocation of water rights, coupled with a professional water resources agency (CNA) able to quantify and regulate the water allocations.
- **Full support and cooperation of the irrigation agency.** Strong support from the I&D agency, the CNA, with a professional, well-organised country-wide awareness campaign and associated training program which enable the transfer programme to be implemented over the whole country in a relatively short time frame.
- **History of adequate fee collection.** Relatively recent history of adequate levels of fee recovery.
- **Well informed farming community.** Well-educated farming community able to understand and take advantage of the opportunities offered by management transfer.
- **Increased transparency and accountability.** Increased transparency and accountability to all stakeholders on water resources availability, allocation and use through river basin councils.

A1.2 Case Study 2: Turkey

Turkey began its program of devolution of department-run irrigation and drainage systems to local districts in the early 1990s. Prior to this the I&D department (DSi, State Hydraulic Works) had designed, built and managed the I&D systems, with water users paying a fee for the services provided. By 2005 80 percent of the large-scale irrigation systems had been devolved to management by locally controlled districts, and Turkey had emerged as one of the examples of "best practice" for other countries to follow. A new irrigation law which would change the current arrangement to one of direct governance by water users has been on the drawing board for several years, but has not progressed beyond this stage.

The Turkish model is based on an association of relevant local government organisations, rather than an association of water users per se. Irrigated agriculture is an important and thus central feature of village life in many locations and local government is elected by the community, many of whom are farmers. Irrigation thus plays an important part in the electoral process, and something for which farmers hold their elected officials to account. Overall management of the I&D systems is delegated to a five-member executive committee elected by a general assembly of some 50 people, comprising local government officials and farmer representatives. Day-to-day management is carried out by hired personnel, generally comprising a general secretary, an accountant and field staff. The general secretary is usually a university graduate in agricultural engineering. In some cases former DSi staff have been appointed as the general secretary and staff of the association.

In the early stages of the transfer program the government provided subsidies to support the new organisation, typically in regard to system maintenance. Once established (generally after 2-3 years) the association is responsible for its own MOM costs. Training and support was also provided by DSi, with a clear mandate from senior DSi management that local DSi staff were to support this initiative. A supporting factor in the program was that DSi O&M staff on the transferred systems were not made redundant but rather transferred to other duties, or employed by the new organisation.

Now that DSi has withdrawn from the day-to-day management of I&D systems it has taken on a regulatory role and monitors the performance of the transferred systems. It also has responsibility for the bulk supply of water to systems, and continues to manage some systems which are deemed too difficult to transfer to local control. Thought DSi are involved in water resources planning, particularly in relation to the construction of dams and irrigation systems, they are not, as yet, functioning as a water resources management agency. This is partly due to gaps in the water law and the lack of a system of water rights and licensing for water (though there is a licensing system for groundwater it does not appear to be strongly enforced).

Turkey can be considered a success to date with regard to increasing the involvement of water users in the management of I&D systems. Key features of the process include:

- **Strong leadership.** Strong support and leadership from politicians and senior management within the I&D agency;
- **Devolution of responsibility to existing local institutions.** Staged devolution from central to local government, with participation of farmers in the election of the WUA personnel at the local level;
- **Support from I&D agency.** There was active support and guidance from the staff of the I&D agency, DSi, in promoting the concept, training and supporting WUAs;

- **Non-threatening environment for I&D agency personnel.** DSi staff jobs not threatened. O&M staff were transferred to other duties or joined the WUA;
- **Professional and well-paid I&D agency.** DSi staff are well paid, there was little or no rent-seeking by I&D agency staff from water users, thus transfer of MOM functions to water users did not result in loss of income.

A1.3 Case Study 3: Kyrgyzstan

Kyrgyzstan is a small country with a population of some 5 million people. Agriculture is the backbone of the rural economy and a major driver of poverty reduction, food security and economic growth. Agriculture contributes 25 percent of the country's GDP and supports 40 percent of all employment and 65 percent of rural employment. Around 1.4 million ha (7 percent) of the 200,000 km^2 surface area of the country is classified as arable land of which 1.04 million ha (75 percent) is irrigated. Landholding sizes are small, with an average of 1.5ha for individual farmers.

The State Committee for Water Resources and Land Improvement (SCWRLI, formerly the Department of Water Resources, DWR) is responsible for management, operation and maintenance of the river system and higher-order off-farm infrastructure[10]. Water users manage the lower-order on-farm systems through recently formed Water Users Associations, traditional communities or individually. The SCWRLI organizational structure is largely based on the country's administrative structure, with seven *Oblvodkhoz* and 43 *Raivodkhoz* offices located in each of the Oblast and Raion administrative districts. The SCWRLI has some 5,200 staff, including 3,000 operations staff, some of whom are temporary staff employed during the irrigation season.

During the Soviet period the on-farm irrigation systems were managed as single management entities, either as *Sovkhoz* (State farms) or *Kolkhoz* (collective farms). Following Independence in 1991 state and collective farms were privatized, with the former workers on these farms becoming the new landowners. Initially there was a period of anarchy at the on-farm level as there was no formal organisation to manage the system at the lower on-farm levels. Ownership of the on-farm infrastructure remained with government, but in 1995 was transferred to Village Councils, though they had neither the expertise nor financial resources to manage, operate and maintain these systems. To address the growing crisis in 1997 the government passed a resolution which permitted the establishment of water users associations and the legal transfer of the on-farm infrastructure to the associations. In 2002, with technical support from the World Bank, this resolution was upgraded and became the Law of the Kyrgyz Republic 'On Unions (Associations) of Water Users', forming a solid base for transfer of responsibility for MOM at the on-farm. Since 2002 the government has actively promoted the establishment of water users associations, such that by 2010 some 474 WUAs have been formed serving a command area of 736,307 ha (71 percent of the total irrigated area).

The mode of transition from a fairly chaotic and anarchic state of affairs at the on-farm level between 1991 and the more stable, organised MOM of the present day is worth noting. The initial move of transferring the responsibility to local government did not work, and whilst the 1995 government resolution made a move in the right direction by delegating responsibility for MOM at the on-farm level to water users it was not sufficient to establish sustainable farmer-managed organisations. Between 1998 and 2000 the World Bank prepared the On-Farm Irrigation Project (OIP) which subsequently came into being in 2000 and was completed in 2008[11]. A priority task under the project was the upgrading of the 1995 government resolution, which passed into law in 2002. In addition to securing the legal

[10] The off-farm system comprises the headworks and main canal up to the delivery point to the on-farm systems. On-farm systems generally comprise tertiary and quaternary systems delivering water to farmers' fields. Larger on-farm systems may also include secondary canals.

[11] A follow-on project (Second On-Farm Irrigation Project, OIP-2) commenced in October 2007 and will be completed in December 2013.

framework, the project set about strengthening the institutional framework by the creation of WUA Support Units (SUs) at Central, Oblast (regional) and Raion (district) level. International consultants with experience of WUA formation and participatory irrigation management in other countries were used to train WUA SU staff in procedures for participatory irrigation management and establishment and support of water users associations. The WUA SUs at the Oblast and Raion levels were provided with and office, training room, a vehicle and operating costs, and spent much of their time in the field working with WUA management and water users. The initial WUA support program concentrated on establishing the WUAs, defining the (hydraulic) boundaries, helping WUAs to get registered, getting WUAs functioning as a management unit and operating and maintaining their I&D systems. A next step was the formation of Representative Assemblies rather than General Assemblies, which required extensive work defining the Representative Zones within WUA commands and assisting WUAs in organising elections for Zonal Representatives. Between 2000 and 2008 the number of registered WUAs rose from 132 WUAs serving 199, 258 ha (average 1509 ha/WUA) to 474 WUAs serving 736,307 ha (average 1553 ha/WUA), representing 72 percent of the total irrigated area and 96 percent of the SCWRLI-managed command area.

	
Farmer (on left) getting authorisation to take water the next day from the WUA Director (centre)	Simple control gate at division point within the WUA command with sharp-crested Cipoletti measuring weir in the channel in the background

Under the project 63 WUAs (serving an area of 121,436 ha, average 1927 ha/WUA) achieving stated levels of performance were selected for rehabilitation. A key feature of the project was that in the initial project design only 160 WUAs were to be supported in selected areas. However during the project, at the request of government, this restriction was abandoned and the WUA support program was expanded to the whole country. This made a dramatic difference, it was now a national rather than project program.

An important indicator of the success of a WUA formation programme is the transition, at some stage, of the WUAs interest from management of their internal system to the management of water in the (external) off-farm or main system. As the WUAs gained confidence and experience they started to look at water management outside the WUA command and formed Water Councils for canal networks together with local government and the main system management (SCWRLI). In other locations WUAs formed Federations of WUAs and after negotiations with SCWRLI took over the MOM of the main system. To date around 40 Water Councils have been formed serving some 250,000ha, whilst there are

35 Federations of WUAs serving some 184,020 ha. In March 2006, of their own initiative, WUAs formed a National Association of WUAs, with an elected executive. By December 2010 there were 201 WUAs registered as members, each paying a membership fee of KGS 2/ha (US$ 0.43/ha). The National Association maintains an office, publishes a quarterly newsletter and continues to seek financial support from donors for a number of initiatives.

	
Calibrated flow measuring structure at the intake to the WUA command area from the main system. The flow is measured here at least once per day by the Irrigation Agency staff and the WUA staff together.	WUA manager explaining the allocation of water to farmers along a quaternary channel
	
WUA-employed field water master with his notebook showing the water allocations planned for the day.	Farmer receiving water and distributing it evenly to his furrows.

At the present time the formation, development and growth of water users associations in Kyrgyzstan can be considered a success. WUAs have been established and function under a purpose-built legal framework and are accepted by water users as the organisation responsible for water management, system operation and maintenance. Farmers actively participate in the running of the WUAs through their Zonal Representatives, and have clear and transparent procedures for obtaining irrigation water, for which they pay the irrigation service fee (ISF). Though the level of the ISF charged by SCWRLI is still low (50 KGS/1000 m^3 or US$ 1.08/1000 m^3) the payment percentage is high, between 80-100 percent. The total ISF contribution to SCWRLI is around US$ 1.1 million per year, which represents between 8-9 percent of SCWRLI's current total income of approximately US$ 14.3 million. The income is significant at the Raion level as the funds are retained at this level and contribute to staffing and other MOM costs. The WUAs are raising additional funds to cover the costs of MOM of their own systems, and are in some cases the water users are contributing further funds for specified capital works, or O&M equipment.

From analysis of the Kyrgyz case study the following factors have contributed to the success of the transfer programme:

- **Support from government**. In general the government has been supportive of the IMT program.
- **Relatively stable political environment.** During the initial period of establishment (2000-2008) there was a relatively stable political environment in the country.
- **Well drafted legal framework.** With the support of the World Bank a comprehensive legal framework was formulated to support the establishment of water users associations.
- **Well established and well-functioning WUA Support Units**. WUA Support Units were formed and were well established, with external international assistance initially, adequate finances and resources, including offices and vehicles. They were able to get to the field frequently to work closely with WUAs and water users to build well-functioning WUAs. As a team they were well led and have become highly valued and respected by WUA management and water users.
- **Active and consistent support and supervision from the World Bank.** The World Bank project supervision team have been closely involved with the two projects (OIP-1 and OIP-2) from 2000 to date. Timely measures have been taken as required to adapt the projects to suit developing needs.
- **Supportive communities.** In general Kyrgyz village communities are community orientated, farmers cooperate and work together.
- **Viable size to support adequate staffing levels.** The boundaries of the WUAs are based on the former state and collective farms, and are generally between 1500-3000 ha in size. This is a viable size to support the management and O&M staff costs. Having experienced paid staff has resulted in good standards of water management and system maintenance.
- **Organic growth of higher level management structures.** The initial focus was on the establishment and strengthening of the water users associations, followed by deepening of the representative system so that water users became fully engaged with the management of their WUA. When the WUA had become established and functioning, water users looked to improve the management of the main system, and have, of their own volition, formed Water Councils, Federations of WUAs and a National Association of WUAs.

However, such change management programs are fragile until they become fully established, and there are some areas of concern:

- **Political instability.** In April 2010 there was serious unrest throughout the country and the President was ousted. There were instances in the south of the country of differences arising between different ethnic groups, leading to uncertainty and discord. In general the WUAs have weathered this situation, and have been able to provide some stability for water users during the crisis.

- **Changes in senior management.** Up to October 2009 the Director Generals of SCWRLI were supportive of the WUA formation and support process. However a change around this time to a Director General of the old order (top-down, not trusting of water users) put the process on hold, and in some respects moved it backwards for a while.
- **Weakening of the WUA Support Units.** Under the agreement with the World Bank the government agreed to take over the funding and management of the WUA Support Units during OIP-1. This was delayed until OIP-2, and when staff were transferred from the project to government their salaries and support facilities (transport, operating costs) were reduced. There was serious discontent amongst WUA Support Unit staff, partly due to the lower salaries, but also on a professional basis as a result of not being able to get to the field to liaise and work with WUAs and water users.
- **Low ISF and continued deterioration of I&D system.** The formation of WUAs has significantly improved the water management and system maintenance at the on-farm level, but the MOM of the main system remains a concern due to lack of adequate finance. Service fees will need to increase 4-5 times to meet the actual MOM needs.
- **Need to modernize the main system management agency.** There is a pressing need for SCWRLI to modernize and become more customer focussed and service orientated. It needs to work in partnership with WUAs and water users, rather than in its historic top-down mode.

Appendix A2: Indian Experience

A2.1 Case Study: Dharoi Irrigation Project, Gujarat[12]

In 1995 the Government of Gujarat allowed Water Users Associations(Irrigation Cooperatives) [13] to take over the management of their irrigation and drainage systems for an initial period of 5 years by signing a Memorandum of Understanding (MoU) with the system's ID Executive Engineer. The MoU defines the roles and responsibilities of the different parties, with the following roles transferred to the WUA:

- Operation and maintenance of the canal system;
- Crop planning;
- Setting and collection of water charges.

and with the following responsibilities:

- Timely and equitable water supply to all users in the command area;
- Timely payment of water charges due to the ID;
- Timely resolution of water-related disputes between water users;
- Adequate and timely maintenance of the system;
- Sustaining agricultural productivity and water use efficiency in the command area.

Farmers in the right bank command of the Dharoi Irrigation Project, supported by an NGO (Development Support Centre, DSC), took over the management and control of a 25,000 ha command area serving some 90 villagers. Of the 130 WUAs in the command area 30 agreed to take over the management of the system following rehabilitation, whilst 100 agreed to take over the management of the system prior to rehabilitation, in the expectation that they could manage it better than the ID despite its poor physical condition.

The Dharoi command area lies in a low rainfall area (<700 mm/year) where water is in short supply. The command is supplied from a reservoir which has filled only 10 times in the last 25 years. Surface irrigation water supplies from the reservoir are supplemented by many hundreds of private tubewells in the command area.

Allocation of water is decided at a meeting in September of the Advisory Committee comprising the WUA office bearers (usually the President and Secretary), the ID Superintending and Executive Engineers, the Member of Parliament, local MLA and Sapanchs. At the meeting the Executive Engineer provides information on the water available for irrigation (based on the storage in the reservoir and precipitation) and makes recommendations on the number of irrigations possible in each command area. The Committee decides on whether critical irrigation can be provided in Kharif, and publishes the decisions in the local newspapers and ID Sub-Divisional offices. Generally 1 irrigation is provided in Kharif and 5-6 irrigations during Rabi, with the canals being operated for 15-20 days at a time on an agreed roster.

Following the meeting the WUAs call a General Meeting of the members to share the information on the number of waterings available, following which there is discussion and

[12] Taken from a paper written by Mohan Sharma, Director(Programmes), Development Support Centre, Ahmedabad,
Gujarat for the Sustainable Development of Water Users Associations study, 2010.

[13] In Gujarat WUAs are termed Irrigation Committees. The term WUA has been retained in this section for continuity.

agreement on the cropping pattern for each WUA command. In general the Irrigable Command area of a WUA is 300-500 ha, with a membership of 70-95 percent of farmers within that command area. In a good year 70-80 percent of the command area can be cropped, with cotton and millet grown in Kharif and wheat, mustard, fennel, alfalfa and some other crops grown in the Rabi season. At or following the meeting each farmer completes the demand forms, which are colour coded to the crops to assist illiterate farmers.

At the start of the Rabi season the WUAs hold another meeting with the ID to present their irrigation needs based on their cropping patterns. Based on these figures the ID then informs the WUAs on the rotations and the number and timing of irrigations that can be supplied. If the water requested by the WUAs is more than that to be provided by the ID the WUA takes on the responsibility of meeting the farmers' demands. It has been found that the ID estimates are generally on the conservative side, and that the WUAs can support a larger area by working with the water users to make water delivery more efficient and effective (such as timely desilting and repairs to canals). In years with a shortage of water it has been found that farmers prefer to practise extensive, rather than intensive irrigation, and will often adopt less water intensive crops. In these cases the surface irrigation water is supplemented by irrigation from groundwater, which is factored into the equation by the WUAs and the farmers.

For water distribution during the season the farmers submit the area they want to irrigate to the WUA Secretary[14] at least 15 days before the date the water is to be released. They pay their water fees in advance and receive a gate pass from the WUA Secretary, which the farmer then passes on to the WUA's gate operators (for some areas the gate passes are colour coded to avoid confusion between the farmer and the gate operator). The farmer is also informed of the date, time and duration of his/her irrigation. The WUA secretary also provides each gate operator with the list of farmers to be provided with water during each irrigation.

	
Cut-throat flume measuring device within a WUA command area on the Dharoi Irrigation Scheme.	WUA staff with a map of their irrigation system and location of measuring structures.

Each WUA employs between 2-5 gate operators, each gate operator being responsible for a command area of some 40-50 ha. The gate operators are appointed locally through a formal recruitment process, and are employed at local wage rates to work 12 hour shifts, day or night, during the irrigation season. The gate operators report to the WUA Chairman or Secretary on a daily basis.

[14] This is done at the WUA's office, which usually comprises one or two rooms in a centrally located building within the command area.

During operation the distributary is divided in to head, middle, and tail reaches. The last outlets in the head reach are opened first, together with the last outlets in the middle and tail reaches. This is followed by the middle section gates in each reach and finally the head section gates in each reach are irrigated. Within each outlet a number of crops are grown, each with different irrigation demands. With the assistance of the operator, who has a record of each farmer and the crops they are growing, farmers decide which crops to irrigate during their irrigation turn. Though the operator informs the farmer when they can expect water for their field, there is some flexibility in the system to allow a farmer to take water at another time if there is a genuine problem.

A central feature of the arrangements on the Dharoi scheme is that the water users decide the water charges for their command area. Each June the WUA budgeting working group submits a budget to the WUA General Body meeting for discussion and approval. The budget includes the service fee charged by the ID, plus an additional amount required for the management, operation and maintenance of the WUA. The current government rates are Rs 199/ha (US$ 4.4/ha), excluding a 20 percent local cess for the Panchayat development fund). Under the agreed WUA rules farmers are required to pay the water charges before each irrigation. Farmers not paying beforehand are charge an additional 50 percent, and under the rules non-members can be charged 30 percent extra though this rule is not often applied. Prior to the turnover of management to water users the ID collection water charge collection rate was 50-60 percent, since turnover WUAs have been able to collect 100 percent each year. The ID retains a regulatory role on the area reported as irrigated and the thus the water charges due, and carries out an assessment of each WUAs command area by taking a sample of 10 percent of the command area. In addition the Cooperative Department carries out a financial audit of the registered WUAs.

ID Executive Engineer discussing irrigation water supply with WUA representatives.

WUA budget for one of the WUAs on the Dharoi Irrigation Scheme.

The annual expenditure of the WUAs varies between Rs 150-350 per hectare (Irrigable Command Area) depending on the physical condition of the canals and the actual number of irrigations during each season. If the canals have not been rehabilitated and the irrigated area is less than 50 percent of the ICA then the service fee is around Rs 350/ha as maintenance is more costly. The size of the WUA is a key factor in the costs incurred by a WUA and the setting of the service fee. The costs include seasonal salaries of the Secretary, seasonal operator costs, regular and periodic maintenance works before and during each season, and running costs for the WUA (stationery, office facilities, etc.). Costs are greater for WUAs with command areas less than 300 ha, whilst WUAs with command areas of 500 ha are able to manage the costs reasonably well. It has been found that WUAs with command areas greater than 1000 ha face additional difficulties and costs for patrolling, coordination, reporting and governance.

There are a number of rules which the WUAs have evolved for themselves over recent years of managing the system themselves. These include:

- Procedures for irrigation during times of water shortage. For example, in some WUAs with a small percentage of large landholdings the WUA will apply a proportionate reduction in water allocation equally to all farmers. However in commands with a greater proportion of large landholdings (4-5 ha) then the WUA applies a cap on the maximum supply that can be provided in order to protect the farmers with smaller and marginal landholdings;
- Farmers have to complete an irrigation demand form, otherwise they must pay 50 percent extra;
- Farmers found irrigating without a valid receipt of payment from the WUA are punished by the WUA. Also any operator allowing a farmer to irrigate without payment is punished by the WUA;
- Farmers agree that decisions agreed upon in the WUA General Body are binding on all members;
- Irrigation water has to be paid for in advance;
- Each member will receive water according to his/her agreed turn, and must provide the operator with a gate pass before each irrigation;
- No-one can take irrigation water without the authorization of the operator;
- Each member can receive only one irrigation in one rotation of water;
- If the canal infrastructure is damaged due to a farmer's negligence or actions, then the farmer must repair the damage at their own cost.

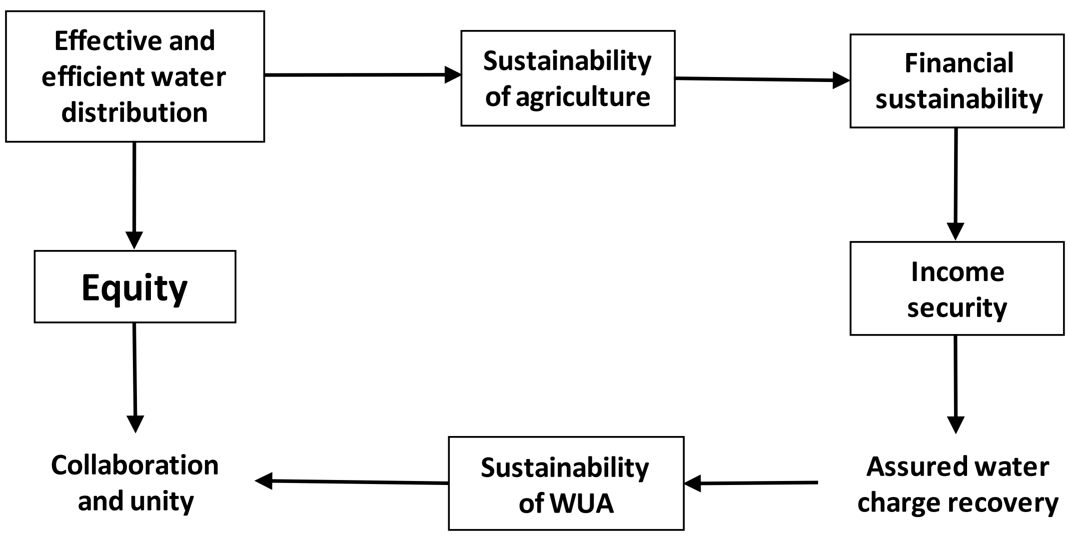
Instances of violation of the rules are put before a General Body meeting of the members and a decision made on whether to punish the offender or not. The WUA has a Nyaya Samiti (Justice Committee) to set the penalty for the different offences. The Committee is drawn from members of the WUA, and includes the President and Secretary. The form of the penalty varies between WUAs, with some WUAs setting rates based on the offender's landholding size and position in the canal network. This arrangement has evolved in order that the penalty is an effective deterrent for all classes of farmers. The penalties vary from Rs 151-550, with the rate being such that the it is equal to or more than the cost of receiving an irrigation from a borewell.

A number of criteria and indicators have been developed for assessing the performance of the WUAs. Table A2.1 summarises these, whilst Figure A2.1 links these factors together as issues influencing WUA sustainability.

Table A2.1: Summary of WUA performance criteria and indicators

Criteria	Explanation	Indicator	Results
Equity	All members get proportionally equal benefits regardless of caste, class, sex and location in the system. If there is any discrimination it should be in favour of the disadvantaged.	Disputes Access to irrigation water	Number of disputes reduced through better water management
Efficient water distribution system	Includes efficient utilization of water, prevention of wastage, water-logging, etc.	Area irrigated	Net area irrigated has increased by 40 percent since management transfer
Effective water distribution	Increased crop production due to timely irrigation.	Crop yield and production Fee recovery	Wheat yields have increased from 28.6 quintal/ha to 31.1 quintal/ha 100 percent fee collection of Rs 91 lakh, with Rs 51 lakh retained by WUAs and Rs 39 paid to government
Sustainability of WUA	Refers mainly to the financial sustainability of the WUA, but also relates to social cohesion and cooperation	Fee recovery Cash reserves Dispute resolution	Fee recovery has increased from 50-60 percent to 100 percent. WUAs are building cash reserves, those working for more than 3 years have reserves of over Rs 1 lakh WUAs have resolved 99 cases of disputes
Sustainability of agriculture	Refers to the maintenance of land fertility and productivity due to farmers' cultivation and irrigation practices, and reduction of adverse impacts (waterlogging, salinisation, etc.)	Crop yield and production	

Figure A2.1: Relationship of factors influencing WUA sustainability



A2.2 Case Study: Andhra Pradesh

The key objective of participatory irrigation management in Andhra Pradesh is to improve the sustainability and productivity of irrigation through sharing irrigation management responsibility jointly with the farmers organized as Water Users Associations. Towards this the state government has enacted the Andhra Pradesh Farmers Management of Irrigation System Act in 1997. Presently, water users' organizations under the APFMIS Act is constituted at three different levels in major irrigation projects - Water Users Associations (WUAs) at the minor canal level, Distributary Committees (DCs) at the distributary canal level and Project Committee (PCs) at the main canal level. In medium irrigation project they are constituted at two levels – WUA at the minor canal level and PC at the main canal level. In minor irrigation tanks only a WUA is constituted covering the whole tank command. The structure of the three levels of the farmers' organizations and their link is shown in the figure below.

A total of 10,748 WUAs have been constituted – 2261 in major irrigation projects, 410 in medium irrigation projects and 8077 in minor irrigation tanks. There are also 323 Distributory Committees and 23 Project Committees constituted under the major irrigation projects and 60 Project Committees constituted under medium irrigation projects.

A WUA is created by delineating a portion of the command area under an irrigation system at the end of construction of the irrigation project. All land holders (farmers and tenants) within the delineated area constitute the members of the WUA. The area of a WUA is subdivided in order to equitably handle water management, maintenance, and governance. These constitute the Territorial Constituencies within a WUA. Each territorial constituency elects its representative, who together constitutes the Managing Committee of the WUA. The Managing Committee members then elect the WUA President and Vice President from among themselves.

The WUA in a major irrigation project is constituted of 12 Territorial Constituencies and hence the Managing Committee has 12 members. The TC members have a 6 years term with one-third TC members retiring every two years, thereby making the Managing Committee a continuous body. However, the President and the Vice President of the WUA have terms of only 2 years and the Managing Committee elected them after every two years.

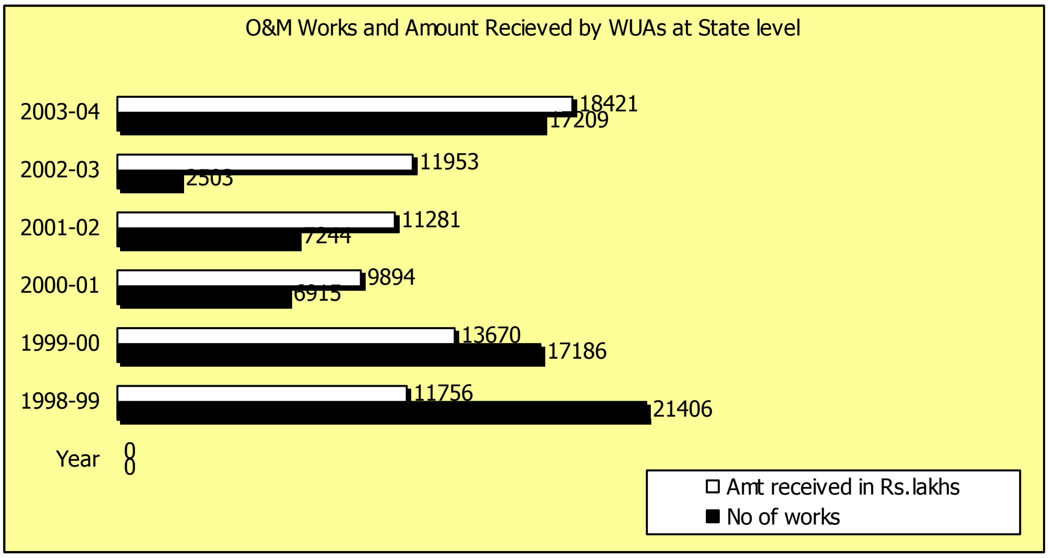
The Presidents of the WUA falling within a Distributory constitute the members of the Distributory Committee for that particular Distributory. They then elect the President and Vice President of the DC among themselves. The term of the DC members and the President and Vice President is for two years each. Similarly, the Presidents of the DCs in a Project constitute the members of the Project Committee of an irrigation project. They then elect the President and Vice President of the PC among themselves. The term of the PC members and the President and Vice President is for two years each.

To start of the process of PIM in the state GoAP initiated the Andhra Pradesh Economic Restructuring Project (APERP) (Irrigation Component) with World Bank assistance with a Project Cost of Rs. 9,622.4 millions. The project was basically designed as a WUA support programme. The Farmers' Organizations themselves undertook minimum rehabilitation works and O&M works with respect to their irrigation systems. This process enabled the farmers to acquire experience in undertaking maintenance works and also to understand the complexity of operating and maintaining the irrigation system.

The minimum rehabilitation programme of the APERP was executed through the farmers' organizations. Farmers were exposed to a new working environment – they had to negotiate for machinery at cheaper rates, persuade the village to take up maintenance works and maintain records to enable payment. A "mobilization advance" was made available for farmers to start the work. Subsequent payments were given on actual taking up of work.

The works taken up by the WUAs during 1998-2004 is given below. The total expenditure upto the end of March 2004 incurred under APERP was Rs. 7,697.5 millions. The figures below show the O&M works done and amounts received by the WUAs.

Figure A2.2: Q&M works amount received by WUAs at the state level



Source: Irrigation and Command Area Development Department, GoAP

In future, however, the WUA role in operation and maintenance of irrigation system would depend on its ability to generate resources. As per the APFMIS Act, provisions are made to generate revenue for WUA to self manage and achieve financial reliance and sustainability. A closer look at the revenue flows to WUAs indicates that the major source of revenue is plough back from the water tax. Therefore a buoyant water tax collection would directly affect the ability of the FOs to carry out their function of system O&M.

In order to levy water tax with respect of every land receiving water for irrigation and aqua-culture purposes from any government source of irrigation the government fixed water tax rates as given below:

Table A2.2: Government water tax rates

S. No.	Nature of Crop	Rates of Water Tax / Acre (in Rs.)	
		Category – 1	Category – 2
1	First or Single Wet Crop	200	100
2	Second and Third Wet Crop	150	100
3	First Crop Irrigated Dry	100	60
4	Second and Third Crop Irrigated Dry	100	60
5	Dufasal Crop in Fasli Year	350	350
6	Aqua-culture per year	500	500

Source: Irrigation and Command Area Development Department, GoAP

To fund the activities of the farmers' organizations the GoAP in 2001 had notified proportions of the water tax collection that would be shared among the various concerned organizations in the operation and maintenance (O&M) of irrigation projects.

Table A2.3: Water tax shared among concerned organisations for O&M

	Major Irrigation Project (In Rs.)		Medium Irrigation Project (In Rs.)		Minor Irrigation Project (In Rs.)	
	INR	%	INR	%	INR	%
Irrigation Department	100.00	50	100.00	50	0	
Water User Association	50.00	25	60.00	30	90.00	90
Distributory Committee	20.00	10	NA		NA	
Project Committee	20.00	10	30.00	15	NA	
Gram Panchayat	10.00	5	10.00	5	10.00	10

Source: Irrigation and Command Area Development Department, GoAP

However, the water tax figures for the years 1997-06 (for all irrigation projects), given in the table below, belied this situation. The water tax demand and collection for the years 1997 to 2006 is given in Table below.

Table A2.4: Water tax for the years 1997-06

Year	Demand (in Rs. Crores)			Collection (in Rs. Crores)			% of Collection to Demand		
	Arrears	Current	Total	Arrears	Current	Total	Arrears	Current	Total
1997-98	115.9	175.3	291.2	41.7	28.4	70.1	35.94	16.21	24.06
1998-99	115.9	221.2	337.1	62.9	30.3	93.2	54.23	13.71	27.64
1999-00	116.8	243.9	360.7	56.8	49.0	105.7	48.60	20.08	29.31
2000-01	109.8	189.7	299.5	59.0	56.7	115.7	53.76	29.89	38.64
2001-02	109.8	182.6	292.4	26.7	31.9	58.7	24.35	17.49	20.06
2002-03	102.0	233.7	335.7	42.4	52.6	95.0	41.52	22.52	28.29
2003-04	252.8	78.3	331.1	19.6	15.0	34.6	7.74	19.16	10.44
2004-05	260.0	66.3	326.3	31.7	25.1	56.8	12.20	37.78	17.40
2005-06	285.8	66.3	352.1	45.8	37.6	83.4	16.01	56.76	23.69

Source: Irrigation and Command Area Development Department, GoAP

An analysis of the table above shows that right since the inception of PIM in the state in 1997, the level of water tax collection has been too low for any effective resourcing of the WUAs for O&M. This is further complicated by the Revenue Department by taking enormous time to plough back the water tax to WUAs. Consequently, between 2004 and 2006 there were no plough back to the WUAs and no O&M works taken up by them.

To correct this situation, GoAP set in motion from 2006-07 onwards a process of simplification of the water tax collection, O&M planning and plough back procedure through issuing of a number of Government Orders. In order to provide support to WUOs to carry out effectively the O&M and institutional activities, I&CAD Department issued GO No 170 dated 14-10-2008, which provides for re-plough of 100% water tax collection to the WUOs. Finally, as a part of the need to institutionalize farmer's organizations the I&CAD Department has authorized the WUAs to utilize 10% of the plough back money for administrative and incidental charges.

Sector	WUA		DCs		PCs		GP
	Works	Admin	Works	Admin	Works	Admin	
Major	50%	10%	15%	5%	14%	1%	5%
Medium	50%	10%	-	-	30%	5%	5%
Minor	80%	10%	-	-	10%		

Source: Irrigation and Command Area Development Department, GoAP

Subsequent to these changes, there has been a marked improvement in status of water tax collection and plough back for O&M in the last four years as can been seen from the table below.

Table A2.5: Water tax in four years

Year	Collection (in Rs. Crores)	O&M Plan (in Rs. Crores)	Plough Back (in Rs. Crores)	Budgetary Support (in Rs. Crores)
2006-07	67.0	NA	30.0	0
2007-08	75.0	NA	30.0	0
2008-09	115.0	200.0	60.0	140.0
2009-10	475.0	160.0	100.0	60.0

Source: Irrigation and Command Area Development Department, GoAP

Further, to improve the performance of the WUAs, and to institutionally strengthen the farmers' organizations and to empower them to take up the responsibilities given to them I&CAD Department has devised an elaborate capacity building and training programme for the WUOs. It is proposed to use various approaches in implementation of the capacity building and training programme.

1. **Awareness Generation Camps:** A one day awareness generation camp will be organized in each WUA by the respective WUA Managing Committee, the Roving Trainers, the Trained Competent Authorities and the Training Coordinator. The awareness generation camp will be used to generate awareness about participatory irrigation management and APFMIS Act among the farmers in general and about the roles and responsibilities of farmers' organizations in specific. The camp will use various communication means such as audio-visual aids, posters and banners, street plays and kalajathas (folk plays), etc. to generate awareness.
2. **Exposure Visits:** It is proposed to organize exposure visits for the WUA Presidents to irrigation projects with well performing WUAs within the state and other states; for DC Presidents exposure visits to irrigation projects with well performing farmers' organizations in other states of the country; and for PC Chairpersons exposure visits to other states and also to other country with good experience of PIM to get an understanding on farmer participation in irrigation management.
3. **Training Workshops:** Training programme in modular form has been designed and planned for all the three levels of the farmers' organizations.
4. **Work Books:** Work books will be developed and published for the farmers' organizations for guiding them in management of the irrigation projects. The Work Books will contain the process steps, the sequence of activities and the formats for preparation of action plan for the different levels of the farmers' organizations. The activities that will be covered in the Work Book are:
    - Area Irrigated Assessment
    - Water Tax Demand & Collection
    - Plough Back Funds

- Operation & Maintenance Action Plan
- Social Auditing of O&M Works

The proposed training of the farmers' organizations will be carried out using these Work Books in which they will be trained in actually filling up the formats and prepare their action plans.

5. **WUA Self-Assessment:** The WUA Self-Assessment tool has been developed by I&CAD Department to assess the performance of a WUA on 15 identified indicators related to their roles and responsibilities. The underline principle of the WUA Self Assessment tool is to assist the WUAs to understand their roles and responsibilities by assessing the status of their functioning. It is also used to create awareness among the WUA members, plan remedial measures and to empower them to function sustainably. It is proposed to use the WUA Self-Assessment tool to facilitate the WUAs to self assess themselves and monitor their performance.

A total of eight modules have been developed for the WUAs. The subject and target of the eight modules are as follows.

Sl. No.	Module	Targets
1	WUA Awareness Generation Camp Through Kalajatha	All WUA Members
2	WUA Roles & Responsibilities	WUA MC Members
3	Finance Management	Sub Committee Members
4	Works Management	Sub Committee Members
5	Water Management	Sub Committee Members
6	Monitoring& Evaluation & Training	Sub Committee Members
7	Self Assessment	WUA MC Members
8	Exposure Visit	WUA Presidents

The trainings are carried out locally either at the Sub-Division or Division level by the Competent Authorities and the Training Coordinators.

A total of 3 modules have been developed for the DCs. The subject matter and target of the modules are as follows:

Sl. No.	Training Module	Target
1	DC Roles & Responsibilities	DC President & Vice President
2	DC Monthly Meetings at one constituent WUA Office on Rotational Basis	All DC members
3	Exposure Visit on Water Management	DC President & Vice President

They are carried out locally either at the Sub-Division or Division level by the Competent Authorities and the Training Coordinators.

To make the PCs active and functional the following activates are organized for them:

- An orientation meeting with the PC members on "know your project theme" and better water management practices adopted in the irrigation projects in the state
- An orientation meeting on PC roles and responsibilities as per the APFMIS Act

- An exposure visit to a well performing irrigation project in the country to sensitize the PC Presidents and Vice Presidents of medium irrigation projects on group building, understand management of irrigation system and productivity enhancement in agriculture
- An exposure visit to a well performing irrigation project in the country or other country to sensitize the PC Presidents and Vice Presidents of major irrigation projects on group building, understand management of irrigation system and productivity enhancement in agriculture

The training and capacity building of the PC Presidents and Vice Presidents are carried out by WALAMTARI staff, senior irrigation engineering staff and consultants.

Post training to facilitate activities among the farmers' organizations I&CAD Department has developed a number of Work Books. The Work Books delineate the formats, process steps and sequence for the preparation of action plans for the different levels of farmers' organizations covering the following activities:

- Irrigated area assessment
- Crop water requirement and water indent
- Assessment of water tax demand & collection
- O&M plan
- Water audit and water use efficiency
- Social auditing of O&M works

Training of farmers' organizations is carried out using the Work Books. During the training the concerned farmers' organizations members are trained to fill up the relevant formats with the required information and prepare the action plan on the basis of the information collected. Subsequent to the training the farmers' organizations have carried out the actual exercise of collecting information from their area and members and filled up the formats in the Work Book and prepared the actual annual action plan for themselves for the years 2008-09 and 2009-10.

The procedures to be followed in gathering the information and preparing the action plan has been detailed in GO Ms. No. 96 dated 08-06-2007. These action plans are then collated at the irrigation circle level by the Superintending Engineer and then at the irrigation project level by the Chief Engineer (for major irrigation projects) and submitted to the office of the Commissioner, CADA for fund disbursement. On disbursement of funds through the Letter of Credit procedure to the irrigation circles the planned activities are executed by the farmers' organizations. The support team and the irrigation engineers in the irrigation circles provide technical and facilitation support to the farmers' organizations in execution of the action plan. They also monitor the execution of the action plan. The farmers' organizations, especially the WUAs also monitor the progress and outcome of the execution of the action plan through the WUA self-assessment tool.

The work book based planning and execution of farmers' organization activities follows a cropping cycle with plan preparation in the beginning of each cropping season and its execution henceforth.

The training and capacity building programme for the farmers' organizations will need to cover over 3000 WUA/DCS/PCs of the major and medium irrigation projects in the state. To systematically organize these numbers of training and capacity building activities there was a need to design and adopt an effective implementation arrangement. Towards this, in each irrigation circle, one Field Training Centre (FTC) has been established in an existing Irrigation Department building by providing training infrastructure facilities like furniture, computer and printer, LCD projector, audio visuals and sound systems, etc. The FTC facility is being used to conduct training for the farmers' organizations and hold regular review meetings with them.

The FTC is manned by a team of professional support staff consisting of one Training Coordinator and one Irrigation Engineer (Retired). The support team functions under the Superintending Engineer and coordinates and carries out the training and capacity building programme for the farmers' organizations. The support team provides training and facilitation support to the Competent Authorities (irrigation engineers) and the WUOs. They also monitor the progress and outcome of the training and capacity building programme. 16 Training Coordinators have been be engaged for the 18 irrigation circles. To assist the Training Coordinators selected component authorities and DC Presidents (as roving trainers) who have good communication skills and show aptitude for farmer training have been trained through Training of Trainers programme. The overall responsibility of the training and capacity building programme for the farmers' organizations is with WALAMTARI (WALMI).

A2.3 Case Study: Waghad Irrigation Project, Maharashtra

Extract from paper by Sanjay Belsare et al (2009).

IMPROVING IRRIGATION EFFICIENCY UNDER SMALL LANDHOLDING CONDITIONS THROUGH PARTICIPATORY IRRIGATION MANAGEMENT: A SUCCESS STORY OF WAGHAD IRRIGATION PROJECT, INDIA

Sanjay Belsare[15], S.V. Ahirrao[16], Bharat Kawale[17] and Shahaji Somwanshi[18]

Participatory Irrigation Management (PIM)

Participatory Irrigation Management (PIM) approach was introduced in India in 1990s. The Government of India has been promoting the PIM in many irrigation schemes, especially in major and medium scale, with an objective of improved operation and maintenance of irrigation schemes, reducing fiscal burden on the States, increased cost recovery, and higher crop production through better water management. As a result more than fifty thousand Water User Associations were formed all over the country. However, the contemplated benefits of PIM are yet to be realized due mostly to institutional weaknesses. PIM is still looked with suspicion by many. Yet there are some examples of successful WUAs who can act as role models for others to follow. Waghad Irrigation Scheme of Maharashtra State is one among those.

Introduction to Waghad Project

Waghad Irrigation Scheme located in Nashik district of Maharashtra State was commissioned in 1981. The scheme's cultivable command area is 9642 ha but only one-third of it (3212 ha) was irrigated as farmers in tail reaches were deprived of the irrigation water. In 1990, a local civil society called *Samaj Parivartan Kendra* (Center for social transformation) in collaboration with the State Irrigation Department motivated farmers to come forward in taking over the operation and management of the scheme. At the outset only 3 Water User Associations were formed at the tail area of the canal command, where barely some 100 ha out of 1150 ha were irrigated. Initially, these WUAs had to struggle to get their share of irrigation. But with transfer of management to WUAs, farmers in tail area received their quota of irrigation water and thus could irrigate more area. Enthused with the success of the 3 WUAs, farmers from the entire command gradually formed 24 WUAs (Figure A2.3). As a step forward, in the year 2003, all the WUAs joined their forces to takeover the operation and management of the entire irrigation scheme by forming an apex organization called *Waghad Project Level Water Users Association (PLWUA).*

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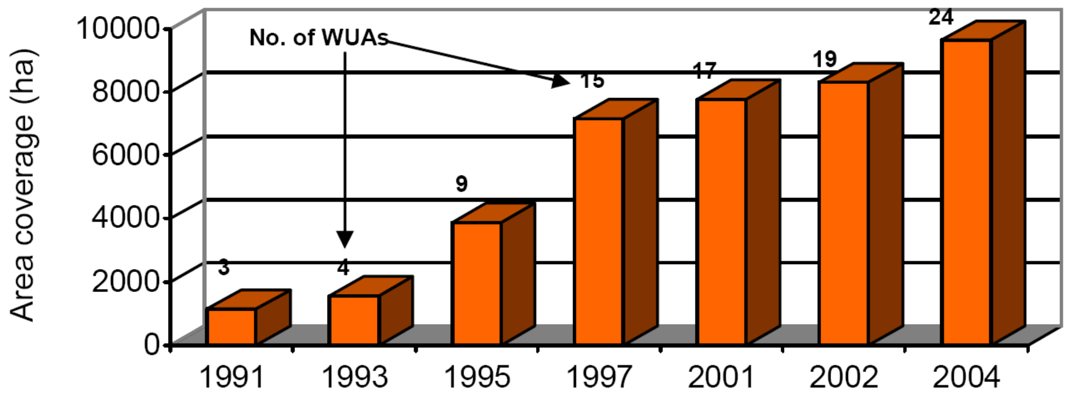
[18] Shahaji Somwanshi, Chairman, Waghad Project Level Association (PLWUA),Mohadi.

Figure A2.3: Progress of formation of WUAs in Waghad Irrigation Scheme



Functioning of PLWUA

The PLWUA undertakes the water management with technical guidance and support from Water Resources Department. Water is supplied volumetrically at the head of canal and subsequently the PLWUA distributes the water among 24 WUAs as per their demand and entitlements. WUAs further distribute water among their members. As average land holding of farmers is very small (0.5-1.0 ha), volumetric supply to each farm holding is difficult, so farmers have *devised innovative way to share water on time basis*. The PLWUA collect water charges from its member associations. Management transfer to PLWUA has resulted in to 100 % utilization of irrigation potential, saving in water, crop diversification, and 100 % collection of water charges (Table A2.6).

Table A2.6: Status of area irrigated, recovery of water charges - before and after management transfer

Sr. No.	Description	Before formation of PLWUA (1980-90)	After the management transfer (2006-09)
1	Average Area Irrigated	3,212 ha	10,750 ha
2	Mode of Water Supply	Area basis	Volumetric basis
3	Average Water charges Recovery	Rs. 0.3 million	Rs. 2.2 million
4	Recovery of Water Charges	60 %	100 %
5	Crop pattern	Restricted	Cropping freedom
6	Water Entitlement	No entitlement	Transparent and enforceable

The PLWUA is also responsible for holding general body and regular management committee meetings from time to time for planning of rotation and its implementation, encouraging active participation of women in management committee, annual auditing of expenditure, and publication of annual report.

Impact on equity, productivity and growth

- Crop diversification - farmers now can grow high value crops like grapes, vegetables, flowers, etc rather than traditional crops like. Rice, Bajra, Sorghum, Wheat, Gram, etc

- Increase in farmers income - the average income of a farmer in 2003-2004 was Rs. 60,000/- per hectare (about US$ 1200/ha) which doubled to Rs 1, 20,000/ ha (US$ 2400/ha) in 2008-09.
- Generation of local employment for the workers which increased from average 2 months per year to 8 months/ year. Thus there is a reduction in the migration of farm laborers from village to cities, as now there is a job availability in their own villages round the year
- Waghad Irrigation project has been receiving National Productivity Award of the Govt. of India since last five years
- The construction of water conservation structures like weirs, ponds, etc in command area has resulted in recharging of about 2523 wells. This led to increased availability of water to farmers even in hot weather season. This has resulted in reduction in use of deep bore-wells quite drastically.
- Farmers have invested in drip irrigation systems for grapes, vegetables etc. as there is an assured water supply throughout the crop-period. Today about -4100 ha are brought under drip irrigation system.
- Farmers have become confident and have started new initiatives and ideas, materials and crops. PLWUA has registered **Waghad Agricultural Producer Company (WAPCO)** in September 2009 to market and process agricultural produce of farmers.

Summary and Conclusion

Participatory irrigation Management by PLWUA in Waghad Project resulted into saving of 13 million cubic meter of water in the irrigation year 2008-2009 (as compared to 2003-04) which is almost 1/3 of water diverted for the irrigation. The saving of water has been improved over the years of work of WUAs / PLWUA and it is a major step towards sustainable irrigation management. The consistent success in saving the water and increasing the productivity in the present success story strongly advocates the formation of federation of water users' associations and handing over the entire irrigation management of project to them.

The role of government in water management is just needed in the form of guidance and help to the farmers. The decentralization of power and freedom of the decisions to the farmers will improve the people's participation in irrigation management which in turn results into innovative and sustainable irrigation management in large irrigation scheme. The Govt. of Maharashtra (GOM) has taken policy decision to supply water for irrigation through WUAs only, based on success of WUAs and PLWUA in Waghad project. GOM has enacted stand alone act for formation of WUAs and its federation.

This model of efficient management by Waghad Project Level Water Users Association (PLWUA) can be very well replicated at different locations in the country as well as in developing countries of the world.

A2.4 Innovative Provisions in PIM Acts of Various States

State	**PIM Act Provision**
1. Delineation of WUA area	
Uttar Pradesh	**6. Delineation of area of operation of water users' association** (1) The competent canal officer may, by notification in the Official Gazette, delineate or modify on hydraulic and/or administrative basis/the command area of an irrigation project or part thereof to be an area for which water users' association of appropriate level shall be constituted in such manner as may be prescribed: Provided that no such notification regarding modification of a delineated area shall be issued unless a reasonable opportunity is provided to the water users' associations and landholders likely to be affected. (2) The notification under sub-section (1), *(a)* shall consist of a certified copy of updated shajra map of area of operation and other documents as may be prescribed. *(b)* shall be widely displayed in and in the vicinity of the area of operation of the water users' association. *(c)* on demand by any interested landholder, the copies shall be made available to him on such payment as may be prescribed. (3) Any person aggrieved by the notification or part thereof may within thirty days from the date of notification, file an appeal before the appellate officer. (4) The appellate shall within three months of receipt of the appeal pass such order as he thinks fit and thereupon the notification shall from the date specified in such order stand modified. Provided that no such order shall be made without giving the person concerned an opportunity of being heard.
Maharashtra	**6. Delineation of Command Area of Water User's Association at minor level** (1) A Canal Officer not below the rank of an Executive Engineer, duly empowered in this behalf, may, by notification in Official Gazette and in accordance with the rules, on hydraulic basis and having regard to the administrative convenience delineate command area of Water Users' Association at Minor Level separately within lands under irrigable command and declare it to be an area of operation of Water Users' Association at Minor Level for the purposes of this Act. The area of operation so declared may include both, the flow and lift irrigation. (3) The notification published under sub-section (1) may be given wide publicity as prescribed and may be published in such other manner in or in the vicinity of such area of operation of Water Users' Association at Minor level as the Canal Officer may think fit. (4) Any person desirous of obtaining a copy of the notification under sub- section (1) may, on an application being made in that behalf and on payment of such fees as may be prescribed, obtain the same. (5) Any person aggrieved by the notification issued under subsection (1) may, within thirty days from the date of publication of such notification in the Official Gazette, file an appeal before the Canal Officer:

State	PIM Act Provision
	(6) The Appellate Officer may pass such order in the appeal as he deems fit, and may pass order modifying the notification. On passing such modifying order, such notification shall stand modified to the extent and from the date as specified in the order; Provided that, no order of modification of any such notification or part thereof, affecting any person shall be made without giving such person a reasonable opportunity of being heard.
2. Constitution of WUA	
Chhattisgarh	**4. Constitution of Water Users' Association** (2) Every Water Users' Association shall consist of the following members, namely:- (a) all the water users who are land holders in a water users' area: Provided that where both the owner and the tenant are landholders in respect of the same land, the tenant would be deemed water user; Provided further that any person who is in lawful possession and enjoyment of the land under a water source, on proof of such possession and such enjoyment in a crop year, may claim membership not withstanding whether he is recorded land holder or not, in which case the Water Users' Association shall not refuse the membership of such person for the purposes of this Act, and such person shall be liable to pay the water charges and the fees as may be prescribed as if he is the water user; Provided further that the wife / wives of such land holder, who do no hold land, shall deemed to be the landholders for the purpose of this act. (b) all other water users in a water users' area;
Gujarat	**Establishment of Water User Association** 5. For the purpose of this Act, there shall be formed by the Competent Authority a Water Users' Association for each service area consisting of- (1) holders of land in such area using the water for the purpose of irrigation, and (2) persons residing or carrying on business in such area using water made available from the minor canal through sub-minor, field channel, water courses or pipe lines for irrigation or other purposes, If the Association represents fifty one percent of the holders of land in the service area and the aggregate area of land held by such holders of land is not less than fifty one percent of the service area. **Ascertainment of willingness of Association to undertake irrigation management** 12. The Competent Authority shall ascertain from the designated person the willingness or otherwise of the Association to participate in the irrigation management of the minor canal from which water is to be supplied to the service area for irrigation. **Willing Association to enter into an agreement** 13. Where an Association expresses its willingness to participate in irrigation management under section 12, it shall be required to enter into an

State	PIM Act Provision
	agreement with the State Government in such form as may be prescribed, providing for such participation. **Repairs to canal** 15. (1) Where, on account of the joint inspection of the minor canal and water courses under section 14, it appears, both to the Competent Authority and the designated person, that it is necessary to carry out repairs to the minor canal and any of the water courses, as mutually agreed upon, before entrustment of the irrigation management of the minor canal along with the water courses, the Association shall carry out the repairs to the minor canal and water courses. (2) The cost of the repair to the minor canal and water courses carried out under sub-clause (1) shall be borne both by the State Government and the Association for such proportion as may be prescribes. (3) Where Association fails to carry out repairs under sub-clause (2) within such time as may be stipulated by the Competent Authority, the same shall be carried out by the Competent Authority, the cost of such shall be borne as provided in sub-clause (2). **Entrustment of irrigation management to Association** 16. (1) Where repairs to the minor canal and water courses are carried out under section 15, the Competent Authority shall, by an order in writing, entrust the irrigation management of the minor canal and water courses to the Association. (2) Where an order under clause (1) is issued, the Association shall take over the irrigation management of the minor canal and water courses and upon the Association taking over the irrigation management of the minor canal and water courses, the designated person shall make an endorsement to the effect on the order so issued.
Maharashtra	**8. Constitution of Water Users' Association at Minor Level** (1) When an area of operation of a Water Users' Association at Minor Level has been delineated under section 6, the holders and occupiers of the land so delineated shall form a Water Users' Association. Such Water Users' Association shall be registered in the prescribed manner. **22. Joint Inspection, Repairs, Rehabilitation and handing over of management of Command Area to minor level Water Users' Association** (1) After the Water Users' Association at a minor level has been duly constituted and the agreement between Water Users' Association and the Canal Officer, as the case may be, has been entered into, there shall be held a joint inspection of the canal system under the said Agreement within a period of three months from the date of Agreement. The entire canal system within the command area of Water User's Association, shall be jointly inspected by the Executive Engineer or his representative and the office-bearers of the Water Users' Association and the works pertaining to the systems shall be classified into two separate lists i.e. Priority-I and Priority-II. (2) The Priority-I List shall include the mandatory nature of works, which are absolutely essential for passing of designated discharge, control and measuring and conveyance of water, by flow under gravity in the area of operation of WUAs. The Priority II List shall include the works other than those mentioned in Priority-I which although necessary for the efficient functioning of WUAs, can be taken up after the Priority-I works. (3) The findings of the joint inspection shall be recorded in duplicate, signed by both the minor level Water Users' Association and the Canal

State	PIM Act Provision
	Officer and one copy thereof shall be retained by each party. (4) Within one month of joint inspection, a list of items of works which need to be carried out for rehabilitation of the canal system, based on the findings of such joint inspection and in accordance with the directives and orders of the Appropriate Authority, and agreed to between the Canal Officer and the Water Users' Association, shall be prepared. (5) On preparation of such list of items of works under subsection (4), the Canal Officer not below the rank of an Executive Engineer duly empowered in this behalf, shall inform the Water Users' Association, the schedule of completion of repairs and renovation, if any required, to ensure that water can be delivered to all the command area of the canal system, the designed and specified period. The schedule of completion for the works of Priority-I, shall not extend beyond a period of twelve months, from the date of joint inspection, except with the consent of the concerned Water Users' Association. After completion of Priority-I works, the system will be tested and handed over to WUA. If the Water Users' Association fails to take over the system, within one month of such testing, it will stand handed over to the Water Users' Associations. The participation of Water Users' Association in repairs and renovation works shall be as prescribed. After such handing over of the system, Priority-II works shall be completed within a period not exceeding eighteen months. The Canal Officer shall have power to extend such period in exceptional circumstances. (6) There shall be annexed to such document, the copies of the joint inspection findings, the agreed schedule of completion of the repairs and renovation, together with the list of items of such repairs and renovation agreed to by both the parties
3. Constitution of WUA Managing Committee	
Odisha (Orissa)	**4. Election of members of Chak Committee and that of the President and members of the Executive Committee of Pani Panchayat** (1) All the land holders in a Chak will elect three members in the manner as may be prescribed to form a Chak Committee in such a way that there shall be one member from the upper reach, one from the middle reach and one from the lower reach within the Chak. They will also simultaneously elect one among those three to represent the Chak in the Executive Committee of the Pani Panchayat. In case of Lift Irrigation Points the members of the Executive Committee of a Pani Panchayat shall be elected by the members of the General Body of the said Pani Panchayat. A person eligible to become a member of more than one Chak Committee of a Pani Panchayat under sub-section (i) shall be entitled to be a member of all the respective Chak Committees but he can be an Executive Committee Member of only one Pani Panchayat of his / her choice.
Andhra Pradesh	**4. Election of President, Vice-President and members of the Managing Committee of Water Users Association** (1) There shall be a Managing Committee for each Water Users Association comprising members of the Territorial Constituencies as specified in sub-section (2) of Section (3) elected directly by the water users as specified in clause (i) of sub-section (4) of Section 3 of the Act from their respective Territorial Constituencies. Provided that two members nominated by the Gram Panchayat of whom one shall be a woman, shall be the members of the Managing Committees of Minor Irrigation Water Users Associations, without voting rights, in the manner prescribed. (2) The Managing Committee for Water Users Association shall be a continuous body, with one third of its elected members thereof retiring

State	PIM Act Provision
	every two years as specified in sub-section (3). (3) The term of the office of the members of the Territorial Constituencies shall if not recalled or removed or disqualified under the provisions of the Act, be six years from the date of first meeting of the Managing Committee appointed by the Commissioner; Provided that at the first election, all the Territorial Constituency members shall be elected at one time, out of which one third of the members thereof shall retire as soon as may be on the completion of two years, another one third members after completion of four years and the remaining one third shall retire after completion of six years in office and their terms of retirement shall be decided by drawal of lots. (4) The term of office of all the Territorial Constituency members elected subsequent to the first election against the vacancies of retirement, as specified in sub-section (3) shall be of six years, if not recalled or removed or disqualified under the provisions of the Act. (5) The District Collector shall cause arrangements for the election of a Managing Committee consisting of one member from each of the Territorial Constituencies of a water users area by a simplified election procedure in the manner prescribed; (6) The District Collector shall also cause arrangements for the election of a President and a Vice-President of the Managing Committee from among the members of the Managing Committee of the Water Users Association, in the manner prescribed; (8) The President and the Vice-President of the Managing Committee of Water Users Association shall, if not recalled or removed or disqualified by the provisions of the Act, be in office for a period of two years from the date of election or his tenure as member of Territorial Constituency, whichever is earlier.
4. Functions of Farmers Organization	
Karnataka	**62AA. Functions of Water Users Association** Water Users Association shall perform the following functions, namely:- (1) to develop irrigation infrastructure by availing institutional finance.
Odisha (Orissa)	**19. Functions of the Project Committee** (2) In addition to the above functions, a Farmer's Organisation may perform the following function, namely:- (a) To supply seeds, fertilizers and other inputs and at rates to be approved by the General Body. (b) To market the agricultural products of the members as may be decided by the General Body. (c) To undertake enterprise for value addition to the products of the members as may be decided by the General Body. (d) To establish Agro Service Centre for providing services to the farmers in their agricultural operations as may be approved by the General Body. (e) To act as a Self-help Group for providing credit to the members as may be approved by the General Body.

State	PIM Act Provision
Andhra Pradesh	**17. Functions of Water Users Association** The Water Users Association shall perform the following functions, namely: (t) to encourage modernization of agriculture in its area of operation;
Maharashtra	**4. Objects of Water Users Association** (2) The Association may also engage into any activity of common interest of the members in the Command Area related to irrigation and agriculture, such as introduction of Drip and Sprinkler system for optimising the use of water; developing farm ponds and community projects for exploiting groundwater; procurement and distribution of seeds, fertilisers and pesticides; procurement and renting of agricultural implements; marketing and processing agricultural produce from the Command Area and supplementary business like dairy and fisheries.
5. WUA Agreement	
Uttar Pradesh	**18. Agreement between the Government and water users' association and between water users' associations** (1) For the purpose of supply of bulk water to the water users' associations and related issues, the distributary level water users' association shall enter into an agreement with the Irrigation Department in such manner as may be prescribed. Every other lower level water users' association shall enter into similar agreement with its immediate upper level water users' association. (3) No right to the use of the water from a canal shall be, or be deemed to have been acquired, nor shall the Irrigation Department/water users' association, as the case may be, be bound to supply to any water users' association/landholder with available water except in accordance with the terms and conditions of the agreement.
Chhattisgarh	**25. Powers and Functions of Water Users' Association** (3) Agreement with the Water Users' Association:- (a) There shall be an agreement between the Water Users Association and the upper level committee or the Canal Officer within three months of the constitution of the concerned Water Users' Association; (b) Supply of water for irrigation to any Water Users' Association within the area of management of irrigation systems by farmers and provisions for proper maintenance and repairs of irrigation systems within the area of a farmers' organisation shall be in accordance with the agreement; (c) The Agreement shall contain the contents as may be prescribed.
Maharashtra	**29. Contents of Agreement** (1) Supply of water for irrigation to any Water Users' Association at any level within the area of Management of Irrigation Systems by Farmers shall be in accordance with the Agreement to be signed by the Chairperson of Water Users' Association and the Chairperson of upper level of Association or the Canal Officer duly empowered in this behalf as the case may be. A note of such agreement shall be kept with the Water Resources Department in the prescribed manner.

State	PIM Act Provision
	(2) The agreement shall, inter alia, contain the provisions for following:- (i) Objectives of the agreement; (ii) Water use Entitlement; (iii) Water rate and assessment on volumetric basis; (iv) Rights of member of the Water Users' Association; (v) Rights of Water Users' Association; (vi) Recovery of water charges; (vii) Previous dues; (viii) Maintenance and Repairs of Canal System; (ix) Maintenance and Repairs of field channels and field drains; (x) Special incentives, if any, given by Appropriate Authority from time to time; (xi) Resolution of conflicts; (xii) Period of Agreement; (xiii) Termination or Revision of Agreement; (xiv) Joint inspections, rehabilitation, schedule of balance work and handing over, etc; (xv) Compensation; (xvi) Penalties; (xvii) Technical guidance and training; (xviii) All other matters as prescribed which need to be provided for carrying out the purposes of this Act, in the Agreement under this Act.
6. WUA staff	
Uttar Pradesh	**26. Deputation of Government employees to water users' association** (2) The water users' association may hire/appoint any person to carry out day-to-day work related to office/field at wages as approved in the form of pay and/or foodgrains.
Gujarat	**Officers and employees of Association**

State	PIM Act Provision
	9. (1) The Association, in order to enable it to perform its functions, may appoint- (i) a secretary (ii) a minor canal operator, and (iii) such other officers and employees as may be determined by it. (2) The salary and allowances payable to, and other conditions of service of the secretary, minor canal operator and other officers and employees shall be such as my be determined by the Association.
Maharashtra	**9. Managing Committee of Water Users' Association at Minor Level and election of its Directors and Chairperson** (1) There shall be a Managing Committee for every Water Users' Association at Minor Level, consisting of such number of members including Chairperson and Directors as may be prescribed. Such Association shall have a Secretary having prescribed qualifications and the pay and allowances of such person shall be fixed by the respective Water Users' Association, in the prescribed manner.
7. WUA Records	
Gujarat	**Annual report** 27. The Association shall, during each financial year, prepare, in such form and at such time as may be prescribed, an annual report giving a true and full account of its activities during the previous financial year and an account of activities likely to be undertaken by it in the current financial year and copies of such report shall be forwarded to the Competent Authority.
Andhra Pradesh	**28. Records** (2) The books of accounts and other records shall be open for information to the members of the Farmers Organization and also for inspection to any officer or officers authorized by the Government or Commissioner, as may be prescribed. (3) To encourage effective functioning of the Farmers Organizations, the Government may prescribe incentives and disincentives for Farmers Organisations, based on their performance.

8. Power to levy, collect fee and water tax by Farmers Organization	
Karnataka	**62AA. Functions of Water Users Association** Water Users Association shall perform the following functions, namely:- (4) to levy and collect water charges and service charge from the land holders. (11) to levy water charges and service charges on non-members at rates approved by the General Body of the Society.

State	PIM Act Provision
Gujarat	**Determination and collection of water charges by Association** 21. An Association may determine the water charges due from its members for the water supplied from the minor canal to their land for irrigation and collect the same. **Other functions of Association** 22. The Association shall perform the following functions, namely- (8) to collect water rates levied under section 44 and 45 of the Bombay Irrigation Act, 1879 from its members, (9) to collect such water charges from members for use of water for purposes other than irrigation as may be determined by the Competent Authority with the previous approval of the State Government, (12) to collect from its members expenses incurred by it in carrying out normal maintenance and repairs of the entrusted minor canal,
Maharashtra	**27. Powers of Water Users' Association to charge for supply of Water to members** (1) The Water Users' Association shall have powers and responsibility to charge to its members, water rates as may be approved by the General Body of the Water Users' Association. (3) The Water Users' Association shall also have the power to levy the water charges for use of recycled water or ground water by members.
9. Resources of Farmers' Organisation	
Odisha (Orissa)	**22. Resources of Farmers' Organisation** 22. The funds of the Farmers' Organisation shall consist of the following namely:- (e) amounts received from any other source including M.L.A. Local Area Development Fund and M.P. Local Area Development Fund etc.
10. Representation of Scheduled Caste, Scheduled Tribe, Gram Panchayat and Women in Farmers Organization	
Madhya Pradesh	**Managing Committee of Water Users' Association** (4) If the Managing Committee of the Water users' Association does not have a woman member, the Managing Committee shall co-opt a woman as a member who shall ordinarily be a resident of the farmers' organisation area. **Election of Managing Committee of Distributory Committee** (3) If the managing Committee of the Distributory Committee does not have a woman member, the Managing Committee shall co-opt a woman as a member who shall ordinarily be a resident of the farmers' organisation area. **Election Managing Committee for Project Committee** (3) If the Managing Committee of the Project Committee does not have a woman member, the Managing Committee shall co-opt a woman as a

State	PIM Act Provision
	member who shall ordinarily be a resident of the farmers organisation area.
Uttar Pradesh	**8. Managing committee of water users' association at outlet level (Kulaba samiti) and election of its members and office bearers.** (2) There shall be a managing committee for every kulaba samiti headed by a Chairperson. The committee shall have one representative each from every subcommand. If there is no representation of person belonging to Scheduled Castes or Scheduled Tribes or of women or panchayats in the managing committee, one person against each unrepresented category and chairman of jal prabandhan samiti of gram panchayat shall be co-opted by the managing committee from amongst members of the general body. Such managing committee shall be responsible to discharge the functions of the kulaba samiti. **10. Managing Committee of alpika samiti, rajbaha samiti and shakha Samiti** (1) There shall be a managing committee for each water users' association at minor, distributary or branch level. The committee will be comprised of a Chairperson, a Secretary, a Treasurer and such number of other members as may be prescribed. If there is no representation of persons belonging to the Scheduled Castes or Scheduled Tribes or of women or panchayats of appropriate level situated at the tail end of canal, in the managing committee, then one person against each unrepresented category shall be coopted by the managing committee from amongst members of the general body or panchyats of appropriate level situated at the tail end of canal, as the case may be. Such managing committee shall be responsible to discharge the functions of the water users' association in its area of operation.
Chhattisgarh	**5. Constitution of Managing Committee of Water Users Association and election of its President and Members** (11) Seats shall be reserved in every Management Committee of Water Users' Association for the Scheduled Castes, Scheduled Tribes and other Backward Classes and the number of seats so reserved shall bear as nearly as may be the same proportion to the total number of seats to be filed by direct election in that Water Users' Association as the number of Scheduled Castes, Scheduled Tribes and other Backward Classes of the water users in that water users area bears to the total number of water users of that area and such seats shall be allotted by the prescribed authority to different Territorial Constituency in that Water Users Association, in the prescribed manner. Provided that such reservation of seats shall not exceed fifty percent of the total members of the Managing Committee of the Water Users Association. (13) One third of total number of seats reserved under subsection (11) and unreserved seats shall be reserved for women candidates and the reservation shall be horizontal and compartment-wise. Explanation: "Horizontal and compartment-wise reservation" means reservations in each category namely; Scheduled Castes, Scheduled Tribes, other Backward Classes and General. (14) Seats reserved for women may be allotted by the prescribed authority by drawing of lots and by rotation to different Territorial Constituency in a Water Users' Association in the prescribed manner. (15) There shall be nomination of one member from the Gram Panchayat, from among the Gram Panchayat(s) within the water users' area to the Managing Committee and such member shall not have the right to vote.

State	PIM Act Provision
	Provided that such nomination would be decided by the Managing Committee in concurrence with the Gram Panchayat(s) in the water users' area and in the prescribed manner. **8. Constitution of Managing Committee of Distributory Committee and election of its President and Members** (6) Seats shall be reserved in every Managing Committee of Distributory Committee for the Scheduled Castes, Scheduled Tribes and other Backward Classes and the number of seats so reserved shall bear as nearly as may be the same proportion to the total number of seats to be filed in that Managing Committee as the number of Scheduled Castes, Scheduled Tribes and other Backward Classes of the water users in that distributory area bears to the total number of water users of that area and such seats shall be reserved by the prescribed authority and in the prescribed manner. Provided that such reservation of seats shall not exceed fifty percent of the total members of the Managing Committee of the Distributory Committee. (7) One third of total number of seats reserved under subsection (6) and unreserved seats shall be reserved for women candidates and the reservation shall be horizontal and compartment-wise. Explanation: "Horizontal and compartment-wise reservation" means reservations in each category namely; Scheduled Castes, cheduled Tribes, other Backward Classes and General. (9) There shall be nomination of one member from the Janapad Panchayat, from among the Janapad Panchayat(s) within the Distributory area, to the Managing Committee and such member shall not have the right to vote. Provided that such nomination would be decided by the Managing Committee in concurrence with the Janapad Panchayat(s) in the Distributory area and in the prescribed manner. **11. Constitution of Managing Committee of Project Committee and election of its President and Members** (6) Seats shall be reserved in every Managing Committee of the Project Committee for the Scheduled Castes, Scheduled Tribes and other Backward Classes and the number of seats so reserved shall bear as nearly as may be the same proportion to the total number of seats to be filed in that Managing Committee as the number of Scheduled Castes, Scheduled Tribes and other Backward Classes of the water users in that Project area bears to the total number of water users of that area and such seats shall be reserved by the prescribed authority and in the prescribed manner. Provided that such reservation of seats shall not exceed fifty percent of the total members of the Managing Committee of the Project Committee. (7) One third of total number of seats reserved under subsection (6) and unreserved seats shall be reserved for women candidates and the reservation shall be horizontal and compartment-wise. Explanation: "Horizontal and compartment-wise reservation" means reservations in each category namely; Scheduled Castes, Scheduled Tribes, other Backward Classes and General. (9) There shall be nomination of one member from the Zila Panchayat, from among the Zila Panchayat(s) within the Project area, to the Managing

State	PIM Act Provision
	Committee and such member shall not have the right to vote. Provided that such nomination would be decided by the Managing Committee in concurrence with the Zila Panchayat(s) in the Project area and in the prescribed manner.
Andhra Pradesh	**4. Election of President, Vice-President and members of the Managing Committee of Water Users Association** (1) There shall be a Managing Committee for each Water Users Association comprising members of the Territorial Constituencies as specified in sub-section (2) of Section (3) elected directly by the water users as specified in clause (i) of sub-section (4) of Section 3 of the Act from their respective Territorial Constituencies. Provided that two members nominated by the Gram Panchayat of whom one shall be a woman, shall be the members of the Managing Committees of Minor Irrigation Water Users Associations, without voting rights, in the manner prescribed. **5. Delineation of distributory area and constitution of the Distributory Committee** (1) The Government may, by Notification and in accordance with the rules made in this behalf, delineate every command area of the irrigation system, comprising of five or more Water Users Associations**,** and declare it to be a distributory area for the purpose of this Act. Provided that all Presidents of the Manadal Parishads within the distributory area nominated by the District Collector shall be the members of the Managing Committee of the Distributory Committee without voting rights, in the manner prescribed. **8. Election of Chairman, Vice-Chairman and constitution of the Managing Committee** (1) There shall be a Managing Committee for every Project Committee, consisting of all the members of the general body. Provided that all Members of the Legislative Assembly, all Members of the Parliament and Chairpersons of Zilla Parishads within the Major Project area nominated by the Government shall be the members of the Managing Committee of the Major Project Committee without voting rights, in the manner prescribed : Provided further that all Members of the Legislative Assembly, all Members of the Parliament and Presidents of Mandal Parishads within the Medium Project area nominated by the District Collector shall be the members of the Managing Committee of the Medium Project Committee without voting rights, in the manner prescribed.
11. Volumetric supply of water to WUAs	
Uttar Pradesh	**21. Modes and rates for supply of water to water users' association** Water shall be supplied by the Irrigation Department to the distributary level water users' associations measured volumetrically at supply point. The competent canal officer and the water users' association shall jointly check the discharge at the beginning of each crop season. Such joint measurements of discharges may also be made at other points of time if so required for correct assessment of water delivery to water users' association during the fasal period. Water charge shall be impressed at the end of each crop season fasal wise.

State	PIM Act Provision
Karnataka	**62AA. Functions of Water Users Association** Water Users Association shall perform the following functions, namely:- (2) to procure water in bulk on volumetric basis from the Irrigation Department or Krishna Jala Bhagya Nigam or Karnataka Neeravari Nigam and distribute it to the land holders in accordance with the principles laid down by the General Body for equitable distribution of water.
Gujarat	**Competent Authority to provide assured supply of water** 11. For the purpose of enabling an Association to undertake participatory irrigation management, the Competent Authority shall, so far as possible, provide an assured supply of water from a minor canal on volumetric basis, or such other basis as may be prescribed, to the service area by ensuring that- (a) there is measuring devices at the minor canal, and (b) the minor canal is operated in accordance with a programme for supply of water for each season prepared by the Competent Authority in consultation with the designated person.
Maharashtra	**26. Modes and Rates for supply of water to Water Users' Association** (1) Water from the canal system shall be supplied to the Water Users' Associations (WUAs) at various levels, from tail to head on bulk basis measured volumetrically as per their water entitlements by Canal Officer or upper level Water Users' Association, as the case may be. (2) The rates for supply of water to a Water Users' Association shall be on the volumetric basis measured at the point of supply.
	28. Supply of water as per Entitlement (1) It shall be the responsibility of the Appropriate Authority to supply water as per the Applicable Water Use Entitlement, in the prescribed manner to the Water Users' Associations on a bulk basis measured volumetrically. (2) It shall be the responsibility of the Water Users' Association to supply water equitably in its area of operation as per Applicable Water Entitlement of each member.
12. Installation of measuring devices on minor canal	
Uttar Pradesh	**20. Installation of measuring device** The competent canal officer shall provide and maintain a measuring device for volumetric measurement of water at the point of supply to water users' associations as prescribed and also determine the water carrying capacity every year for every season considering practical situation and directives issued by State Government.
Maharashtra	**23. Installation of Measuring Device** (1) For every area of operation delineated under this Act or where a Water Users' Association for flow irrigation has been duly constituted under this Act, it shall be the duty of the Canal Officer to provide a proper measuring device or devices on the canal at the point of supply to Water

State	PIM Act Provision
	Users' Association and ensure its proper working from time to time. (2) The accurate flow measurement, the form of record in which it shall be entered into and periodic evaluation thereof; as well as the mode of ascertaining the volume of water for a period in which measuring device is out of order, shall be such as may be prescribed.
13. Training of WUAs	
Uttar Pradesh	**50. Training** The State Government shall initially make arrangements for the capacity building of water users' associations for discharging their functions under this Act and may also facilitate subsequent training on the basis of full or partial payment.
14. Protection of local government and tribal rights	
Odisha (Orissa)	**42. Savings** (1) Nothing contained in this Act shall affect the rights or properties vested in a Gram Panchayat, Zilla Parishad, Panchayat Samiti, Municipality or Municipal Corporation under any law for the time being in force. (2) Nothing contained in this Act shall apply to the minor water bodies if any, in the Schedule Areas in the State of Orissa Explanation I - Minor water bodies mean the projects which irrigate less than forty hectares of land Explanation II - schedule areas mean such areas as the President of India may by order declare to be schedule areas, under the Fifth Schedule of the Constitution of India.
Rajasthan	**46. Savings** (1) Nothing contained in this Act shall affect the rights of or properties vested in Panchayati Raj Institutions and Municipalities under any law for the time being in force. (2) Nothing contained in this Act shall apply to the minor water bodies in the Scheduled Areas declared by the President of India under Part C of the Fifth Schedule of the Constitution of India, in the State of Rajasthan.

National Water Resources Framework Study

Large Scale Irrigation Reform

Working Paper No.3:

Reforming Management in the Irrigation and Drainage Sector

Martin A. Burton and Rahul Sen

Contents

Questions raised

With regard to reforming management in the I&D sector the following questions were put forth by the Planning Commission:

Management reform - I

- In what ways should/can the irrigation bureaucracies be reformed?

Management reform -II

- Can we suggest a new set of conditionalities/ reforms to make AIBP more effective?
- How do we reintegrate AIBP and CADP?

Measurement

- What is the best way forward to ensure volumetric pricing of water?

1 Introduction

With the growing concern over the availability of sufficient water resources for economic development in India there is increased focus on how water is managed and used. With over 70 percent of the water abstracted in most States being used for irrigation, improvement in the management of irrigation and drainage systems is high on the agenda for action.

As discussed in Working Paper No. 2: Re-engaging with Participatory Irrigation Management, reforms are underway in many states with the manner in which water users are involved in the management of I&D systems with a view to improving the efficiency and productivity of water at the on-farm level. Linked to this is the need to reform and modernise the Irrigation Department in order that the main system water allocation and delivery matches the farmers' and crop needs such that water use efficiency and productivity improves throughout the water supply chain.

With more efficient and productive water use in the irrigation sector abstractions of water can be reduced and utilized for other purposes, such as domestic and industrial water supply, as well as for the environment.

This paper therefore addresses the main question posed by the National Planning Commission "In what ways should/can the irrigation bureaucracies be reformed?" In the section dealing with operation of the main system the answer paper also address the question "What is the best way forward for volumetric pricing of water".

2 Overview of proposals for reform

This paper identifies a number of key issues in the irrigation and drainage sector and makes a number of recommendations for reform to address them at different levels:

On-farm

- Specify annual and seasonal volumetric water allocations to WUAs;
- Change attitudes within the ID towards WUAs and farmer-management;
- Diversify staffing in the ID to include disciplines other than civil engineering;
- Encourage the ID to allow for conjunctive use of surface and groundwater;
- Improve main system supply to match on-farm needs.

Service delivery

- Introduce a service delivery culture within the ID;
- Provide enforceable service delivery agreements between the ID and WUAs;
- Create a direct link between the fees paid by water users on their systems and the service provided;
- Develop the concept of water users and the ID working *in partnership* to improve the performance of the system.

Operation (main system)

- Rewrite the operation rules, processes and procedures to allow for conjunctive use of surface and groundwater;
- Introduce a system for charging for groundwater where it is recharged from surface water systems;
- ID to recruit young graduates and modernise their operations processes and procedures (computerise data processing, MIS, GIS, use remote sensing, etc.);

- Introduce a system of performance management at individual scheme level and hold ID system managers accountable for performance. Utilise benchmarking to identify best practices, performance gaps and measures for performance improvement;
- Introduce the concept of water auditing, opportunity cost and benefits lost due to poor system O&M;
- Significantly upgrade the ability to measure, record and utilise data on canals discharges in order to be able to deliver planned and measured volumes of water.

Maintenance (main system)

- Adopt more transparent and accountable processes for assessing maintenance, repair and capital investment requirements of individual I&D systems by using asset management planning;
- Based on prepared asset management plans increase the funds available (either from government or water users) so as to adequately maintain I&D systems;
- Quantify the actual costs of failing to maintain I&D systems and the productive potential lost as a result of inadequate levels of maintenance.

Finance

- Establish the service fee for individual systems using asset management planning;
- Convert the water tax to a service fee charge;
- Reduce the transaction costs of service fee recovery by allowing WUAs to collect the service fee;
- Get the water users to increase their contributions towards MOM of the I&D systems by accounting for income and expenditure by system, and using more open and transparent methods (i.e. asset management planning) for assessment of maintenance needs and costs;
- Allow WUAs to set, collect and utilise the irrigation service fee.

Water resources management

- Create one agency with overall responsibility in the state for water resources management;
- Establish water rights for water users (or groups of water users, such as WUAs);
- See Working Paper No. 6 – Water Resources Management.

Human resources development

- Improve the human resources management within the ID by:
    - Modernising and making more professional the staff training programmes;
    - Reviewing and modernising the promotion system to encourage early progression of more able staff members to senior positions;
    - Recruiting professionally trained HRM staff (not civil engineers);
    - Carrying out a comprehensive analysis of the current and future human resource and associated training needs of the ID;
    - Providing adequate funds for training;
    - Ensuring that training is carried out by professional trainers, with specified and measureable outcomes specified for each training course;
    - Encouraging progressive thinkers and change agents within the

	Department.
Education and training	• Support ID staff members in attending postgraduate education courses in irrigation, water resources management, GIS, remote sensing, etc. • Improve the quality of WALMIs by: o Provide greater support from senior management; o Change the approach and attitude to training amongst ID staff; o Changing policies and procedures for appointing staff; o Allow more flexibility in organisational structure; o Provide staff with incentives to take up research and learning in new areas; o Improve the funding, BUT make it results and outcome based (payment by results); o Provide training centres (temporary or permanent) at District level to support field-based training; o Upgrade the skills levels of trainers, particularly in relation to PIM and adult education; o Allow and encourage WALMIs to link with other organisations (universities, research and training centres, etc.) to broaden the skills base (e.g. link with a university to teach remote sensing).
ID management, policy, processes and procedures	• Provide leadership and form a vision for the future; • Change the culture of the ID from a construction focus to a management focus in states where the developed irrigation area exceeds the potential area remaining for irrigation development; • Change the culture of the organisation from top-down, beneficiary focussed to an organisation focussed on service delivery working in partnership with customers and clients; • Change the charter of the ID to allow for employment of a much wider range of professions, including hydrologists, agriculturalists, socio-economics, sociologists, etc.; • Overhaul the approach to human resources development and management, including employing professional HRM specialists to manage the human resource; • Modernise management, operation and maintenance (MOM) procedures (computers, remotes sensing, GIS, MIS, computer scheduling, computerised asset management databases, etc.); • Focus system managers thinking on ways to improve the overall performance of the systems they manage. Develop a culture of performance-based management for individual systems, taking account of their water consumption (via water audits), maintenance needs and implementation, operational management and outputs achieved (agricultural production, water consumed).

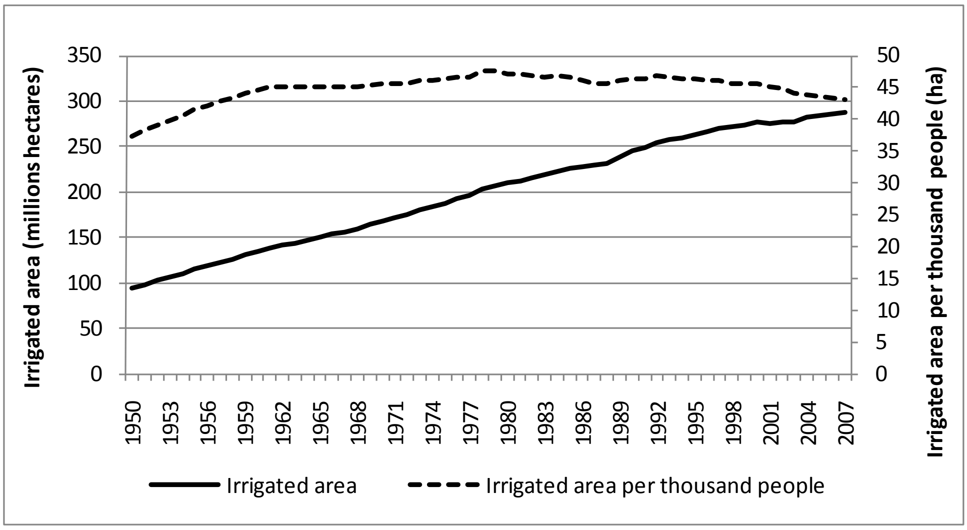
Further discussion of these points is provided in the following sections.

3 Trends in irrigation development and management worldwide

3.1 Growth of irrigation and water abstraction

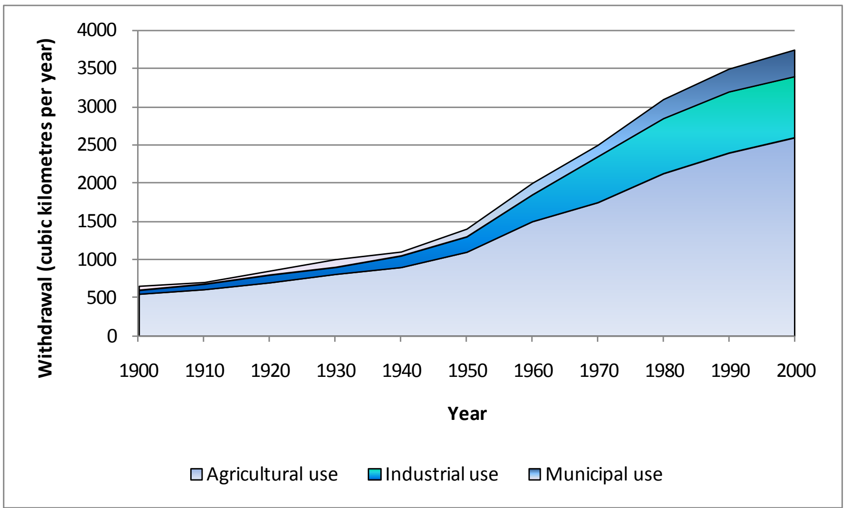
Over the last 60 years there has been a massive increase in the irrigated area, both in India and worldwide (Figure 1). Over the period 1950 to 2000 the irrigated area worldwide has increased at a rate of around 3.9 percent per annum, though this growth has only just kept pace with the population growth, with area irrigated per person changing relatively little from 37.3 ha/1000 people in 1950 to 43 ha/1000 people in 2007. In recent years the rate of development of the irrigated area has decreased as the availability of adequate water resources and suitable sites for development have reduced.

Figure 1: Growth in the irrigated area worldwide, 1950-2007 (Data from EPI, 2009)



Coupled with the decrease in the availability of suitable sites and water resources for irrigation has been the growth in demand for water from other sectors since 1950 (Figure 2). Though smaller than the abstractions for irrigation the demand for water for industrial and domestic use has increased significantly, allied to the growth in the urban population. In India, as in other countries, the agricultural sector is under increasing pressure to release water for these other uses.

Figure 2: Growth in water withdrawals, 1900-2000 (From IWMI, 2006 after Shiklomanov, 2000)

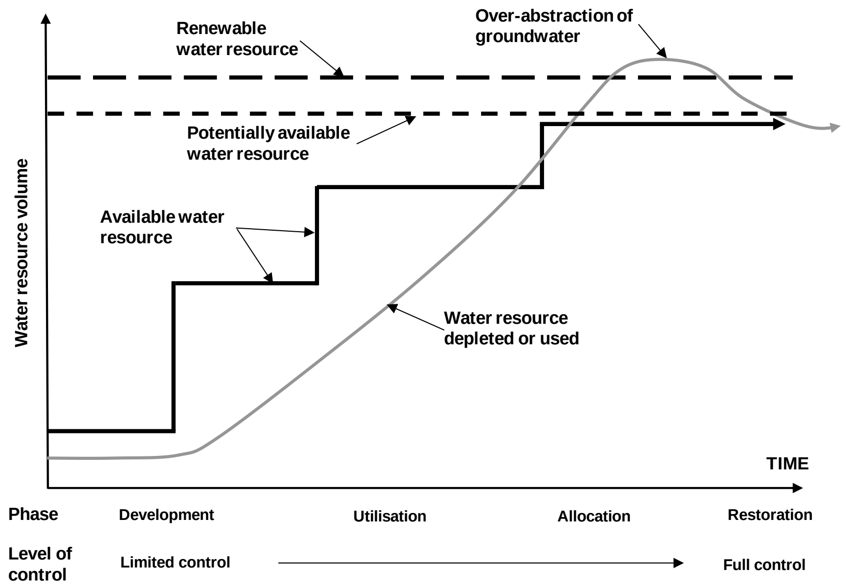


3.2 Development pathway and changes in management

Figure 3 summarizes the development pathway in many river basins. The diagram shows the total renewable water resources available in the basin, and the potentially available water resources that can be abstracted via technical interventions such as the construction of dams, barrages, boreholes, tubewells and the like. In the early development stages there is more than enough water available and water is abstracted by relatively simple structures. Over time more sophisticated structures are built (barrages, dams and reservoirs) resulting in step changes in the available water resource. Allied to this is the construction of larger and more technically challenging irrigation systems, with canal networks conveying water many miles away from the river source.

The water resource depleted or used curve generally follows behind the available water resource, though there may be periods when the depleted water resources exceed the developed resource and the groundwater reservoir is mined. At some time all possible physical works have been completed and the potentially available water resource limit is reached. At this stage the basin is "closed", as there is no more room for (physical) development. Typically, as is happening in several Indian river basins, the groundwater is mined at this stage, and as the total amount of water depleted or used exceeds the amount of renewable water resource the groundwater level falls, and continues to fall unless total abstraction is brought back in line with the renewable water resource quantum.

Figure 3: River basin development phases (modified from Molden et al, 2001)



Planning, design and construction of physical works plays an important part in the early stages of this development pathway. Typically in many arid countries and the humid tropics the main political pressure has been to develop the land and water for irrigated agriculture, thus very powerful irrigation agencies have developed over time[19]. However as the available water and land resources are developed and the basin approaches closure factors other than

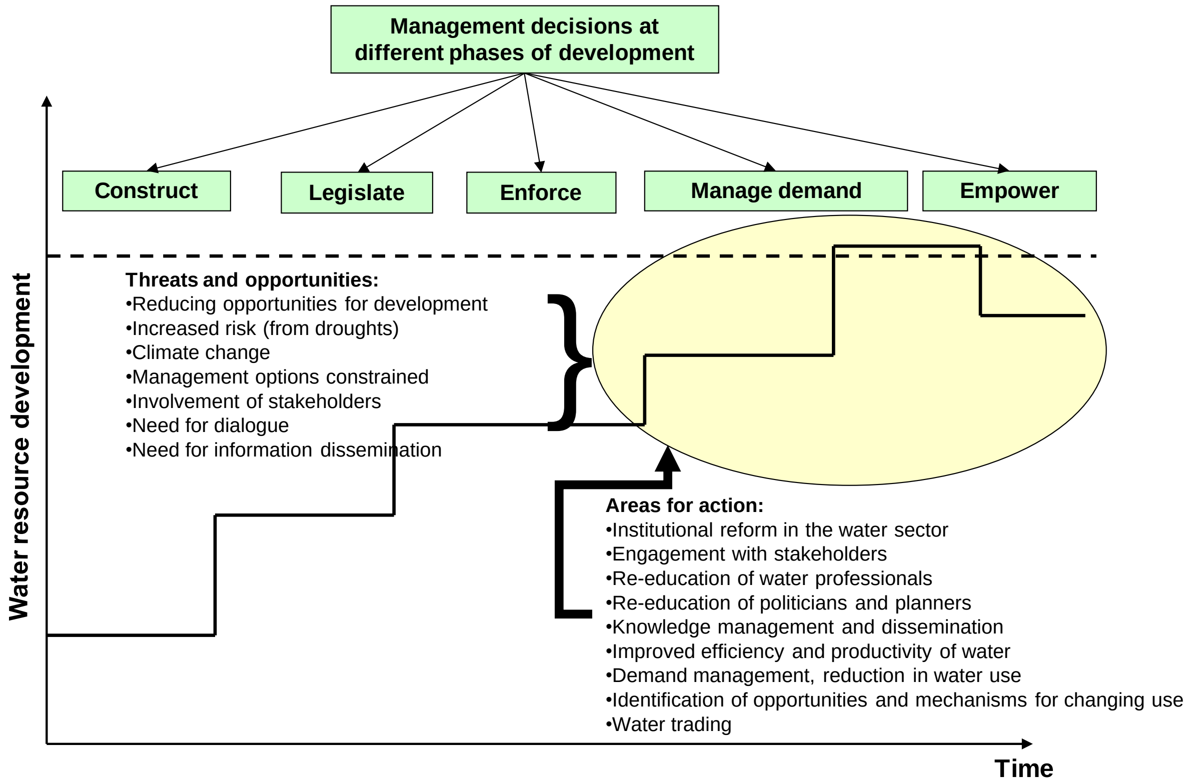
[19] This has been the case in India, Pakistan, Turkey, Egypt and Indonesia to name a few.

construction come into play, including the need for better management of the developed resource, and licensing and regulation of the resource (Figure 4). As there is no more spare water available the only option remaining is to manage the available water better, and to engage in a process of "vertical intensification" by improving the performance of existing I&D systems. It is at this stage that the non-availability of water becomes a constraining factor to further economic development within a river basin. An additional factor to consider, which is apparent in many of the developed countries, is that with economic development and universal education comes an increasing awareness and concern with the environment. This concern shapes social thinking, and in Europe has led to legislation such as the Habitats Directive and the Water Framework Directive, both of which focus on ensuring an adequate quantity and quality of water in water bodies.

Faced with the latter stages of the development pathway organisations which have hitherto been focussed primarily on construction of new infrastructure, much of it for irrigation, have to reassess their position. Two new roles emerge at this stage, water resources management, and management of water delivery to water users (be they irrigators, domestic or industrial users). Several countries, including India, Pakistan and Turkey, with hitherto a strong focus on development of new infrastructure, particularly for irrigation, are now facing the challenge of how to organise and structure their water sector organisations for this era of closed river basins and water scarcity.

In some countries, such as the UK, other parts of the European Union, Australia and the USA, the water resources management function has been separated from the water delivery function and greater powers given to the water resources management organisations, particularly in regard to licensing, monitoring and regulation of the available resources.

Figure 4: Changing opportunities and decisions as river basins face closure (Burton, 2010)



4 Irrigation development in India

4.1 Role and potential for irrigation and drainage

In India agriculture is of fundamental importance to the national, state and rural economies, contributing 14.6 percent (2009/10) of GDP and over 55 percent of employment. It provides a livelihood for the majority of the population and food security for the each state and the country as a whole.

Some 102 million hectares is irrigated, almost one-third of the total cultivated area. In many regions due to low or erratic rainfall irrigation has played a major role in enabling and enhancing food production. Irrigation gives farmers the security of water supply that enables them to invest in higher yielding crop varieties and increased inputs leading to greater levels of agricultural production than would have been possible under rainfed agriculture. Irrigation is generally a prerequisite in moves by farmers away from subsistence agriculture to higher value crops. It is estimated that the major part of the agricultural growth in India has come about as a result of irrigation (World Bank, 1998), and that the productivity of land under irrigation is some 7 times that under rainfed agriculture (Saleth, 1997).

With a more assured supply of water crop production has increased, particularly in relation to rice and wheat, with foodgrain production rising from 51 million metric tonnes in 1951 to over 218.2 million metric tonnes by 2010 with average foodgrain yields increased from 1 tonne/ha to 1.8 tonnes/ha[20]. During this period India has moved from being an importer of foodgrains to being self-sufficient and more recently a net exporter.

As well as contributing to the nation’s food production, irrigated agriculture also contributes significantly to rural employment, both for landholders and the landless. It has been estimated (Haggblade and Hazell, 1989) that ever Rs 100 invested in irrigated agriculture generates an additional Rs 105 in manufacturing and a further Rs 114 in the tertiary service sector, giving an overall multiplier effect of 2.19. There is also a link between poverty alleviation and irrigation development. In districts with less than 10 percent of the cultivated area under irrigation the incidence of poverty may be as high as 69 percent, while in districts with over 50 percent of the cultivated area under irrigation the incidence of poverty falls to around 26 percent (Rao et al, 1988; Saleth, 1997). In Punjab and Haryana, with some 70 percent of the cultivated area being under irrigation the incidence of poverty is only 10 percent.

The ultimate irrigation potential in the country has been estimated to be 139.89 mha (major & medium - 58.46 mha and minor - 81.43 mha), out of which irrigation potential to the extent of 101.7 mha had been created by March, 2007, leaving a potential balance of 38.19 mha.

The approach to irrigation development of the Government of India (GoI) has evolved over the Five Year Plans to address the emerging issues in irrigation in the country. The landmarks in the development of irrigation programme in the country under the various Five Year Plans are summarized in following Table 1.

[20] These low nationwide figures include rainfed cereals such as millet, sorghum and maize.

Table 1: Landmarks in the irrigation programme in Five Year Plans

Plan Details	**Status**
First Plan (1951-56)	Start of irrigation sector development
Second Plan 1956-61	Commencement of new projects
Third Plan 1961-66	
Annual Plans (1966-69)	
Fourth Plan 1969-74	Emphasis on completion of on-going projects
Fifth Plan 1974-78	Launching of Command Area Development Programme to fill the widening gap between potential creation and utilization
Annual Plans (1978-80) & Sixth Plan 1980-85	New projects and completion of on-going projects
End of Eighth Plan (1996-97) to Eleventh Plan (2007-12)	Central assistance under AIBP to support State Governments to complete projects. Improving the efficiency of the irrigation projects Water Sector Reform

Source: Planning Commission

4.2 Investment in irrigation and drainage

There has been a massive level of investment in the I&D sector since independence, with a total investment of over Rs 2.45trillion since 1951 (Table 2). During this time there has been an almost four-fold increase in irrigated area from 23 million hectares in 1951 to some 102 million hectares by 2007, an average of around 3 percent per annum. Of the area irrigated groundwater accounts for some 61percent, surface water some 29 percent and other sources 5 percent (Table 3). Whilst the majority of the surface water I&D systems have been publically funded, the majority of the groundwater development has been privately funded, mostly by individual farmers financing the drilling of a borehole and purchasing a pump. Whilst the area of publically-funded systems (major, medium and minor) increased threefold from 1951 to 1990, the area under groundwater increased seven-fold[21]. In many states the command area under groundwater irrigation exceeds that under surface water.

Table 2 shows that the percentage allocation for irrigation from First Plan to Tenth Plan has reduced from 22.5% to 6.3%. However, in terms of absolute amounts it has increased by more than 200 times. Yet, as per the data available from the Planning Commission, at the end of the Tenth Plan period (March 2007) the gap in the Total Irrigation Potential created (101.7 million ha) and utilized (85.2 million ha) in the country was 16.5 million ha, which is over 16% of the total irrigation potential created. At the same time, the Eleventh Plan has set a target of developing Irrigation Potential of 16 million ha through major and minor works in the entire country with a projected investment of Rs. 2,533 billion.

[21] There may be some double counting here as there are many groundwater wells lying within surface water command areas, with farmers using a mix of sources for irrigation of their crops.

Table 2: GoI expenditure on irrigation development under each 5 Year Plan

Plan Period	Major & Medium Irrigation (Million Rs)	Minor Irrigation & CAD (Million Rs)	Total Irrigation (Million Rs)	Percentage of Total Plan Expenditure (%)
First (1951-56)	3762	656	4418	22.5
Second (1956-61)	3800	1616	5416	11.6
Third (1961-66)	5760	4431	10191	11.9
Annual (1966-69)	4298	5609	9907	15.0
Fourth (1969-74)	12423	11734	24157	15.3
Fifth (1974-78)	25162	14096	39258	14.2
Annual (1978-80)	20786	13449	34235	14.3
Sixth (1980-85)	73688	41599	115287	10.5
Seventh (1985-90)	111073	76268	187341	8.6
Annual (1990-92)	54592	36495	91087	7.4
Eighth (1992-97)	210719	138853	349572	7.6
Ninth Plan (1997-02)	492890	137600	630490	6.7
Tenth Plan (2002-07) Outlay	712130	245214	957344	6.3
Eleventh Plan (2007-12)[22]				
Total	**1,731,083**	**727,620**	**2,458,703**	

Source: Planning Commission

[22] Data requested from Planning Commission

Table 3: Relative role of irrigation sources by States, 2001[23]

Major States	Net sown area	Net irrigated area	Proportion by type of irrigation				Cropping intensity	Irrigation intensity
			Canals	Tanks	Wells	Others[1]		
	(mha)	(mha)	(%)	(%)	(%)	(%)	(%)	(%)
Andhra Pradesh	11.115	4.528	36.43	16.06	43.16	4.35	122.54	130.93
Arunachal Pradesh	0.164	0.042	2.22	2.22	2.22	93.33	163.41	102.38
Assam	2.734	0.170	86.55	0.58	1.17	11.70	144.73	127.06
Bihar	7.437	3.625	31.34	4.28	57.74	6.65	128.725	133.24
Chattisgarh	4.763	0.984	68.90	5.59	17.28	8.23	116.56	106.60
Goa	0.141	0.023	16.00	4.00	76.00	4.00	119.15	165.22
Gujarat	9.443	2.979	16.51	0.60	82.28	0.60	111.56	119.31
Haryana	3.526	2.958	49.90	0.03	49.59	0.47	177.17	180.77
Himachal Pradesh	0.555	0.126	2.40	0.80	11.20	85.60	173.82	177.45
Jammu & Kashmir	0.748	0.311	91.32	0.96	0.64	7.07	147.86	144.84
Karnataka	10.410	2.643	36.56	9.88	38.53	15.03	116.34	120.43
Kerala	2.206	0.381	27.56	13.12	30.45	28.87	136.56	114.59
Madhya Pradesh	14.664	4.135	19.54	2.06	64.11	14.29	128.16	103.46
Maharashtra	17.636	2.959	35.36	0.03	64.57	0.03	127.03	132.37
Manipur	0.140	0.065	1.47	1.47	1.47	95.59	154.29	115.38
Meghalya	0.230	0.054	94.74	1.75	1.75	1.75	120.43	128.81
Mizoram	0.094	0.009	75.00	8.33	8.33	8.33	100.00	106.25
Nagaland	0.300	0.072	1.33	1.33	1.33	96.00	113.51	123.08
Orissa	5.829	1.933	45.37	14.57	40.00	0.05	150.54	131.37
Punjab	4.264	3.602	18.76	0.03	79.93	1.28	187.88	190.94
Rajasthan	15.865	4.907	27.59	0.77	70.78	0.86	124.06	124.43
Sikkim	0.095	0.017	5.00	5.00	5.00	85.00	138.95	105.88
Tamil nadu	5.303	2.888	28.85	20.40	50.19	0.55	120.38	121.81
Tripura	0.280	0.037	61.11	13.89	11.11	13.89	151.07	159.46
Uttar Pradesh	17.612	12.816	24.12	0.64	73.22	2.02	153.89	149.575
West Bengal	5.417	2.354	11.09	7.35	59.35	22.22	177.09	154.08
All India	**141.101**	**54.682**	**29.24**	**4.62**	**60.86**	**5.29**	**134.62**	**136.81**

Source: Central Water Commission, Ministry of Water Resources, Government of India

Notes: [1]Includes area being irrigated by streams, ponds, and other surface water bodies other than tanks.

However, despite the massive investment in irrigation (and drainage) the benefits appear to be tailing off, with the area under surface irrigation actually declining in recent years (Shah, 2009), whilst the area irrigated using groundwater has dramatically increased (Figure 5). The relative stagnation, even decline, of the area under surface irrigation is a matter for serious concern, as are the consequences of increasing abstractions from groundwater, with significant groundwater overdrafts being recorded in some states (Table 4).

[23] These are the latest data that could be obtained for the study. As the 4 MI Census is now completed data for 2010 should be available with the Planning Commission.

Figure 5: Public expenditure on irrigation and areas irrigated, 1960-2006 (Shah, 2009)

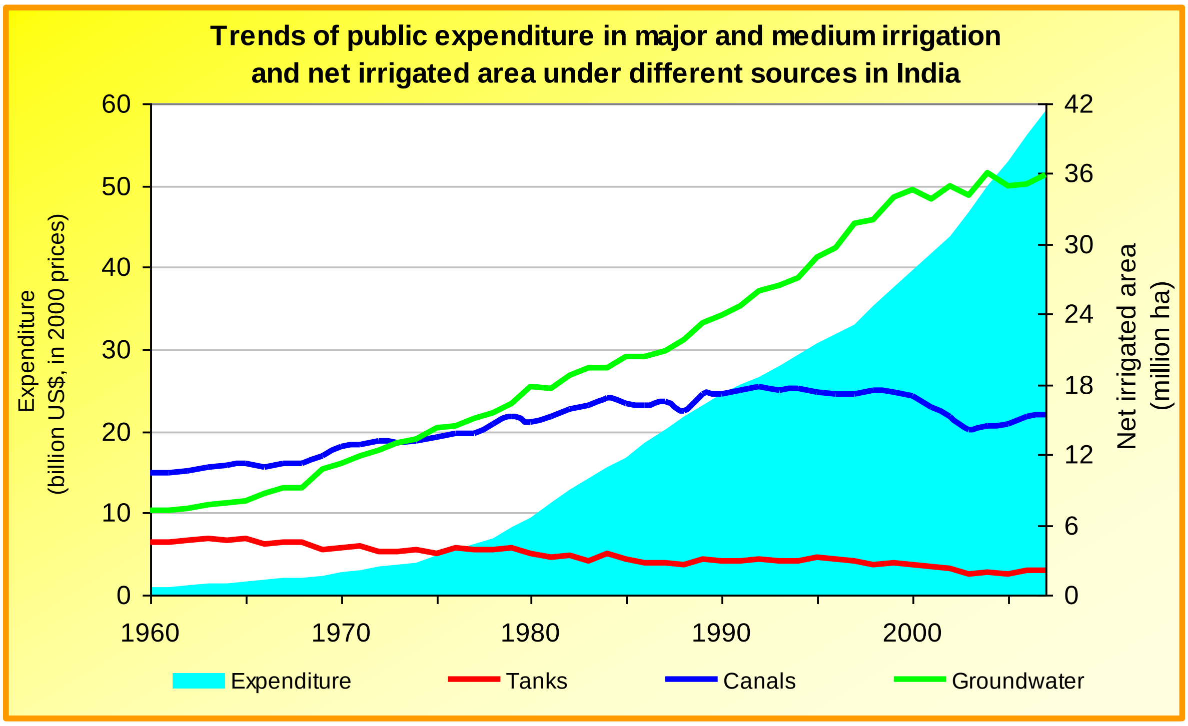


Table 4: State-wise groundwater resources availability, utilization and stage of development (billion m^3)

State	Annual Replenishable Ground Water Resource					Natural Dis-charge during non-monsoon season	Net Annual Ground Water Availability	Annual Ground Water Draft			Projected Demand for Domestic & Industrial Use (2025)	Ground Water Availability for Future Irrigation	Stage of Ground Water Development (%)
	Monsoon Season		Non-monsoon Season		Total			Irrigation	Domestic & Industrial Use	Total			
	Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources									
Andhra Pradesh	16.04	8.93	4.2	7.33	36.5	3.55	32.95	13.88	1.02	14.9	2.67	17.65	45
Arunachal Pradesh	1.57	0.00009	0.98	0.0002	2.56	0.26	2.3	0.0008	0	0.0008	0.009	2.29	0.04
Assam	23.65	1.99	1.05	0.54	27.23	2.34	24.89	4.85	0.59	5.44	0.98	19.06	22
Bihar	19.45	3.96	3.42	2.36	29.19	1.77	27.42	9.39	1.37	10.77	2.14	16.01	39
Chattisgarh	12.07	0.43	1.3	1.13	14.93	1.25	13.68	2.31	0.48	2.8	0.7	10.67	20
Delhi	0.13	0.06	0.02	0.09	0.3	0.02	0.28	0.2	0.28	0.48	0.57	0	170
Goa	0.22	0.01	0.01	0.04	0.29	0.02	0.27	0.04	0.03	0.07	0.04	0.19	27
Gujarat	10.59	2.08	0	3.15	15.81	0.79	15.02	10.49	0.99	11.49	1.48	3.05	76
Haryana	3.52	2.15	0.92	2.72	9.31	0.68	8.63	9.1	0.35	9.45	0.6	-1.07	109
Himachal Pradesh	0.33	0.01	0.08	0.02	0.43	0.04	0.39	0.09	0.03	0.12	0.04	0.25	30
Jammu & Kashmir	0.61	0.77	1	0.32	2.7	0.27	2.43	0.1	0.24	0.33	0.42	1.92	14
Jharkhand	4.26	0.14	1	0.18	5.58	0.33	5.25	0.7	0.38	1.06	0.56	3.99	20
Karnataka	8.17	4.01	1.5	2.25	15.93	0.63	15.3	9.75	0.97	10.71	1.41	6.48	70
Kerala	3.79	0.01	1.93	1.11	6.84	0.61	6.23	1.82	1.1	2.92	1.4	3.07	47
Madhya Pradesh	30.59	0.96	0.05	5.59	37.19	1.86	35.33	16.08	1.04	17.12	1.74	17.51	48
Maharashtra	20.15	2.51	1.94	8.36	32.96	1.75	31.21	14.24	0.85	15.09	1.51	15.1	48
Manipur	0.2	0.005	0.16	0.01	0.38	0.04	0.34	0.002	0.0005	0.002	0.02	0.31	0.65
Meghalaya	0.79	0.03	0.33	0.005	1.15	0.12	1.04	0	0.002	0.002	0.1	0.94	0.18
Mizoram	0.03	0	0.02	0	0.04	0.004	0.04	0	0.0004	0.0004	0.0008	0.04	0.9
Nagaland	0.28	0	0.08	0	0.36	0.04	0.32	0	0.009	0.009	0.03	0.3	3
Orissa	12.81	3.56	3.58	3.14	23.09	2.08	21.01	3.01	0.84	3.85	1.22	16.78	18
Punjab	5.98	10.91	1.36	5.54	23.78	2.33	21.44	30.34	0.83	31.16	1	-9.89	145
Rajasthan	8.76	0.62	0.26	1.92	11.56	1.18	10.38	11.6	1.39	12.99	2.72	-3.94	125
Sikkim	-	-	-	-	0.08	0	0.08	0	0.01	0.01	0.02	0.05	16
Tamil Nadu	4.91	11.96	4.53	1.67	23.07	2.31	20.76	16.77	0.88	17.65	0.91	3.08	85
Tripura	1.1	0	0.92	0.17	2.19	0.22	1.97	0.08	0.09	0.17	0.2	1.69	9
Uttar Pradesh	38.63	11.95	5.64	20.14	76.35	6.17	70.18	45.36	3.42	48.78	5.3	19.52	70

Uttaranchal	1.37	0.27	0.12	0.51	2.27	0.17	2.1	1.34	0.05	1.39	0.06	0.68	66
West Bengal	17.87	2.19	5.44	4.86	30.36	2.9	27.46	10.83	0.81	11.65	1.24	15.33	42
All India	**248.01**	**69.59**	**41.85**	**73.18**	**433.02**	**33.77**	**399.25**	**212.5**	**18.1**	**230.59**	**29.14**	**161.43**	**58**

Source: Central Ground Water Board, Ministry of Water Resources, Government of India

4.3 Organisational structure for irrigation

The State Irrigation Departments in India have the mandate to plan, develop, utilize and manage the state's water resources for its economic and social development. The departments formulate the state water resource policies and legislations and the water plans. It undertakes the execution of these water plans through survey and investigation, planning and designing, construction, quality control and operation and maintenance of irrigation projects. In this respect, an important function of the irrigation department is to represent the state in matters related to inter-state water issues for rivers that flow through more than one state. It also undertakes exploration and monitoring of groundwater, flood control and drainage development works, command area development activities and allocation of water for various uses. More recently, promoting participation of farmers in irrigation management and monitoring and managing irrigation water quality has also been added to its mandate.

The detailed structures of Irrigation Departments in India are as many as the number of states in the country. However, in terms of overall functions most of these Irrigation Departments can be described to have some common features. At the administrative level the Irrigation Department is headed by one or more ministers (members of the State Legislative Assembly and State Council of Ministers) usually one for major and medium irrigation and one for minor irrigation and groundwater. The primary function of the ministers is to represent the department's needs to the State Cabinet and the Legislative Assembly. Additionally, all decisions on policy and major programmes are vested with the ministers.

Reporting to the ministers and responsible for the day-to-day administration of the Irrigation Department are one or more Secretaries to the Government (senior members of the State cadre of Indian Administrative Services). The Secretaries are supported by a team of other administrative officers in the ranks of Commissioners, Special Secretaries, Deputy Secretaries, etc. who are usually from allied All India Service cadre of the State or from the State Administrative Services cadre. Constituting the "Secretariat" of the Irrigation Department, the Irrigation Secretaries and their administrative team are primarily responsible for budget and financial sanctions, administrative approvals for irrigation projects and allocation of water for non irrigation use, staff recruitment, land acquisition, etc.

The technical tasks of the Irrigation Department are handled by the irrigation engineering staff that constitutes the "Technical Wing" of the department. The engineering staff are headed by one or more engineer-in-chiefs, who are supported by an engineering cadre of chief engineers, superintending engineers, executive engineers, deputy executive engineers, assistant executive engineers and junior engineers. The engineering cadre of the irrigation department mostly constitute of civil engineers along with some numbers of mechanical and electrical engineers. The engineering staff are supported in the field by a large force of technicians such as gate operators, surveyors, work charge staff, etc.

The Technical Wing of the Irrigation Department is itself usually divided into a number of divisions that perform specific technical tasks. These include:

- **Irrigation/Water Resources division** responsible for irrigation project planning, construction, operation and maintenance
- **Planning and Design division** responsible for preparation, approval of structural design of irrigation infrastructure, dam safety
- **Inter State Water division** responsible for representing the state is matters related to rivers that have basins shared by more than one state

- **Quality Control division** responsible for monitoring of quality of construction of irrigation infrastructure
- **CAD/PIM division** responsible for command area development works and promotion of participatory irrigation management
- **Minor Irrigation division** responsible for flow minor irrigation projects (minor irrigation tanks)
- **Groundwater division**, mostly staffed by hydro-geologists, responsible for monitoring and maintaining records of groundwater levels, availability and use
- **Commissioner of Tenders** responsible for issuing, scrutinizing, approving and sanctioning work tenders above a certain amount of money
- **Water and Land Management Institute (WALMI)** responsible for training of Irrigation Department staff, taking up research into emerging technical issues in irrigation and supporting PIM activities

In addition to these divisions, many State Irrigation Departments have established financially autonomous irrigation corporations that are meant to function as public sector corporations. The most common of these corporations are Lift Irrigation Corporations and Water Resources Corporations. While the former is usually to promote minor group lift irrigation projects the latter has usually been used by the States to pledge the irrigation assets to mobilize funds from the financial market.

The irrigation department in most state in India has a similar field structure. From the bottom up a group of Chaks (farm plots that receive irrigation water from the same pipe outlet) constitute a Section usually formed around a minor canal and under the charge of a junior engineer/assistant engineer. A few Sections combine to form a Sub-division around a distributary canal with a deputy engineer in charge. A group of sub-divisions combine to form a Division usually around a major canal and under the charge of an executive engineer. Finally 3 to 4 divisions together constitute an Irrigation Circle under a superintending engineer. Irrigation Circles are usually of two varieties – construction circles and O&M circles. Other than these there may be some circles with state wide jurisdiction such as quality circle. Above the irrigation circle usually a very large major irrigation project or a group of major irrigation projects is placed under the charge of a chief engineer.

5 Issues related to water resources development and irrigation in India

5.1 Overview

As in other parts of the world, whilst irrigation development has had a significant and positive impact on agricultural production and rural livelihoods, the opportunity for further development are diminishing as water resources grow scarcer, suitable sites for development dwindle and costs of development increase. It is now recognised that the major opportunity for sustaining and expanding agricultural production lie in vertical intensification rather than horizontal expansion. Not only must irrigated agriculture produce more for a growing population, there is also the imperative that it must be more efficient and productive with its water allocation, producing "more crop per drop", and releasing water for other uses and users.

The current situation in the water sector has been summed up in the introduction to Chapter 2 – Water Management and Irrigation in the 11th 5-Year Plan (Box 1), demonstrating the considerable concern felt at the highest level with the water resources and water management situation.

Box 1: Manifestations of the impending water crisis (11th 5-Year Plan, GoI)

"Sustainable development and efficient management of water is an increasingly complex challenge in India. Increasing population, growing urbanization, and rapid industrialization combined with the need for raising agricultural production generates competing claims for water. There is a growing perception of a sense of an impending water crisis in the country. Some manifestations of this crisis are:

- There is hardly any city which receives a 24-hour supply of drinking water.
- Many rural habitations which had been covered under the drinking water programme are now being reported as having slipped back with target dates for completion continuously pushed back. There are pockets where arsenic, nitrate, and fluoride in drinking water are posing a serious health hazard.
- In many parts, the groundwater table declines due to over-exploitation imposing an increasing financial burden on farmers who need to deepen their wells and replace their pump sets and on State Governments whose subsidy burden for electricity supplies rises.
- Many major and medium irrigation (MMI) projects seem to remain under execution forever as they slip from one plan to the other with enormous cost and time overruns.
- Owing to lack of maintenance, the capacity of the older systems seems to be going down.
- The gross irrigated area does not seem to be rising in a manner that it should be, given the investment in irrigation. The difference between potential created and area actually irrigated remains large. Unless we bridge the gap, significant increase in agricultural production will be difficult to realize.
- Floods are a recurring problem in many parts of the country. Degradation of catchment areas and loss of flood plains to urban development and agriculture have accentuated the intensity of floods.
- Water quality in our rivers and lakes is far from satisfactory. Water in most parts of rivers is not fit for bathing, let alone drinking. Untreated or partially treated sewage from towns and cities is being dumped into the rivers.
- Untreated or inadequately treated industrial effluents pollute water bodies and also contaminate groundwater.
- At the same time water conflicts are increasing. Apart from the traditional conflicts

about water rights between upper and lower riparians in a river, conflicts about quality of water, people's right for rainwater harvesting in a watershed against downstream users, industrial use of groundwater and its impact on water tables and between urban and rural users have emerged."

Source: 11th 5-Year Plan, Chapter 2 – Water Management and Irrigation, Government of India

Similar concerns were expressed at the Government of India (GoI) supported National Facilitation Workshop for Piloting Future Actions, held in Hyderabad from 28-30th January, 2010 (Box 2; see also www.apwaterreforms.in) where the need was identified to upgrade traditional institutional structures and institutions to address and manage emerging challenges posed by competing demands, water scarcity, climate change and environmental concerns. The workshop went on to identify objectives, priorities and a strategy for implementing change in water management, including reforms in the Irrigation Department, water fee charging and collection processes, transfer of management, operation and maintenance responsibilities to water users organizations, establishment of regulatory institutions, and modernization of management systems to incorporate modern technology (computers, remote sensing, GIS, communications, etc.)

Box 2: Drivers for reforming water management

Key Concerns of Irrigation

- Deteriorating condition of irrigation projects leading to decreasing Irrigation potential working at 35-45% efficiency
- Construction Costs Increasing and making new investment economically unviable / unaffordable (increasing from Rs. 8,620/ha in the period of the first five year plan to Rs. 29,587/ha in 1990-92 at constant price 1980-81)
- Increasing Operations and Maintenance costs emerging as major constraint often making the systems dysfunctional
- Mounting alternative claims on water resources – Maintaining balance between water for industry to power growth – water to raise food for the population and water for drinking
- Drinking water (2001) utilization at 601 mcm (about 0.90 % of the total water needs) is poised to register an increase of almost 581 % needing about 3,468 mcm by 2025 (representing 3.10 % of total water needs)
- The current need of water for industries at 288 mcm is projected to register an increase to 1445 (510%)
- Irrigation Service Delivery Machinery created in the era of copious per capita water availability is attempting to address issues related to water management in an era of decreasing per capita water availability
- Emerging demand for water rights, emerging water conflicts, issues for allowing privatisation, environmental impacts and civil society participation are challenging conventional irrigation governance
- Challenges by Climate Change - typified by unpredictable precipitation cycles, increasing incidence of floods and droughts and changed weather conditions demanding respective changes in agricultural seasons and approaches

Source: National Facilitation Workshop for Piloting Future Actions, Ministry of Water Resources, Government of India, Hyderabad, 28-30 January, 2010

The workshop recognized the experience gained from other countries that have progressed through similar water resources development situations, and the need to learn from these experiences where the pressure on land and water for agriculture is one of the main drivers forcing change in the water resources sector.

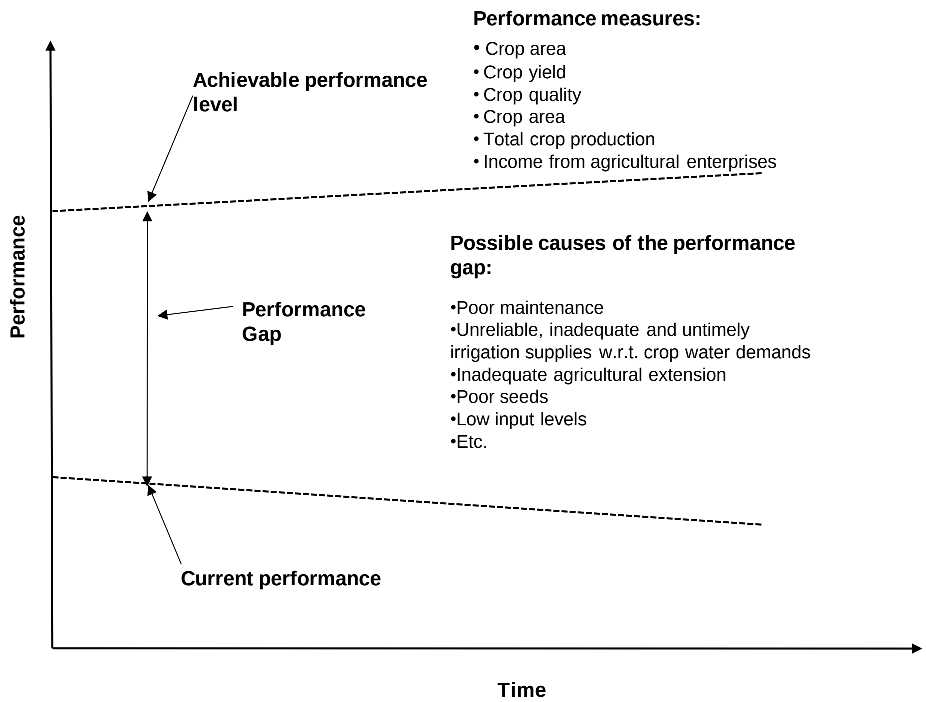
5.2 Issues with management in the I&D sector

The main issues facing the irrigation sector and Irrigation Departments in particular include:

- A focus on construction rather than management of existing I&D systems;
- A top-down, sometimes patronising, attitude to farmers;
- An organisation staffed almost predominantly with civil engineers, with little appreciation of agriculture and agricultural needs;
- Outdated and resource-costly procedures for setting and collection of water charges;
- Outdated processes and procedures for I&D system management, operation and maintenance, including a failure to appreciate the significant potential for conjunctive use of surface and groundwater for increased agricultural production.
- Deteriorating irrigation infrastructure due to lack of regular O&M leading to low water use efficiency and incomes to farmers;
- Low priority to command area development activities such as on farm development activities, water application in fields, farmers training in improved irrigation practices, etc.

There is currently a gap between the actual and potential performance of I&D systems in many parts of India (Figure 6). In some cases, due to a failure to adapt to changing needs, current performance is declining and the performance gap widening. The causes of this performance gap are many and varied, including poor maintenance of I&D systems and unreliable water delivery, but also poor agricultural practices, seed varieties, lack of soil nutrients, etc.

Figure 6: Identifying the performance gap in irrigated agriculture



In looking at the issues around this performance gap the World Bank funded Sustainable Development of Water Users Associations (SDWUAs) study in 2010 identified some of the factors and organised them into a “problem tree”, as shown in Figure 7.

The problem trees covers a range of issues identified in the I&D sector, ranging from irrigation technology employed at the field level by farmers to policy issues within the Irrigation Department. The issues are discussed in the sections below.

Figure 7: Management, operation and maintenance problem tree (Part I: System focused)

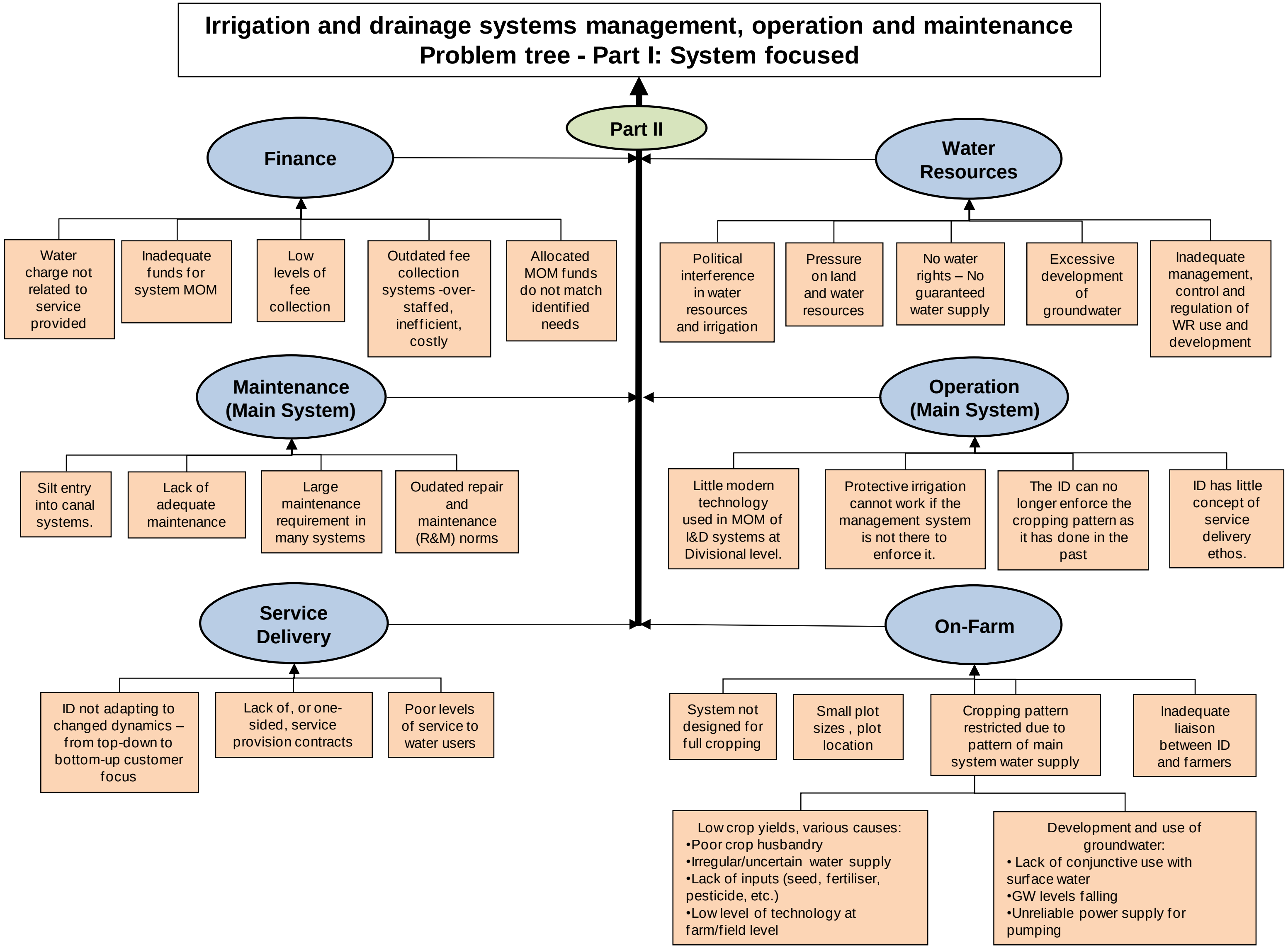
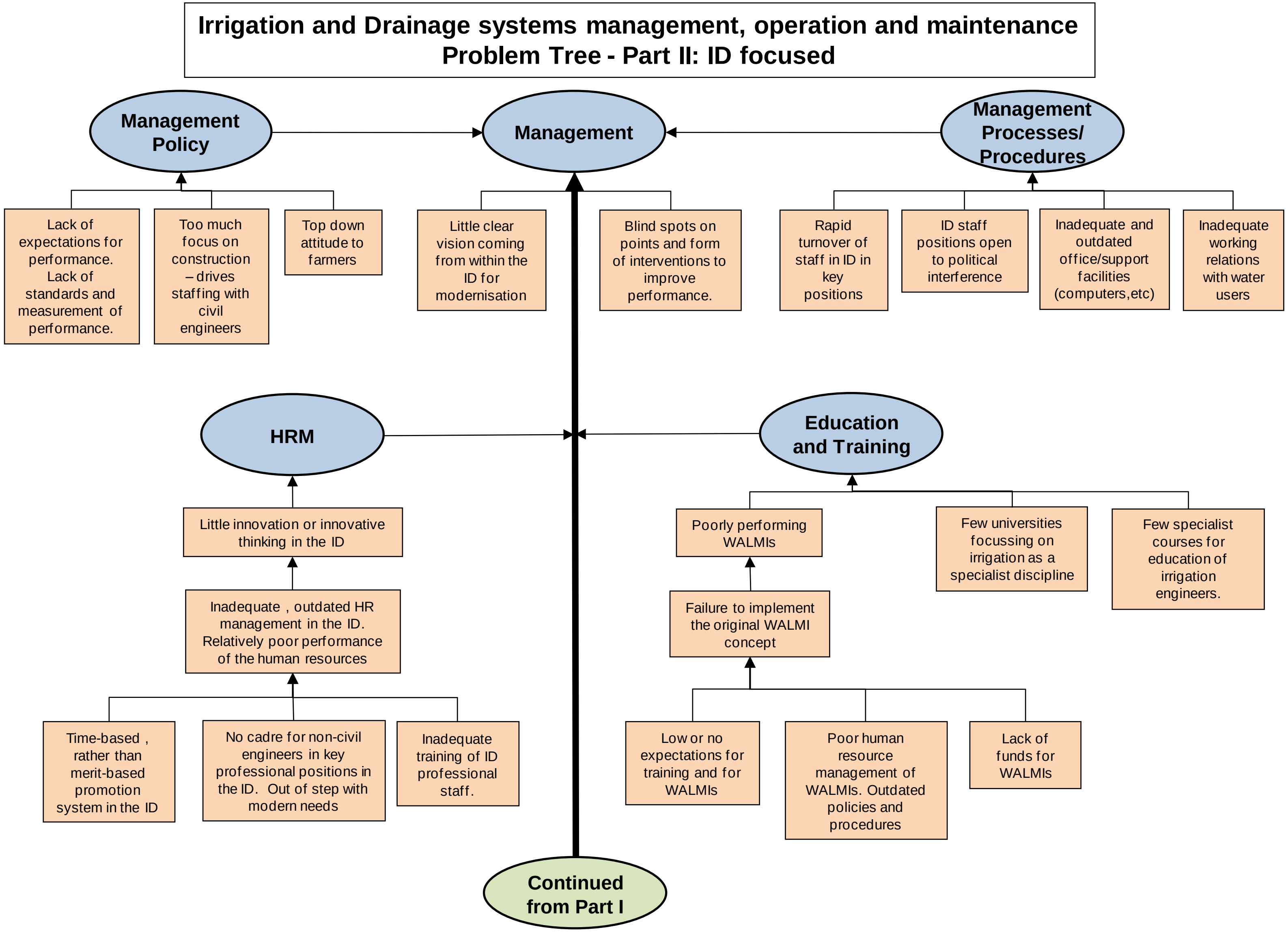


Figure 7 (cont.): Management, operation and maintenance problem tree (Part II: ID focused)



5.2.1 On-farm

There are a number of issues at the on-farm level. The main issues include:

- Small size of a farmer's landholdings, often not contiguous;
- Location within the minor canal command can be an issue, with tailend landholdings suffering less reliable, timely and adequate water supply;
- Systems not designed for 100% cropping in the Rabi season with the result that headenders are tempted to crop more land than design, thus depriving tailend farmers of water;
- ID sanction water supplies based on original design cropping patterns, not based on demands from farmers;
- Little or no conjunctive planning and management by the ID of surface and groundwater resources;
- Inadequate liaison and agreement between the ID and farmers on irrigation management issues;
- Insufficient uptake by farmers of modern technologies for improving irrigation management and water use efficiency and productivity.

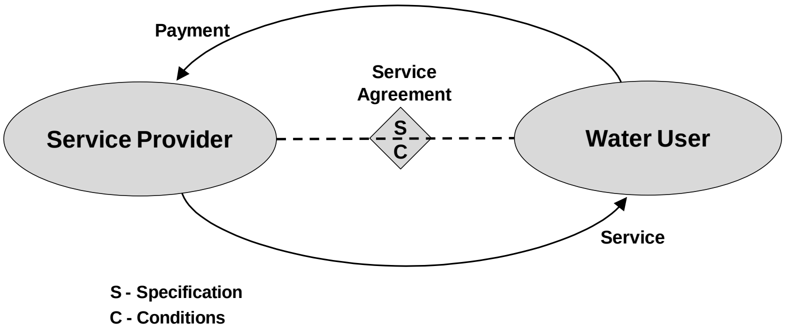
Possible approaches to addressing some of these issues include:

- Allocation of annual and seasonal volumetric water allocations (based on a defined water entitlement) to WUAs, as is the case in Maharashtra;
- Change of attitude of the ID managers such that they work in partnership with WUAs and water users to enhance the performance of the ID scheme as a whole;
- Diversifying the staff composition of irrigation department from only engineers to multi-disciplinary expertise covering institutional development, agricultural engineering and extension, performance and impact monitoring, data and information management, etc.
- Appreciation by the ID managers of the important role of groundwater and the need to use surface and groundwater conjunctively;
- By improving the working relationship between the ID and the WUAs the main system supply would become more suited to the farmers' needs (more reliable, timely and adequate), enabling the farmers to feel more secure in investments in modern technologies.

5.2.2 Service delivery

Service delivery is in two parts. The first part is in the supply of water by the ID from the main system to the water users (WUAs), the second part is in the supply of water by the WUAs to the individual water users. The basic principles of service delivery are summarised in Figure 8. The water user is provided with a service by the service provider, for which they pay a service fee. The terms of the service delivery and payment are defined in the Service Agreement, which provides the specification of the service to be provided and the conditions under which the service is to be provided and paid for. The basic philosophy is that the service provider has a service for which the user is prepared to pay. In an ideal market the level of payment reflects the quality of service provided. In the irrigation sector this is shown by the willingness of water users to invest in tubewells where the irrigation water supply can be more reliable, timely and adequate than surface water supplies[24].

Figure 8: Core elements of service delivery



A major failing in the irrigation sector is the failure of the ID to update and enforce its service agreement with water users. Whilst in the past there may not have been a written service agreement between water users and the ID[25], the design parameters of each system defined the service to be delivered, and the water charge the payment to be made. Due to a number of reasons, including lack of enforcement and corruption, this service agreement has been breached on both sides – by water users in upper reaches cropping more than their design share of their landholdings and accordingly taking more water, and by the ID in failing to protect the interests of the tailenders by enforcing the design water allocations to headenders.

A further failing in the current service provision context is the failure to utilize the collected fee payments on the system on which these payments were collected. In most states the fees are collected by the Revenue Department and paid into the central exchequer. The funds allocated to a given system are not linked to the revenue collected from that system, farmers see little difference in service delivery between paying the water charges or not. The importance of the linkage is shown by the case of AP, where once the "flowback" to WUAs was related to the actual water charges collected from that WUA, the fee collection rate rose dramatically. Even in AP though the pathway linking the water charge paid and the service provided is far too long and torturous (Figure 9). The transaction costs involved in collecting and utilizing the water charge are excessive.

[24] Though the market mechanism is disrupted in States where farmers are given free electricity for pumping.

[25] The Irrigation Act has provision for service contracts between the ID and water users, and in some locations these do exist.

Figure 9: Linkages between water charges paid and service delivered in Andhra Pradesh

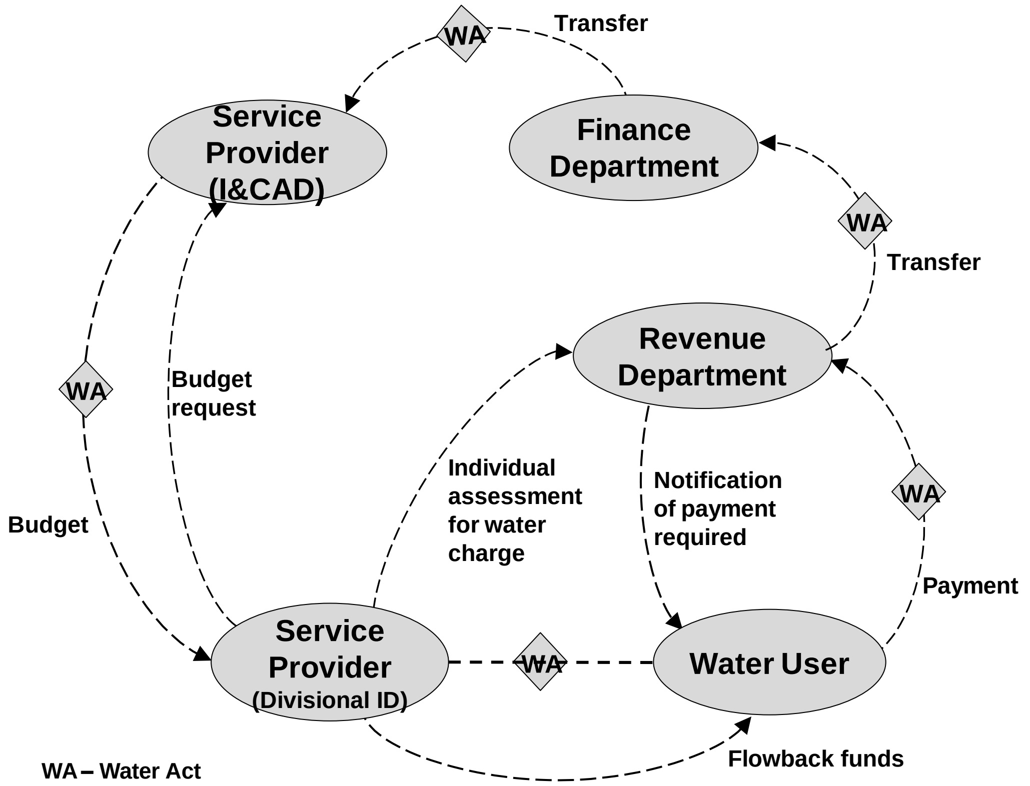


Table 5 shows the impact of allowing the collected water charges collected from WUAs to be used on their systems. The flowback approach was first proposed in 2003/4 and initiated in 2006/7 when Rs 300 million was repaid to WUAs to use for maintenance work on their systems. After this the flowback was 100 percent of the money collected, with concomitant rises in the amounts and percentages collected.

Table 5: Water tax demand and collection in Andhra Pradesh, 2001-2010

Year	Demand (in Rs. Million)	Collection (in Rs. Million)	Percentage Collection
2001-02	2924.1	580.6	19.9 %
2002-03	3357.8	895.6	26.7 %
2003-04	3310.4	345.7	10.4 %
2004-05	3263.5	566.0	17.3 %
2005-06	3534.2	834.0	23.6 %
2006-07	3609.8	554.9	15.4 %
2007-08	3901.2	1259.8	32.3 %
2008-09	3746.2	1150.0	30.7 %
2009-10	3780.2	4750.0	125.7 %*

* *Including arrears*
Source: Revenue Department, GoAP

There are significant opportunities for increasing agricultural production, water use efficiency and productivity of water if the ID can adopt a service delivery culture. At present the service delivery culture is not strong, it is very top-down, based too much on the cropping patterns and water allocations detailed in the original project designs, rather than evaluating the current cropping patterns, farmers' demands and taking account of the potential for conjunctive use of surface and groundwater. Effective procedures for high levels of service delivery based on liaison, dialogue, participation, agreement and partnership with water users have yet to be developed in most States.

Service delivery between the WUA and individual water users is also generally poor at present. This is not surprising given that many WUAs do not have paid staff and thus do not have effective mechanisms for delivery of system operation and maintenance services. This is a major area to focus on in the re-engagement of water users associations.

Possible measures to address these service delivery issues include:

- Introduction of a service culture within the ID;
- Provision of service agreements between the ID and water users on each I&D system;
- Create a direct link between the service fee paid and the service provided by allowing WUAs to set and collect the service fee. A portion of the service fee to cover the costs of running the main system will be set by the ID, charged as part of the WUA service fee and paid to the ID by the WUA. All money collected by the ID for a given system will only be used on that system, with details provided to WUAs of how the money collected has been used;
- Develop the concept of water users and the ID working in *partnership* to improve the performance of the system;

If the ID is unable to develop a service culture and work in partnership with water users then consideration could be given to the introduction of private sector partners to manage the main system water supply. In some countries, such as Mexico, Turkey, Australia and the Western USA, water users have taken over the management of the main system from the government irrigation agency. In other countries, such as France, long-term franchises have been let for the management of the main system (see Appendix A2 in Working Paper No.6 – Water Resources Management for more detail).

5.2.3 Operation (main system)

There is a desperate need to modernise the water delivery service provided by the Irrigation Department. This relates both to the attitudes and capabilities of the professional staff within the ID, and the technology employed to manage, operate and maintain the I&D systems. Issues here include:

- Failure of the ID to operate irrigation systems taking account of opportunities offered by conjunctive use of surface and groundwater resources;
- Lack of knowledge and understanding amongst ID managers of crop and irrigation water management at the farm level;
- Little use of modern technology for water management – computers, scheduling programs, remote sensing, GIS, MIS, etc.;
- No assessment of ID managers based on the performance of the irrigation systems that they manage. No culture of performance management within the ID for system operation;
- Adherence to outdated cropping patterns and irrigation water demands;
- Inadequate discharge measurement in many systems, thus not allowing for volumetric delivery of water.

Possible options for addressing some of these issues include:

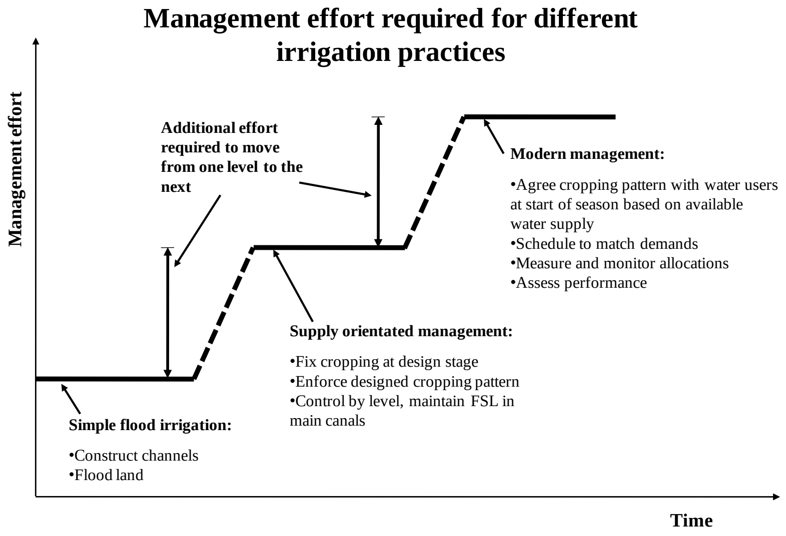
- Rewrite the rules for operation of the main system in order to take account of the conjunctive use of surface and groundwater. This would involve the ID employing groundwater hydrologists, and working with water users to understand how and when they use groundwater;

- Introduce a system for charging for groundwater where agreement is reached between water users and the ID to adopt a scheduling programme based on conjunctive use[26];
- ID to recruit young graduates experienced in use of modern applications, such as computers, GIS, remote sensing, MIS and the like and equip the ID with these modern resources and applications. Assist older staff by running training courses related to these applications.
- Introduce a system of performance management at scheme level, whereby the ID system manager would be held accountable for assisting in improving the performance of the irrigation scheme. While it is recognised that the ID manager's area of responsibility at present is limited to the operation of the main system, there are significant opportunities for him to work with water users to enhance the output and water productivity of the scheme (e.g. by adopting an operational schedule for conjunctive use of surface and groundwater);
- Introduce the concept and calculation of benchmarking, water audit, opportunity cost and benefits lost in poor operation and maintenance of irrigation systems and use it to improve future planning of operations and if possible also in assessing the performance of the managers;
- Significantly upgrade the ability to measure, record and utilise discharges in canals in order to be able to deliver measured volumes of water at key delivery points (such as to intake structures to WUA command areas). Appendix A2 provides information on the procedures followed in Kyrgyzstan where water deliveries are measured and WUAs billed based on the volume of water delivered during the irrigation season.

Improvement in the operation of the main system and the scheduling of irrigation water to WUAs and water users can have a significant impact on the agricultural output from the scheme, and the efficiency and productivity of irrigation water. However it will require a significant increase in the management effort if the ID is to move from the current level of supply-orientated management to a more modern demand-orientated management (Figure 10). Other countries have had to move to this level in order to address the demands of the farming community and the pressures on their water resources. Several States in India are now also at this stage.

[26] However, if groundwater is charged in the command area similar charges may have to be applied to groundwater irrigators in the non-command area. Charging one and not the other will be administratively and politically difficult for governments to implement.

Figure 10: Increased management effort required over time to cope with increasing demands in the irrigation sector



As noted above the ability to measure discharges is a central component of volumetric pricing of water. The process is not, unfortunately, that straightforward. Standard structures need to be installed at the key measurement points, and properly maintained. A process of data collection, processing and analysis then needs to be established, with daily readings of discharge being taken by ID staff. At the intake to the WUA command area the daily discharge measurement readings need to be taken jointly by the ID staff and a WUA representative. Invoicing for the water received can be carried out monthly, or seasonally. Appendix A3 outlines the process followed in Kyrgyzstan were WUAs are charged for the volume of water supplied.

5.2.4 Maintenance (main system)

Lack of adequate maintenance of I&D systems not only results in a loss of agricultural production, it also results in social injustice as farmers at the tailend of irrigation systems fail to get timely and adequate water supplies, and those in low lying localities suffer from waterlogging and salinisation due to lack of adequate drainage.

Issues related to main system maintenance include:

- Lack of adequate funds for system maintenance;
- Lack of transparency and accountability related to the implementation of maintenance work and use of maintenance funds;
- Inadequate quantification of maintenance needs and required maintenance budget on a system-by-system basis;
- Little or no use of modern approaches for infrastructure maintenance, such as asset management planning, computerised inventories of infrastructure condition and performance, etc.;
- No direct link between water charges collected from a system and maintenance expenditure on that system;
- Use of generalised norms for calculating maintenance budgets rather than system-by-system assessment of needs;

- No link between budget allocated for maintenance of I&D systems and their actual needs (top-down rather than bottom-up budgeting);
- Delay or untimely release of funds to the irrigation department and field engineers leading to maintenance works missing the canal closer period.

A further issue is that there appears to be no effort to link system condition with agricultural production, or to determine the lost production arising as a result of poor or inadequate maintenance. As shown in Figure 11 a new irrigation system may enjoy a period of stability and growth in productivity following completion. However, if adequate maintenance is not carried out the system deteriorates over time and the productivity declines (irrigation supplies become unreliable, untimely and inadequate and parts of the system may receive no water at all). Unless the decline is halted by an increase in maintenance funding, or rehabilitation, the system will eventually return to the original rainfed levels of production.

Thus a system may experience a decline in average productivity equivalent to US$ 50/ha/year followed by rehabilitation at some stage at a cost of between US$ 500-1000/ha. The lost production over several years, plus the cost of rehabilitation, is substantial in relation to an annual incremental maintenance outlay in the region of US$ 10-20/ha/year to adequately maintain and sustain the system.

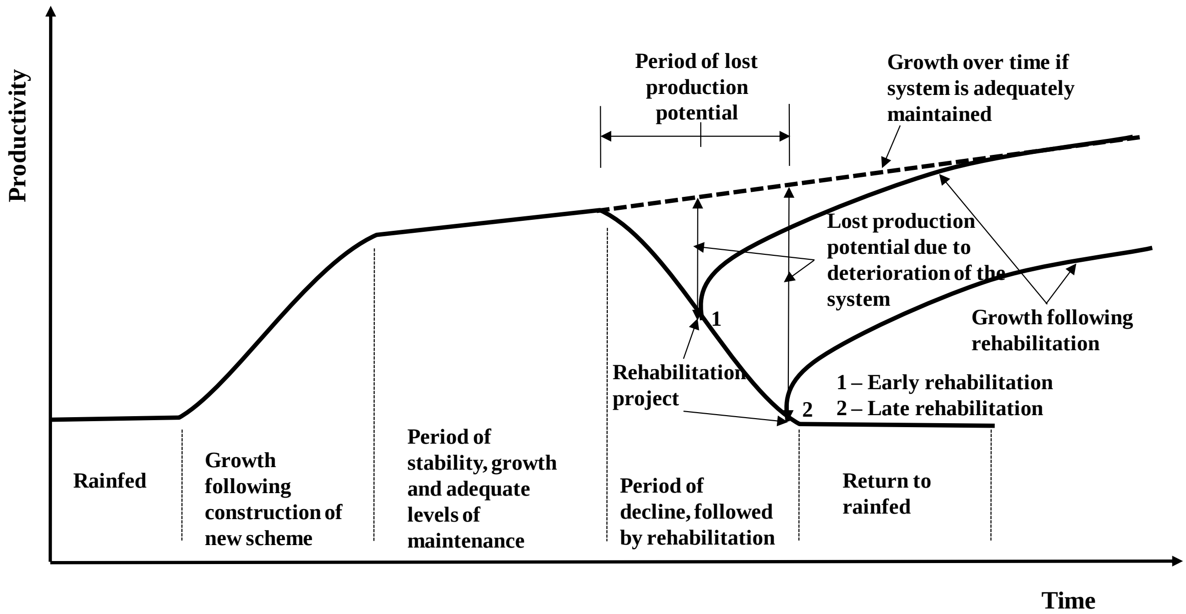
A study by Skutsch (1998) from HR Wallingford using data from India and Indonesia found that over a period of time with adequate maintenance the incremental net present value (NPV) arising from production that would otherwise have been lost was in the range US$470-1000 depending on the cropping pattern and scheme. The equivalent annual incremental benefits were US$50-100/ha, several times in excess of the incremental annual costs of US$6.5-14/ha required to move from poor to adequate levels of maintenance[27].

In all the cases examined the cost of expenditure on adequate levels of maintenance over a 30 year period was less than the combined costs of low expenditure on maintenance and the cost of rehabilitation (which is required at some stage if maintenance is not sufficient). On a 20,000 ha scheme the total discounted savings between Scenario 1 - Adequate maintenance, no rehabilitation and Scenario 2 - Low maintenance with rehabilitation was in the range US$1million to US$4 million depending on the location of the scheme.

Skutsch concluded that good maintenance was technically and economically justified and recommended that governments review their maintenance budgets, processes and procedures to avoid the (uneconomic) Build-Neglect-Rebuild scenario that is all too common in the I&D sector.

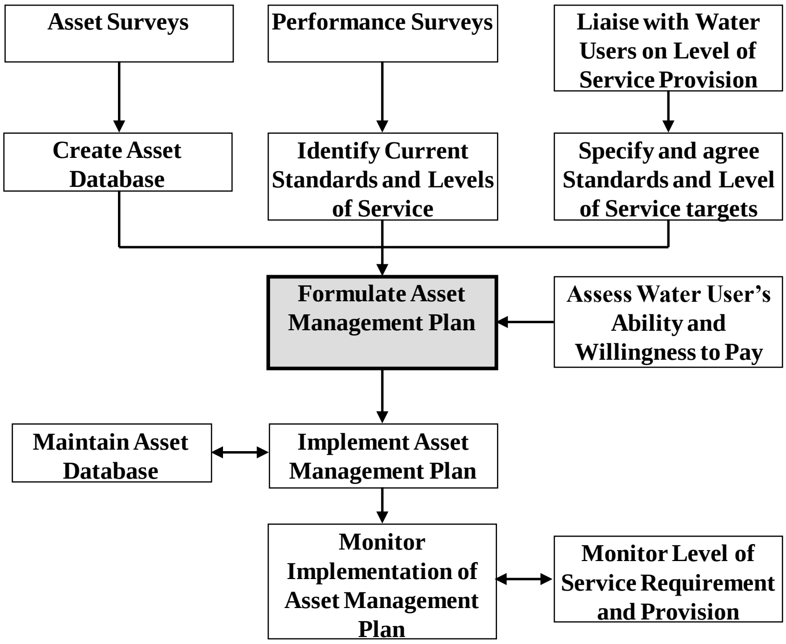
[27] The figures of US$50-100/ha already take account of the US$13.5-23/ha costs for adequate maintenance. The poor levels of maintenance expenditure were in the range US$6-9/ha, giving an incremental cost of US$6.5-14/ha.

Figure 11: Lost production resulting from deterioration of the irrigation system due to lack of adequate maintenance



Asset management planning (Figure 12) is an approach which is increasingly being used to address the issues of deterioration of physical infrastructure. The approach bring together several key elements in sustaining I&D infrastructure: (i) assessment of the condition of the physical infrastructure; (ii) assessment of the performance of the system; (iii) discussion and agreement with users on standards and levels of service required; (iv) assessment of the users' ability and willingness to pay for the desired level of service; (v) determination of the short to long-term maintenance, repair and replacement needs, costs and income stream; and (vi) long-term monitoring of implementation of the asset management plan, the condition and performance of the infrastructure.

Figure 12: Framework for asset management planning



An outline of the processes and procedures involved in asset management planning is provided in Appendix A1. It is important to note that the process can be used by the Irrigation Department to quantify and define the maintenance, repair and replacement needs and costs over time (20-25 years, broken down into 5 year segments) of the main system infrastructure, as well as by WUAs to establish their maintenance, repair and replacement costs and income stream over time (generally a shorter period of 5-10 years). A further important element is that the process is intended to be participatory in nature, with the ID carrying out joint inspections of the main system with WUA personnel and jointly agreeing the work that is required. It is worth noting that these joint inspections are only carried out every 3-5 years depending on the situation, in between the ID would monitor the implementation of the agreed plan over the intervening period.

With the ID and WUAs jointly identifying the maintenance, repair and replacement needs and agreeing the costs over time there is a far greater likelihood that water users will be prepared to increase the fee levels to cover the agreed costs as they can: (i) see what they are paying for; (ii) monitor what is being spent; and (iii) monitor the level of service provided and the performance of the system for which they are paying.

Thus possible approaches to address the issues outlined above include:

- Adoption of more transparent and accountable systems for assessing maintenance and repair requirements over time using asset management planning;
- Use of the asset management planning process to make the maintenance, repair and capital replacement costs over time more open and transparent to water users, resulting in increased levels of service fee payment;
- Quantification of the real costs of failing to maintain I&D systems through commissioned studies. A form of this quantification is often carried out when a system is being considered for rehabilitation in that the cost of the investment required to rehabilitated the deteriorated system is measured against the anticipated

benefit from increased agricultural production (often in the form of increased irrigated area and increased yields). It is an anomaly that similar calculations are not carried out to assess the cost of not adequately maintaining the I&D system (reduced yields, areas lost to production, social inequity between head and tailenders) compared to the cost of adequate maintenance. It is likely that the cost of adequate maintenance would be significantly less than the value of the lost production;

5.2.5 Finance

Lack of adequate finance for the MOM of the I&D system is one of the root causes of poor performance of I&D systems in India. It is a vicious circle, lack of adequate funds for maintenance results in poor delivery of irrigation water (and removal of excess water) which in turn results in reduced crop yields, reduced farmer incomes and a reduced ability and willingness to pay water charges.

Farmers' financial contribution is linked to the *ability* to pay the water charge or service fee and also to their *willingness* to pay. The ability to pay is governed by their income from their landholdings; the willingness to pay is governed by the quality of the service they receive. That farmers are prepared to pay for a better level of service is shown by the many thousands of farmers who invest in digging and equipping boreholes to pump water for their crops. In some States the pump operating costs are minimal as the State provides free (but not always reliable) electricity, in other locations farmers are willing to pay the operating costs (electricity or diesel fuel) for groundwater as they get an assured return on their cropping.

Issues related to finance include:

- Allocation of funds for system MOM are decided at the State level and then disbursed amongst the I&D systems. This system is top-down and limited by the budget available, it does not relate to the true needs of each system on the ground;
- Funds allocated at the State level for I&D system MOM are inadequate. Funding needs to be some 2-3 times higher if the systems are to be adequately maintained;
- Out-dated labour intensive method for assessing the water charges based on measuring the cropped areas;
- Though the water charge is assessed on the crop grown the farmer may not receive sufficient irrigations for that crop;
- As mentioned above there is often no link between the water charges paid and the service provided by the ID. This significantly affects the water users willingness to pay the water charges;

Possible options for resolution of the financial issues include:

- Establish service fees for individual systems using asset management planning procedures;
- Reduce the transaction costs of collecting the water charges and increase the collection rates by transferring the responsibility for setting and collecting the service fee to WUAs. <u>As part of this process change the terminology from water charge (or tax) to irrigation service fee</u>;
- Get the water users to pay more or look after more parts of the system. In Mexico the process of transferring I&D systems to management by water users was prompted by a financial crisis in government. Government relieved themselves of the financial responsibility for the I&D systems through an extensive irrigation management

transfer (IMT) programme. In India a participatory irrigation management approach has been adopted, rather than IMT. Consideration should be given to transfer of some irrigation systems, or parts thereof, to water users under an IMT programme;

- As mentioned above WUAs should be permitted to assess their MOM needs and costs, set and then collect the service fee. The ID should use asset management planning techniques to assess the service fee for the main system and charge the WUA for bulk water delivery. This would (a) relieve the ID of the need to measure land areas within the WUA commands, and (b) encourage WUAs and water users to quantify water use and seek to conserve water through more efficient water management practices. The ID can obtain information on the crop area within a WUA command area from the WUAs when they submit their seasonal water request, and can use remote sensing to check these data, or carry out sampling surveys within WUA command areas;

- If WUAs are given the right to assess, set and collect the service fee they can then choose from a number of approaches to charge water users. Table 6 shows different methods used worldwide for charging the service fee. Charging for each watering has significant benefit, especially if the water user is required to pay up front. This approach is proving quite successful in Kyrgyzstan in reducing the time spent by the WUA in collecting the service fees due by the end of the season.

Table 6: Possible options for charging irrigation service fee

Method	Description	For	Against
Volumetric.	Charge per unit of water delivered. Unit generally defined as 1000 m^3.	• Theoretically sound. • In theory able to match supply with demand. • Pay for what you get principle.	• Requires measuring structures and daily measurement by field staff. • Potential for argument over figures if not measured jointly by ID and water user. • High transaction costs involved in measuring, recording and processing daily discharges. • Open to abuse through mis-recording of discharges.
Area based	Charge based on size of landholding owned or irrigated.	• Easy to understand and simple to implement. • Easy to measure and record. • Low transaction costs. • Open and transparent, easily verifiable.	• Doesn't measure/assess the quantity of water delivered/used. • Not applicable if different crop varieties are grown with different irrigation demands.
Crop type and area basis	Charge per unit area of each crop type. Charge varied per crop based on the crop's irrigation water needs.	• Proxy for measuring volume of water delivered. • Theoretically correct if charges are related to crop water requirements. • Relatively easy for water users to understand • Can be verified using remote sensing.	• High transaction costs involved in measuring crop areas and types. • Open to abuse through mis-recording of crop type and area.
Duration of irrigation	Charge per unit of time the user takes water.	• Easy to understand and relatively simple to implement. • If water is allocated through a rotation plan then system is self-policing by water users.	• Moderate transaction costs, requires WUA to employ field staff, this would be one of their main duties. • Potentially open to abuse and mis-recording.
Each watering	Charge for each irrigation.	• Easy to understand and simple to implement. • Relates crop water use to water supplied and charge made. • Relatively straightforward for the WUA to measure and verify.	• Moderate transaction costs, requires WUA to employ field staff, this would be one of their main duties. • Potentially open to abuse and mis-recording

5.2.6 Water resources management

This topic is discussed in more detail in Working Paper No. 6 – Water Resources Management.

There are a wide variety of water environments in India, from the arid north-west to the humid tropics in the north-east. Rainfall varies widely across the country, with the rainfall pattern and amount being key determinants in how irrigation and drainage systems are operated.

The main issue in relation to water resources management in India is that there is no one body responsible either at national or at state level for the management and regulation of the water resource. As a consequence there is a significant lack of coordination in relation to abstraction and utilization of water resources, whether it be for rainwater harvesting, irrigation, hydropower, water supply and sanitation or the environment.

Other issues include:

- Significant political interference in how water resources are allocated and used;
- Growing pressure on the available water resources;
- Except in Maharashtra no water rights or entitlement to water, allowing upstream late entrants to appropriate water from established water users downstream;
- Excessive mining of groundwater (this is a symptom of a failure to manage water resources in general);
- Lack of focus on quality of water resources despite plethora of legal and statutory provisions that remain mostly unimplemented. This limits the possibility of reuse of wastewater, especially municipal wastewater in agriculture.

There are two main proposals for dealing with the issues related to water resources management, the need to create one agency in each State responsible for the management of water resources, and the need to establish water rights.

At present there is no single organisation which has responsibility for the planning and management of water resources development. The Irrigation Department (or Water Resources Department, WRD in some States) has been focussed mainly on the development of water resources for irrigation, the Power Department and Generation Companies for development of hydropower, the Rural Development Department for watershed development, Rural Drinking Water Department for rural drinking water, urban municipalities for urban drinking water, Pollution Control Board for water quality, etc. It is difficult to see how with the increasing competition for water it is going to be possible to coordinate the demands of these different organisations, hence the need for a single organisation which will be responsible for the planning, management, licensing, regulation and monitoring of water resources, both surface and groundwater. It is appreciated that this will not be an easy task.

Allied to this is the need to provide water users with some security on their access to, and use of, water through a system of water rights. This will apply to municipalities for domestic water supplies, industry, power generation, irrigation, navigation and the environment, amongst others. Establishing a system of water rights is fundamental to providing water users with a measurable level of security in order that they can plan and make investments. Steps have been taken towards this objective with the World Bank funded Water Sector Restructuring Projects, and have to date been most effective in Maharashtra where the

Maharashtra Water Resources Regulatory Authority (MWRRA) has been created and is creating entitlements to water. There are, however, some issues with this process, a key one being the limited staff and resources available to the MWRRA to carry out this work (see Working Paper 7 on the role of the Water Regulator.

5.2.7 Human resource development

The performance of the Irrigation Department and its ability to provide a good level of service to water users is heavily dependent on the professional workforce. Unfortunately the human resources management capability in the Department is weak and outdated. In many cases the HRM unit within the ID is not staffed by professional human resource managers, and its role is seen more as administrative rather than managerial[28].

Though management, operation and maintenance of I&D systems is now the key function of the ID there are a disappointingly low number of ID staff trained in system MOM, the focus of the organisations remains on construction. WALMIs, which were established for the explicit purpose of training civil engineers about irrigation and irrigated agriculture, are poorly supported by the Department.

The promotion system in the ID is outdated, being based more on time spent in the organization rather than on demonstrated ability. The current system limits innovation and does not allow able younger professionals to progress through the system. By the time the more able staff reach the top echelons they are nearing retirement. In many organisations development and growth of the organisation is stimulated and driven by younger personnel with the energy, ambition and motivation to innovate and modernise processes and procedures. This is not the case in the Irrigation Department.

Lack of promotion opportunities is another issue plaguing the ID. There are a number of staff who enter at the assistant engineer level and retire at the deputy executive engineer level, i.e. only 2 promotions in their entire service period. In a recent study of the Orissa WRD showed that on average an assistant engineer took 20 years to become an assistant executive engineer. The other problem that this creates is that due to annual increment in salary staff with long service in position of a DEE start receiving salary of the EE level, which makes them stop wanting to take up the tasks of the DEE.

Proposals to improve the human resource management issue within the ID include:

- Recognise that appropriate and timely training must be at the heart of a modern organization, and should be one of the key mechanisms through which the organization functions and grows;
- Reviewing and updating the promotion system, with the current rigid time-based promotion being supplemented by a system which recognizes and rewards professionalism, motivation, innovation and hard work, allowing the more capable staff to rise more quickly through the organization to senior positions. Having younger personnel in senior positions[29] will facilitate adaptation to changing demands, and will be one of the central measures for ensuring that the organization remains abreast of these changing demands;

[28] Internationally in large professional organisations such as the ID human resource management is seen as central to the functioning and performance of the organisation, and is staffed and resourced accordingly.

[29] The ID will need to resolve the current issue where the CAT does not permit younger personnel to be appointed over older personnel.

- Recruit professional HRM and training personnel (not civil engineers) into senior positions in the ID HRM units;
- Carry out a comprehensive analysis of the current and future multidisciplinary human resource needs of the ID, and prepare a human resource development plan that identifies these needs and details the staffing and training requirements to meet them. The Plan would detail the staffing number and disciplines required within the organization.
- Reorganise HRM and training procedures to match current needs, including the use of modern technology and applications such as computers, remote sensing, GIS, MIS, etc.
- Provide adequate funds and resources for training;
- Ensure training is carried out by professional trainers, with training outcomes specified for each course, and training provided for individual staff members in according with an agreed training plan for that individual.
- Encourage progressive thinkers and possible change agents from within the Department who can champion the change processes required for the ID to adapt to meet current and future needs.

5.2.8 Education and training

WALMIs were established in the 1980s to provide ID staff with training in water and land management. The concept is right, though unfortunately the implementation of the concept has been relatively poor. At the heart of the problem is very poor human resources management by the ID, with inappropriate staff being posted by the ID to work in WALMIs. WALMIs are now often seen as a punishment or pre-retirement posting, rather than an exciting opportunity to bring knowledge and understanding to the ID workforce in order to improve the performance of irrigation systems and irrigated agriculture in general.

In some cases there are a small dedicated team of training professionals in the WALMIs, but they are in the minority. Without experienced, skilled and motivated trainers WALMIs cannot function effectively. They may give training courses but the training impact is often minimal.

Two other key issues affecting WALMIs include lack of adequate funds, and low (or no) expectations from senior ID management for staff development and the increase of knowledge and understanding on water and land management issues. Again the focus appears to be on construction, rather than MOM.

It is surprising that India, with one of the largest irrigated areas in the world, has relatively few water management professionals . There appear to be few university courses specialising in irrigation engineering and management, and few opportunities within the ID for employing graduates from such courses. The majority of professional staff with the ID is civil engineers, who will have had some exposure to irrigation as part of their civil engineering degree[30]. Few of these civil engineers who have joined the ID have had any post-graduate education in irrigation and drainage engineering and management.

Another problem besetting training in the Irrigation Department is the attitude of the staff towards it. Training is usually considered as unnecessary nuisance and an excuse for the field staff to spend time in the headquarters to follow up on pending personal/administrative work.

[30] This may be one module amongst forty on a typical civil engineering course.

Junior staff are usually not released from duty by their reporting authorities to attend training sessions and senior engineers find the facilities available at the WALMI below their standard. This often results in WALMI's either running courses with few trainees attending it or cancelling it totally due to lack of attendance.

Possible measures to address issues related to education and training includes:

- Changing the policies and procedures for appointing staff to WALMIs. WALMIs need to be able to hire and fire their own staff, independently of the ID. This will enable WALMIs to appoint and retain professional trainers and specialists;
- WALMIs need to given flexibility in faculty structure and expertise to effectively service the training needs of the Irrigation Department. This should include permission to invite guest faculty members and hire professional resource persons from outside;
- WALMI staff should be provided with incentives to take up research and learning in new technical and institutional approaches and methods in irrigation management through establishment of a good information and knowledge centre, permission to bid for or avail grants for irrigation management research and formulate a human resource development programme for its faculty members;
- In the short term WALMIs will need to be supported with funds and resources (including possibly advice from international specialists) to train staff and to develop suitable training courses for the ID;
- WALMIs need to be contracted and paid to run courses for the ID on the basis of identified training needs. The WALMIs should be contracted to carry out a training needs assessment in the irrigation sector and submit a report to the ID with findings and proposals which will form the training plan for the next 3-4 years. This training plan will detail the types of training required, for whom and at what cost. The outcome and impact of the training will be independently assessed, and if the WALMIs are not performing then the contract may be terminated;
- WALMIs should decentralise and establish training centres at District level with associated demonstration sites for farmer and WUA training;
- If WALMIs are to be involved in training related to PIM and the formation and support of WUAs they need to significantly increase their understanding, knowledge and capabilities in this area of work;
- WALMIs should adopt training approaches and methods other than classroom teaching. This could include short action research programmes, learning while doing practical courses, exposure visits, visual based and web based training, etc;
- WALMIs should link up with other organisations, including universities, training institutes, research institutes and NGOs in order to bring together parties with specialist skills (e.g. link with a university to teach remote sensing);

5.2.9 ID Management, policy, processes and procedures.

As mentioned previously the main problem with the ID is that it continues to be focussed on the design and construction of new I&D systems rather than on the efficient and productive management of built systems. This policy and attitude pervades the organisation, and little improvement in performance of existing schemes can be expected until this policy and attitude are changed.

Table 7 shows the total cultivable area in the States together with the estimated maximum potential area that could be developed for irrigation together with the area already developed and the area currently irrigated annually. As can be seen from the table 15 of the 28 states, including several major states such as Bihar, Chattisgarh, Gujarat, Haryana, Maharashtra, Tamil Nadu, and West Bengal, have developed over 60 percent of their estimated ultimate irrigation potential area. Some other major states, such as Kerala, Punjab, Rajasthan and Uttar Pradesh have in fact exceeded the estimated ultimate irrigation potential area. In 9 out of the 28 states the area remaining to be developed is less than 20 percent, with Jharkhand, Kerala, Punjab, Rajasthan, and Uttar Pradesh having no remaining irrigation areas to be developed. <u>In 20 out of the 28 states the actual created potential exceeds the potentially remaining area to be developed</u>[31]. In these cases there are significant opportunities for increasing agricultural production through relatively low cost investment to improve the management, operation and maintenance of the I&D systems. Following the discussion in Section 5.2.4 such measures are likely to provide good returns on the money invested.

Due to the construction focus the ID employs mainly civil engineers, with few mechanical and electrical engineers, or hydrologists in the groundwater department. As a result there is insufficient understanding amongst the ID scheme managers of the relationship between irrigation water supply and agricultural performance, and relatively little innovation in the way in which these schemes are managed. It is likely that if there were a mix of civil, irrigation and agricultural engineers and agronomists involved in the management of I&D systems the performance of the schemes would improve.

Due to the historical way in which the ID has grown with a focus on construction and civil engineering there tends to be a top-down attitude of the civil engineers towards the farmers. This may be caused by a number of factors, but it results in an approach by ID management which is not always understanding and supportive of farmers needs. The idea that the farmers are customers of the ID, and should be treated as such, has yet to take root[32].

In the current GoI terminology farmers are described as beneficiaries of irrigation which implies that the government and thus the ID are the benefactor. This thinking is in-built in the ethos of all government departments in India, though it is changing markedly in aviation and power sectors[33]. Such thinking is unfortunately quite pervasive in government, for example in the Consumer Protection Act of India the Definitions section describes a user of services as a beneficiary.

Under the current policy the ID is only interested in managing the water distribution and maintenance of the main system, and not in the performance of the scheme overall. If the focus was broadened to a more holistic view, and the ID were also interested in the overall performance of the scheme, then the management approach would change significantly. The emphasis would then be on the ID managers to work with farmers on increasing agricultural production and water use efficiency and productivity. In this context the approach of the ID

[31] Note that the method used to estimate the Ultimate Irrigation Potential area has not been checked. It is not clear if this figure has allowed for development and growth by other competing uses of water, such as domestic, industrial, etc.

[32] In the current GoI terminology farmers are described as beneficiaries of irrigation which implies that the government and thus the ID are the benefactor. This thinking is in built in the ethos of all government departments in India, and is in contrast to the concept of the ID (as a utility) being the customer or client of the user. This attitude needs to change if the service provision concept is to take hold. It needs to be borne in mind that the Consumer Protection Act India mentions a user of services as a beneficiary in the section on Definitions.

[33] It is likely that other utilities, such as irrigation, will be forced by to adopt a more customer, rather than beneficiary-focused approach in the coming years.

managers to the formation and support of WUAs would improve, with the ID managers then seeing the WUAs as a partner in moves to improve scheme performance.

In some States ID staff are transferred from one position to another each 3 years. This practice is outdated and inappropriate in the ID where it is important that the ID manager builds up a relationship with the water users in his command area. In Maharashtra this practice has been stopped and in some other States the rotation period has been increased to 6 years. Allied to this there are instances reported of politicians placing undue pressure on the ID manager to allocate water preferentially to certain areas in the irrigation command, coupled with the threat to bring about the transfer of the ID manager if these wishes are not met. ID managers need to be free of such interference, and provided with the necessary support within the organisation to resist such pressures.

Table 7: Comparison of feasible irrigable area, irrigation potential created and actual areas irrigated in selected States

Major irrigation states											Large (>3mha)		High (>80%)	High (>80%)	High (>60%)	High (>80%)	Large (>50%)
Key irrigation states											Moderate (1-3mha)		Mod. (40-80%)	Mod. (40-80%)	Med. (30-60%)	Mod. (40-80%)	Mod. (20-50%)
											Small (<1mha)		Low (<40%)	Low (<40%)	Low (<30%)	Low (<40%)	Small (<20%)
State/UTs	**Total Land Area (mha)**	**Net Cultivated Area (mha)**	**Gross Cultivated Area (mha)**	**Ultimate Irrigation Potential (mha)**			**Irrigation Potential created till March 2007 (mha)**						**Indicators**				
				Major & Medium Irrigation	**Minor Irrigation**	**Total**	**Major & Medium**		**Minor Irrigation**		**Total**		**Gross cultivated area/ Total land area**	**Ultimate Irrigation Potential/ Gross Cultivated area**	**Total Created Irrigated Area/ Ultimate Irrigation Potential**	**Total Utilized Irrigated Area/ Total Created Irrigation Potential**	**Remaining estimated potential area to be developed**
							Created	**Utilized**	**Created**	**Utilized**	**Created**	**Utilized**					
Col.1	**Col.2**	**Col.3**	**Col.4**	**Col.5**	**Col.6**	**Col.7**	**Col.8**	**Col.9**	**Col.10**	**Col.11**	**Col.12**	**Col.13**	**Col.4/Col.2**	**Col.7/Col.4**	**Col.12/Col.7**	**Col.13/Col.12**	**(Col.7-Col.12)/ Col.7**
Andhra Pradesh	27.51	10.41	12.76	5	6.26	11.26	3.6	3.24	3.09	2.84	6.69	6.09	46%	88%	59%	91%	41%
Arunachal Pradesh	8.37	0.16	0.27	0	0.17	0.17	0	0	0.11	0.09	0.12	0.09	3%	63%	71%	75%	29%
Assam	7.84	2.73	3.96	0.97	1.9	2.87	0.3	0.21	0.63	0.51	0.93	0.72	51%	72%	32%	77%	68%
Bihar	9.42	5.66	7.9	5.22	5.66	10.89	2.88	1.81	4.76	3.79	7.64	5.61	84%	138%	70%	73%	30%
Chattisgarh	13.52	4.8	5.6	1.15	0.57	1.72	0.57	0.95	0.66	0.53	1.23	1.47	41%	31%	72%	120%	28%
Goa	0.37	0.14	0.17	0.06	0.05	0.12	0.03	0.02	0.02	0.02	0.06	0.05	46%	71%	50%	83%	50%
Gujarat	19.6	9.62	10.73	3	3.1	6.1	2.23	1.84	2.02	1.89	4.25	3.73	55%	57%	70%	88%	30%
Haryana	4.42	3.57	6.32	3	1.51	4.51	2.19	1.89	1.64	1.58	3.83	3.48	143%	71%	85%	91%	15%
Himachal Pradesh	5.57	0.55	0.96	0.05	0.3	0.35	0.02	0.01	0.17	0.14	0.19	0.15	17%	36%	54%	79%	46%
Jammu & Kashmir	22.22	0.75	1.11	0.25	1.11	1.36	0.22	0.18	0.45	0.4	0.68	0.58	5%	123%	50%	85%	50%
Jharkhand	7.97	1.77	2.09	1.28	1.18	2.46	2.13	0.24	1.59	1.55	3.72	1.78	26%	118%	151%	48%	0%
Karnataka	19.18	10.03	11.67	2.5	3.47	5.97	1.13	2.12	0.7	0.65	1.82	2.77	61%	51%	30%	152%	70%
Kerala	3.89	2.19	2.99	1	1.68	2.68	1.45	0.59	2.3	2.18	3.75	2.77	77%	90%	140%	74%	0%
Madhya Pradesh	30.83	14.86	19.04	4.85	11.36	16.21	1.47	1.17	0.57	0.39	2.04	1.56	62%	85%	13%	76%	87%
Maharashtra	30.77	17.62	22.38	4.1	4.85	8.95	3.49	2.31	3.06	2.65	6.55	4.96	73%	40%	73%	76%	27%
Manipur	2.23	0.14	0.22	0.14	0.47	0.6	0.11	0.08	0.09	0.07	0.2	0.15	10%	273%	33%	75%	67%
Meghalaya	2.24	0.23	0.28	0.02	0.15	0.17	0	0	0.06	0.05	0.06	0.05	13%	61%	35%	83%	65%
Mizoram	2.11	0.12	0.12	0	0.07	0.07	0	0	0.02	0.01	0.02	0.01	6%	58%	29%	50%	71%
Nagaland	1.66	0.33	0.38	0.01	0.08	0.09	0	0	0.09	0.07	0.09	0.07	23%	24%	99%	78%	1%
Orissa	15.57	5.85	8.8	3.6	5.2	8.8	1.97	1.88	1.65	1.44	3.62	3.32	57%	100%	41%	92%	59%
Punjab	5.04	4.25	7.99	3	2.97	5.97	2.57	2.51	3.43	3.37	6	5.88	159%	75%	101%	98%	0%
Rajasthan	34.22	16.77	20.8	2.75	2.38	5.13	2.86	2.53	2.47	2.37	5.33	4.9	61%	25%	104%	92%	0%
Sikkim	0.71	0.1	0.13	0.02	0.05	0.07	0	0	0.03	0.03	0.03	0.03	18%	54%	43%	100%	57%
Tamil Nadu	13.01	5.17	6.23	1.5	4.03	5.53	1.56	1.56	2.14	2.13	3.7	3.69	48%	89%	67%	100%	33%
Tripura	1.05	0.28	0.42	0.1	0.18	0.28	0.01	0.01	0.13	0.12	0.15	0.13	40%	67%	54%	87%	46%
Uttar Pradesh	24.09	16.81	25.82	12.15	17.48	29.64	8.78	6.81	23.6	18.87	32.39	25.68	107%	115%	109%	79%	0%
Uttranchal	24.09	16.81	25.82	0.35	0.52	0.86	0.29	0.19	0.52	0.41	0.81	0.6	107%	3%	94%	74%	6%
West Bengal	8.88	5.52	9.78	2.3	4.62	6.92	1.75	1.57	4.02	3.28	5.78	4.86	110%	71%	84%	84%	16%
Total	**328.73**	**141.35**	**190.28**	**58.47**	**81.43**	**139.89**	**41.64**	**33.74**	**60.1**	**51.48**	**101.74**	**85.22**	**58%**	**74%**	**73%**	**84%**	2.7

Note: 1. Uttar Pradesh figures for total land area, gross and net cultivated area look incorrect

Source: Source: Planning Commission & Central Water Commission, Ministry of Water Resources, Government of India

During the SDWUA study it was only in AP and Maharashtra that there were signs that the senior ID management had a vision for the future and recognition that change was required in the way the Department is organised and managed. There appear to be many blind spots on the need for reform in the Department and the approach needed to address the growing crisis in the water sector. Appendix A2 provides information on the changes that took place in Mexico and Turkey following a period of reform in the water resources and irrigation sectors. In the case of Mexico the former irrigation agency transformed itself into the nation's water resources agency, handing over the management of the majority of the I&D systems to WUAs and Federations of WUAs. In Turkey the irrigation agency has not (yet) transformed itself, and remains focussed on irrigation and the further development of the irrigation area, rather than on water resources management.

The main measure to address the current constraints in relation to ID management policy processes and procedures is the need to develop a new vision for the Irrigation Department in each State. This vision needs to incorporate the following:

i) moving from a focus on construction of new schemes to a focus on improving the management of existing systems in those states where the developed irrigation area exceeds the potential area remaining for irrigation development;

ii) creation of a service delivery culture within the ID;

iii) strengthening and modernising the approach to irrigation scheduling, including incorporating conjunctive use of surface and groundwater;

iv) changing from a top-down management style to a participatory style, working in partnership with water users towards enhanced agricultural production and water use efficiency and productivity;

v) restructuring the organisation to include a greater range of disciplines, including hydrologists, irrigation and agricultural engineers, agronomists and social scientists;

vi) modernising MOM processes and procedures to include increased use of computers, remote sensing, GIS, MIS and the like;

vii) overhauling the approach to human resource management, including employment of HRM specialists in the HRM unit and development of modern approaches to HRM;

viii) development of a culture of performance management, incorporating a focus on enhancing the performance of individual systems, and comparison of performance (benchmarking) between schemes.

6 Conclusions and recommendations

This Working Paper has outlined trends in the water resources development worldwide and within India and the changing relationship between construction of new hydraulic works and the management of built systems. As in many other parts of the world the Irrigation Department has historically been the major developer of the water resources, creating greater availability and distribution through the construction of dams, barrages, canals and the like. In many river basins the construction phase has largely come to its natural end, as water resources are now fully developed and allocated, and the best land for irrigation used up. There is now a pressing need to focus on the better management of the existing irrigation and drainage systems, and utilise the available water resources as productively as possible. As a consequence of the massive expansion of irrigation from groundwater an important consideration, which was not present 50, even 20 years ago, is the need to make the best conjunctive use of surface and groundwater resources.

The paper has identified a number of key issues related to irrigation and drainage and made a series of recommendations for addressing these. Predominant amongst these recommendations is the need for the Irrigation Department to reform in order to address the current and upcoming pressures in the irrigation and water resources sectors.

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Appendix A1: Asset management planning for irrigation and drainage systems

Introduction

The term “asset management” originates in the world of business and finance. The Chambers Twentieth Century Dictionary defines assets as “the entire property of all sorts belonging to a merchant or trading association”. Asset management is then the process of managing assets so as to maximise or optimise the benefits arising from them.

Asset management is routinely applied to a variety of engineering infrastructure, including water supply, transport (roads and bridges) and property. At present it is not widely applied in the irrigation sector, though this is changing. A key principle behind the use of asset management for infrastructure is that the assets (canals, drains, structures, etc.) serve a function from which benefits can be derived. Maintaining or enhancing that function results in sustained or enhanced benefits, either financial or social. Asset management can be more formally defined as:

“A structured and auditable process for planning, implementing and monitoring investment in the maintenance of built infrastructure to provide users with a sustainable and defined level of service.”

Asset management planning identifies asset stock (irrigation canals, drains, structures) and quantifies its condition and performance. From the assessment of asset condition and level of performance estimates can be made for the investment required to either:

- Maintain existing asset condition and system performance
- Enhance or extend asset condition and system performance

Asset management can be used by the owners and managers of infrastructure as part of the process of assessing, monitoring and maintaining the value and utility of the assets. It can also be used by regulatory authorities where publicly owned infrastructure has been sold, franchised or transferred to non-governmental bodies. Such infrastructure often serves a monopoly function (delivery of irrigation water, potable water supply and sanitation, etc.), and the government has a duty of care to ensure that the infrastructure is properly managed and sustained over time. Failure on the part of government in this respect may mean that the management entity “mines” the value of the assets by failing to invest sufficiently in the infrastructure over time, leading to failure of the system in the longer term.

An important current application of asset management is in the process of transferring the management, operation and maintenance of the irrigation and drainage system to water users associations. Applying asset management procedures at the transfer stage can have important benefits, including identification and audit of all infrastructural assets; identification of water users’ desired level of service; identification of the cost of maintaining the system over time commensurate with the agreed level of service provision; understanding by the water users of the relationship between infrastructure condition and system performance; and development and ownership by water users and irrigation service provider of the relationship between fee payment and service provision.

A word of caution is required. Asset management is a management tool; how it is used, and how effective it is, depends entirely on who uses it, and in what context. In the wrong context, where management is weak or lacks control over finances and budgeting, asset management will not work. What asset management can do, if used correctly, is identify infrastructural constraints to performance, and formulate plans to address them within the context of the ability and willingness of the users to pay for a specified level of service.

Asset management – Overview

Asset management planning is at the core of planning for long-term investment and expenditure in irrigation and drainage infrastructure. Asset management planning seeks to relate investment and expenditure to specified, user-defined levels of service. The process (Figure A1.1) involves defining the level of service to be provided, quantifying the ability of the water users to pay for the specified service, identifying the condition and performance of the assets (canal, drains, structures, roads, etc.) and quantifying the investment and expenditure required to maintain, improve or extend the assets in order to satisfy the specified levels of service.

An explanation in terms of the asset management of a group of houses owned by a housing association helps to explain asset management. In the group of 30 houses there are, say, 10 houses which are Grade A (4 bedrooms), 10 which are Grade B (3 bedrooms) and 10 which are Grade C (2 bedrooms). The monthly rental value of Grade A, B and C houses are $500, $400 and $250 respectively. The houses will require different levels of maintenance at different intervals, possibly painting of the exterior woodwork every 3 years, painting of the interior woodwork and walls every 6 years, etc. In addition there will be major capital expenditure at generally longer intervals, rewiring of the electricity circuit every, say, 20 years. A fundamental principal in this process is that the income from rental is able to cover these costs, including an allowance for management overheads. It may also be that the housing association at some stage decides to modernise the houses by providing new kitchens. This modernisation will enhance the level of service provided to the tenants for which an increased rental may be charged.

A similar process can be applied to irrigation and drainage infrastructure. The function and value of the infrastructure can be assessed and the infrastructure categorised according to the potential level of service that it can provide (ability to deliver water to match crop demands)[34]. The level of expenditure required to keep the system operational over time at a specified level can be ascertained and the fee level to be charged to water users determined. If further investment is made in the irrigation or drainage system and the system is modernised, then the fee level can be changed to reflect the increased level of service provision. For example, the conversion of a system with manually operated gates to a system with automatic level control gates will increase the level of service by facilitating water distribution on-demand, thereby better matching supply and demand and facilitating enhanced agricultural production. There will be capital expenditure to remove and replace the control structures whilst the day-to-day operation costs may be reduced due to the saving of labour costs. The balance of the costs and savings will need to be determined by discounting over a 10-20 year time frame to ascertain if the irrigation service fee level needs to be increased or decreased to pay for the changes made. Table 1 shows conceptual relationships between level of investment, canal control systems, level of service, O&M costs and potential income levels. The level of service potential outlined in Table A1.1 assumes a close relationship between the control infrastructure and the management capability.

[34] It is important to note that there are at least two aspects here, the condition and performance of the physical infrastructure, and the performance of the people and organisations which operate the infrastructure. Whilst asset management primarily focuses on the infrastructure, an assessment of the ability of management to use and operate the infrastructure is also required.

Figure A1.1: Framework for asset management and strategic investment planning for irrigation and drainage infrastructure

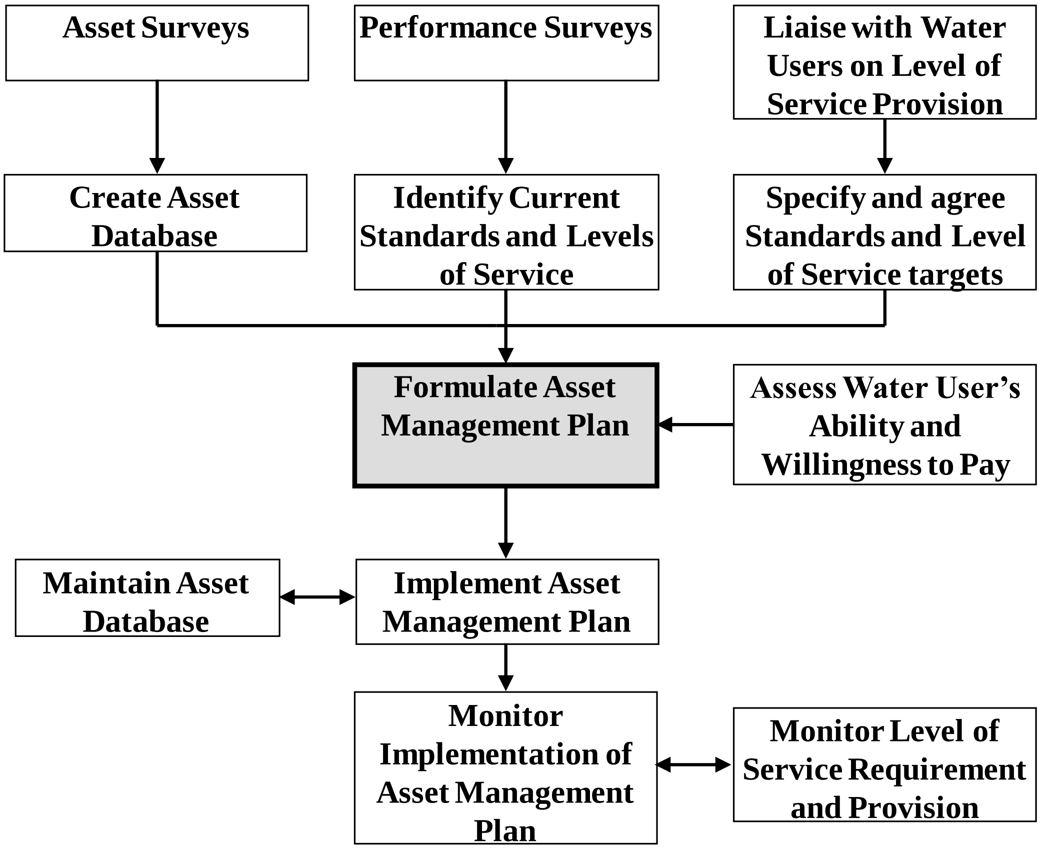
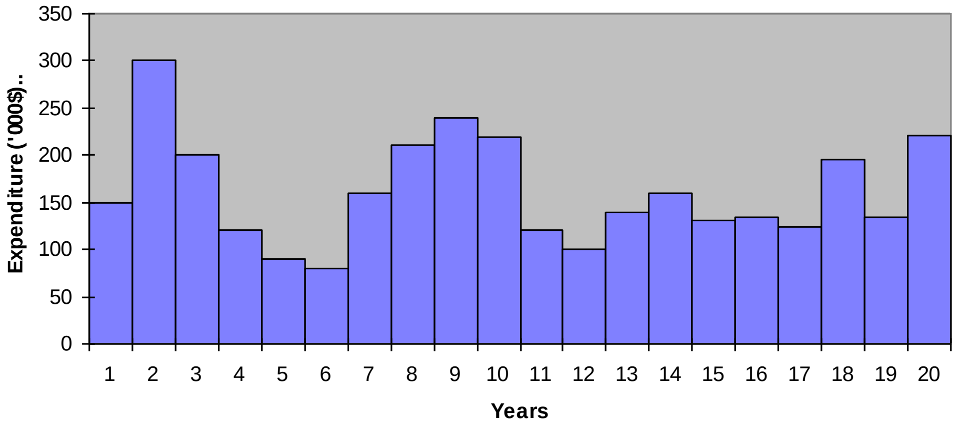


Table A1.1: Indicative relationship between level of investment, canal control, level of service and O&M requirements and costs

Type	Canal control system	Water delivery system	Level of service potential	O&M requirements	O&M costs	Capital invest-ment level	Indicative O&M cost level $/ha	Possible potential income level
1	Fully automated downstream level canal control, fully adjustable and responsive to farmer demands	Demand	Very high, fully responsive to farmers demands for water. Highly efficient in water use	Low staffing levels due to automation, but work force need to be highly skilled.	Low on day-to-day basis but may be high on occasion as control equipment is expensive. High capital cost, moderate O&M cost.	High	35	High
2	Manual control with some automation at key locations. Discharge measurement at flow division and delivery points.	Arranged-demand	High, responsive to farmers demands for water though farmers need to order water in advance. High interaction between service provider and farmer.	High staffing levels due to manual operation and need for measurement to match supply to demand.	High due to cost of O&M staffing and associated facilities (offices, motorbikes, etc.). Maintenance costs high to maintain and replace gates over time.	Moderately high	40	Good
3	Manual control throughout the system. Discharge measurement at flow division and delivery points.	Supply-demand	Moderate. Supply driven with irrigation service provider controlling/ allocating available water taking into account farmers cropping patterns. Relatively low interaction between service provider and farmer	Moderate staffing levels due to manual operation and need for some measurement to match supply to demand	Moderate due to O&M staffing and need for some O&M facilities. Maintenance costs high due to need to maintain control gates.	Moderate	25	Moderate
4	Manual control at main control points, ungated and/or proportional distribution at lower locations. Limited measurement.	Supply	Moderate, not responsive to farmers demands, limited control over water distribution to match demands.	Moderate to low staffing levels due to manual operation, though little measurement	Moderate to low due to O&M staffing and need for some facilities. Maintenance costs moderate due to need to maintain main control gates, kept lower by low-cost control at delivery points.	Low	10	Low
5	Fixed proportional control system, supply controlled, not responsive to demand. Measurement at water source intake only.	Supply	Moderate to low, not responsive to farmers' demands for water but farmers can plan ahead and adjust cropping pattern to suit supply. Inefficient in water use.	Low level of staffing, only low skill levels required	Low due to low O&M staffing levels and to low-cost proportional division structures.	Very low	5	Subsistence

Figure A1.2: Example of a 20-year investment plan profile



The interacting factors of asset condition/performance, current and desired levels of service are incorporated into the asset management plan (AMP) and the investment over time calculated. The resultant expenditure profile (Figure A1.2) is compared with the ability of the water users to pay, in certain cases the standard of the desired level of service may need to be reduced to match the users' ability to cover the planned expenditure.

The asset management plan is then implemented through shorter-term implementation plans, often of 5 years duration. The asset database will be upgraded as work is carried out, and the implementation of the plan and the level of service provision will be monitored.

Asset management processes

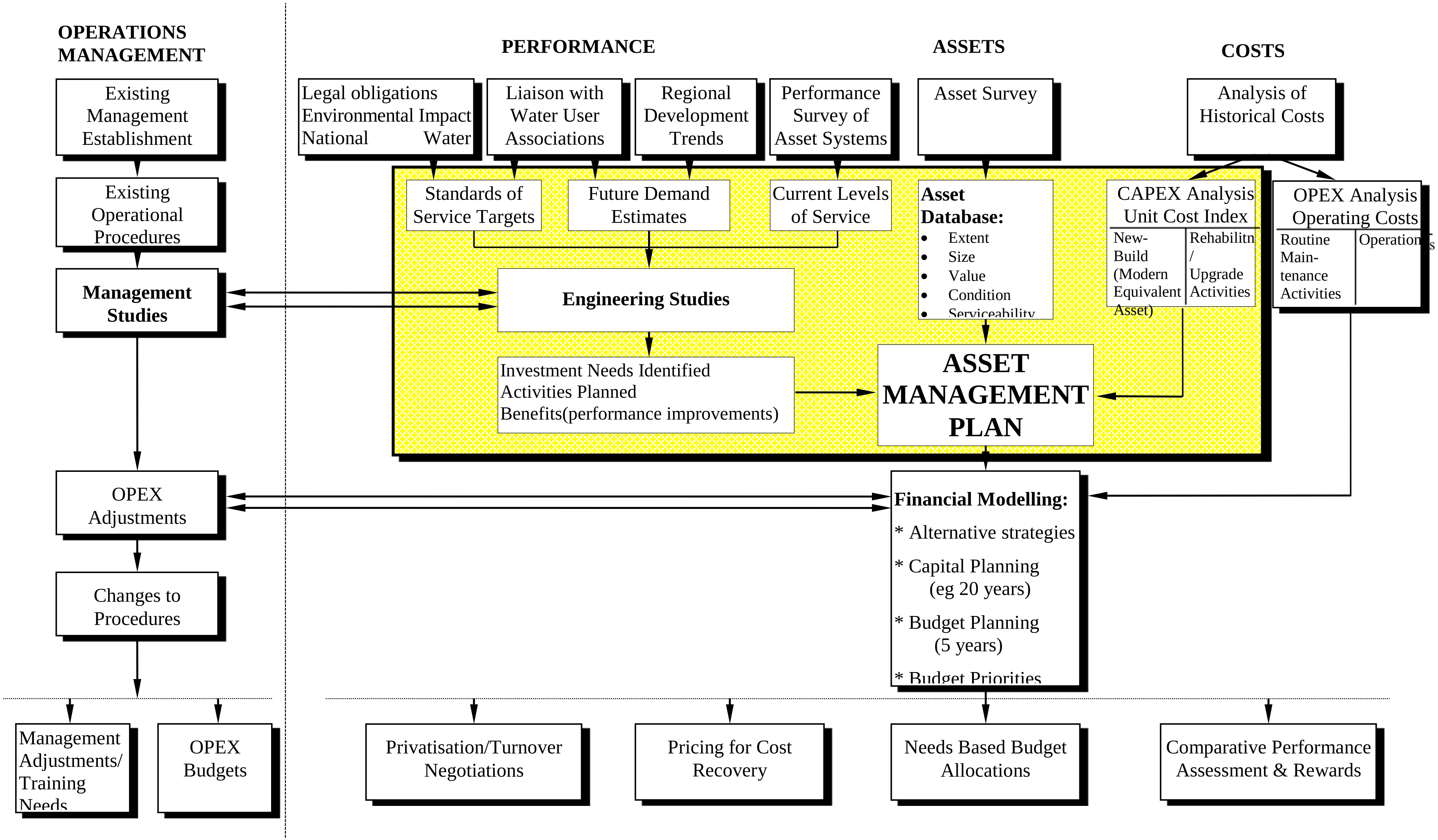
The key elements of preparing an asset management plan have been presented in Figure A1.1. Figure A1.3 gives a more detailed breakdown of the key elements and inter-relationships, each of which is discussed in greater detail in the following sections.

Asset surveys

Asset surveys are a central feature of asset management planning and are carried out at regular intervals generally ranging between 1-5 years. The initial survey represents a significant effort in terms of defining the nature and extent of the various assets, as time goes on the database on the assets is updated and refined and the required survey effort reduces.

It is important to note that if a large area is being surveyed with the intention of determining a budget for sustainable management of the assets it is not necessary to survey all assets. Instead a statistically- based system can be developed for sampling typical systems or sub-systems and then the investment needs and costs for the full set of assets estimated by extrapolation from the investment needs and costs of the sampled set. For more regular types of asset management all the assets are surveyed.

Figure A1.3: Overview of asset management planning for irrigation



The asset survey determines:

- the **category** of components of the system (canal, head regulator, etc).
- the **extent** of the assets that exist (how many and in what categories).
- the **size** of the asset (these can be grouped into Size Bands to facilitate costing).
- the "**importance**" of the asset. This relates to the impact that malfunction of the asset might have on the system as a whole. The head regulator at the river intake is more "important" than a secondary canal head regulator lower down the system.
- the **value** of the assets in each size band. The value is based on the Modern Equivalent Asset (MEA), that is the cost of replacing the structure at today's costs.
- the **components/facets** of each asset (e.g. gates and masonry in a head regulator structure). Different asset components/facets asset may deteriorate at different rates.
- the **condition** of the asset and its components/facets. The condition will affect the level of investment required. **Condition Grades** are used to categorise condition.
- the **serviceability** of the asset, that is, how well it performs its function. An asset may be in a poor condition (masonry damaged) but performing its function satisfactorily (gates operating and passing design discharge). For irrigation serviceability of structures can be divided into **Hydraulic Function** (ability to pass design discharge) and **Operations Function**(ability to control flow across a specified range, ability to provide command level, etc.). **Serviceability Grades** are used to categorise serviceability (Table A1.2).

The assets can be grouped into categories (Water capture, conveyance, control and measurement, ancillary, etc.) and can be grouped within these categories in terms of their size (Table A1.3) . The size can be based on one or two leading variables (such as crest length and height for a river weir, or design capacity for a canal). Grouping in this way means that average costs can be determined for categories and size bands of assets for maintenance and for assessing the Modern Equivalent Asset (MEA) value. The MEA value represents the cost, in today's prices, of replacing the asset, and as such builds to give a complete valuation for the asset base.

To carry out the survey the asset surveyor first gathers available data (maps, design drawings, structure inventories, etc.) before starting on the field work. For the fieldwork the surveyor generally commences at the top of the primary canal system and works down to the tail, then returning to survey each secondary canal in turn. The distance along the canal is measured using a tape or measuring wheel, and condition and performance assessments made of each stretch of canal, and at each structure. The level of detail collected depends on the resources available, in some cases full profiles of the canal are measured each 100 metres, in other observations only are taken. For structures key measurements are taken (gate widths, height, etc.) and in some surveys full measurements are taken for all components/facets of each structure. Standard forms are used to record the survey data (Figure A1.4). The survey may need to be carried out firstly with the canals flowing and then with them dry to capture all the data required.

Table A1.2: Example of Condition and Serviceability gradings for canal cross regulator

COMPONENTS	CONDITION GRADES (implying COST)			
	GRADE 1	**GRADE 2**	**GRADE 3**	**GRADE 4**
Structure Upstream Wingwalls Downstream Wingwalls Superstructure Notice Board Control Section (note type)	**GOOD**: Structurally sound with no deformation of dimensions or profile. Well maintained with little or no signs of deterioration. Upstream and downstream bed having only minor, or no, silt deposition and clear of debris.	**FAIR**: Generally sound but with some deterioration of structure and/or dimensional deformation. Needing maintenance attention with a review of condition in the medium term. **- OR -** Structural and dimensional condition as (1) but with silt and/or debris significantly affecting functionality.	**POOR**: Significant deterioration of structure and/or dimensional deformation, requiring urgent corrective work. **- OR -** Structural and dimensional condition worse than (1) with silt and/or debris significantly affecting functionality.	**BAD**: Serious structural problems causing actual or imminent collapse and requiring partial or complete reconstruction.
Gauge(s)	Gauges securely fixed and readable	Gauges generally satisfactory but may be difficult to read under some flow conditions	No proper readable gauge but level mark present from which to measure	No gauge or level mark available **OR** unreadable **OR** unreliable
Bench mark	Bench mark secure, apparently undamaged and readable	Bench mark condition generally as (1) but difficult to read	Bench mark present but of uncertain reliability	Bench mark missing, damaged or unreadable

FUNCTIONS	SERVICEABILITY GRADES (implying PRIORITY)			
	GRADE 1	**GRADE 2**	**GRADE 3**	**GRADE 4**
Hydraulic: To pass the design flow safely. **Operations:** To control **'command'** (water level) across the required range (except for a **fixed** crest) AND...To allow measurement of flow	**FULLY FUNCTIONAL**: Apparently properly designed and constructed with capacity to pass the design flow safely AND fully capable of being operated to control command across the desired range AND allowing measurement of flow by means of its own components or an adjacent measuring structure. Performance unaffected by silt or debris.	**MINOR FUNCTIONAL SHORTCOMINGS**: Normally able to pass the required flows AND capable of being operated to control command in a measured manner BUT performance likely to be unsatisfactory under extreme conditions of demand or climate. Deficiencies may be due to design or construction inadequacies, insufficient maintenance, measuring devices which are difficult to read or due to the presence of silt and/or debris.	**SERIOUSLY REDUCED FUNCTIONALITY**: One or more of the three defined functions seriously impaired through deficiencies in design, construction or maintenance, or due to the presence of silt and/or debris. (Likely to have a significant detrimental effect on System Performance.)	**CEASED TO FUNCTION**: Complete loss of one or more of the three functions or serious reduction of all three for whatever reason.

Figure A1.4: Example of asset survey form for cross regulators

ASSET SURVEY

Form CR for Cross Regulator

CR

System Details

Cabang Dinas ____________________
Ranting Dinas ____________________
Name of DI ____________________
DI Reference No. ____________________

Data Collected

By (Name) ________________
On (Date) ___◊___◊___

Asset Details

Area Served (ha) __________ Asset Ref. No. ________________
Location (km) __________ Canal Name ____________________________
Type of Canal: Primary ☐ Secondary ☐ Supplementary ☐
Reported Age (years): 0-5☐ 5-10☐ 10-20☐ 20+☐
Control section width (m) ______ Design Flow (l/s) ______
Control section type: Gate(s)☐ Fixed Crest☐ Stop Logs☐ Flume ☐

Component Condition

	General Condition Grade				Worst Case Local			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Structure	☐	☐	☐	☐	☐	☐	☐	☐
Control Section	☐	☐	☐	☐	☐	☐	☐	☐
Upstream Wingwalls	☐	☐	☐	☐	☐	☐	☐	☐
Downstream Wingwalls	☐	☐	☐	☐	☐	☐	☐	☐
Gauges	☐	☐	☐	☐	☐	☐	☐	☐
Bench Mark	☐	☐	☐	☐	☐	☐	☐	☐
Superstructure	☐	☐	☐	☐	☐	☐	☐	☐
Notice Board	☐	☐	☐	☐	☐	☐	☐	☐

Asset Serviceability

Overall Serviceability Grade

1	2	3	4
☐	☐	☐	☐

Notes:

Table A1.3: Examples of asset types, function, components and estimated life span

Asset Type	Size measures to be recorded	Functions to be assessed	Components to check	Depreciation Life (est.)
River weir	crest length crest height	HYDRAULIC -provide level -pass offtake design flow -pass design flood OPERATIONS -gates -gauges	weir wall dividing walls abutments crest apron sluice gate offtake gate stilling basin superstructure	civil 50 years mechanical and electrical (m&e) 10 years
Head Regulator	total gate width design flow	HYDRAULIC -pass design flow OPERATIONS -control flow -gauges	gate(s) structure notice board shelter	civil 25 years m&e 10 years
Cross Regulator * options -fixed crest -gate(s) -stop logs -flume	total gate width design flow	HYDRAULIC -pass design flow OPERATIONS -control command (level) -gauges	control section* structure notice board u/s wingwalls d/s wingwalls gauge(s) shelter	civil 25 years m&e 10 years
Measuring Structure	total crest width design flow	HYDRAULIC -pass design flow OPERATIONS -measure flow	control section gauges structure u/s w/walls d/s w/walls stilling box	25 years
Canal (linings -earth -masonry -concrete tile -cont. concrete)	design flow length	HYDRAULIC -pass design flow OPERATIONS -n/a	embankment side slopes (note type) bed	civil 25 years
Drain (linings -earth -masonry -concrete tile -cont. concrete)	design flow length	HYDRAULIC -pass design flow OPERATIONS -n/a	embankment side slopes (note type) bed	civil 25 years
Hydraulic Structure -aqueduct -culvert -drop struct. -escape struct. (note type)	(depends on structure) design flow length fall	HYDRAULIC -pass design flow OPERATIONS -n/a	conveyance support struct. u/s w/walls d/s w/walls stilling basin	civil 25 years m&e 10 years
Supplementary Structure e.g.: -bridge -cattle dip	(depends on structure) design flow length	HYDRAULIC -pass design flow OPERATIONS -n/a	structure safety other features	civil 25 years m&e 10 years
Access Roads	width length	OPERATIONS -access to system	structure surface drains	civil 25 years

Asset database

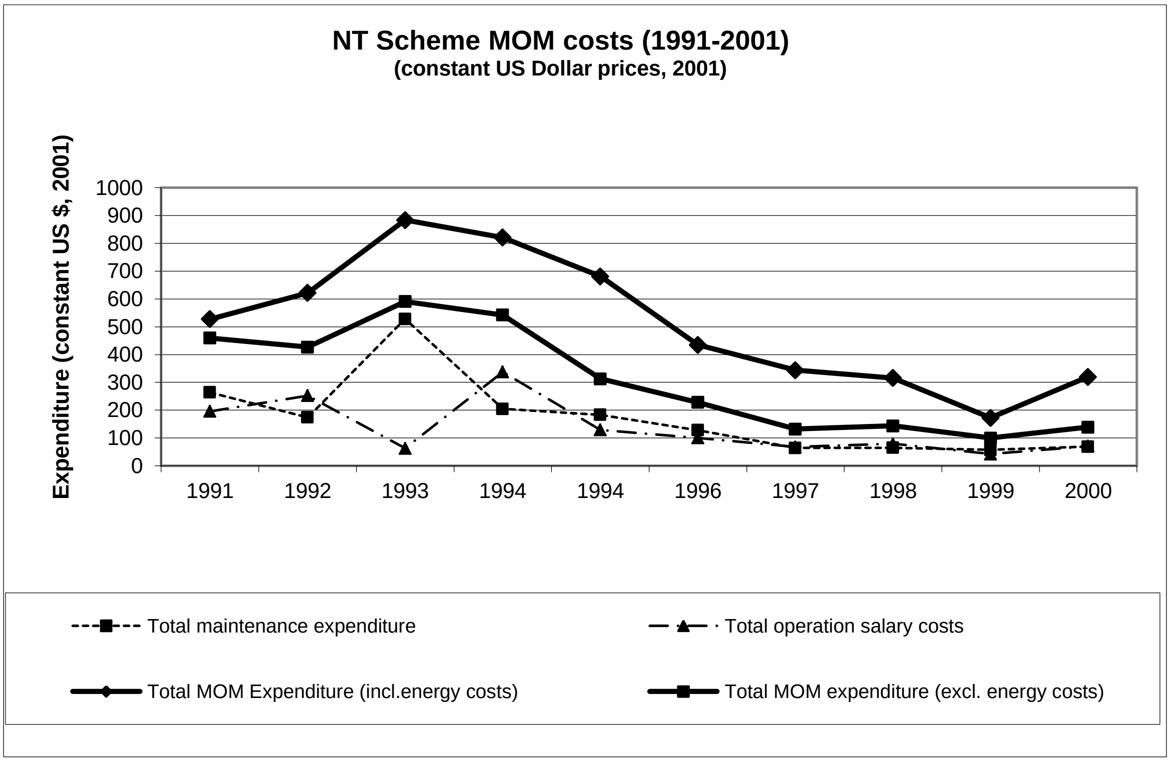
Data collected from the asset surveys have to be entered into a database. This can either be a spreadsheet file in the simplest case, or a specially designed database file. An example of the structure of a relational database is given in Figure A1.5. In some cases the database will include photographs of each asset linked to the survey date.

Historical costs profile

The historic records of capital and O&M expenditure provide a valuable basis for assessing the future capital and O&M expenditure. Past expenditure figures can be brought up to date using standard cost index tables. Records of maintenance work done and costs can inform on cost items and recurrence intervals (vis. How often the main canal is desilted, what volume and at what cost, etc.). Figure A1.5 shows an analysis of a pumped irrigation scheme where in real terms the funding for OPEX costs has declined significantly. As a consequence the physical condition of the assets had declined markedly, requiring (expensive) rehabilitation in 2003. In the meantime the productivity of the scheme declined markedly, in part due to due to poor water delivery caused by improperly functioning infrastructure, especially the pumps.

Costs can be split into two parts – CAPEX and OPEX. CAPEX is capital expenditure, and will include any new, upgrading or rehabilitation works, OPEX is the regular costs for routine maintenance and operations.

Figure A1.5: Analysis of historical OPEX costs using constant prices



Performance surveys to identify current levels of service

One of the most difficult elements of the asset management planning process for irrigation and drainage systems is to assess the level of performance. By comparison performance assessment for water supply systems is relatively straightforward.

For irrigation a clear distinction needs to be made between the performance of the *scheme* (that is the irrigation and drainage network, the fields, the crops, the farmers, etc) and that of the *system* (just the irrigation and drainage network alone). Asset management planning is concerned with the performance of the *system*, the principle performance measures are concerned with water delivery in a reliable, adequate, timely and cost effective manner. Other common scheme performance indicators such as crop production, crop yield, etc are not of direct interest for asset management planning (though improvement in system performance may be quantified in terms of these variables). The distinction between performance of the different parts of the irrigation process is represented in Figure A1.7, where outputs from one "system" are the inputs to another "system". The performance of each part of these nested systems is measured by the efficiency of the processes used to convert inputs into outputs. Impacts also need to be assessed, such as the impact on the environment of application of fertilisers and pesticides in the "irrigated agricultural system".

Performance assessment of the "irrigation system" will relate to the reliability, adequacy, timeliness, equity and cost-effectiveness of the water delivery service. Possible performance criteria and indicators for this system are shown in Table A1.4.

Table A1.4: Possible performance criteria and indicators for performance assessment within the irrigation system

Criteria	Indicator	Where measured
Command	**Relative Water Level, RWL**	**At delivery points**
Adequacy	Relative Water Supply, RWS Water Delivery Performance, WDP Management Performance Ratio, MPR	At intake, division and delivery points At intake, division and delivery points At intake, division and delivery points At intake, division and delivery points
Equity	Relative Water Supply, RWS Water Delivery Performance, WDP Management Performance Ratio, MPR	At intake, division and delivery points At intake, division and delivery points At intake, division and delivery points At intake, division and delivery points
Reliability	Relative Water Supply, RWS Reliability Index, RI	At intake, division and delivery points At intake, division and delivery points
Efficiency	Project Water Use Efficiency, PWUE Conveyance Efficiency, CE	At intake and field At intake and delivery points

In the context of asset management planning it is important to distinguish the performance constraints arising from the condition and performance of the infrastructure, and the performance constraints arising from the operation and use of the infrastructure. Asset management seeks to minimise infrastructural performance constraints in order that system operation is not constrained, it does not directly deal with operational issues.

Figure A1.6: Example of (relational) asset database

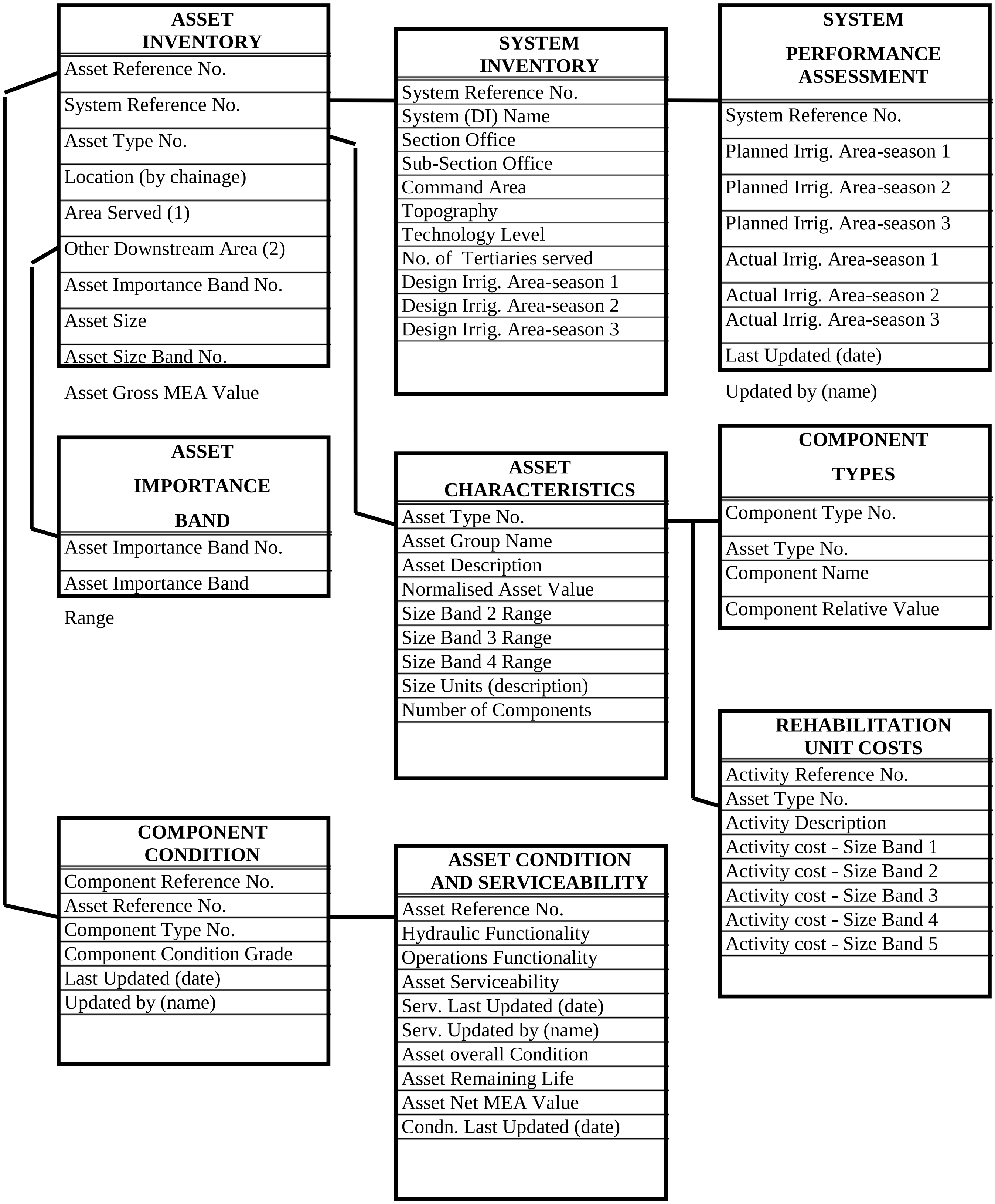
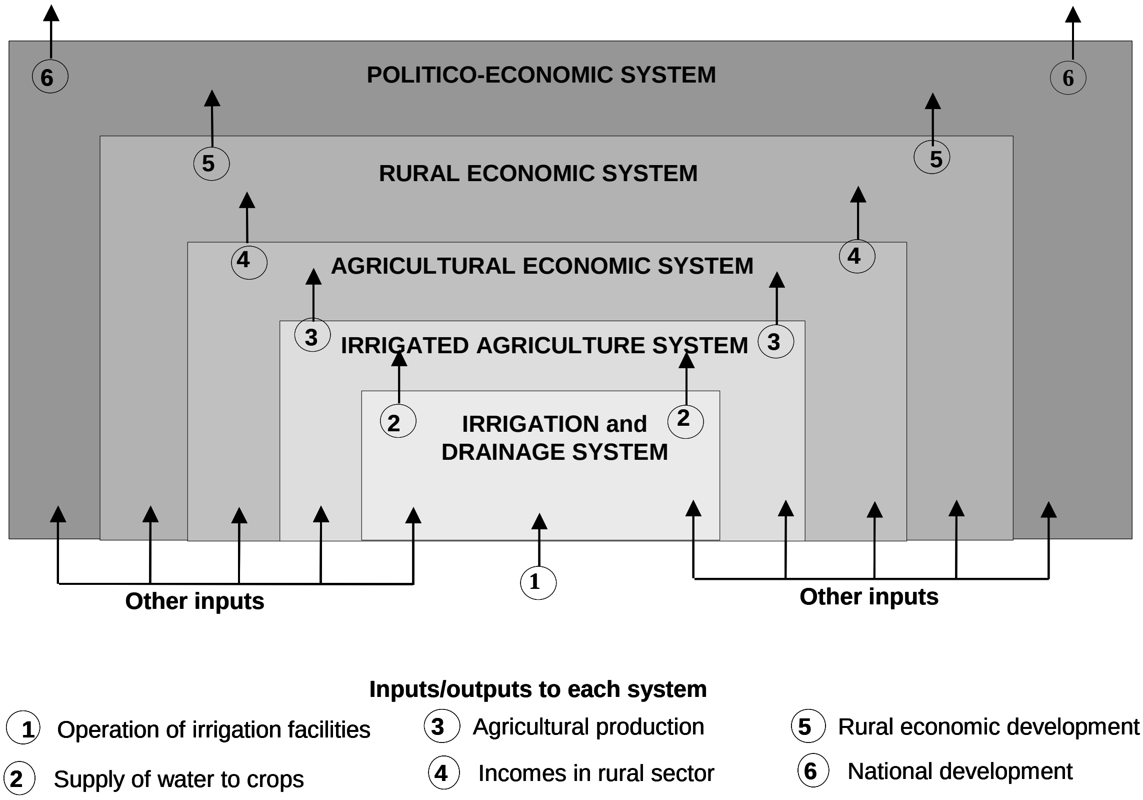


Figure A1.7: Irrigation in the context of nested systems (Small and Svendsen, 1992)



Agreeing on standards and desired level of service provision

A key feature of the asset management planning process is to specify the *desired* level of service and to then determine the performance shortfall by measuring the *current* levels which are being provided by the assets (assuming there are no management constraints).

The ability to deliver the desired level of service will primarily depend on:

1. the type of irrigation infrastructure provided
2. the performance of the infrastructure
3. the capability of the O&M management

Assessment of the desired level of service can be made prior to the preparation of the asset management plan through interviews and discussions with water users, though the cost of providing a given level of service will not be known until the asset survey has been completed and the asset management plan prepared. Establishing the desired level of service will not be easy, as in many schemes such a concept has often not been communicated explicitly to water users. The Warabandi system[35] used in Northern India and Pakistan is an exception. In this instance farmers are well aware of the stated level of service provision, with time shares, and times and duration of water turns, being set out well in advance of each irrigation. One of the benefits of the asset management process is that it requires the stipulation of the standards by which performance will be measured, and that it also requires the stipulation of the desired level of service. Making these explicit facilitates communication between the irrigation service provider and the water user.

[35] A system which defines the allocation and distribution of irrigation water on a time-share basis which is in proportion to the size of each farmer's landholding within the tertiary unit.

From the engineering studies (discussed below) an understanding will be gained of the anticipated improvements in performance benefits arising from different levels of investment. These improvements need to be assessed against the investment costs. The benefits will accrue to the irrigation (investing) service provider from the revenue generated from the water users, who will, in turn, derive their income from agricultural production generated as a consequence of the (improved) water delivery service provided by the irrigation service provider. The link between level of service provision and fee payment is central to the process of asset management.

Engineering Studies

Engineering studies are required to study generic issues such as the deterioration rate of different types of assets and asset components (facets); development of Cost Models (costs for rebuilding/upgrading/rehabilitating assets); and relationships between individual asset performance and system performance

Through engineering studies the cost database for maintaining or enhancing the condition/performance of each *type* of asset (river weir, canal head regulator, aqueduct, culvert, etc.) can be ascertained and applied to the asset condition/performance of each asset. In this way the cost of maintaining or enhancing the condition/performance of the irrigation and drainage system is determined. The deterioration rate of individual components, such as rubber gate seals, or pumps and motors, are estimated and standard profiles drawn up for each type of asset.

The importance of the asset will influence the priority given to investment in it. An asset's importance relates primarily to the asset's function, position in the irrigation or drainage network, and its replacement value. A river diversion weir is more important than a secondary canal head regulator, for example, because of its central function in diverting and controlling inflow to the scheme, its position at the head of the system, and its (usually) significant replacement cost.

An additional feature of the engineering studies is to look at alternatives, for example replacing manually operated gates with automated gates to save operating (OPEX) costs, or replacing a structure that is at the end of its useful life with a new structure, possibly of a different design, or with different features. Replacing a structure may cost more in terms of capital invested (CAPEX) but less in terms of operating costs (OPEX).

Formulating the asset management plan

Utilising information developed from the asset surveys, the performance surveys and the engineering studies the investment requirement in the assets over time is determined. This calculation leads to the formulation of the long-term investment profile as presented in Figure A1.2. This long-term plan needs to be broken down into a schedule of planned activities, and a short-term budget prepared for a 2-5 year period.

Financial modelling is an integral part of the preparation of the asset management plan, as adjustment may be needed to the initial plan to match the investment required with the finances available. Alternative strategies may be need to be looked at, for example reducing the specification for the desired level of service in order to save investment costs, or accelerating or delaying investment. These strategies will take account of the source and profile of funding available (such as capital loans or grants from government, irrigation service fees, etc.). Figures A1.7 and A1.8 show examples of different investment profiles that can be generated depending on the level of service required. In the first case the level of service required is high, resulting in high initial investment and high operational expenditure. In the second case the level of service is lower, with deferred investment and lower operational expenditure. From these calculations the average annual budget can be prepared and linked to the irrigation service fee.

The final asset management plan comprises the information outlined in Table A1.5.

Table A1.5: Summary of information contained in the asset management plan

Report	**Content**
Asset stock, condition and serviceability profile	A statement of all the assets, divided by category and size. Total value of the assets is quoted as gross MEA and net (depreciated) value. Condition and Serviceability Profiles provided for all assets, together with an Importance Profile.
Unit costs report for MEA value and capital investment activities	Presentation of the information contained in the Cost Model – provides the build up of costs for work required on each type of asset.
Investment programme	Report on the total investment estimates for Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) as programmed by each 5 year-period for the next twenty years[36]. Investment is presented in different formats: by each Asset Category; by each Importance Band; by each Purpose Category.
Activity report	Compliments the Investment Programme by detailing the timing of the activities to be carried out. Details how many kilometres of canal to be relined, desilted, etc, each year.
Benefits report	Provides details of the historical trends and the anticipated future benefits of the investment programme, based on the identified performance indicators. Maintaining or improving the Asset Condition Profile will be an important output performance measure.
Asset depreciation categories	A summary report on the assumptions made in the AMP about asset depreciation rates and life span.

An indication needs to be given in the AMP on the accuracy and reliability of the data used in preparation of the AMP. Tables A1.6 and A1.7 present guidelines used by the UK Office of Water Services for confidence grades.

Table A1.6: Data ACCURACY bands

Band	Definition
1	Better than or equal to +/-1%
2	Not band 1, but better than or equal to +/-5%
3	Not bands 1 or 2, but better than or equal to +/-10%
4	Not bands 1, 2 or 3, but better than or equal to +/-25%
5	Not bands 1, 2, 3 or 4, but better than or equal to +/-50%
6	Not bands 1, 2, 3, 4 or 5, but better than or equal to +/-100%

Source: UK Office of Water Services - AMP2 Manual

[36] The selected short and long-term time frames may vary depending on the situation.

Table A1.7: Data RELIABILITY bands

Band	Description	Definitions	
		Actuals	Forecasts
A	HIGHLY RELIABLE	Data based on sound records, procedures, investigations or analysis which is properly documented and recognised as the best method of assessment	Based on extrapolations of high quality records covering or applicable to more than 100% of the study area, kept and updated for a minimum of five years. The forecast will have been reviewed during the current year
B	RELIABLE	Generally as A but with some minor shortcomings, for example the assessment is old, or some documentation is missing, or some reliance on unconfirmed reports, or some extrapolation	Based on extrapolations of records covering or applicable to more than 50% of the study area, kept and updated for a minimum of five years. The forecast will have been reviewed during the previous two years
C	UNRELIABLE	Data based on extrapolation from a limited sample for which grade A or B data is available	Based on extrapolations of records covering more than 30% of the study area. The forecast will have been reviewed in the previous five years
D	HIGHLY UNRELIABLE	Data based on unconfirmed verbal reports and/or cursory inspections or analysis	Based on forecasts not complying with bands A, B or C

Source: UK Office of Water Services - AMP2 Manual

There are a number of sources of variance in the data – cost variations for physical works, differences in asset survey assessments, engineering judgement on life spans of assets, etc.

Assessing water user's ability to pay

The investment plan may need to be revised to match the ability of the water users to pay for the service. If this occurs the potential level of service provision arising from the condition and performance of the infrastructure may be reduced. A reduced level of service may result in a reduction in crop yield and a diminished ability to pay for water. There is obviously a balance to be struck between these two factors[37].

It is important to note that there is a difference between the water users' *ability* to pay and their *willingness* to pay. For this reason it is important that the asset management process is clear, transparent and auditable, and that the water users are active participants in the process.

Implementing the asset management plan

Though asset management plans generally look at a longer term time frame (15-20 years), they are implemented in short-term time segments. The asset management plan will have given a profile of the investment needed in the infrastructure over time, and will have been used to establish the financial plan to sustain the assets over time. This plan may incorporate contributions from different sources, including the irrigation service fees and government subsidies. The short-term budgeting and expenditure sets out to manage the investment such that necessary maintenance and replacement work is carried out to sustain the agreed level of service. Cost control and performance monitoring are key parts of this process, as are making sure that the expenditure is made transparent and accountable to users.

[37] In practice this is not a direct one-to-one linkage, it has to be moderated by other factors.

Maintaining the asset database

The asset database will undergo continuous revision. Maintenance work will be recorded, and periodical updates made to asset condition and performance gradings through further assets surveys. With experience adjustments will be made to the information available on deterioration rates, cost models, CAPEX and OPEX costs, etc. and the asset management plan refined.

Monitoring and evaluation of implementation and service provision

Monitoring and evaluation are important parts of the asset management process, allowing for the monitoring of the levels of investment, and its impact on the service delivery. M&E systems need to be set in place which are transparent and accountable so that those paying for the investment (water users, and/or government) can be satisfied that their money is being efficiently and effectively used. Feedback mechanisms are an important part of the M&E process.

Asset surveys will monitor the condition and performance of the infrastructure, whilst monitoring of key indicators (such as water delivery versus water demand) coupled with user surveys will assess the level of service provision.

Management Studies

In irrigation and drainage the sustainability of the assets can be influenced by how the system is managed. Poor operation of the headworks, for example, can lead the intake gates being left open during high river flow levels, resulting in heavily silt laden water entering and being deposited in the canal network. Poor regulation of the gates can result in excess water entering canals leading to breaches.

For this reason it is prudent to study the operational procedures of the irrigation and drainage system, and look at how these influence the management of the physical assets. It may be that changes to the operational procedures can increase the longevity of the physical infrastructure and reduce maintenance costs. It is also likely that through the asset management planning process the maintenance planning can be improved.

Figure A1.8: Example of investment profile designed for provision of a "Good" level of service rating

Asset Management Program
DI Penewon
Long-Term Budget Forecast

Proposed Standard of Service Good

Discount Rate 10%

Ave. Annual Budget Requirement 18,542,654 Rp
19,057 Rp per hectare

Year	Budget
1	30,776,708 Rp
2	17,183,463 Rp
3	15,374,733 Rp
4	7,194,250 Rp
5	24,895,300 Rp
6	15,114,687 Rp
7	15,480,880 Rp
8	21,136,207 Rp
9	18,814,000 Rp
10	14,313,133 Rp

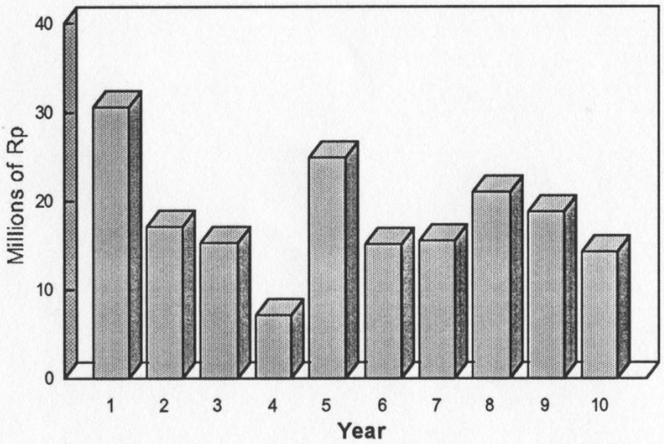


Figure A1.9: Example of investment profile designed for provision of a "Poor" level of service rating

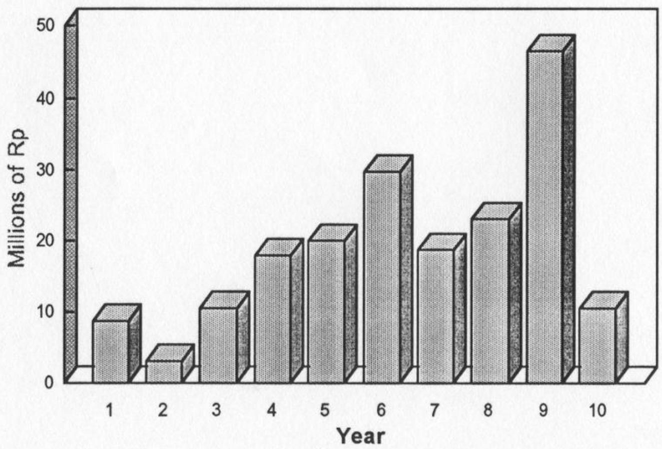
Asset Management Program
DI Penewon
Long-Term Budget Forecast

Proposed Standard of Service Poor

Discount Rate 10%

Ave. Annual Budget Requirement 16,937,113 Rp
17,407 Rp per hectare

Year	Budget
1	8,620,258 Rp
2	3,215,000 Rp
3	10,639,000 Rp
4	17,996,800 Rp
5	19,910,127 Rp
6	29,601,080 Rp
7	18,781,867 Rp
8	23,130,577 Rp
9	46,614,067 Rp
10	10,434,843 Rp



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Appendix A2: Related international experience

Brief examples are provided in the sections below of management reform and management procedures in a number of countries which are relevant to India.

A2.1 Mexico

As is well know significant management reform has taken place in Mexico in relation to the transfer of over 3 million hectares of irrigation command area from government to water users. What is less well know is that associated with this IMT programme there was significant reform of the irrigation agency. The change started in 1976 when the Mexican President merged the SRH (the Ministry of Hydraulic Resources) with the Ministry of Agriculture to form the Ministry of Agriculture and Hydraulic Resources (SARH). As a consequence the SRH, an historically strong and affluent bureaucracy, lost its financial and bureaucratic autonomy (Wester, 2008). This loss of power resulted in bureaucratic struggles within the new ministry, which were eventually resolved when the National Water Commission (CNA) was formed in January 1989. At the same time the transfer of government-managed I&D systems to water users' associations commenced. Both these initiatives were part of a package of reforms in the water sector brought in following the election of President Salinas.

These reforms were part of a political agenda introduced by President Salinas:

> "In Salina's vision shared responsibility would be reached through social reconciliation efforts, both in rural and urban areas. He proposed a mode of governance term "social liberalism", which sought to avoid the excesses of both unfettered free market capitalism and heavy-handed state interventions, thereby leading to the reduction of absolute poverty and an increase in social well-being....Salina's ambitious agenda aimed to modernize the relations between the state, society and the market, and strongly favoured decentralisation and participation of the social and private sector in water management" (Wester, 2008)

As a result of the reforms the CNA took the lead in managing the transfer programme to water users, and in developing a regional and nationwide approach to water resources management. In effect the CNA "let go" of its traditional power base in the irrigation sector, and moved to take up the mantle of the nation's water resources agency.

As part of this process river basin councils and aquifer management councils were formed, with significant representation by civil society. A report by Mestre, CNA's Regional Manager for the major Lerma-Chapala Basin from 1989 to 1997 sums up the perception within CNA at the time:

> "A wide-ranging water diagnosis existing by mid-1989 clearly presented four capital problems in the Lerma River Basin: *scarcity, as well as unsuitable water allocation, pollution, inefficiency of water use, and environmental depredation.* To turn the tide it became clear that it would be insufficient *and imprudent* to maintain that the federal government was soley responsible for this chaos and for its solution or mitigation. Many groups and individuals, both from the public and the private sectors, water users and society itself, should become involved (Mestre, 1997).

A2.2 Turkey

Though Turkey has followed Mexico in transferring the management of irrigation and drainage systems to water users it has not followed Mexico in taking on the mantle as the nation's water resources manager. A World Bank study 2006-7 concluded:

> "DSi[38]'s long-term objective is to attain full capacity from the country's water and land resources, especially in the GAP region, aiming at the development of at least 8.5 million ha of irrigated land. However, considering the increasing over-use of water in a number of river basins, DSI will have to increase its focus on water resources management, which may mean that the days of substantial new irrigation development in most of the Turkish territory have to be scaled back considerably to avoid the looming water shortage. This situation is common to countries and regions with large irrigation sectors reaching a high state of development, such as California in the USA and various regions in Australia. With irrigation accounting for about 75 to 80 percent of all water consumption in Turkey, it is clear where the water for higher value needs in future is going to have to come from." (World Bank, 2007).

The report concluded that both Turkey's surface and groundwater resources were facing difficulties, with surface water resources already fully or over-committed in basins such as the Gediz, and groundwater resources being depleted to alarming levels, as in the Konya basin. Declining water quality was also identified as a growing concern, with serious pollution from industry in several catchments.

The report concluded that there was a need to improve water resources planning and management:

> "The case for strengthening water resources management (WRM) is clear, including taking a multi-stakeholder and river basin approach. This is realized by the State Planning Office (SPO) and is described in the 9th National Development Plan which states the importance and priority to be placed in the efficient use of water resources as a result of economic use of water and within a comprehensive mechanism. According to the Plan, this will enable activities towards developing water resources to be planned with an integrated approach and in a way to provide flexibility in meeting the changing consumption demands in river basins and which is rearranged in a manner to provide a strong and structural coordination among relevant institutions. A strong central agency is required to adopt water resources management as its central focus, with sufficient power and resources to address the existing and upcoming situation..... A new law should centralize the authority for water resources management and provide legal authority for licensing, regulation and prosecution related to water resource use, both surface and groundwater. The law should also describe the concepts of river basin management. There is potential for DSI to be the executing agency for this role, provided that it includes in its mandate not only water resources exploitation, but also an increased focus on water resources management and regulation." (World Bank, 2007).

The report proposed two options, either (i) DSi takes on the responsibilities for water resources management (WRM), or (ii) a separate agency is established with this responsibility. The functions of the WRM entity would comprise: (i) planning surface water and groundwater resources development in all river basins and aquifers in Turkey; (ii) licensing water allocation from surface and groundwater for all public and private uses and

[38] DSi – Directorate of State Hydraulic Works, the government agency established in 1954 to develop water resources, mostly for irrigation.

users; (iii) regulating water resource abstractions (surface and groundwater) by public and private users, and prosecuting unauthorized abstractors or those abstracting above their licensed amount; and (iv) collecting, processing, and analyzing data on the quality and quantity of surface and groundwater resources.

Since the report was published in 2007 DSi has been subsumed into the (previously smaller) Department of Environment in a move towards accession to the European Union and implementation of the Water Framework Directive and other EU legislation on water issues.

A2.3 Kyrgyzstan

As an example of volumetric pricing and measurement of irrigation water reference is made to Kyrgyzstan as it is a country with a relatively sizeable irrigated area (1.04 million hectares), a large number of smallholder farmers with landholdings of around 1 ha and a system of allocation and charging for irrigation water based on flow measurement. The State Committee for Water Resources and Land Improvement (SCWRLI, formerly the Department of Water Resources, DWR) is responsible for the headworks and irrigation system up to the secondary or tertiary outlet, after which it is managed by the Water Users Association. A measuring structure is located at the handover point (Photos 1 and 2) and measurements taken at least once a day by a WUA staff member and the SCWRLI water master. The SCWRLI and WUA keep daily records of the flows and invoice the WUA for the amount of water provided each month (Photos 3 and 4).

The water is delivered to the WUAs according to an outline schedule prepared before the irrigation season. Water users provide details of their cropping pattern to the WUA management who aggregate the data and calculate the monthly and seasonal water demand based on the cropping patter for the WUA command area. The WUA submit a request to SCWRLI and sign a contract with them for the supply of this volume of water. The actual water delivered by SCWRLI during the irrigation season is then based on requests placed by the WUAs at periodic intervals (weekly, two weekly). The WUAs are required to pay a certain percentage of the service fee up front, with a further payment mid-season and another at the end of the season. In some cases in the poorer regions the payment is left until after the harvest season. In general the fee collection rate is high, over 80 percent and commonly 100 percent.

The system is applied countrywide. Although improvements can be made to the accuracy of the discharge measurement, the system is accepted by both parties as a rationale and fair basis for charging for irrigation water provided. It is worth noting that the WUA does not charge the farmers based on measured volumes of water delivered, rather they use a proxy for the water used, either setting an area fee for different crops, or charging for each irrigation or charging by time.

<table>
<tr><td></td><td></td></tr>
<tr><td>Photo 1: Hydropost discharge measurement structure at the intake to a WUA command area</td><td>Photo 2: Hydropost discharge measurement structure at the intake Federation of WUAs command area</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Photo 3: WUA water master using a radio to communicate with the WUA office.</td><td>Photo 4: WUA water manager with his discharge record books. These are used to check against the figures used by the SCWLI to charge for water.</td></tr>
</table>

National Water Resources Framework Study

Large Scale Irrigation Reform

Working Paper No.4

Performance Management in the I&D Sector

Martin A. Burton and Rahul Sen

Contents

Questions raised

The Planning Commission raised the following questions with regard to the performance management in the I&D sector:

Management reform - I

- In what ways should/can the irrigation bureaucracies be reformed?

Management reform -II

- Can we suggest a new set of conditionalities/ reforms to make AIBP more effective?
- How do we reintegrate AIBP and CADP?

1. Introduction

One of the questions asked by the National Planning Commission relates to suggestions for reforming the irrigation bureaucracies.

In this context this working paper proposes that the Irrigation Department manage irrigation and drainage systems using a performance management approach. This approach entails setting targets for individual irrigation schemes and measuring and rewarding the performance of the system managers by the performance of the irrigation scheme[39]. Whilst strictly speaking the ID manager is only responsible for the water delivery in the main system, the decisions he makes relating to authorised cropping patterns, irrigation scheduling, conjunctive use of surface and groundwater, etc. have a marked impact on the performance of the irrigated agriculture in the scheme. It is argued that better management decisions by the ID manager will result in better performance at the field level and better overall production and performance of the scheme. Of particular interest are the twin objectives of increasing agricultural production and increasing productivity per unit of water (more "crop per drop").

The proposals build on a note prepared by Dr Tushaar Shah for the Planning Commission in 2010 in response to enquiries from the Planning Commission on what conditionalities the Government of India might apply when providing AIBP support to state governments.

2. Outcomes

The process of performance management for individual irrigation schemes would serve to:

- Highlight the performance of irrigation schemes, in particular less well-performing schemes;
- Identify well-performing schemes which could be used as benchmarks and "best practice" examples for others to emulate;
- Highlight the central role played by the ID scheme manager in overall performance of the I&D schemes;
- Encourage ID managers and staff to work in partnership with WUA management and water users to improve overall scheme performance;
- Encourage innovative thinking focussed on improving scheme performance, including conjunctive use of surface and ground water;
- Increase agricultural productivity and water use efficiency and productivity on I&D schemes;
- Lead to increased levels of service fee recovery from water users.

3. Background

Agricultural production on irrigation and drainage (I&D) schemes is a function of many variables and several actors. The variables include the climate, soils, availability of water, physical terrain, etc. whilst the actors include the farmers, the Irrigation Department (ID) and traders amongst others. Logic dictates that where the various actors work together in partnership to achieve a common goal the performance will be better than if these various parties work independently or in opposition to each other.

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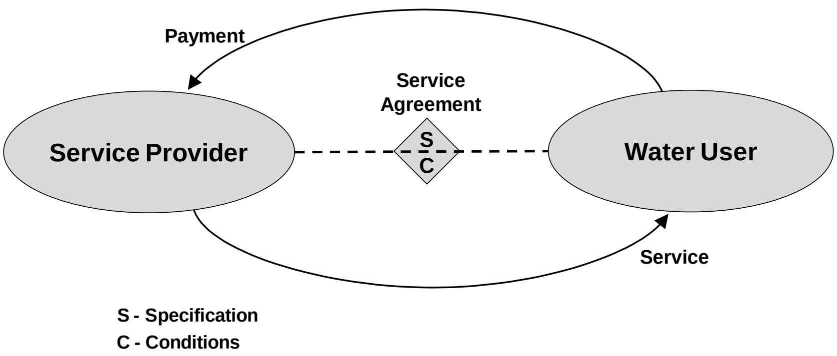
[39] The irrigation and drainage "system" is defined as comprising the irrigation or drainage canal network whilst the irrigation "scheme" comprises all components including the canal and drain network, fields, villages, roads, etc.

A key factor in working together is the concept of service delivery (Figure 1) in which the service provider contracts with the water user to provide a specified level of service for which the water user agrees to pay an agreed service fee. Such agreements and understanding are the basis of successful I&D scheme management in the USA, Australia, France, Spain and other countries in Europe.

Figure 1: Core elements of service delivery



There is little understanding of performance management within the Irrigation Department at present, and apparently little responsibility placed on ID system management personnel to improve the performance of individual schemes. In the private sector, such as in companies like Booker-Tate who manage sugar estates on behalf of governments in Guyana, Southern Africa, Ethiopia, and elsewhere, the manager is held responsible for the performance of the estate and the outgrowers associated with the estate.

Efforts to improve scheme performance are being made in Maharashtra with the introduction of a system of performance benchmarking by the Maharashtra Water Resources Department (GoM, 2008; www.mahagovid.org; www.mwrdc.org)). This programme has been operating since 2004 and has been refined to a point where the performance of individual systems are monitored and comparisons made with state norms and previous years' performance. Through this approach managers are being held to account for the performance of the systems which they manage. This programme commenced in 2002 following the guidelines issued by the National Committee on Irrigation and Drainage (INCID) in 2002 and has grown from benchmarking the performance of 84 schemes using 10 indicators to benchmarking 262 schemes using 12 indicators (Table 1).

Table 1: Maharashtra benchmarking programme, 2001/2 to 2005/6

Year	Number of projects				Number of indicators	Year of report publication
	Major	Medium	Minor	Total		
2001-2	30	26	28	84	10	March 2003
2002-3	49	142	63	254	11	March 2004
2003-4	49	143	69	261	12	March 2005
2004-5	49	144	69	262	12	February 2006
2005-6	49	144	69	262	12	March 2007
2006-7	49	144	69	262	12	March 2008

Source: GoM, 2008

The indicators have been refined over time and now number 12 covering system performance, agricultural productivity, and financial, environmental and social aspects (Table 2).

Table 2: Indicators used in the Maharashtra benchmarking programme, 2006-7

Indicator	Description	Remarks
i) System performance		
Annual Irrigation Water Supply per Unit Irrigated Area	The total quantity of water supplied for irrigation in all seasons divided by the sum of the area irrigated in Kharif, Rabi, HW on canal, reservoir and river in that year	Targets: Major – 7692 m^3/year Medium - 7692 m^3/year Minor – 6667 m^3/year
Potential Created and Utilised	The ratio of potential utilised (crop area measured) to created irrigation potential	
ii) Agricultural productivity		
Output (Agricultural Production) per Unit Irrigated Area	The output in rupees of agricultural production from the irrigated area divided by the total irrigated area	
Output (Agricultural Production) per Unit Irrigation Water Supply	The output in rupees of agricultural production from the irrigated area divided by the total quantity of water supplied	
iii) Financial		
Cost Recovery Ratio	The ratio of the recovery of water charges to the cost of providing the service.	The operating costs include the O&M costs and the costs of the salaries of technical and ministerial staff working on irrigation management
Total O&M Cost per Unit Area	The ratio of the total O&M costs incurred for management of the system and area irrigated during the irrigation year.	Government of Maharashtra has prescribed yearly O&M norms per hectare
Total O&M Cost per Unit Volume of Water Supplied	The ratio of the total O&M costs and the total quantity of water supplied for irrigation and non-irrigation use during the year.	
Revenue per Unit Volume of Water Supplied	The ratio of the total revenue collected and the quantity of water supplied for irrigation and non-irrigation use during the year	
Assessment Recovery Ratio A - Irrigated B - Non-irrigated	This has two components, irrigation and non-irrigation. It is the ratio of the recovery of water charges during the year and the assessment of charges due during Kharif and Rabi and the associated Hot Weather period. For non-irrigation it is the assessment made for the financial year.	Arrears are not considered in this indicator.
iv) Environment		
Land Damage Index	The percentage of land damaged in relation to the command area of the scheme.	Covers areas not utilisable due to waterlogging, salinity, alkaline soils, etc.
v) Social		
Equity Performance	The ratio of the sum of the actual area irrigated in the head, middle and tail reaches to the projected area in the head, middle and tail reaches.	Looks at the equity in the area irrigated in the scheme

In the benchmarking report (GoM, 2008) the performance of individual schemes is analysed, with some grouping of schemes to simplify the analysis. The analysis is made against the performance in the current year against the established norms, and against previous years' performance. The 2008 report also includes a section on benchmarking of Water Users

Associations (WUAs) and a section on benchmarking the WALMI; altogether a very comprehensive document.

A further initiative to focus on improving performance in the irrigation sector was outlined in 2010 in a proposal by Dr Tushaar Shah of the International Water Management Institute (IWMI) to the Planning Commission (Shah, 2010). Dr Shah's note to the Planning Commission made the following observations and suggestions:

> "....the performance of irrigation investments can improve only when irrigation and water resources planning and management by the state agencies will become performance oriented rather than construction oriented as is the case at present. If the Centre and the Planning Commission want to set in to motion such a transformation process in state water bureaucracies, providing support to individual projects is unlikely to help ......if state level irrigation agencies become performance oriented[40]—of which we see little sign at present—the performance of public irrigation systems can easily and majorly improve because there is so much slack in them at present..... public irrigation systems in India can serve at least 8-10 million more hectare than they are doing at present[3] simply by tightening the agencies and improving main system management in irrigation commands without investing a farthing.
>
> In sum ....the AIBP should morph from an irrigation-lending vehicle into a vehicle for transforming irrigation agencies[3]. For this, the centre should support states based on their overall achievement in irrigation and water resources management......that if the Centre and the Planning Commission transformed AIBP into a scheme that rewards strong performance orientation in state irrigation agencies, it will achieve more 'accelerated irrigation benefit' than operating AIBP as an irrigation lending scheme.......such an approach would generate incentives and pressures for improving the performance of public irrigation agencies instead of just mobilizing funds for new construction which will generate no new irrigation".

Dr Shah proposed a scheme of classifying states into three categories based on their performance in the following six areas with categorisation as outlined in Table 3:

1. ***Effective system for performance measurement and monitoring of medium and large irrigation systems****:* Does the state have an effective and transparent system of measuring the performance of public irrigation systems? What are the key performance variables? What data are used? Does the state use remote sensing data to assess irrigated areas in different seasons? Is there any system in place to estimate the extent of conjunctive use of ground and surface water? Is monitoring data used for improving system management and performance?
2. ***Reform of irrigation water pricing and water charge collection:*** what are the irrigation charges in comparison to irrigation productivity? What are the irrigation charges assessed relative to the cost of alternate irrigation sources such as groundwater? Do irrigation charges generate enough resources to meet O&M expenses and minimize deferred maintenance? When was the irrigation charges last revised? What proportion of irrigation charges assessed is actually collected? What is the O&M budget allocation relative to the maintenance needs?
3. ***Organizational reform in the irrigation department:*** are there any mechanisms for ensuring accountability among the employees of the irrigation agencies? What are the mechanisms to enhance performance of irrigation systems? Has the department

[40] This report's underlining, not present in the original document.

unbundled irrigation systems as 'responsibility centres' with well-defined performance parameters? Is the state doing a good job of main-system management? Is it doing a good job of maintenance of infrastructure?

4. ***Institutional reform in irrigation management below the outlet?*** Does the irrigation agency have the capacity needed for creating participatory farmer institutions for water management below the outlet? What arrangements are in place to facilitate orderly and equitable water distribution below the outlet and maintenance of canal infrastructure? Does 'warabandi' operate effectively? Has the state made significant progress in organizing and empowering water user associations? Has the state promoted other institutional arrangements for improving water distribution?

5. ***Improve planning of ground and surface water resources in river basin frame work:*** what are the mechanisms/structures in place for integrated planning and management of ground and surface water resources? How are water resource planning objectives formulated and pursued?

Table 3: Tentative (hypothetical) scheme of performance classification of state water administration

Performance indicator	Class A	Class B	Class C
1. Performance measurement and monitoring system			
1.1 Estimates of area irrigated by different public systems based on conventional data sources (LUS, MI census, other)	Yes	yes	??
1.2 Irrigated area maps for different seasons using remote sensing data	Yes	No	No
2. Reform of irrigation water pricing and water charge collection			
2.1 Has the state instituted a non-discretionary annual increase in irrigation charges over a specified period?	Yes	No	No
2.2 Does the state collect 80% or more of water charges assessed?	Yes	No	No
3. Organizational reform in the irrigation department			
3.1 Are Major systems run as independent responsibility centres with clear performance parameters?	No	No	No
3.2 Are there any incentives for high performance?	No	No	No
4. Institutional reform in irrigation management below the outlet?			
4.1 Has the state been successful in PIM or in implementing 'warabandi'?	partly	No	No
4.2 Has the state experimented with other institutional approaches to enhance efficiency and equity of water management below the outlet?	Some	No	No
5. Improve planning of ground and surface water resources in river basin frame work			
5.1 What is the quality of the state's annual irrigation plan? How well does it integrate ground and surface water? And small and large systems?	Good	Poor	No plan
5.2 What is the quality of the state's perspective water plan?	No plan	No plan	No plan
6. Overall performance of the irrigation and water resources department			
6.1 Reservoir storage per ha of gross irrigated area (m3)	<8000	<10,000	>10,000
6.2 Irrigation fee collection as % of capital investment in irrigation projects	2-4	1-2	<1
or 6.2 Irrigation fee collection as % of irrigation value added.	30	20	<20

6. ***Overall performance of the irrigation and water resources department:*** what is the ratio of peak reservoir storage to storage capacity? What is the gross area irrigated per BCM of reservoir storage? What is the conjunctive use effectiveness? What is the irrigation charge collection as a proportion of assessment? What is the O&M allocation as proportion of capital investment?

4. Proposal for introducing performance management into the I&D sector

4.1. Introduction

It is proposed that the Irrigation Department introduce a system of performance management for irrigation and drainage schemes. This would mean that the ID would measure and monitor the performance of individual schemes and hold the managers to account for this performance. Managers on schemes where performance is good would be rewarded with recognition for the performance, managers on schemes where performance is poor would be provided with training and support in order to improve the scheme's performance.

4.2. Actions to be taken

The proposed actions to be taken are:

i) Identify key performance indicators;
ii) Set up systems to collect the required data;
iii) Collect, process, analyse and report on the data;
iv) Assess the performance relative to past performance of the scheme and in comparison with other schemes;
v) Take action based on assessed performance;
vi) Reward better performers and improvers.

Step 1 – Identify key performance indicators

There are three main parts to the management of an I&D scheme:

i) Management of the main system (by the ID);
ii) Management of the on-farm system (by the WUA or water users);
iii) Management of the in-field system (by the farmer).

Table 4 presents a number of indicators that could be used for the overall performance assessment of an I&D scheme whilst Table 5 presents indicators that could be used for the assessment of the main system water delivery performance. The assessment of the main system management would thus be a combination of selected indicators from Tables 4 and 5, assessing the overall performance of the scheme and the performance of the main ID function of water delivery on the main system. Appendix A1 presents examples of data collected from six irrigation schemes in Egypt where the performance of six schemes was assessed and benchmarked (covering both surface and groundwater).

Table 6 presents indicators that can be used for the assessment of the WUA management performance. These indicators cover the main areas of concern for the WUA management related to the institutional capacity, the area irrigated, the financial performance and the O&M performance.

The farmer's performance is measured by the agricultural production obtained and the resources used, a key one of which is water. While the farmer might be predominantly interested in the agricultural production, either to satisfy subsistence needs or for cash, the WUA and the ID manager will be interested in the farmer's water use efficiency and productivity.

Step 2 – Set up systems to collect the required data

Systems need to be established to collect the data required for the performance indicators. The easiest procedure for this is to establish a spreadsheet into which the data can be entered and the indicators calculated. The benefit of using a spreadsheet program is that it is easy to follow and manipulation of the data is relatively easy in order to produce graphical displays of the data. Pivot tables can be particularly useful in manipulating and presenting data.

Step 3 - Collect process, analyse and report on the data.

Once the data collection system is established the data can be collected, entered into the spreadsheet database and the values of the indicators calculated. The results need to be analysed and any anomalies resolved, and a report produced in a standard format.

Table 4: Key indicators for performance monitoring of irrigation and drainage system management, operation and maintenance (Burton et al, 2008)

Indicators	Definition	Notes[1]
Agricultural production		
Total seasonal[2] area cropped per unit command area (Cropping intensity)	Total seasonal area cropped / Total command area of system	a
Total seasonal crop production (Tonnes)	Total seasonal crop production by crop type within command area	a
Total seasonal crop production per unit command area (crop yield, kg/ha)	Total seasonal crop production / Total command area of system	a
Total seasonal value of crop production ($)	Total seasonal value of agricultural crop production received by producers	a
Total seasonal value of crop production per unit command area ($/ha)	Total seasonal value of crop production / Total command area of system	a
Total seasonal crop production per unit water supply (kg/m^3)	Total seasonal crop production / Total seasonal volume of irrigation water supply	a
Total seasonal value of crop production per unit water consumed ($/$m^3$)	Total seasonal value of crop production / Total seasonal volume of crop water demand (Etc)	a
Total seasonal value of crop production per unit water supplied ($/$m^3$)	Total seasonal value of crop production / Total seasonal volume of irrigation water supply	a
Irrigation water delivery		
Total seasonal volume of irrigation water supply (MCM)	Total seasonal volume of water diverted or pumped for irrigation (not including diversion of internal drainage)	a
Seasonal irrigation water supply per unit command area (m^3/ha)	Total seasonal volume of irrigation water supply / Total command area of system	a
Main system water delivery efficiency	Total seasonal volume of irrigation water delivery / Total seasonal volume of irrigation water supply	b
Seasonal relative irrigation water supply	Total seasonal volume of irrigation water supply / Total seasonal volume of crop water demand	a
Water delivery capacity	Canal capacity at head of system / Peak irrigation water demand at head of system	-
Financial		
Total seasonal MOM expenditure[3] per unit command area ($/ha)	Total seasonal MOM expenditure / Total command area of system	c
Total seasonal MOM expenditure per unit irrigation water supply ($/$m^3$)	Total seasonal MOM expenditure / Total seasonal volume of irrigation water supply	c
Total seasonal maintenance expenditure per unit command area ($/ha)	Total seasonal maintenance expenditure / Total command area of system	c
Total seasonal maintenance expenditure fraction	Total seasonal maintenance expenditure / Total seasonal MOM expenditure	c
MOM funding ratio	Actual annual income / Budget required for sustainable MOM	d
Fee collection ratio	Irrigation (and drainage) service fees collected / Irrigation (and drainage) service fees due	d
Farm profit	Total farm income – total farm expenditure	e
Drainage water removal		
Average depth to groundwater (m)	Average seasonal depth to groundwater calculated from water table observations over the irrigation area	f
Environmental protection		
Salinity of soil water (mmhos/cm)	Electrical conductivity of soil water	f
Soil salinity (mmhos/cm)	Electrical conductivity of soil	f
Salinity of water in open drain (mmhos/cm)	Electrical conductivity of water in open drains	f
Drainage water quality: Biological (mg/litre)	Biological load of drainage water expressed as Biological Oxygen Demand (BOD)	f
Drainage water quality: Chemical (mg/litre)	Chemical load of drainage water expressed as Chemical Oxygen Demand (COD)	f

Source: Adapted from Bos et al, 2005 and Malano and Burton, 2001

Notes:

1. Location and sampling interval:
    a. Determine for total command area and individual tertiary units
    b. Discharges measured at the main canal intake and tertiary unit intakes
    c. Determine for total command area, main system only and individual Water Users Associations
    d. Determine for individual service providers (government agency or Water Users Associations)
    e. For individual water users
    f. Periodic sampling at selected locations
2. May be seasonal or annual, depending on the circumstances. If there is more than one season and there are marked differences between the seasons' cropping patterns and water availability it is preferable to consider each season separately
3. Costs for irrigation water delivery and drainage water removal may be kept separate or combined; it depends if there is a separate drainage authority.

Table 5: Indicators used for assessing different performance criteria related to water delivery (Burton et al, 2008)

Criteria	Performance indicator	Definition	Notes
Reliability	Relative Water Supply	Volume of irrigation water supply / Volume of irrigation water demand	Variation of the RWS at the main canal intake and at tertiary intakes during the season indicates the level of reliability of water supply and delivery
	Delivery Performance Ratio	Volume of irrigation water supplied / Target volume of irrigation water supply	Variation of the DPR at tertiary unit intakes during the season indicates the level of reliability water delivery
Adequacy	Relative Water Supply (RWS)	Volume of irrigation water supplied / Volume of irrigation water demand	Measured at main canal intake and each tertiary unit intake. Target value = 1.0, less than 1.0 indicates water shortage
	Delivery Performance Ratio (DPR)	Volume of irrigation water supplied / Target volume of irrigation water supply	Measured at main canal intake and each tertiary unit. Target value = 1.0. If there is a water shortage the target supply may be less than the actual irrigation water demand.
Timeliness	Dependability of Irrigation Interval	Actual irrigation interval / Planned/Required irrigation interval	The planned/required interval between irrigations is either that planned (such as in a planned irrigation rotation regime) or that dictated by the crop's soil moisture status.
	Timeliness of Irrigation Water Delivery	Actual date/time of irrigation water delivery / Planned/Required date/time of irrigation water delivery	Compares the actual date and time of delivery (planned in the rotation or requested by the farmer) compared to the actual delivery date and time.
Equity	Relative Water Supply	Volume of irrigation water supply / Volume of irrigation water demand	Variation of the RWS at tertiary intakes indicates degree of equity or inequity
	Delivery Performance Ratio	Volume of irrigation water supplied / Target volume of irrigation water supply	Variation of the RWS at tertiary intakes indicates degree of equity or inequity
Efficiency	Relative Water Supply	Volume of irrigation water supply / Volume of irrigation water demand	Comparison of the RWS at the main canal intake and the tertiary unit intakes indicates the level of losses
	Overall scheme efficiency	Volume of water needed by crop / Volume of water diverted/pumped from source	Useful indicator. Relatively easy to obtain a meaningful value. Estimate crop irrigation water demand at the field (using FAO CROPWAT programme, or similar) and measure actual discharge at main canal intake.
	Main system water delivery efficiency	Volume of water delivered (to tertiary unit) / Volume of water diverted/pumped from source	Measure discharges at main canal intake and offtakes to tertiary units. Value may change due to the seasons (wet/dry), with drainage inflow possible in wet season.
	Crop production per unit water supply	Total crop production / Volume of water diverted/pumped from source	As measure of efficiency use to determine change in production per unit of water diverted at source. Useful for monoculture schemes.
Productivity	Crop production per unit water delivered	Total crop production / Volume of water delivered (to tertiary unit or field)	Increasingly important indicator. Need to be careful where there is mixed cropping.
	Value of crop production per unit water delivered	Total value of crop production / Volume of water delivered (to tertiary unit or field)	Increasingly important indicator. Use the value of crop production where there is mixed cropping.
Cost effective-ness	ISF collected to GVP ratio	Total irrigation service fee (ISF) collected / Total gross value of production (GVP)	Assesses the cost of the ISF compared to the total gross value of production. A broad indicator only as other costs are involved.
	ISF to total crop input costs ratio	Irrigation service fee (ISF) due for the crop / Total input costs for the crop	Assesses the costs of the ISF as a fraction (or percentage) of the total input costs for planting, harvesting and marketing the crop. Often found to be in the range of 4-10% of total input costs where the ISF is set at adequate levels to recover sustainable MOM costs.

Source: Adapted from Bos et al, 2005 and Malano and Burton, 2001

Table 6: Example of key indicators used to monitor the performance of Water Users Associations (Burton et al, 2008)

Water Users Association Performance Indicators				
Indicator	**Definition**	**Value**	**Scoring**	**Score**
Formation				
Area transferred to WUA	Area transferred to WUA / Total gross area serviced by the system		2 = 100% 1 = 50-99% 0 = <50%	
Membership, Representation and Accountability				
WUA membership ratio	Total number of WUA members / Total number of irrigators in service area		2 = >50% 1 = 25-50% 0 = <25%	
Annual General Meetings	Annual General Meeting held		2 = Yes 0 = No	
Annual General Meeting attendance	Number of WUA members attending AGM / Total number of WUA members		2 = >50% 1 = 30-50% 0 = <30%	
Administrative Council meetings held	Number of meetings held during the year (January-December)		2 = >5 1 = 1-5 0 = 0	
Administrative Council elections	Number of elections for members of Administrative Council held in last 2 years		2 = Yes 0 = No	
Women members of Administrative Council	Number of women members of Administrative Council		2 = 1 or more 0 = None	
Area irrigated				
First irrigation crop area ratio (of total service area)	Total annual recorded (first) irrigation crop area / Total gross area serviced by the system		2 = >50% 1 = 30-50% 0 = <30%	
Crop audit correction factor	Reported area of first irrigation / Crop area measured from crop area audit survey		2 = >90% 1 = 75-90% 0 = <75%	
Financial				
Employment of Accountant	Accountant employed and duration of employment		2 = Yes, >4 months 1 = Yes, <4 months 0 = None	
ISF collection per hectare of service area	Total ISF collected / Total gross area serviced by the system * Adjusted to current values		2 = >1800* Lek/ha 1 = 1000-1800 Lek/ha 0 = <1000 Lek/ha	
ISF collection as percent of target	Total ISF collected / Target total annual Irrigation Service Fees		2 = >90% 1 = 60-90% 0 = <60%	
ISF collection per hectare irrigated	Total ISF collected / Total annual irrigated crop area * Adjusted to current values		2 = >2500* Lek/ha 1 = 1000-2500 Lek/ha 0 = <1000 Lek/ha	
Financial Audit of WUA	Level of approval of WUA financial affairs by independent auditors		2 = Accounts approved 1 = No audit undertaken 0 = Accounts qualified/rejected	
Operation				
Area managed by Water Masters	Total gross area serviced by the system / Number of Water Masters employed by WUA		2 = < 250 ha 1 = > 250 ha 0 = No Water Masters	
Degree of flow measurement	Level of flow measurement at the head of the system (either primary canal or secondary canals)		2 = Full water measurement record 1 = Some water measurement 0 = No measurement	
Maintenance				
Annual maintenance planning	Extent of annual maintenance planning, costing and implementation *Note: The inspection plan must be reviewed and scored by experienced personnel.*		2 = Inspection undertaken and detailed plan produced 1 = Maintenance plan produced without proper inspection 0 = No plan produced.	
Maintenance expenditure per unit of total service area	Maintenance cost / Total gross area serviced by the system * Adjusted to current values		2 = >1000* Lek/ha 1 = 500-1000 Lek/ha 0 = <500 Lek/ha	
Maintenance expenditure to revenue ratio	Maintenance expenditure / Gross revenue collected		2 = >70% 1 = 40-70% 0 = <40%	
Total Score	Sum of scores for performance indicators. Low scores identify WUAs which require more support, high scoring WUAs need less support.		2 = >32 1 = 20-32 0 = <20	

Source: Halcrow, 2003 Note: 1 US$ = 140 Lek (2002)

Step 4 - Assess the performance relative to past performance of the scheme and in comparison with other schemes.

At the scheme level the ID manager will be able to compare the performance of any particular scheme with its performance in previous years, and in comparison with other schemes in his District. At the Circle level the performance of schemes within the Circle command area can be compared and relative performance assessed.

In Maharashtra (GoM, 2008) the performance across the State is assessed for some 260 irrigation schemes (Table 7). For the assessment irrigation schemes are categorised such that schemes with similar characteristics are compared. The five main categories used are:

i)	Type of water control	Fixed proportional division; manual control; automatic control. In the Maharashtra case manual control systems are considered.
ii)	Method of allocation and distribution of water	Supply-orientated; arranged-demand; on-demand.
iii)	Water availability	Abundant to Highly Deficit.
iv)	Water source	Surface water; groundwater; surface and groundwater.
v)	Size	Major; Medium; Minor.

Table 7: Irrigation schemes selected for Maharashtra benchmarking exercise, 2006-7

Sr. No.	Plan Group	Nagpur, Amravati Region			Pune, Konkan Region			Aurangabad, Nashik Region			Total
		Major	Medium	Minor	Major	Medium	Minor	Major	Medium	Minor	
1	Highly deficit	-	-	-	1	10	3	-	16	4	34
2	Deficit	3	9	13	-	-	-	10	43	19	97
3	Normal	5	12	6	6	1	3	10	17	7	67
4	Surplus	3	24	3	-	-	-	-	-	-	30
5	Abundant	2	2	1	8	10	11	-	-	-	34
	Total	**13**	**47**	**23**	**16**	**21**	**17**	**20**	**76**	**29**	**262**

Source: WRD, 2008

Step 5 - Take action based on assessed performance.

Base on the analysis action should be taken to either reward the system managers where performance is good, or look at ways to improve management performance where system performance is relatively poor. Special recognition should be given to managers and systems where significant improvements in performance are obtained. The process of comparing performance identifies “best practice” locations and managers. These practices and managers can be used for training of other managers.

Step 6 – Rewarding better performers and improvers

A number of options exist for rewarding good performers, and those whose systems have improved since the previous assessment(s). The obvious form of reward for scheme managers is financial, with a bonus paid to the manager and staff. Another option, used at one time in East Java, Indonesia, is to award prizes to the best performers and the best improvers. For the irrigation systems a reward could be additional funds for system improvement. For both managers and staff, and irrigation systems, publicity about the achievements in local newspapers can form an important part of the reward system.

4.3. Resources required

The proposal requires the following actions and resources to be implemented:

- Agreement to adopt the approach by senior ID management at state level;
- Formulation of the approach, indicators to be used, data required and method of analysis;
- Training of ID managers in the proposed approach, its objectives, components, indicators and processes;
- Implementation by the ID managers for their schemes, primarily with the collection and processing of data. Provision of computers and tailored software would assist the process of data processing at the Divisional level;
- Data processing and analysis of data at the Circle and state level;
- Financial resources to match the agreed rewards package. These financial resources could be provided under a reformed/refocused AIBP.

5. Related international experience

Assessment of I&D scheme performance has been of increasing interest over the last 10-15 years as a result of increasing pressure on available water supplies (Bos et al, 2005). The initial interest in the 1980s and 90s was to understand and quantify the performance of I&D systems (Small and Svendsen, 1992; Murray-Rust and Snellen, 1993; Bos et al, 1994). This was followed by an interest in the comparative performance of I&D systems (Molden et al, 1998) which in turn was followed by performance benchmarking (Malano and Burton, 2001; Sodal, 2003).

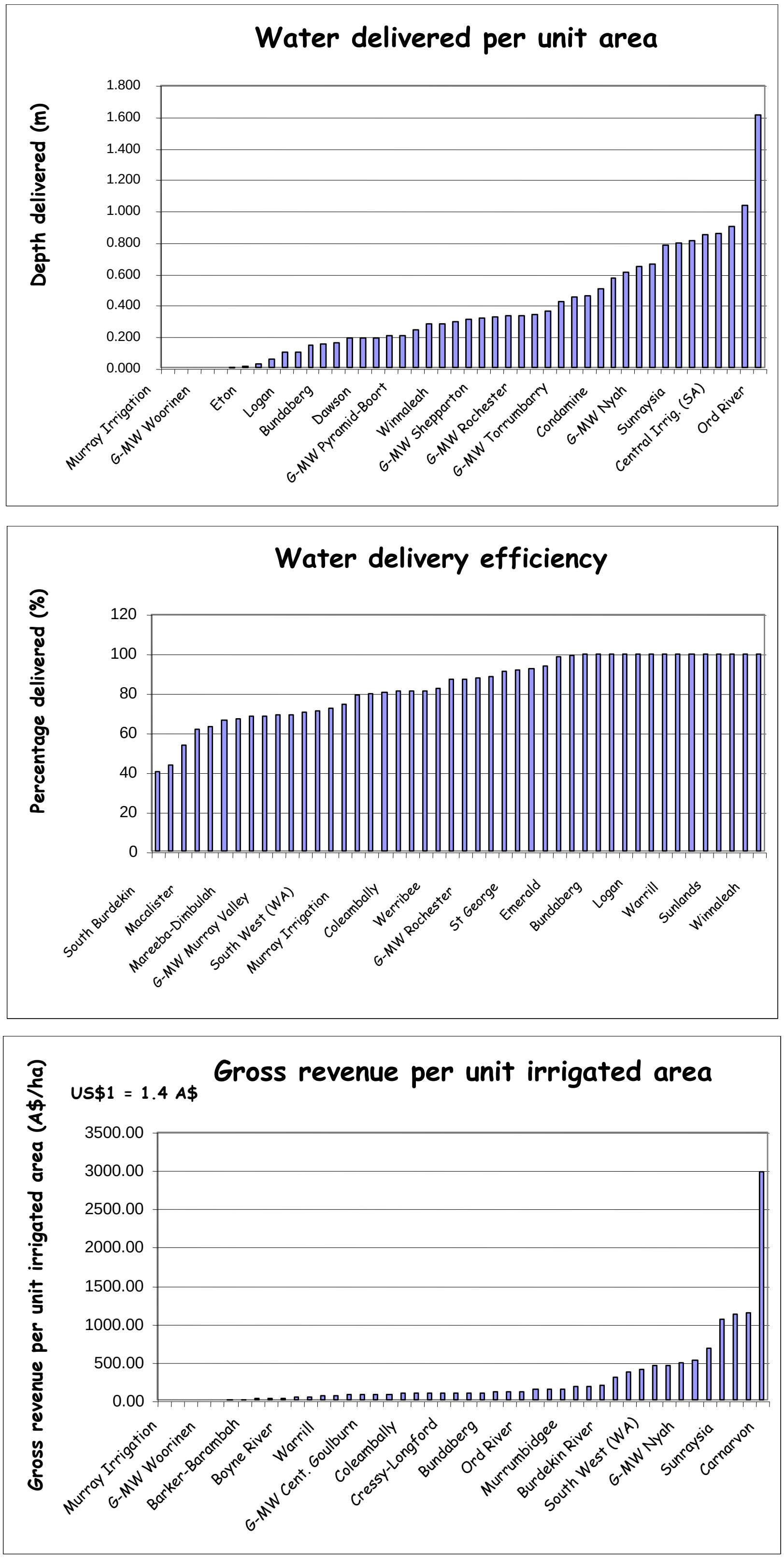
The Australian National Committee of Irrigation and Drainage (ANCID) was one of the first organisations to implement a benchmarking programme in the irrigation and drainage sector. It began in 1998 with 33 schemes managed by irrigation service providers and now has over 40 schemes in the programme, covering some 75% of the irrigation water provider business in Australia. The total business distributes 18,000 GL of water annually, providing water for some 2 million ha and generating an annual business turnover of US$ 162 million from a production base of some US$ 5.7 billion (Alexander and Potter, 2004). The crops grown include rice, maize, grape vines, cotton, sugar cane, pasture, citrus and vegetables.

The benchmarking programme uses 65 performance indicators:

- System operation (12 indicators)
- Business processes (25 indicators)
- Financial management (14indicators)
- Environmental management (14indicators)

These indicators have been formulated to fit with the "triple bottom line" approach adopted by the industry, measuring performance in economic, environmental and social dimensions. Figure 2 presents graphical displays of the comparison between some of the indicators, showing some marked differences in performance. It is important to note that these data have not been categorised, so that for example the water delivered per unit area covers all types of crops from rice to pasture, and water delivery efficiency will include open channel and closed pipe systems. More detailed analysis of these data would separate the data into groups in order that "like-with-like" comparisons can be made.

Figure 2: Examples of performance data plots from the Australian benchmarking programme



Source: ANCID, 2000

The achievements of the Australian benchmarking programme are summarised as (Alexander and Potter, 2004):

- Allowing comparison of the performance of irrigation water providers relative to each other, both at the domestic and international level;
- Providing a more progressive and accountable image of the irrigation sector;
- Monitoring the uptake and impact of modern technology;
- Improvement in record keeping and performance analysis by service providers;
- Availability of objective and reliable data across a substantial part of the irrigation industry;
- Adoption by businesses of the ANCID benchmarking approach and formulation of their own inter-business benchmarking systems;
- More confident setting by business managers of targets for water delivery efficiency, operation, health and safety and resource use.

As a result of the promotion of the benchmarking approach by the International Commission on Irrigation and Drainage (ICID) since 2001 there have been benchmarking initiatives in a number of countries, including Spain, Sri Lanka, India and Turkey (Malano et al, 2004). Recently a benchmarking programme has commenced in the UK for the potato and soft fruit sectors with funding from the Department of Food and Rural Affairs, DEFRA (Cranfield, 2011).

Under the World Bank funded Water Management Improvement Project in Kyrgyzstan the state irrigation agency is moving towards monitoring the performance on a system-by-system basis. One of the first steps in the process has been to change the accounting system such that accounts can be kept for each system rather than by administrative unit (a Rayon, equivalent to a District in India). This will allow the agency and the WUAs to monitor the fees raised for each system, and the expenditure made, particularly on maintenance. In addition the performance of WUAs is being monitored through records kept by the WUA Regulatory Authority. These records are compiled from annual reports submitted to the Regulatory Authority which are then entered into the Authority's database.

Table 6 provides an example of the analysis carried out in 2007 using the 2006 data. Five key indicators were calculated and weightings applied to each indicator to come up with a total score for each WUA. The indicators and weightings were:

- Cropping intensity (%) – Weighting 2
- Collected Irrigation Service Fee (ISF) per unit command area (KGS[41]/ha) – Weighting 3
- ISF collection ratio (%) – Weighting 1
- Maintenance expenditure per unit command area (KGS/ha) – Weighting 3
- O&M expenditure as percentage of total ISF collected (%) – Weighting 1

Table 8 presents the results of the 10 best performing WUAs and the 10 worst performing WUAs. The differences are significant, with the 10 best performing WUAs having 100% cropping intensity, high levels of ISF collection per unit area (475-937 KGS/ha), high ISF collection ratios (95-150%), high levels of maintenance expenditure per unit area (301-417 KGS/ha) and a high proportion of the total spend on maintenance (40-76%). For the least well-performing WUAs cropping intensities are low (23-38%), the fee collection per unit area (8-31 KGS/ha) around 2% of those achieved by the best performers, ISF collection ratios

[41] KGS – Kyrgyz Som. US$ 1 = KGS 42 (2006 rates)

(23-38%) are low and there is no expenditure on maintenance. Two of the rehabilitated systems, Chomo and S.Jaloldinov are in the top ten best performers.

Table 8: Results of the analysis showing the ten best and ten least well-performing WUAs, Kyrgyzstan, 2006

									Key indicators					Weightings score						
Год/ *Year*	Наименование области/ *Oblast*	Наименование района/ *Rayon*	Наименование АВП/ *WUA*	Date rehabilitation completed	/WUA Code No.	Подвешенная площадь (га)/ Command area (ha)	На какой ступени находится АВП (1-7)/ Milestone	Площадь, орошаемая в текущем году (га)/ Irrigate area this year (ha)	*Cropping intensity (%)*	*Collected ISF per unit command area (KGS/ha)*	*ISF collection ratio (%)*	*Maintenance expenditure per unit command area (KGS/ha)*	*O&M expenditure as percentage of total ISF collected (%)*	*Cropping intensity (%)*	*Collected ISF per unit command area (KGS/ha)*	*ISF collection ratio (%)*	*Maintenance expenditure per unit command area (KGS/ha)*	*O&M expenditure as percentage of total ISF collected (%)*	*Total weighted score*	*Ranking*
10 best performing WUAs									**2**	**3**	**1**	**3**	**1**							
2006	Osh	Kara-Suu	Haliljan-Ota		50322	171	3	171	100%	937	101%	403	43%	200	2812	101	1210	43	4366	1
2006	Osh	Kara-Suu	Monok		50305	524	4	524	100%	893	95%	361	40%	200	2679	95	1083	40	4097	2
2006	Osh	Kara-Suu	Kara-Dobo		50311	300	2	300	100%	683	115%	400	59%	200	2049	115	1200	59	3622	3
2006	Osh	Kara-Suu	Murza-Ajy		50302	1406	4	1406	100%	570	125%	417	73%	200	1709	125	1252	73	3360	4
2006	Osh	Kara-Suu	Sultan-Naz		50303	1997	3	1997	100%	600	102%	392	65%	200	1800	102	1176	65	3343	5
2006	Osh	Kara-Suu	Chomo	19-Jan-07	50323	1593	7	1593	100%	573	109%	400	70%	200	1718	109	1199	70	3296	6
2006	Osh	Kara-Suu	S. Jaloldinov	21-Sep-07	50316	1734	7	1734	100%	514	100%	385	75%	200	1541	100	1154	75	3070	7
2006	Osh	Kara-Suu	Jar-Ooz		50314	485	3	485	100%	475	150%	363	76%	200	1426	150	1089	76	2941	8
2006	Osh	Kara-Suu	Uch-Aiyl		50321	734	3	734	100%	539	126%	301	56%	200	1616	126	903	56	2901	9
2006	Osh	Kara-Suu	Abror		50304	1059	3	1059	100%	479	96%	358	75%	200	1438	96	1073	75	2882	10
10 least well performing WUAs																				
2006	Chuy	Chuy	Burana-Kara-Oi		70603	526	1	200	38%	17	100%	0	0%	76	50	100	0	0	226	429
2006	Issyk-Kul	Ton	Ak-Bulak-Tyup		30410	1737	3	1442	83%	12	23%	0	0%	166	36	23	0	0	225	430
2006	Chuy	Moscow	Nazar-Suu		70202	1690	3	1162	69%	20	27%	0	0%	138	60	27	0	0	225	431
2006	Naryn	Kochkor	Cholpon Suu		40403	2500	3	1566	63%	20	25%	0	0%	125	59	25	0	0	210	432
2006	Naryn	Ak-Talaa	Konorchok-Aksay		40209	670	4	265	40%	31	31%	0	0%	79	94	31	0	0	204	433
2006	Naryn	Ak-Talaa	Boz-Barmak		40203	360	4	156	43%	19	29%	0	0%	87	58	29	0	0	174	434
2006	Issyk-Kul	Ton	Konur-Alan		30407	2963	1	1260	43%	14	38%	0	0%	85	43	38	0	0	166	435
2006	Osh	Kara-Kuldja	Sabitali-Suu		50402	850	7	485	57%	6	25%	0	0%	114	18	25	0	0	157	436
2006	Chuy	Jaiyl	SSB		70506	1136	3	82	7%	8	32%	2	28%	14	23	32	6	28	103	437
2006	Chuy	Jaiyl	Chokmor-Suu		70505	2334	3	580	25%	0	0%	0	0%	50	0	0	0	0	50	438

Using this form of analysis of data collected from WUAs enables the WUA Regulatory Office, the Central WUA Support Unit and Oblast and Rayon WUA Support Units to identify good and poor performers. Causes for low performing WUAs can then be investigated and measures applied to help these WUAs and their members to improve their performance. Identifying and understanding the reasons for good performance are equally important; best practice processes and procedures can then be transferred to the less well performing WUAs. Information gathered from the best practice WUAs can also be used in the preparation of training material.

6. Conclusions and proposals for reforms

This Working Paper has outlined a proposal for the Irrigation Department to adopt a system of performance management for all irrigation schemes under their control. Several phrases from the Maharashtra 2008 Benchmarking Report (GoM, 2008) summarises the opportunities offered by the proposal for management to focus on scheme performance:

> p.30 "In Purna project the water use has increased from 11,345 to 18,390 Cum/ha as compared to the last year and it is 2.5 times more than the state norms. The field officers are required to go through the reasons behind it and do the needful for improvement in performance."

> p.39 "In Girna project output/ha is increased from Rs 16,724/ha (2005/6) to Rs 19,250 (2006/7) which is about 84% of the state norm."

> p.43 "In Bhima (Ujjani) project, output per unit water supply for (irrigation) is Rs4.5/cum. Overall performance is very good."

> p.70 “NIC Nanded. All three projects under this circle viz. Manar, Vishnupuri, Purna the ratio has decreased from 0.73 to 0.64, 0.72 to 0.28, 0.99 to 0.16 respectively, lesser recovery affecting the indicator value. The field officers are required to recover 100% recovery with more efforts.”

By establishing standards and targets the scheme manager and his senior managers are able to assess performance and to strive to make improvements. Over time the scheme managers will become familiar with the performance of their systems, and the causes of low or high performance (which may vary from year to year due to a number of factors). This understanding and knowledge will then enable them to work with the water users and others to raise the performance levels.

In summary the process of performance management for individual schemes will serve to:

- Highlight the performance of irrigation schemes, in particular less well-performing schemes;
- Identify well-performing schemes which could be used as benchmarks and “best practice” examples for others to emulate;
- Highlight the central role played by the ID scheme manager in overall performance of the I&D schemes;
- Encourage ID managers and staff to work in partnership with WUA management and water users to improve overall scheme performance;
- Encourage innovative thinking focussed on improving scheme performance, including conjunctive use of surface and ground water;
- Increase agricultural productivity and water use efficiency and productivity on I&D schemes;
- Lead to increased levels of service fee recovery from water users.

The approach proposed by Dr Tushaar Shah of IWMI to transform the AIBP from a construction-focused programme into a management improvement focused programme is strongly supported. Under the reformed approach states would be supported and rewarded based on the steps they take towards improving the (measured) output and process performance of existing schemes

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Appendix A1: International Experience

A1.1 Examples of performance assessment of six I&D schemes in Egypt

The following data are taken from a benchmarking study carried out in Egypt during 2004-5. The study collected data from schemes rehabilitated under the World Bank funded Irrigation Improvement Project (IIP). Under the IIP secondary canals and mesqas (tertiary units) in selected command areas were rehabilitated and modernized, operation procedures were updated and Water Users Associations formed to manage the tertiary (on-farm) systems.

A central feature of the project was the substantial change in the management and operation procedures on the secondary and tertiary canals. For the evaluation the performance of selected improved secondary and tertiary canals was compared to unimproved secondary and tertiary canals.

For this exercise a table was drawn up (Table A1.1, Figure A1.1) to show:

- where the data were to be collected
- the measurement units
- who was to collect the data
- how it was to be collected
- the frequency of collection
- the period over which the data were to be collected

The cropping pattern for the six branch canals that were studied are presented in Figure A1.2. The use of pie-charts is useful in that it allows a quick visual understanding of the similarities and differences in the cropping pattern in each command area. In this example the five of the studied canal commands have relatively similar cropping, with Daqalt being noticeably different due to the area planted to sugar beet.

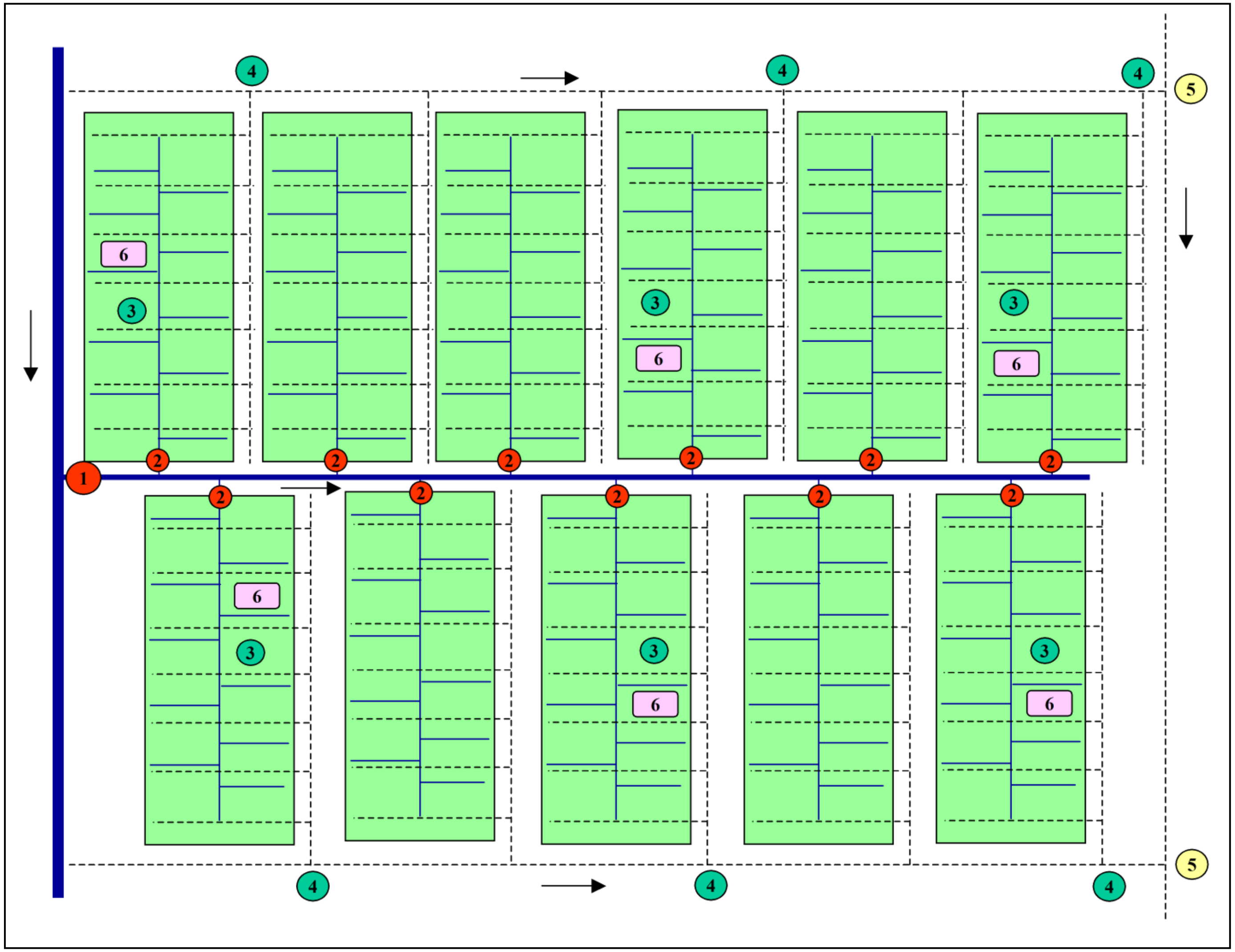
Table A1.2 shows how the irrigation water demand can be calculated for each secondary (branch) canal and information on the value of crop production per unit of water delivered at the secondary (branch) canal intake. Note that due to the mixed cropping and different crop yields the production per unit water consumed is determined for each crop but not for the Branch Canals as a whole. The key indicator is the **value** of the crop production per unit of water consumed which is determined for each crop and the Branch Canal as a whole.

Table A1.3 shows the data needs and calculations to determine the key indicators for secondary (branch) canal performance, showing the total seasonal volume of demand, supply, and delivery per unit area, the main system water delivery efficiency and the seasonal relative irrigation water supply. These figures allow comparison between each secondary canal each year, and when collected for several years allow trend analysis of the performance of each Branch Canal. Note that, in this case, the seasonal relative irrigation water supply is calculated from the irrigation demand in the field and the water delivered at the mesqa intake. The calculation does not include the losses in delivering the water from the mesqa intake to the crop root zone as these losses were not measured during the survey and are thus unquantified. This factor should be taken into account when assessing the values of the relative irrigation water supply (RIWS); for example if the tertiary system losses are 50% a target value of the RIWS (actual supply/demand) would be 2.0. In the case shown here the (surface) irrigation supply may be supplemented by contributions from groundwater.

Table A1.4 provides an example of the data collected and processed to determine the performance indicators related to the MOM cost and number of personnel. In the example shown there are only two sets of data for the six secondary (branch) canals as the canals are located in two Directorates and data for each secondary canal has been derived from the data for each of these Directorates. These costs can be compared with the value of the crops produced, either on a per unit area or per unit water supply basis.

Table A1.5 provides an example of a summary table for presenting drainage information in secondary (branch) canal command areas. Data were collected for tertiary units (mesqas) in each secondary canal command area and summarised in this table. The figures presented are compared with the standards and colour coding used to show areas of concern or critical areas.

Figure A1.1: Example of locations for data collection *(to be read in conjunction with Table A1.1)*



Source: World Bank, 2005a; 2005b

Table A1.1: Example specification for data collection

Map	Location	Data collected	Units	By whom collected	How collected	Frequency of collection	Period collected	Remarks
1	Branch canal intake	Discharge entering branch canal: • Flow depth • Gate opening • Discharge • Duration of flow	 m m m^3/s hrs, mins	Irrigation Service District staff IIS staff	Measurement	Daily	Season	Level data recorded daily by Irrigation Service staff. On two systems water level and gate opening data collected by WMRI under contract to IIP, using automatic water level recorders.
1	Branch canal intake	• Water quality	mmhos/cm	Irrigation Improvement Service (IIS) staff	Measurement	Once per month	Season	Data regularly collected for two canals by Water Management Research Institute (WMRI)
1a	Branch canal tail escape	Discharge leaving branch canal: • Flow depth • Discharge • Duration of flow	 m m^3/s hrs, mins	IIS staff	Measurement	Daily	Season	Data regularly collected for two canals by WMRI
2	Mesqa[1] intake	Discharge delivered to mesqa: • Pumping hours • Pumping head (intake, delivery) • Fuel consumed	 hrs m litres	Pump operator	Measurement	Hourly	Season	Data collected by WUA for all mesqas for charging and cost calculation purposes
3	Selected mesqas in head, middle, and tail)	Groundwater and soil data: • Depth to groundwater • Salinity of groundwater (EC) • Soil salinity at 40 cm depth	 m mmhos/cm mmhos/cm	EPADP staff		10-12 times per season Once/season	Season	12 piezometers installed in each branch canal command.
4	Selected mesqas (outfalls to selected mesqas in the head, middle, and tail)	Drainage water levels: • Number of days collector outlet submerged during season	m	Drainage service field staff	Measurement	Periodically	Season	EPADP field staff will monitor selected collector drain outfalls during the season and record the number of days they are submerged
5	Secondary drain outfall	Drainage water level and flow: • Drainage water level • Discharge • Water quality (EC)	 m m^3/s mmhos/cm	Drainage service field staff EPADP staff	Measurement	Daily (water level) Monthly (water quality)	Season	WMRI are monitoring drainage water quality on a regular basis for two of the systems
6	Selected mesqas along branch canal (head, middle, tail)	• Command area For a typical 10 ha sample area: • Crop type • Crop area • Crop duration • Crop production (bags) • Weight of bags (by crop type) • Crop market price • Cost of production	ha - ha days bags kgs LE[2] LE	WUA IIS staff	Interviews with farmers. From agricultural cooperatives and Ministry of Agriculture	Once per season	Season	Simple crop data collection procedures need to be tested with WUAs to ascertain whether reliable crop data can be obtained for comparison between WUAs. These can be cross checked with data collected from other sources (crop cuttings by Ministry of Agriculture, data collected by agricultural cooperatives, etc.)

6	Selected mesqas along branch canal (10 head, 10 middle, 10 tail)	Water user satisfaction survey: • Satisfaction with water delivery • Satisfaction with drainage removal • Problems/constraints	- -	IIS staff	Survey	2 times per season (mid-season and just after harvest)	Season	
7	District irrigation system	Irrigation Directorate MOM expenditure and staffing: • Total command area • Total annual MOM expenditure (salaries, office costs, operation, maintenance, etc.) • Total annual *planned* maintenance expenditure on canal systems • Total annual *actual* maintenance expenditure on canal systems • Total number of staff • Total cost of staff	ha LE LE LE No. LE	District Irrigation Engineer	Office records	Seasonally	Season	These data are available at the Directorate level. If possible they should be broken down to Branch Canal command areas. If not the Directorate level data can be used as they are representative of the average annual MOM expenditure and maintenance expenditure. Historic data can also be analysed for comparative purposes and trend analysis.
8	District drainage system	Drainage Directorate MOM expenditure and staffing: • Total command area • Total annual MOM expenditure (salaries, office costs, operation, maintenance, etc.) • Total annual *planned* maintenance expenditure on drainage systems • Total annual *actual* maintenance expenditure on drainage systems • Total number of staff • Total cost of staff	ha LE LE No. LE	District Drainage Engineer	Office records	Annually	Season	These data are available at the Directorate level. If possible they should be broken down to Branch Canal command areas. If not the Directorate level data can be used as they are representative of the average annual MOM expenditure and maintenance expenditure. Historic data can also be analysed for comparative purposes and trend analysis.
9	Branch canal and mesqas	Complaints: • Number of complaints • Nature of complaint • Action taken	No. - -	District Irrigation Engineer	Office records	Each season	Season	
9	Branch canal collector drain and secondary drains	Complaints: • Number of complaints • Nature of complaint • Action taken	No. - -	District Drainage Engineer	Office records	Each season	Season	

Source: World Bank, 2005a; 2005b

Notes: 1. Mesqa – Tertiary unit
2. LE – Egyptian pounds

Figure A1.2: Example presentation of cropping patterns

Source: World Bank, 2005a

Table A1.2 Example of irrigation output performance

Season: Winter 2004-05 — Data entry point

	Base data									Outcome indicators						
Name of branch canal	**Com-mand area**	**Crop type**	**Cropped area**		**Crop yield**	**Crop price**	**Irriga-tion water demand**	**Total crop irrigation water require-ment**	**Total seasonal volume of irrigation water supply**	**Total seasonal crop produc-tion**	**Total seasonal value of crop produc-tion**	**Crop yield**	**Total seasonal value of crop produc-tion per unit command area**	**Total seasonal crop produc-tion per unit water consumed**	**Total seasonal value of crop produc-tion per unit water consumed**	**Total seasonal value of crop produc-tion per unit water supplied**
	Fed.		**%**	**Fed.**	**kg/fed.**	**LE/kg**	**m3/fed.**	**m3**	**m3**	**Tonnes**	**'000 LE**	**kg/fed.**	**LE/fed.**	**kg/m3**	**LE/m3**	**LE/m3**
Besentway	5500	Berseem	48.17	2649	3000	0.90	2700	7,153,245		7,948	7,153	3000	2,700	1.11	1.00	
		Wheat	45.9	2525	2860	0.97	1850	4,670,325		7,220	7,003	2860	2,774	1.55	1.50	
		Beans	5.93	326	1350	1.27	1450	472,918		440	559	1350	1,715	0.93	1.18	
		Sugar beet	0	0	22000	0.11	1750	0		0	0	22000	0	0.00	0.00	
		Vegetables	0	0	14000	0.35	1800	0		0	0	14000	0	0.00	0.00	
Branch Canal values			100	5500	-			12,296,488	16,633,728		14,716	-	2,676	-	-	0.88
Zaweit Nain	2000	Berseem	61.1	1222	3000	0.90	2700	3,299,400		3,666	3,299	3000	2,700	1.11	1.00	
		Wheat	34.66	693	2860	0.97	1850	1,282,420		1,983	1,923	2860	2,774	1.55	1.50	
		Beans	4.24	85	1350	1.27	1450	122,960		114	145	1350	1,715	0.93	1.18	
		Sugar beet	0	0	22000	0.11	1750	0		0	0	22000	0	0.00	0.00	
		Vegetables	0	0	14000	0.35	1800	0		0	0	14000	0	0.00	0.00	
Branch Canal values			100	2000	-			4,704,780	6,577,459		5,368	-	2,684	-	-	0.82
El Baidda	5600	Berseem	49.75	2786	3000	0.90	2700	7,522,200		8,358	7,522	3000	2,700	1.11	1.00	
		Wheat	26.2	1467	2860	0.97	1850	2,714,320		4,196	4,070	2860	2,774	1.55	1.50	
		Beans	9.84	551	1350	1.27	1450	799,008		744	945	1350	1,715	0.93	1.18	
		Sugar beet	0	0	22000	0.11	1750	0		0	0	22000	0	0.00	0.00	
		Vegetables	14.21	796	14000	0.35	1800	1,432,368		11,141	3,899	14000	4,900	7.78	2.72	
Branch Canal values			100	5600	-			12,467,896	12,800,160		16,436	-	2,935	-	-	1.28
Daqalt	5400	Berseem	11.31	611	3000	0.90	2700	1,648,998		1,832	1,649	3000	2,700	1.11	1.00	
		Wheat	31.09	1679	2860	0.97	1850	3,105,891		4,802	4,657	2860	2,774	1.55	1.50	
		Beans	20.17	1089	1350	1.27	1450	1,579,311		1,470	1,867	1350	1,715	0.93	1.18	
		Sugar beet	37.43	2021	22000	0.11	1750	3,537,135		44,467	4,891	22000	2,420	12.57	1.38	
		Vegetables	0	0	14000	0.35	1800	0		0	0	14000	0	0.00	0.00	
Branch Canal values			100	5400	-			9,871,335	19,316,511		13,065	-	2,419	-	-	0.68
Sanhour El-Kadeema	5640	Berseem	44.06	2485	3000	0.90	2700	6,709,457		7,455	6,709	3000	2,700	1.11	1.00	
		Wheat	31.99	1804	2860	0.97	1850	3,337,837		5,160	5,005	2860	2,774	1.55	1.50	
		Beans	16.34	922	1350	1.27	1450	1,336,285		1,244	1,580	1350	1,715	0.93	1.18	
		Sugar beet	0	0	22000	0.11	1750	0		0	0	22000	0	0.00	0.00	
		Vegetables	7.61	429	14000	0.35	1800	772,567		6,009	2,103	14000	4,900	7.78	2.72	
Branch Canal values			100	5640	-			12,156,146	4,768,848		15,398	-	2,730	-	-	3.23
Nesheel	3630	Berseem	58.7	2131	3000	0.90	2700	5,753,187		6,392	5,753	3000	2,700	1.11	1.00	
		Wheat	27.2	987	2860	0.97	1850	1,826,616		2,824	2,739	2860	2,774	1.55	1.50	
		Beans	4.53	164	1350	1.27	1450	238,437		222	282	1350	1,715	0.93	1.18	
		Sugar beet	0	0	22000	0.11	1750	0		0	0	22000	0	0.00	0.00	
		Vegetables	9.57	347	14000	0.35	1800	625,304		4,863	1,702	14000	4,900	7.78	2.72	
Branch Canal values			100	3630	-			8,443,543	3,993,408		10,476	-	2,886	-	-	2.62

1 Feddan = 1.04 Acres = 0.42 hectares   1 US$ = 5.78 LE (Aug 2005)

Source:World Bank 2005a; 2005b

Table A1.3: Example of irrigation water delivery performance

Season: Winter 2004-05

Data entry point

Name of Branch Canal	Directorate	Status (Improved/ Unimproved)	Total command area of irrigation system	Total seasonal volume of irrigation water supply	Total seasonal volume of irrigation water delivery	Total seasonal volume of crop water demand (at field)	Canal capacity at head of system	Peak irrigation water demand at head of system	Total seasonal volume of crop water demand (at field)	Total seasonal irrigation water delivery per unit commnand area	Total seasonal irrigation water supply per unit command area	Main system water delivery efficiency	Seasonal relative irrigation water supply
	General data			Irrigation data					Indicators				
			feddans	m3	m3	m3	m3/s	m3/s	m3/feddan	m3/feddan	m3/feddan	%	
Besentway	Behera	I	5,500	16,633,728	7,372,439	12,296,488	n/a	n/a	2236	1340	3024	44.3%	0.60
Zaweit Naim	Behera	I	2,000	6,577,459	4,073,157	4,704,780	n/a	n/a	2352	2037	3289	61.9%	0.87
El Beida	Behera	UI	5,600	12,800,160	7,499,270	12,467,896	n/a	n/a	2226	1339	2286	58.6%	0.60
Daqalt	Kafr El-Sheik	I	5,400	19,316,511	8,570,999	9,871,335	n/a	n/a	1828	1587	3577	44.4%	0.87
Sanhour El-Kadima	Kafr El-Sheik	I	5,640	4,768,848	3,239,384	12,156,146	n/a	n/a	2155	574	846	67.9%	0.27
Neshil El- Kadima	Gharbia	UI	3,630	3,993,408	n/a	8,443,543	n/a	n/a	2326	n/a	1100	n/a	n/a

n/a - Data not available

Source: World Bank, 2005a; 2005b

Table A1.4: Example of assessment of MOM costs

Season: Winter 2004-05

Data entry point

General data			Area		Water supply	Directorate annual costs and personnel				Branch Canal annual costs and personnel			
Name of Branch Canal	Directorate	Status (Improved/ Unimproved)	Command area of Branch Canal	Total command area of Directorate	Total seasonal volume of irrigation water supply	Total annual Directorate MOM expenditure	Total annual Directorate O&M costs	Total number of Directorate personnel	Total annual cost of Directorate personnel	Total annual Branch Canal MOM costs	Total annual Branch Canal O&M costs	Total annual Branch Canal personnel cost	Total Branch Canal personnel
	-	-	feddans	feddans	m3	LE	LE	No.	LE	LE	LE	LE	No.
Besentway	Behera	I	5,500	360,000	16,633,728	13,270,000	9,700,000	915	3,570,000	202,736	148,194	54,542	13.98
Zaweit Naim	Behera	I	2,000	360,000	6,577,459	13,270,000	9,700,000	915	3,570,000	73,722	53,889	19,833	5.08
El Baidda	Behera	UI	5,600	360,000	12,800,160	13,270,000	9,700,000	915	3,570,000	206,422	150,889	55,533	14.23
Daqalt	Kafr El-Sheik	I	5,400	300,000	19,316,511	12,000,000	6,000,000	800	3,000,000	216,000	108,000	54,000	14.40
Sanhour El-Kadeema	Kafr El-Sheik	I	5,640	300,000	4,768,848	12,000,000	6,000,000	800	3,000,000	225,600	112,800	56,400	15.04
Nesheel	Gharbia	UI	3,630	300,000	3,993,408	12,000,000	6,000,000	800	3,000,000	145,200	72,600	36,300	9.68

Performance Indicators					
Branch Canal seasonal costs and personnel per unit area					
Total seasonal MOM costs for irrigation water delivery per unit command area	Total seasonal MOM costs for irrigation water delivery per unit irrigation water supply	Total seasonal maintenance expenditure for irrigation water delivery per unit command area	Total annual maintenance expenditure fraction for irrigation water delivery	Total cost per person employed on water delivery	Irrigation command area per unit staff
LE/feddan	LE/m3	LE/feddan	-	LE/person	Feddan/person
18.43	0.012	13.47	0.73	3,902	393
18.43	0.011	13.47	0.73	3,902	393
18.43	0.016	13.47	0.73	3,902	393
20.00	0.011	10.00	0.50	3,750	375
20.00	0.047	10.00	0.50	3,750	375
20.00	0.036	10.00	0.50	3,750	375

Note: O&M costs taken as maintenance costs
as operation cost element is low

Source: World Bank 2005a; 2005b

Table A1.5: Example of a summary of drainage performance at tertiary unit level

Season: Winter 2004-05

Branch Canal	Mesqa	Grounwater level (m)		Groundwater salinity (Mmhos/cm)		Soil salinity (Mmhos/cm)		Crop yield (tonnes/feddan)			
								Wheat		Beans	
		Top	Tail	Top	Tail	Top	Tail	Top	Tail	Top	Tail
Besentway	Sharaf Elden 1	90	93	1	1.2	1.36	0.46	3	2.4		
	Sharaf Elden 2	65	68	1.5	1.6	0.85	0.45	1.6	3.2	1.34	1.42
	Eldeb and Abdallah	60	75		1.2		0.9	2.2	2.68	1.28	1.2
	El Tlaten	65	85	2.7	2.6	1.19	0.67	3.16	2.72		
	El Tabakh	82		2.1		0.43			2.8	1.27	1.15
	El Shnawy	50	93	2.8	2	0.46	0.8	3.52	1.8		
	Average values	**69**	**83**	**2.02**	**1.72**	**0.86**	**0.66**	**2.70**	**2.60**	**1.30**	**1.26**
Zaweit Naim	Omr Darwesh	58	61	1.5	1.9	0.69	1.16	2.8	1.52		1.22
	Eslah Naaym	32	60	1.5	3	0.2	0.26	2.6	3.68	1.57	1.28
	Elmostahdasa	64	58	1.9	2.1	0.74	0.89	1.4	3.2		
	Mohamed Ramadan	55	54	5.7	4.8	0.68	0.98	3.72	1.8		
	Saleh Elbana	55	54	3.2	1.8	0.36	0.66				
	Elbarada	54	50	2	3	0.52	0.93	2.2	2.4	1.1	
	Average values	**53**	**56**	**2.63**	**2.77**	**0.53**	**0.81**	**2.12**	**2.10**	**0.45**	**0.42**
El-Baidda	Mesqa 1	62	56	1.4	1.5	0.91	0,68	1.84	1.48	1.55	1.22
	Mesqa 2	92	101	1.9	2.7	1.01	1.13	2.12	3.44	1.34	1.42
	Mesqa 3	93	98	3	3.1	1.9	1.3	1.95	2.05	1.57	1.34
	Mesqa 4	72	96	1.9	3.8	0.66	0.71	1.87	1.75	1.28	1.2
	Mesqa 5	74	81	1.4	1.5	1.92	0.75				
	Mesqa 6	55	60	1.6	1.7	0.92	2.13				
	Average values	**75**	**82**	**1.87**	**2.38**	**1.22**	**1.00**	**1.95**	**2.18**	**1.44**	**1.30**
Daqalt	El Beda	70	82	1	0.9	1.5	1.65			1.1	
	El Hohoda	72	70	1.2	1	2.65	2.69		2.56		
	Om Hnesh	65	98	0.9	3.2	2.1	2.3				1.3
	El Raha	78	45	2.1	0.9	2.5	2.6		2.12		
	El Kom	45	55	0.8	2.2	3.2	2.3			1.5	
	Shams Elden	75	60	2.1	2	2.3	2.5	2.25			
	Average values	**68**	**68**	**1.35**	**1.70**	**2.38**	**2.34**	**2.25**	**2.34**	**1.30**	**1.30**
Sanhour El-Kadeema	El Oydat	50	50	3.5	2.2	2.5	2.7		5.06	1.7	
	El Sant	45	45	3.1	3.8	3.8	5.4	5.8	5.8	1.4	1.6
	El Nahal	70	96	3.7	3.2	3.1	2.9	2.45	2.45		1.3
	Mobasher 9	40	43	2	3.7	3.4	3.3	5.4	5	1.5	1.2
	Mobasher 15	58	50	1.8	1.6	2.5	3.3		5.9	1.5	
	Mobasher 16	50	63	1.2	1.5	2.6	3.5	5.4	5.2		
	Average values	**52**	**58**	**2.55**	**2.67**	**2.98**	**3.52**	**4.76**	**4.90**	**1.53**	**1.37**
Nesheel	El Hoyyd	75	92	7.5	9.3	0.69	1.16	2.8	2.16		
	El Barary	82	108	1.8	3.2	0.2	0.26	2.4		1.3	1.5
	Gobran	77	75	1.5	6.2	0.74	0.69	3	2.96		
	Andria	75	92	2.4	10.3	0.66	0.48				1.4
	Naser 1	93	90	1.8	8.1	0.36	0.66		2.33	1.4	
	Naser 2	93	92	2.2	4.7	0.52	0.73		2.2		
	Average values	**83**	**92**	**2.87**	**6.97**	**0.53**	**0.66**	**2.73**	**2.41**	**1.35**	**1.45**

Area of concern **Critical value**

Source: World Bank, 2005a; 2005b

National Water Resources Framework Study

Ground Water Management

Working Paper No.5:

Managing Ground Water for Multiple Uses

Rahul Sen and Martin Burton

Contents

Questions raised

The following questions were raised by the Planning Commission with regard to managing ground water for multiple uses:

Energy-ground water nexus

- What is the best way to break the "energy-ground water" nexus?
- Can we develop a State-specific road-map of reforms in breaking the "energy-ground water" nexus?
- What conclusions should we draw from the work of Aditi Mukherji on West Bengal in this respect?
- Is metering/licensing of ground water an option?

Legal reforms

- Does India need new ground water legislation in line with the PTD enunciated by the Supreme Court?

Ground water quality

- Do we know enough about arsenic in ground water? Is it true that we still do not understand what triggers the occurrence of arsenic in ground water as scientists from Bangladesh recently told me? What is the state of knowledge on this internationally?

Institutional reforms A

- If we are to take the required steps in the direction of sustainable ground water management, what kinds of changes are required in the CGWB, CGWA and the SGWBs?
- What are the kinds of partnerships these institutions would need to develop with other agencies?

Institutional Reforms B: AMAs

- What would be the best institutional design for Aquifer Management Associations (AMAs)?
- What would be their interface with the statutory ground water bodies?
- How best could the AMAs be part of river basin planning?

International experience

- What does the international experience on ground water management teach us (especially Spain, Mexico)?

Case study: AP

- What does the APFMGS experience on ground water management teach us?
- Detailed case-study of APFMGS

Case study: Gujarat

- What does the Gujarat experience in the first decade of the 21st century teach us? Is the Gujarat turnaround (on ground water levels) mainly attributable to separation of feeders? What was the contribution of the larger power sector reforms in this?

1. Introduction

This Working Paper discusses the status, concerns and possible future course of actions for management of ground water in India. Since irrigation occupies the most space in volumetric terms in ground water use, the paper focuses on issues related to it analysing its present status, the problems arising out to it, some experiences in trying to manage these problems and possible future actions that may be considered.

The paper seeks to address the questions posed on ground water management by the National Planning Commission: (i) What does the international experience on ground water management teach us (especially Spain, Mexico); (ii) What does the APFMGS experience on ground water management teach us; (iii) Detailed case-study of APFMGS; (iii) Is metering/licensing of ground water an option; (iv) What does the Gujarat experience in the first decade of the 21st century teach us? Is the Gujarat turnaround (on ground water levels) mainly attributable to separation of feeders? What was the contribution of the larger power sector reforms in this; (v) What is the best way to break the "energy-ground water" nexus; (vi) Can we develop a State-specific road-map of reforms in breaking the "energy-ground water" nexus; (vii) What conclusions should we draw from the work of Aditi Mukherji on West Bengal in this respect; (viii) Do we know enough about arsenic in ground water? Is it true that we still do not understand what triggers the occurrence of arsenic in ground water? What is the state of knowledge on this internationally; (ix) If we are to take the required steps in the direction of sustainable ground water management, what kinds of changes are required in the CGWB, CGWA and the SGWBs; (x) What are the kinds of partnerships these institutions would need to develop with other agencies; (xi) What would be the best institutional design for Aquifer Management Associations (AMAs); (xii) What would be their interface with the statutory ground water bodies; and (xiii) How best could the AMAs be part of river basin planning?

A number of case studies are provided in the appendices. Appendix A1 provides examples of experience with the management of groundwater in the western United States: (i) with the Central Arizona Project where water from the Colorado River has been transported 540 kms to restore the groundwater balance in three counties in Arizona; (ii) the Deschutes River Conservancy, which seeks to restore depleted groundwater and surface water flows by purchasing unused water rights from Irrigation Districts, and (iii) the Edwards aquifer of south-central Texas, which has been brought under the control of the Edwards Aquifer Authority that has been given broad powers to regulate withdrawals from the Edwards aquifer following serious decline of groundwater levels over recent years. Appendix A1 also provides details of groundwater use and management in Spain, and the establishment of groundwater aquifer management councils (COTAS) in Mexico.

Appendix A2 provides examples of groundwater management programmes in India with the Andhra Pradesh Farmers Managed Groundwater Systems Project and a description of the Jyotirgram Scheme and groundwater management in Gujarat.

2. Background to ground water management and use in India

Ground water availability in India is still good and apparently even huge. But, it is highly variable in space and time. Besides, there are instances when large parts of the country get deficit rainfall leading to crisis and scarcity. Even areas famous for high rainfall face water shortages at one time or the other.

The proximity of the country to the equator and the fact that the country lies within the tropics (southern part) and in sub-tropics (northern part) lends huge draught on the water that is received through rainfall and is stored in sub-soils or surface water bodies. Evaporation losses are estimated to about 40 to 60% of the annual precipitation. Water availability is further skewed by the fact that there is high variability in the number of rainy days in different parts of the country. There are just 20 rainy days per annum in north-western parts that increase to about 40 to 60 in the central and southern India (increasing from west to east). Similarly, while the north-eastern parts get 140 to 180 rainy days, the regions west of the Sahyadries get around 80 to 120 rainy days.

The country can be divided into two distinct hydrological units. These are:

- The Indus-Ganga-Brahmaputra (Indo-Gangetic region) water regions that has almost 50% of the country's surface water and 46% of dynamic ground water resource and 70% of all the utilizable ground water of the country. These are part of sandy alluvial aquifers.
- The region forming the rest of the country, which comprises 18 other rivers catchments. These regions have both granular aquifers and compact rock aquifers.

The Indo-Gangetic region is endowed with high amount of resources as this belt is a fortuitous mix of high rainfall zone and dry season snow melts from the Himalayan Mountains and the thick alluvial aquifer system, which forms an unusually big and copious storehouse of ground water. South of this catchment is the Indian plateau, the Deccan Traps, which forms high grounds and on the west the Aravalis, which also forms high topographic region, thus completely separating the Indo-Gangetic regions from rest of the country. The rivers of the region are seasonal, with largely compact rock aquifers mostly poor with low well yields (many of them seasonal, which function only in the wet season). Semi-arid to arid regions lie in these catchments, while the south-west region is tropical humid.

There are essentially two types of aquifers in India in roughly 1:3 proportions. These are the granular aquifer and the compact rock aquifers.

The granular aquifer with inherent pore spaces or porosity occurs in about a third of the country. These are further classified as sandy alluvial aquifer, which is loose unconsolidated sand of different sizes and mixed with clays in various proportions (Indo-Gangetic alluvial plain, many coastal and deltaic areas and flood plains of the rivers and streams); and the loosely consolidated or semi-consolidated porous rocks and consolidated porous rocks aquifers (in the coal and oil bearing regions of the country).

The compact rock aquifers lack inherent porosity. But, subsequently due to geologic forces acting on them these rocks develop pore spaces or fractures or fissures (secondary porosity) good enough to hold and transmit water. About two-third of the country has these types of aquifers. Ground water in India is found within the confines of these two distinct types of aquifers.

The first systematic estimation of ground water availability in the country was made by the Ground water Over Exploitation Committee in 1979 that assessed the gross ground water recharge as about 460 billion cubic metres (bcm) and the net recharge as about 320 bcm.

Later in 1995 the assessment was further refined[42] and the annual replenishable ground water resources was estimated to about 432 bcm and the ground water resources available for irrigation use was estimated to about 361 bcm. In terms of utilizable irrigation potential this volume of useable ground water was assessed to about 64.5 million ha. The most recent assessment carried out in 2004[43] has only marginally increased the annual replenishable ground water resources to 433 bcm but revised the assessment of the net annual ground water availability to 399.25 bcm.

The detailed state wise ground water recharge, availability, utilization and stage of development based on the 2004 estimate is given in Table 1[44]. The Table shows that by 2004 the total ground water use in the country was 230.62 bmc with irrigation use at 212.51 bmc (92.15%) and domestic and industrial use at 18.09 bmc (7.85%), which gave the country a ground water development stage of 58%. Ground water is therefore an important resource for meeting the needs for irrigation, domestic and industrial use in the country.

About 55% of water demand for irrigation is met from ground water primarily extracted from the shallow aquifers of upto 50 m by about 25 million water extraction devices installed by farmers through their private investments. Off these about 15.9 million (CEA, 2009) are electricity energized pump sets while the remaining are powered by diesel. The net area irrigated by ground water is around 33.28 million ha (61%)[45]. Agriculture contributes about 17% of the country's GDP (2010-11)[46] and between 70-80%[47] of that is estimated to come from ground water irrigation. In other words about 10% of the national GDP is ground water based.

This was not the case at the time of independence (1947) when ground water based irrigation was comparatively less and primarily carried out using mechanical devices from dug wells and the number of energized pump sets in the country was only 21,000 (CEA, 2009). The government policy was to create irrigation potential in the country through river valley projects and surface canal systems. However, by the mid-1960s there was a shift in the government position to include promoting ground water based irrigation in its irrigation programme. The government thereafter aggressively persuaded the farmers to install electric pump sets and the state owned power utilities were asked to scale up their rural electrification programme and sanction agriculture connections on priority.

This was aided by the fact that new modular well and pump technologies became widely available in the country along with easy subsidized credit to finance them. Ground water irrigation was also realized as an effective mechanism to control the problem of water logging and salinity by lowering ground water levels in the effected areas Punjab, Harayana and Uttar Pradesh. Further, farmers' found ground water irrigation very convenient as they could have it "on demand" and "just in time" in contrast to the uncertainty and unreliability of canal irrigation. The legal position of land owners having absolute and inalienable right over the ground water underlying their field[48] allowed farmers to extract as much ground

[42] CGWB 1995 Ground water Resources of India

[43] CGWB 2006 Dynamic Ground water Resources of India (as on March 2004)

[44] Garg, N. K. and Hassan, Q. in their paper "Alarming Scarcity of Water in India" Current Science Vol. 83 No. 7 have, however, questioned these estimates and argue that the level of ground water development is much higher.

[45] CWC, 2005, Water Sector at Glance, Table : 2.12 State / Source-Wise Net Area Irrigated

[46] GoI, 2011 Economic Survey 2010-11

[47] World Bank and GoI, 1998 p. 2

[48] Under provisions of Indian Easements Act, 1882; Transfer of Property Act; and 1882 and Land Acquisition Act, 1894.

water as they desired without any obstruction from the government or the neighbour, something not possible in canal irrigation.

Through the last three decades of 2000 and to this day the march of ground water irrigation continues in the country spreading out of the Indo-Gangetic alluvial plains of north India to the semi-arid hard rock regions of peninsular India and the arid zones of western India. Along with it, it has brought complex problems and adverse impacts that are not only making ground water irrigation economy in the country unsustainable jeopardizing the livelihoods of millions of people but also creating rippling effects on other sectors of the economy and society. In the next section we shall analyze these major problems and actions that have been taken or proposed to mitigate them. In the final section we shall propose a framework for sustainable ground water management that may be considered for adoption by the government during the 12th Plan and onwards.

Table 1: State Wise Ground Water Resources Availability, Utilization and Stage of Development (for 2004)

Sl. No.	State/Union Territory	Annual Replenishable Ground Water Resources (bmc)					Natural Discharge During Non Monsoon Season (bmc)	Net Annual Ground Water Availability (bmc)	Annual Ground Water Draft (bmc)			Ground Water Availability for Future Irrigation (bmc)	Stage of Ground Water Development (Percentage)
		Monsoon Season		Non Monsoon									
		Recharge Rainfall	Recharge Other Sources	Recharge Rainfall	Recharge Other Sources	Total			Irrigation	Domestic and Industrial Use	Total		
1	Andhra Pradesh	16.04	8.930	4.20	7.33	36.50	3.55	32.95	13.88	1.02	14.90	17.65	45
2	Arunachal Pradesh	1.57	0.00009	0.98	0.0002	2.56	0.26	2.30	0.0008	0	0.0008	2.29	0.04
3	Assam	23.65	1.99	1.05	0.54	27.23	2.34	24.89	4.85	0.59	5.44	19.06	22
4	Bihar	19.45	3.96	3.42	2.36	29.19	1.77	27.42	9.39	1.37	10.77	15.89	39
5	Chattisgarh	12.08	0.43	1.30	1.13	14.93	1.25	13.68	2.31	0.48	2.80	10.67	20
6	Delhi	0.13	0.06	0.02	0.09	0.30	0.02	0.28	0.20	0.28	0.48	0.00	170
7	Goa	0.22	0.01	0.01	0.04	0.28	0.02	0.27	0.04	0.03	0.07	0.18	27
8	Gujarat	10.59	2.08	0.00	3.15	15.81	0.79	15.02	10.49	0.99	11.49	3.05	76
9	Haryana	3.52	2.15	0.92	2.72	9.31	0.68	8.63	9.10	0.35	9.45	-1.07	109
10	Himachal Pradesh	0.33	0.01	0.08	0.02	0.43	0.04	0.39	0.09	0.02	0.12	0.25	30
11	Jammu & Kashmir	0.61	0.77	1.00	0.32	2.70	0.27	2.43	0.10	0.24	0.33	1.92	14
12	Jharkhand	4.26	0.14	1.00	0.18	5.58	0.33	5.25	0.70	0.38	1.09	3.99	21
13	Karnataka	8.17	4.01	1.50	2.25	15.93	0.63	15.30	9.75	0.97	10.71	6.48	70
14	Kerala	3.79	0.01	1.93	1.11	6.84	0.61	6.23	1.82	1.10	2.92	3.07	47
15	Madhya Pradesh	30.59	0.96	0.05	5.59	37.19	1.86	35.33	16.08	1.04	17.12	17.51	48
16	Maharashtra	20.15	2.51	1.94	8.36	32.96	1.75	31.21	14.24	0.85	15.09	16.10	48
17	Manipur	0.20	0.005	0.16	0.01	0.38	0.04	0.34	0.002	0.0005	0.002	0.31	0.65
18	Meghalaya	0.79	0.03	0.33	0.005	1.15	0.12	1.04	0.00	0.002	0.002	0.94	0.18
19	Mizoram	0.03	0.00	0.02	0.00	0.04	0.004	0.04	0.00	0.0004	0.0004	0.04	0.90

Sl. No.	State/Union Territory	Annual Replenishable Ground Water Resources (bmc)					Natural Discharge During Non Monsoon Season (bmc)	Net Annual Ground Water Availability (bmc)	Annual Ground Water Draft (bmc)			Ground Water Availability for Future Irrigation (bmc)	Stage of Ground Water Development (Percentage)
		Monsoon Season		Non Monsoon									
		Recharge Rainfall	Recharge Other Sources	Recharge Rainfall	Recharge Other Sources	Total			Irrigation	Domestic and Industrial Use	Total		
20	Nagaland	0.28	0.00	0.08	0.00	0.36	0.04	0.32	0.00	0.009	0.009	0.30	3
21	Orissa	12.81	3.56	3.58	3.14	23.09	2.08	21.01	3.01	0.84	3.85	16.78	18
22	Punjab	5.98	10.91	1.36	5.54	23.78	2.33	21.44	30.34	0.83	31.16	-9.89	145
23	Rajasthan	8.76	0.62	0.26	1.92	11.56	1.18	10.38	11.60	1.39	12.99	-3.94	125
24	Sikkim	-	-	-	-	0.08	0.00	0.08	0.00	0.01	0.01	0.05	16
25	Tamil Nadu	4.91	11.96	4.53	1.67	23.07	2.31	20.76	16.77	0.88	17.65	3.08	85
26	Tripura	1.10	0.00	0.92	0.17	2.19	0.22	1.97	0.08	0.09	0.17	1.69	9
27	Uttar Pradesh	38.63	11.95	5.64	20.14	76.35	6.17	70.18	45.36	3.42	48.78	19.52	70
28	Uttarakhand	1.37	0.27	0.12	0.51	2.27	0.17	2.10	1.34	0.05	1.39	0.68	66
29	West Bengal	17.87	2.19	5.44	4.86	30.36	2.90	27.46	10.84	0.81	11.65	15.32	42
	Total States	247.88	69.51	41.83	73.15	432.42	33.73	398.70	212.38	18.04	230.44	161.92	58
	Total UTs	0.138	0.075	0.012	0.031	0.597	0.036	0.556	0.129	0.051	0.181	0.365	33
	All India	248.01	69.59	41.85	73.19	433.02	33.77	399.25	212.51	18.09	230.62	162.29	58

Source: Central Ground Water Board 2010, Ground Water Scenario of India 2009-10

3. Issues with ground water management and use

3.1. Ground water overdraft

Table 2: State Wise Ground Water Ultimate Irrigation Potential and Created Potential (2001)

Sl. No.	Name of the State/UT	Ground Water Irrigated Area (million ha)		
		Ultimate Potential	Created Potential	Percentage*
1	Andhra Pradesh	3.96	1.95	49.34
2	Arunachal Pradesh	0.02	0.00	0.00
3	Assam	0.90	0.00	0.22
4	Bihar	4.95	2.09	42.31
5	Goa	0.03	0.02	65.52
6	Gujarat	2.76	2.45	88.97
7	Haryana	1.46	1.47	100.34
8	Himachal Pradesh	0.07	0.01	20.59
9	Jammu & Kashmir	0.71	0.00	0.28
10	Karnataka	2.57	1.02	39.55
11	Kerala	0.88	0.12	13.20
12	Madhya Pradesh	9.73	2.65	27.24
13	Maharashtra	3.65	1.91	52.35
14	Manipur	0.37	0.00	0.00
15	Meghalaya	0.06	0.00	0.00
16	Mizoram	0.01	0.00	0.00
17	Nagaland	0.01	0.00	0.00
18	Orissa	4.20	0.77	18.42
19	Punjab	2.92	2.88	98.73
20	Rajasthan	1.78	3.47	195.33
21	Sikkim	0.00	0.00	0.00
22	Tamil Nadu	2.83	1.45	51.17
23	Tripura	0.08	0.00	4.94
24	Uttar Pradesh	16.80	9.38	55.86
25	West Bengal	3.32	1.40	42.10
	Total UTs	0.12	0.05	41.38
	All India	64.17	33.28	51.86

Source: Central Water Commission 2005, Water Sector at a Glance

* Calculated from Columns 3 and 4

The total ground water irrigation potential in the country is estimated to be around 64.5 million ha of which the net irrigation potential already created is 33.28 million ha (51.6%). From this it appears that there is still the potential to nearly double the net irrigated area underground water. However, this pan India estimate hid alarming regional status where the potential created has already exceed or nearing the ultimate potential. States such as

Rajasthan (195%), Haryana (100%), Punjab (99%) and Gujarat (89%) already faced this situation in 2001[49].

At a further lower geographical level of ground water assessment (block/mandal/taluks/etc.) even more areas show this trend. According to the CGWB criteria for categorization of ground water assessment unit 839 (15%) of the ground water assessment units in the country are over exploited[50], 226 (4%) are critical, 550 (10%) are semi-critical and the remaining 4078 (71%) are safe. The state wise status of categorization of ground water assessment unit is given in the Table 3.

Table 3: State Wise Categorization of Ground Water Assessment Units (2004)

Sl. No.	States / Union Territories States	Total No. of Assessed Units	Safe		Semi-critical		Critical		Over-exploited		Percentage Unsafe Units
			Nos.	%	Nos.	%	Nos.	%	Nos.	%	%
1	Andhra Pradesh	1231	760	62	175	14	77	6	219	18	38.3
2	Arunachal Pradesh	13	13	100	0	0	0	0	0	0	0.0
3	Assam	23	23	100	0	0	0	0	0	0	0.0
4	Bihar	515	515	100	0	0	0	0	0	0	0.0
5	Chattisgarh	146	138	95	8	5	0	0	0	0	5.5
6	Delhi	9	2	22	0	0	0	0	7	78	77.8
7	Goa	11	11	100	0	0	0	0	0	0	0.0
8	Gujarat	223	97	43	69	31	12	5	31	14	50.2
9	Haryana	113	42	37	5	4	11	10	55	49	62.8
10	Himachal Pradesh	5	5	100	0	0	0	0	0	0	0.0
11	Jammu & Kashmir	8	8	100	0	0	0	0	0	0	0.0
12	Jharkhand	208	208	100	0	0	0	0	0	0	0.0
13	Karnataka	175	93	53	14	8	3	2	65	37	46.9
14	Kerala	151	101	67	30	20	15	10	5	3	33.1
15	Madhya Pradesh	312	264	85	19	6	5	2	24	8	15.4
16	Maharashtra	318	287	90	23	7	1	0	7	2	9.7
17	Manipur	7	7	100	0	0	0	0	0	0	0.0
18	Meghalaya	7	7	100	0	0	0	0	0	0	0.0
19	Mizoram	22	22	100	0	0	0	0	0	0	0.0
20	Nagaland	7	7	100	0	0	0	0	0	0	0.0
21	Orissa	314	308	98	0	0	0	0	0	0	0.0
22	Punjab	137	25	18	4	3	5	4	103	75	81.8
23	Rajasthan	237	32	14	14	6	50	21	140	59	86.1
24	Sikkim	1	1	100	0	0	0	0	0	0	0.0
25	Tamil Nadu	385	145	38	57	15	33	9	142	37	60.3
26	Tripura	38	38	100	0	0	0	0	0	0	0.0

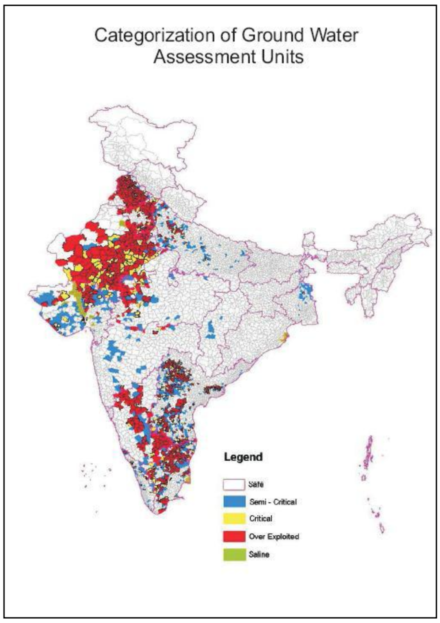
[49] CWC, 2005, Water Sector at Glance

[50] Over exploited - > 100% stage of ground water development; Critical - > 90% and </= 100%; Semi Critical - > 70% and </= 90%; and Safe - </= 70%

Sl. No.	States / Union Territories States	Total No. of Assessed Units	Safe		Semi-critical		Critical		Over-exploited		Percentage Unsafe Units
			Nos.	%	Nos.	%	Nos.	%	Nos.	%	%
27	Uttar Pradesh	803	665	83	88	11	13	2	37	5	17.2
28	Uttarakhand	17	12	71	3	18	0	0	2	12	29.4
29	West Bengal	269	231	86	37	14	1	0	0	0	14.1
	Total States	5705	4067	71	546	10	226	4	837	15	28.2
	Total UTs	18	11	61	4	22	0	0	2	11	33.3
	All India	5723	4078	71	550	10	226	4	839	15	28.2

Source: Source: Central Ground Water Board 2006, Dynamic Ground Water Resources of India (as on March 2004)

Figure 1: Ground Water Assessment Units



The table shows that states of Andhra Pradesh, Gujarat, Haryana, Karnataka, Punjab, Rajasthan and Tamil Nadu already had more than one third of their ground water assessment units under the unsafe category in 2004. These are also the states that have already developed a high percentage of their ultimate potential for ground water irrigation. Geographically, the unsafe ground water assessment units (Figure 1) are found clustered in the dry north-west region and the semi-arid south-central and south-east region of India, which are known to have ground water aquifers of limited capacity.

The ground water level fluctuation analysis carried out by CGWB (2011) also show significant falling trend in ground water levels in these areas over the last decade. Off the 10561observation wells monitored by CGWB for ground water levels in August 2009, it found that 3761 wells showed fall of 0-2 m against the decadal mean (1999-2008), 1410 wells showed fall of 2-4 m against the decadal mean and 906 wells showed fall of >4 m against the decadal mean. Similarly, during the month of January 2010 it found that 3768 wells showed fall of 0-2 m against the decadal mean (2000-2009), 1080 wells showed fall of 2-4 m against the decadal mean and 690 wells showed fall of >4 m against the decadal mean. The geographical distribution of the water level fluctuation for the months of August 2009 and January 2010 are given in Figures 2 and 3, which also clearly show clustering in the dry north-west and semi-arid south-central/south-east region of the country.

Figure 2: Water level fluctuations for August 2009

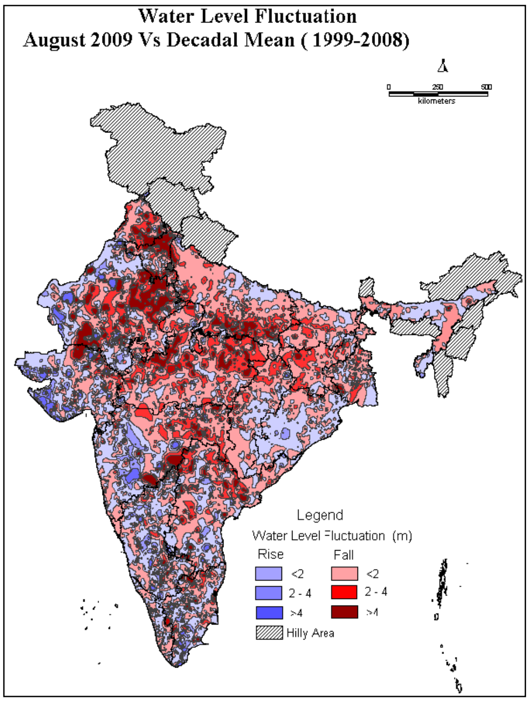
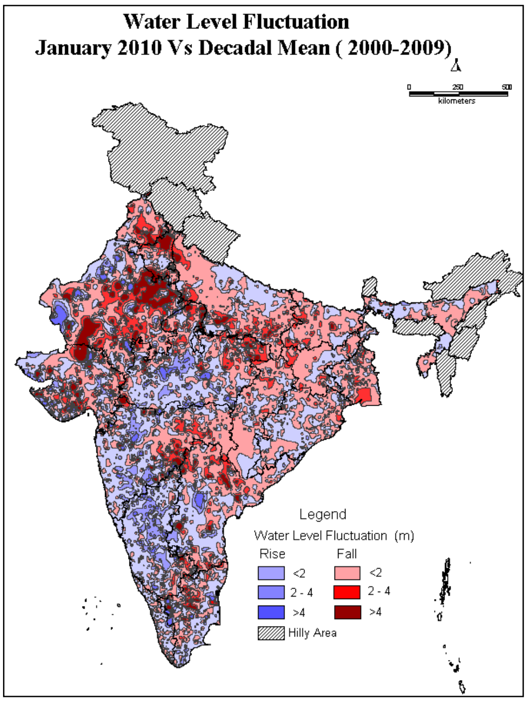


Figure 3: Water level fluctuations for January 2010



Source: Central Ground Water Board 2010, Ground Water Scenario of India 2009-10

3.2. Agricultural energy consumption

As already mentioned, the rapid spread of ground water irrigation in India has been achieved through private investment by the farmers on energized ground water extraction devices that had been facilitated by easy availability of subsidized credit and energy sources. Records show that between 1951 and 2009 the number of agricultural electric pump sets increased from 26,000 to 15.9 million and agricultural diesel pump sets from 83,000 to 7.2 million. By 2009 CEA reported a cumulative energizing of 16.18 million pump sets.

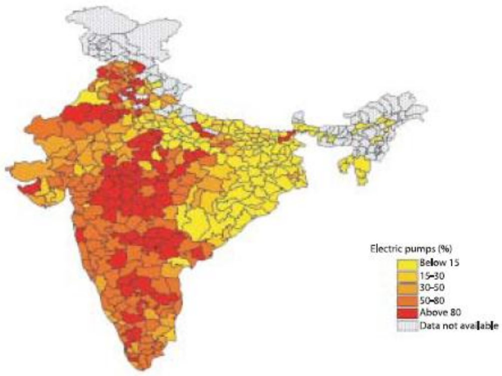
Table 4: Trend in Growth of Irrigation Pump Sets

Year	Electric Pumps	Diesel Pumps	Total
1951	26,000	83,000	109,000
1961	160,000	230,000	390,000
1972	1,618,000	1,546,000	3,164,000
1982	3,568,000	3,101,000	6,669,000
1991	9,696,000	4,659,000	14,355,000
2003	8,446,000	7,237,000	15,683,000
2009*	16,184,257		

Source: IASRI 2010, Agricultural Research Data Book 2009 (http://www.iasri.res.in/agridata) / * CEA 2010, Annual Report 2009-10

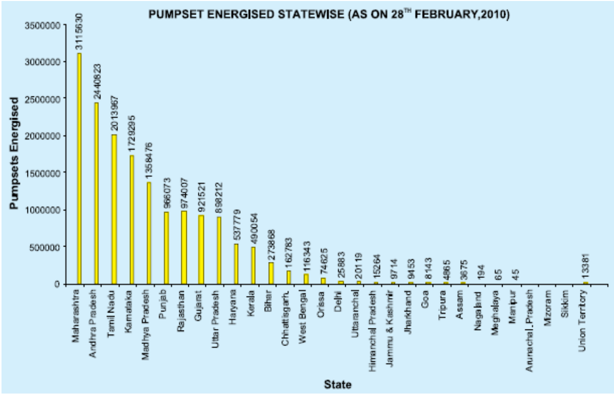
The rapid growth in agricultural pump sets has led to a corresponding increase in energy consumption both in terms of electricity and diesel. Interestingly, these two sources of energy use also have a definite regional determinant as can be seen from Figures 4 and 5 that plot the geographical distribution of electric and diesel pump sets in the country and the state wise number of energized pump sets.

Figure 4: Distribution of electric pumps



Source: Shah, et. al. 2003

Figure 5: Distribution of diesel pumpsets



Source: Source: CEA 2010, Annual Report 2009-10

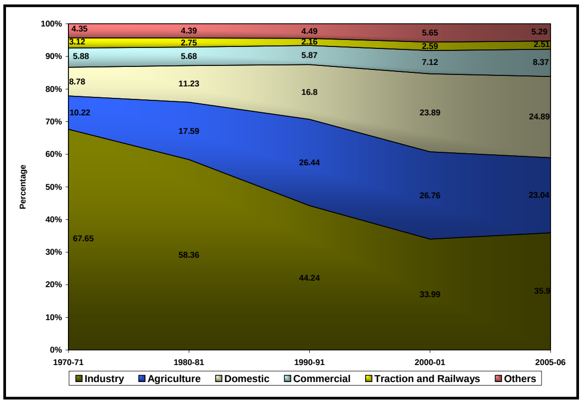
One consequence of such large numbers of energized agriculture pump sets is that agricultural consumption is rapidly increasing and emerging as a major consumer of electricity in the country. This regular growth in agricultural consumption can be seen from the aggregated user sector wise consumption of electricity at the country level from 1970-71 to 2005-06 as given in Table 5. The Table shows that while industrial consumption has increased by about 500% between the period 1970-71 and 2005-06 agricultural consumption has increased by 2141% during the same period. Only domestic consumption has grown at a higher rate of 2692%. The total energy consumption in the country during this period has increased by 950%.

Table 5: Sector Wise Electricity Consumption in India (in MW)

Year	Industry	Agriculture	Domestic	Commercial	Traction and Railways	Others	Total energy consumed
1970-71	29,579	4,470	3,840	2,573	1,364	1,898	43,724
1980-81	48,069	14,489	9,246	4,682	2,266	3,615	82,367
1990-91	84,209	50,321	31,982	11,181	4,112	8,552	190,357
2000-01	107,622	84,729	75,629	22,545	8,213	17,862	316,600
2005-06	149,092	95,685	103,368	34,761	10,424	21,969	415,299
% >Increase (1970-71 & 2005-06)	504	2,141	2,692	1,351	764	1,157	950

Source: IASRI 2010, Agricultural Research Data Book 2009 (http://www.iasri.res.in/agridata)

In terms of percentage of total energy consumed (Figure 6), agricultural consumption has showed a steady increase from 10.22 in 1970-71 to 26.76% in 2000-01 and then a slight decline to 23.04% in 2005-06. During the same period industrial consumption as percentage of total energy consumed has declined from 67.65% in 1970-71 to 35.9% in 2005-06. Only domestic consumption has showed comparable grow



during this period from 8.78% in 1970-71 to 24.89% in 2005-06.

It has been observed that the SEBs have the tendency to report part of their T&D losses as agricultural consumption both to conceal inefficiencies and power theft and to recover the cost of the lost power under agricultural tariff subsidies offered by the governments. Table 6 gives the annual percentage composition of agricultural and T&D losses for 4 states between 1995-96 and 2001-02. All the states have undergone unbundling during this period.

Table 6: Power Supply to agriculture and T&D Losses

	1995-96	**1996-97**	**1997-98**	**1998-99**	**1999- 2000**	**2000-01**	**2001-02**
Andhra Pradesh							
Agriculture % of total sales	***48***	***37***	39	39	40	39	40
%T&D loss	***19***	***33***	33	32	35	33	33
Karnataka							
Agriculture % of total sales	46	46	***52***	***44***	39	37	40
%T&D loss	19	19	***19***	***30***	38	37	36
Maharashtra							
Agriculture % of total sales	32	32	35	***34***	***25***	26	25
%T&D loss	15	18	17	***16***	***31***	30	28
Uttar Pradesh							
Agriculture % of total sales	36	36	35	***35***	***19***	20	18
%T&D loss	23	27	26	***26***	***42***	40	39

Source: Planning Commission

It is observed that SEBs of each state has upward adjustment its % T&D losses and downward adjustment its agricultural consumption during this period (Andhra Pradesh between 1995-96 and 1996-97; Karnataka between 1997-98 and 1998-99; Maharashtra between 1998-99 and 1999-2000; and Uttar Pradesh between 1998-99 and 1999-2000). However, even after this downward adjustment, the percentage share in agricultural consumption to the total power consumption is significant in all the four state (Andhra Pradesh – 37%; Karnataka – 44%; Maharashtra – 25%; and Uttar Pradesh – 19%).

Hence, it is evident that agriculture has emerged as a major consumer sector for the power utilities and the service and tariff conditions offered to the sector has become an important and significant determinant of the health of the utilities.

4. Energy ground water nexus

This rapid growth in agricultural pump sets in the country side has developed into a special energy ground water relation often referred to as a “nexus” in the ground water irrigation research in the country. One face of this nexus is the electricity tariff policy of the power utilities for agriculture consumption and its impact on ground water use for irrigation. The other is the price of diesel, which determines the cost of ground water irrigation for diesel pump set farmers and their access to irrigation services. Interestingly, the two faces of the energy ground water nexus also have a definite regional determinant. Agricultural electricity tariff policy, therefore, invariably excites the farmers in the north-west and southern region of the country, while the price of diesel is a factor that most agitates farmers in the central and eastern Ganga-Brahmaputra basin.

4.1. Energy ground water nexus – electricity pricing

4.1.1. Bane of a flat tariff regime

As mentioned above, it became a clear government policy during 1960s to promote ground water irrigation using electricity. To make it happen the government made available on priority power connection and credit to the farmers. However, during the initial years, when the number of agricultural connections was less, the State Electricity Boards, the sole service providers then, provided the service on actual consumption basis on metered each connection. The agricultural tariffs then were not highly subsidized and in fact were higher than the industrial tariff, which was then highly subsidized.

By the mid-1970s the number of electric pump sets had increased to such extent that the SEBs started finding it difficult and costly to individually meter them for charging. The transaction costs of agricultural supply – in terms of the cost of containing rampart tampering of meters, under-billing and corruption at the level of meter readers, of maintaining an army of meter readers and increasing pilferage of power - were to high and administratively cumbersome and needed an alternate solution. A 1973 study of multiple states by the Rural Electrification Corporation found that the cost of metering electricity consumption by farmers and rural households was over 40% of the cost of the power.

Hence, to minimize the costs involved in metering, billing and collection of charges from the scattered agricultural consumers, the SEBs shifted away from metering sales to flat tariff based on the capacity of the pump. The strategy was to assess an appropriate tariff based on an average annual level of power consumption by pumping capacity (HP). It was also envisaged that this tariff would be adjusted as per the cost of services for agricultural consumption. UPSEB was the first to introduce the flat tariff practice in 1975, which was soon followed by a number of other states.

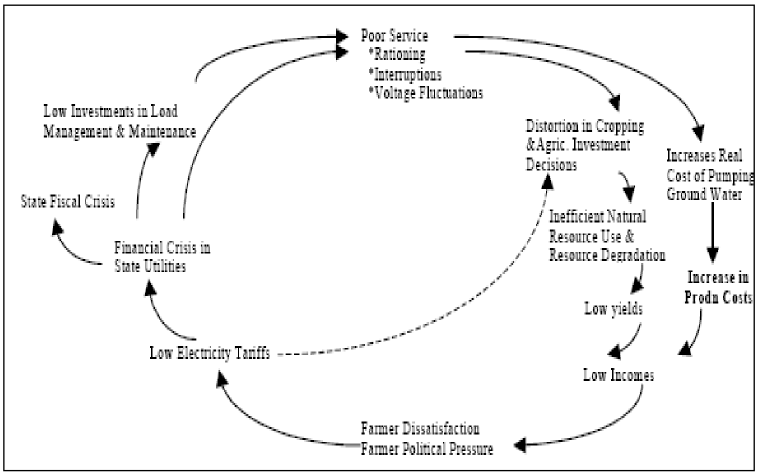
Flat tariffs, however, soon became "sticky" for the SEBs. As the power supply to agriculture emerged as a major driver of irrigated agriculture, governments and farmers found it's pricing a powerful weapon in populist posturing. On one side, the governments were inclined to keep flat tariffs low as a visible sign of their concern for poor farmers, on the other, any talk of raising tariff invariably led to farmer mobilization and agitation pressurize the government to withdraw.

Unable to increase the flat tariff for years on end and under pressure from the government to supply abundant power to farmers, SEBs soon began to find their balance sheets turning red. The sector managers as well as its investors (such as multilateral donors) have therefore veered around to the view that reverting to a metered tariff for the agricultural power supply is a precondition to restoring the viability of the power industry (pro-rota metering). Recounting this argument the World Bank in its report India: Power Supply to Agriculture – Vol. 1 Summary Report" (World Bank, 2001) lists the cost of flat tariff as

"…From the utility's point of view, providing agricultural power costs more than supplying industry because the fixed costs per hook-up of serving connections spread across the countryside and the line losses are much higher. The political pressures that have resulted, over time, in increasing subsidization of electricity tariffs to agriculture have made many of the electricity utilities unviable and resulted in low capital investments without which reliability suffers. Distribution losses due to widespread pilferage further exacerbated the situation, the resultant inadequate and deteriorating quality of supply of electricity to farmers, the frequent power outages and voltage fluctuations. As a consequence, consumer

dissatisfaction increased and, with it, unwillingness to pay even highly subsidized charges. As users often postpone paying electricity bills and resist tariff revisions, cost recovery diminishes for the utility, further perpetuating the circle."

Figure 7: Power ground water nexus



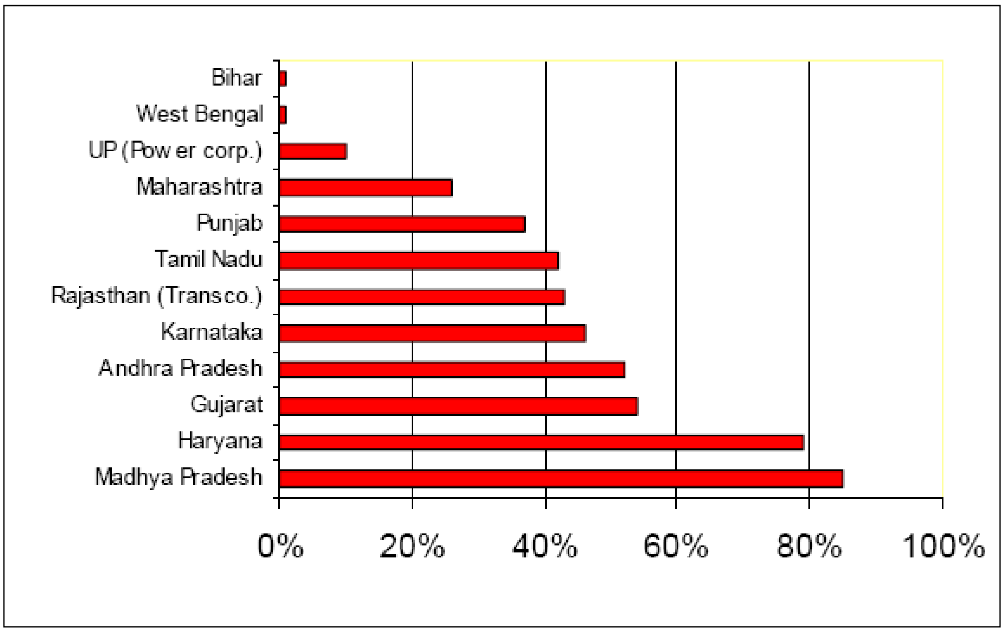
For the farmer, the costs are

"…in power outages, damaged pumping equipment, irrigation foregone because of power losses, distorted investment patterns, among others – exact a heavy toll from ordinary farmers. In the form of deficits, the subsidies also sap state budgets of funds that could otherwise be invested in rural infrastructure, extension services and advanced agricultural technology. As unrecovered costs, they starve suppliers of funds for maintenance and improved service. On the other side of the coin lie the benefits that reliable flows of power and good quality of other electricity services could deliver to rural India".

The report visualizes the power ground water nexus vicious circle burdening the energy utilities as given in Figure 7.

The World Bank (Briscoe and Malik, 2005) has estimated the subsidies to farmers on power consumption account for about 10% of the total cost of supply, or about Rs. 240 billion a year. This is equivalent to about 25% of India's fiscal deficit with large impacts on fiscal deficits at the individual state level. Figure 8 gives the power subsidy to agriculture as percentage of gross fiscal deficit of selected states for the year 2000-01. Interestingly again, it is the states of north-west and southern region of the country that show high percentages (> 25%) while the states of the central and eastern Ganga-Brahmaputra basin that show low percentages (< 10%).

Figure 8: Power subsidy percentage



The solution advocated by the protagonists of pro-rota metering is to charge agricultural customers at the cost of service level based on metered use of power. This would ensure the health of the power utilities and enable investments to improve quality of power supply to villages.

4.1.2. Flat tariff regime has virtues

Contrary to this “neo-classical economic” view on flat tariff regime for agricultural consumption is the “institutional economic” view of it propagated by a group of natural resource economists and ground water experts. Question the theoretical premise of pro-rota metering they argue that it considers only the “transformation cost” of generating and distributing power and overlooks the “transaction costs” of unit pricing of the power supply to farmers – the original cause for shifting to the flat tariff policy.

However, their defence of the flat tariff regime goes beyond the issues of administrative and managerial aspects of utility management. They argue that one of the major outcomes of flat tariff is the equity in access to ground water regime it has promoted in many states. Under the flat tariff regime owners of pump sets have a positive incentive to sell water to others. With the marginal cost of pumping becoming zero or near zero, additional hours of pumping does not entail additional costs. However, by selling water, the pump owners are able to recoup their electricity bills and also earn some profit. This increases access of irrigation for farmers who cannot afford their own pump sets allowing distribution of the benefit of irrigation to them, most of whom happen to be small and marginal farmers. As a direct result cropping intensity goes up, as does demand for labour. Since there were a number of pumps owners in any village there was competition among pump owners to sell water to their neighbouring farmers giving the irrigation buyers a choice of alternate sellers making the ground water market a buyers’ market. This pared down the price of water to its lower levels effectively making available irrigation to the small and marginal farmers at costs comparable to that for pump owners.

Studies show that existence of ground water markets and their efficient functioning have facilitated water buyers to achieve similar cropping pattern, cropping intensity, crop productivity and even comparable gross incomes as pump owing farmers (Shah, 1993, Dubash, 2000 and Mukherji, n.d.). Analysing the data related to 294 pump owners and 286 water buyers from 40 villages in West Bengal Mukherji (Mukherji, n.d.) found that cropping intensity for the two categories of farmers was 184% and 180%, respectively. Similarly, the productivity of boro paddy for both categories of farmers was 6.7 q/bigha[51] and potato was 21.6 and 24.0 q/bigha, respectively. In terms of gross income too the amounts were comparable at Rs. 4160 per year per bigha for the pump owners and Rs. 3811 per year per bigha for water buyers. Based on her studies she goes on to claim that

“At a macro level too, it was precisely the rise in ground water irrigation through the operation of ground water markets that propelled West Bengal to very high rates of agricultural growth in the 1980s and 1990s. Thus, …ground water markets have been beneficial to West Bengal’s rural economy and introduction of flat rate tariff … has helped in further developing such markets.”

In this context, the proponents of the flat tariff regime claim that a change in mode of electricity pricing to pro-rota metering would immediately change the incentive structure for ground water markets. Under the pro-rota metering regime the marginal cost of pumping would no longer be zero and so either the pump owner will stop selling water or increase the price to levels (higher than the cost of supplying water - cost of pro-rota power consumption

[51] In West Bengal 1 bigha equals to 1333.33 m²

+ profit) that would become unaffordable to non-pump owning small and marginal farmers. This would revert back the productivity and incomes of such farmers to levels of rain fed farming bringing back inequity to access to irrigation.

4.1.3. Towards a rational flat tariff regime

The proponents of the flat tariff regime argue that the problem of a flat tariff is not in its economy but in the way power is supplied to agricultural consumers. This is because the power utilities have failed to invest more intelligence in managing a rationed power supply to agricultural consumers. Until now, most SEBs has tried to maintain the duration of the farm power supply at 8-15 hours per day right through the year. However, for farmers a good quality power supply is not long durations of power supply but supply of power of uniform voltage and frequency during the time crops face critical moisture stress. Hence, supplying quality power to agricultural consumers during these periods would satisfy their needs. There is no need to supply power to them for long hours all year round. Based on the cropping pattern, crop water requirement and the soil moisture stress of an area the power utilities can propose a rooster of power supply to the farmers for irrigation services. This could then develop into a rational power supply strategy for agricultural consumption.

However, implementing such an intelligent power supply to agricultural consumers requires fulfilling certain preconditions (Shah, et. al, 2003).

i. Separation of agricultural and non-agricultural power supply - Typically in rural power supply, the lowest level of 11 KV feeders serves a group of 2 to 5 villages wherein all connections – domestic, agricultural, and commercial – are through this feeder. Consequently, the power utilities have to maintain 24 hours supply in the feeder and are unable to ration power supply for agricultural consumption by switching off supply. To restrict agricultural use the power utilities supply few hours of 3-phase power through the feeder and switch to 2-phase during the remaining hours of the day. The reason is that pump sets require 3-phase power supply for operation while domestic and commercial needs can be met with 2-phase supply. This strategy for power rationing to agriculture has not worked as farmers have found a technical solution to the phase problem[52] and are able to run pump sets at will and for longer hours. A solution to this problem is to separate the agricultural and non-agricultural feeder to a village with 24 hour supply of 2-phase power through the non-agricultural feeder and an agreed duration of supply of 3-phase power through the agricultural feeder. After providing the agreed duration of power supply through the agricultural feeder the power utility can completely switch off supply through it thereby effectively rationing the use of power for agricultural consumption. Gujarat under its Jyotirgram scheme has implemented the separation of the agricultural and non-agricultural feeder and its power utilities are already benefiting from its impact.

ii. Enhancing the predictability and certainty of supply better matched to the peak demand period – More than the total quantity of power delivered it is the timely and adequate quality of power supply that is important for the farmers. Hence, announcing a seasonal schedule of power supply finely tuned to match the demand pattern of the farmer[53] would result in power utilities not only to efficiently service the needs of irrigation but also effectively ration power supply to them.

[52] Farmers use phase splitting capacitors on the pump sets to convert 2-phase power supply to 3-phase power supply. Although this has adverse impacts both on the pump set and the feeder line it allows farmers to run their pumps at will and for longer hours than intended by the power utilities.

[53] Comparable to the water scheduling practiced in canal irrigation

iii. Use of off-peak power – A large part of the power for agricultural consumption is supplied during the off-peak hours, especially during the night. In fact, but for the agricultural supply, power utilities would be hard pressed to dispose of this power. The proportion of agricultural power supply during off-peak hours can be further increased. This would not only improve the efficiency of the power utilities but also keep the cost of service of agricultural supply low decreasing the level of subsidy to irrigation.

iv. Better up keep of power supply infrastructure and improving the quality of power supply – Power utilities should supply quality power to farmers at uniform voltage and frequency to ensure minimum damage to the motors and pumps and downtime of transformers. This can also be ensured by the power utilities by better maintaining the transmission and distribution infrastructure in the rural areas.

v. Using a progressive flat tariff structure – At present the flat tariff regime follows an annual charge per horsepower capacity. This has led to farmers to install larger than required capacity pump sets as the cost per horsepower is the same. In contrast, a flat tariff regime charging higher rates for increasing horsepower of pumps, i.e. differential rates for increasing pump capacity may be considered. This would provide incentive to the farmers to install smaller capacity efficient pump sets that would consume less power.

While a rational flat tariff regime has its advantages, experience from Gujarat (Shah et. al 2008) and West Bengal (Mukherji, A. n.d.) show that they have direct adverse impact on the small and marginal farmers. In a flat tariff regime, because of the near zero marginal cost of pumping, pump owners sell water to their neighbouring non pump owning farmers who are mostly marginal and small farmers. As already mentioned above, this ground water markets and their efficient functioning has facilitated water buyers to achieve similar cropping pattern, cropping intensity, crop productivity and even comparable gross incomes as pump owing farmers.

However, with the introduction of a rational flat tariff regime, especially with rationing of power supply on separation of feeders, the pumping hours significantly decrease. There is now sufficient irrigation supply only for the pump owner, which results in constricting the irrigation water market. The immediate sufferers are the marginal and small non pump owning farmers who not only lose the irrigation service but also the cropping pattern, cropping intensity, crop productivity and incomes that came with it.

Hence, implementation of a rational flat tariff regime will require concurrent implementation of a targeted compensatory subsidy to mitigate the losses of the marginal and small farmers. If ground water status is significantly improved them subsidized credit for pump installation and subsidy on power tariff needs to be made available to the marginal and small farmers. This may be possible through direct cash transfer using either the route of a smart cash cards or Aadhaar UID cards.

4.2. Conserving agricultural energy use – efficient technology solutions

4.2.1. High voltage distribution system (HVDS)

Rural electricity networks in India, in line with pre-independence (English) practices, is characterized by long low tension (LT) network fed from an 11/0.4 kV transformer. Even for supplying to widely dispersed load blocks of agricultural pumps, similar LT network arrangement has been adopted resulting in an unsatisfactory situation stemming from factors like[54]:

[54] Study carried out for NPCL in Andhra Pradesh

- Rampant pilferage from accessible low voltage lines causing revenue losses - field survey suggested that on an average, there existed 2 cases of unauthorized abstraction of energy for every 3 authorized agricultural connections
- High technical losses attributable to high LT current on the network - calculations based on field data indicated that for a group of load consisting of 3 authorized and 2 unauthorized pump connections, the technical loss accounted for 8.17% of the total energy intake for 3 authorized connections
- High peak power loss of network due to unauthorized load - for a given situation of 3 authorized and 2 unauthorized pumps, the peak power loss was found 40 % of the total authorized power requirement
- Unsatisfactory voltage profile at consumer installations - the minimum voltage at the customer premises was recorded as 370 Volts against the rated voltage of 430 Volts
- Unreliable supply consequent upon overloading of LT lines - LT faults per annum per 100 circuit km of lines supplying agricultural pumps were as high as 1500.

Against this backdrop, high voltage distribution system (HVDS) has been conceived as a means to curb the menace of pilferage of energy, reduce peak power loss, improve voltage profile and enhance reliability of supply arrangement.

HVDS represents a North American practice whereby the HV line is extended up to the load point. In the Indian agricultural situation it means tapping supply off from 3-phase HV mains in proximity of an agricultural pump and providing power via a distribution transformer of 10 kVA capacity to serve a 5-7 HP load. This would restrict the LT line to the length of the service cable.

The HVDS scheme piloted by NPCL showed benefits to NPCL as well as to the farming community. Losses attributable to pilferage reduced significantly, thereby making the investments productive, while voltage conditions improved, thereby arresting damage to the pump motor. More significantly, compelling circumstances were created for unauthorized consumers to regularize their supply, as the HV lines were out of bounds for dishonest abstraction of electricity. Elimination of pilferage has led to virtual nullification of the peak power loss, thereby freeing up capacity to serve regular loads. The voltage profile at the pump end has improved from 370 volts to 400 volts, thereby improving the pump efficiency. Motor windings have also been spared the fluctuations in voltage profile, resulting in increased life. An incidental benefit has been that the distribution transformers have been relieved of overloading, resulting in a lower overall failure rate.

Experience from Andhra Pradesh show that conversion to HVDS has the potential to reduce agricultural power consumption on an existing connection by about 20%, which then becomes available for supply to other consumers. The NPCL pilot showed that the payback period for one HVDS scheme implemented to reconfigure network for a 3 authorized and 2 unauthorized connections is 2.75 years.

HVDS conversion has been introduced in Andhra Pradesh by all the four distribution companies through the replacement of lengthy low voltage network with high voltage network and with installation of small capacity distribution transformers like 25/16/10 KVA for supply to agricultural consumers and 648,582 agricultural pump sets have been covered by September 2010 at the cost of Rs. 1974.45 crores (approximately Rs. 30,500 per pump). At present HVDS conversion is ongoing for another 155,000 agricultural pump sets at the cost of Rs. 533.63 crores (approximately Rs. 34,400 per pump) and proposal has been submitted to the Government of Andhra Pradesh for sanction of another 2,24,000 agricultural pump sets at the cost of Rs.990.00 crores (approximately Rs. 44,000 per pump).

The Andhra Pradesh experience in HVDS conversion shows that it can become a major technological solution to reducing agricultural power consumption in the country.

4.2.2. Efficient pumps

There are several estimates of energy efficiency and conservation potential in the Indian economy. Most of them are based their assessment at the macro level taking note of some demonstration projects that were implemented in various sectors. Prominent amongst them are the Integrated Energy Policy (2006) that provides an estimate of energy saving potential in the Indian economy of about 15-20% and the very recent National Mission for Enhanced Energy Efficiency that seeks to unlock a market potential of Rs. 74,000 crores and an avoided capacity addition of 19,000 MW. In this background, Bureau of Energy Efficiency, Government of India considered it necessary to carry out a detailed assessment of energy saving potential state-wise in some key sectors of the economy. National Productivity Council was tasked to undertake this work in all 35 states / UTs (BEE, 2011). The study focused on estimation of the total electricity consumption and saving potential in the following sectors of each state / UT:

- Agricultural pumping
- Municipal water and sewage pumping, street lighting
- Commercial buildings like hotel/resorts, hospital, shopping mall/multiplex, office building, public park/monument having connected load of more than 500 KW
- Representative small and medium enterprises (SMEs) which have high saving potential

In agriculture sector, the major energy consumption is in the area of energizing agricultural pumps. Based on several studies carried out on agricultural pump set efficiency, it has been found that the pump efficiency varies from 25-35% due to various factors. By adopting BEE star labelled agricultural pump sets, the efficiency can be enhanced upto 50-55%. It is therefore estimated that, by replacement of existing agricultural pumps with the BEE star labeled pumps, the achievable energy saving potential is between 30-40%. Projecting this potential on the total present agricultural consumption of 92.33 billion kWh BEE reports that there is a possibility of saving 27.79 billion kWh simply replacing.

Table 7: State wise energy saving potential from improving agricultural pump efficiency

Sl. No.	Name of State	Agricultural Pump sets		Percentage Energy Saving (%)
		Consumption (MU)	Saving Potential (MU)	
1	Andhra Pradesh	14480	4340	30.0
2	Assam	5.6	1.7	30.4
3	Bihar	305	92	30.2
4	Chattisgarh	1413	432	30.6
5	Delhi	37	11	29.7
6	Goa	5.72	1.7	29.7
7	Gujarat	11950	3586	30.0
8	Haryana	6700	2010	30.0
9	Himachal Pradesh	26.5	7.95	30.0
10	Jammu & Kashmir	196	58.8	30.0
11	Jharkhand	59	17.7	30.0
12	Karnataka	10981.5	3250	29.6
13	Kerala	240	72	30.0
14	Madhya Pradesh	7032	2260	32.1
15	Maharashtra	4893	1469	30.0
16	Orissa	147	44.1	30.0
17	Punjab	8500	2550	30.0
18	Rajasthan	8140	2442	30.0
19	Tamil Nadu	10030	3000	29.9
20	Tripura	4.79	1.44	30.1
21	Uttar Pradesh	5693	1700	29.9
22	Uttarakhand	300	90	30.0
23	West Bengal	1110	333	30.0
24	All India	92249.11	27770.39	30.1

Source: BEE, 2011. State-wise Electricity Consumption and Conservation Potential in India

In follow up to this BEE has already instituted technical field studies for preparation of detailed project documents for pump replacement in the seven states of Maharashtra, Rajasthan, Gujarat, Punjab, Haryana, Andhra Pradesh and Karnataka.

Field testing of this preposition has been carried out in states like Andhra Pradesh, Madhya Pradesh and Gujarat and detailed project proposals drawn up in Karnataka, Maharashtra and Andhra Pradesh. In Madhya Pradesh MPSEB replaced 50 agricultural pump sets under a pilot project supported by CIDA. On an average, the power saving per pump set was 45%. A similar pilot project of agricultural pump replacement was carried out in Gujarat by the Institute of Cooperative Management, Ahmedabad. Under this project 1009 pump sets were replaced with an average per pump power saving of 47%. A third larger scale pilot of agricultural pump replacement was implemented in Andhra Pradesh by the AP State Electricity Board with DFID funding. Under this pilot 1600 agricultural pumps were replaced in Nalgonda district. The average power saving achieved in this project was around 40%. A final pilot has been initiated in Karnataka by BESCOM with financial support from USAID (WENEXA Project) for the replacement of 700 pump sets with the issuing for RFP for bidding by ESCOs. The technical studies carried out under the WENEXA project indicate that on an average power saving can be achieved to the level of 30-40% depending on the efficiency of the present pump set in use.

Scaling up of these pilots, detailed project proposals have been prepared for states of Maharashtra and Andhra Pradesh. In the case of Maharashtra, MSEDCL with financial support of BEE, GoI has issued RFP for the replacement of 4475 agricultural pump sets in Sholapur district at an estimated cost of Rs. 68 crores (per pump set cost approximately Rs. 1,52,000). In the case of Andhra Pradesh, JICA has funded a study to prepare a pump replacement project in coordination with APTRANSCO as an extension of the in pipe line project of HVDS conversion of agricultural connection in the state. The study proposes the replacement of 400,000 pump sets all over the state at the cost of Rs. 1600 crores (per pump cost of Rs. 40,000).

4.2.3. Micro-irrigation

Micro irrigation concepts date back to as early as 1917. Originally developed in England, Denmark, Germany, New Zealand and America for irrigating greenhouse crops, drip irrigation became a commercially viable technology only after the advent of inexpensive, weather-resistant polyethylene plastics post World War II in Australia and Israel. In India, drip irrigation technologies arrived in the 1970s from developed countries like Israel and the USA.

Though both drip and sprinkler irrigation method of irrigation is treated as micro irrigation, there are distinct characteristics differences between the two in terms of flow rate, pressure requirement, wetted area and mobility. While drip method supplies water directly to the root zone of the crop, sprinkler irrigation method sprinkles water into the air through nozzles which subsequently break into small water drops and fall on the field surface. Since drip irrigation method supplies water directly to the root zone of the crop the water losses occurring through evaporation and distribution are completely absent. The on-farm irrigation efficiency of properly designed and managed drip irrigation system is estimated to be about 90%, while the same is only about 35-40% for flood method of irrigation. In sprinkler irrigation method, water saving is relatively low, up to 70 percent, as compared to drip irrigation since it supplies water over the entire field of the crop.

Micro-irrigation is introduced primarily to save water and increase the water use efficiency in agriculture. However, it also delivers many other benefits. Reduction in water consumption due to drip method of irrigation over the flood method of irrigation varies from 30-70 percent for different crops. Apart from reducing water consumption, drip method of irrigation also helps reducing cost of cultivation and improving productivity of crops as compared to the same crops cultivated under flood method of irrigation. Quite a few studies have studied the impact of drip method of irrigation on productivity of crops. They show that the productivity of different crops is significantly higher under drip method of irrigation when compared to flood irrigation method. Productivity increase due to drip method of irrigation is noticed over 40% in vegetable crops such as bottle gourd, potato, onion, tomato and chillies, whereas the same is noticed over 70% in many fruit crops. Productivity difference is also found to be over 33% in sugarcane cultivated under drip irrigation method over the same crop cultivated under flood irrigation method. While increasing the productivity of crops significantly, drip irrigation method also reduces weed problems, soil erosion and cost of cultivation substantially, especially in labour-intensive operations. The reduction in water consumption in micro-irrigation also reduces the energy use (electricity) that is required to lift water from irrigation wells.

Table 8. Irrigation Service Companies and range of products

Sl. No.	Company Name	Location	Products
1	Nagarjuna Fertilizers & Chemicals Limited	Hyderabad, Andhra Pradesh	In line drip laterals flat, In line drip laterals cylindrical, Plain laterals, HDPE sprinkler pipes and welding PVC pipes
2	Jain Irrigation Systems Ltd	Jalgaon, Maharasrhta	Micro irrigation systems and components, PVC and PE piping systems, moulded and extruded plastic products and plastic sheets
3	Hallmark Aqua equipment Pvt. Ltd.	Kolkata, West Bengal	Sprinkler irrigation system, Micro sprinkler, Dripper and Foggers
4	Tijaria Polypipes Ltd.	Jaipur, Rajasthan	Micro drip irrigation system and HDPE sprinkler system,
5	Netafim Irrigation India Pvt. Ltd.	Vadodara, Gujarat	Agricultural drip products, Sprinkler / Micro sprinkler products and Irrigation systems

4.3. The other face of energy ground water nexus: escalating diesel prices

As already observed earlier, the central and eastern Ganga Brahmaputra basin faces a different kind of energy ground water nexus – the escalating diesel price. As the other parts of the country, this region also experienced rapid growth of ground water irrigation during the period 1960s to 1980s through electric pump sets, both private and public[55]. Here too the SEBs moved from a pro-rota metered tariff to a flat rate tariff like the rest of the country during the 1970s. However, unlike the other states the flat tariff rates were fixed reasonably high close to the breakeven point for the pre-change level of average electricity consumption and raised at regular intervals to reach Rs. 50/ hp/ month in early 1990s in Uttar Pradesh. Such high rates were also maintained in West Bengal where the charges were Rs. 1100 per year/tube well in 1991. The consequence of these comparable higher rates of electricity and also progressive rural de-electrification of eastern India[56] led to farmers shifting to diesel pump sets instead of the electric ones. The low cost of diesel and its easy availability further promoted this shift, which was facilitated by the shallow and abundant ground water table in the region[57]. Use of diesel pump sets rapidly spread in the region and soon replaced most of the electric pump sets.

For a long time the government has provided high subsidy on diesel maintaining its price at levels that made ground water irrigation through diesel pump sets still accessible to farmers of this region despite the de-electrification. This had also led to the development of a diesel pump set based ground water market, which although not very cheap still brought irrigation services to the small and marginal farmers.

However, after the advent of the economic liberalization process in the country since 1991 and the policy of deregulation of the price of fossil fuel to integrate the Indian energy market

[55] In Uttar Pradesh World Bank and the Royal Netherlands Government assisted public tube well schemes were implemented during the 1980s. Similar public tube well programmes were implemented in West Bengal, Bihar and Orissa.

[56] Rural de-electrification in eastern India was primarily due to poor maintenance of transmission and distribution infrastructure, pilferage of assets and lack in augmenting generation capacity. This led to creation of areas of "electrically privileged" and "electrically deprived" in the eastern states.

[57] The depth of ground water table and its geological occurrence in the western Ganga basin and in the western and peninsular region of India does not allow for use of diesel pump sets for its extraction.

into the world market the price of diesel has risen steadily resulting in adverse impact on the ground water market in eastern India.

Analysis from West Bengal (Mukherji, n.d.) shows three kinds of impact of escalating diesel cost on ground water markets. First, the most immediate impact is the contraction of the water market operations. This shrinkage in water market transactions and the absence of any other affordable irrigation source has negatively affected the water buyers who were primarily small and marginal farmers. Therefore, the escalation in diesel price has hurt the poor farmers the hardest.

Second, there has been a shift away from boro paddy cultivation to rain fed crops or vegetable and orchard crops. Irrigated boro paddy, though highly water intensive, was the most profitable crop in West Bengal, which had driven the agricultural grown in the state during the 1990s. However, with high cost of diesel the input output price ratio for boro crop has reversed and made it less profitable. Water buyers are no longer able to afford the quantity of water required to irrigate boro paddy. At the same time, inadequate marketing channels and lack of insurance and credit market has made emerging alternatives such as vegetable and orchard crops risky ventures. Therefore the direct impact of the increase in diesel prices has been the lowering of cropping intensity, productivity and changing of cropping pattern back to rain fed cropping systems.

Third, in response to escalating diesel prices farmers have resorted to dubious technical innovations such as use of light weight Chinese pumps smuggled from Bangladesh that can also be operated with kerosene or cooking gas.

5. Management of ground water

5.1. The supply side management – recharging the ground water

Farmers, NGOs and government have been more enthusiastic to augmenting the supply of ground water resources than contain its demand and overdraft. There are particular hydro-geological and sociological reasons for this. First, ground water irrigation in India primarily relies on the dynamic, shallow circulating ground water up to the depth of about 50 m that can be recharged through natural and artificial means. Second, the annual ground water draft in India is just around 5% of the country’s rainfall while the natural recharge is between 7-10%. Third, India’s high rural labour availability increases the feasibility of farm and community level rainwater harvesting and management options such as watershed management programmes.

Towards this, harvesting rainfall and using proximate water bodies such as tanks, dug wells, streams and canals for ground water recharge is becoming increasingly common. In southern India, where irrigation tanks were the main stay of agriculture for centuries, it is now common for communities to convert the irrigation tank into recharge tank by sealing the sluice. A number of NGOs in the country have supported local communities in taking ups these activities with encouraging results.

Table 9: Area covered and expenditure on watershed development programmes in India

Sl.	Ministry / Scheme and Year of Inception	Total Since Inception up to March, 2006	
		Area (in million ha)	Expenditure (in Rs. Crore)
(A) Ministry of Agriculture (Department of Agriculture & Cooperation)			
1.	NWDPRA (1990-91)	8.559	2,671.56
2.	RVP & FPR (1962 & 81)	6.251	2,037.74
3.	WDPSCA (1974-75)	0.353	255.58
4.	RAS (1985-86)	0.687	105.94
5.	WDF (1999-2000)	0.039	21.02
6.	EAPs	1.715	3,567.35
Sub Total		17.60	8,659.19
(B) Ministry of Rural Development (Department of Land resources) *			
1.	DPAP (1973-74)	12.177	4,482.50
2.	DDP (1977-78)	6.738	1,679.88
3.	IWDP (1988-89)	8.457	1,953.15
4	EAP	0.397	212.67
Sub Total		27.768	8,328.20
(C) Ministry of Environment & Forests			
1.	NAP (1989-90)	0.070	47.53
TOTAL (A+B+C)		45.442	17,034.92

Source: Ministry of Rural Development, Government of India

In support of this effort, the India government too runs a nation-wide watershed development programme to improve soil and moisture regime and make rainfed farming productive. However, both in terms of works taken up and the expectation of the beneficiaries ground water recharge appears to be its purpose. Over the last decades the cumulative expenditure by the government on watershed development programmes is about Rs. 17034.92 crores covering and area of 45.4 million ha. Further, the Planning Commission has proposed covering another 36 million ha during the 11th Plan period (2007-12) with an expenditure of about Rs. 36,000 crores.

While there has been no systematic study on the overall impact of the watershed development on ground water recharge, various micro studies of watershed projects report positive ground water impacts. However, they also report that due to lack of any sustained social regulation on ground water extraction by the watershed communities such impacts are often momentary and the magnitude of the impact are not significant in regional scale. As Shah (2007) says

"While systematic studies are still to begin of the impact of the movement and the popular science of rainwater harvesting and decentralized recharge that has emerged as a result of farmers' experiments, available indicative evidence suggests that for regions critically affected by ground water depletion, only mass popular action on regional scale may be adequate to meet the challenge of depletion".

5.2. The demand side management – legislating ground water regulation

The track record of demand side management of ground water is at best indifferent in India. The standard government response has been to enact laws with provisions to regulate new ground water extraction devices and pumping of ground water. As early as in 1969 the Ministry of Agriculture had drafted a model Ground water (Regulation and Control) Bill and circulated to the state governments for suitable action. The salient points of the model bill were:

- The state governments were to acquire powers to restrict the construction of ground water abstraction structures (including wells, bore wells, tube wells, etc) by individuals or communities for all uses except drinking water
- For discharging the various functions to be acquired by the government under legislation, a Ground water Authority was to be constituted by each state
- This Authority would review applications for sinking wells for purposes other than domestic use, keeping in view the purpose for which water is to be used, existing competitive users and the availability of ground water,
- Individuals or organizations engaged in the business of sinking wells and tube wells to be registered with the Authority, which is to be vested with powers to cancel permits/licenses if their activities contravene the norms laid by the Authority,
- This Authority was to be provided with complete legal support to enforce the different provisions. It was also provided that the orders issued by the Authority would fall outside the purview of Civil Courts and that Civil Courts were to be barred from granting injunctions on any decision taken by the Authority.

However, the Bill did not find support from the states and no government took any action on it. Only Gujarat attempted to implement some of the provisions suggested by amending the existing Bombay Irrigation Act in 1976 but took another 8 years to actually pass it (1988). In 1992 a modified Ground water (Regulation and Control) Bill proposed now by the Ministry of Irrigation was again circulated to the states for action. Maharashtra was the first state to respond to this modified Bill and formulated a legislation that sought to regulate development in relation to drinking water through the Maharasthra Ground water (Regulation for Drinking Water Purposes) Act, 1993. A similar legislation was enacted in Andhra Pradesh in the year 1996. However, these Acts focused on protecting drinking water sources. Only later, between 2000-03 did states like Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal formulated and enacted legislation that provisioned for regulation of ground water extraction. Although many states have now legislative provisions for regulating ground water they have all had limited impact as their enforcement has been abysmal due to lack of political and administrative will, the logistic complexities of implementing and monitoring actions and the limited enforcement capacity of the designated authority.

In the cases Vellore Citizens Welfare Forum vs. Union of India and Indian Council for Enviro Legal Action vs. Union of India, the Supreme Court of India has also passed orders in 1996 regards ground water regulation, specifically depletion, where it has issued directions to the Government of India to set up of Central Ground Water Authority (CGWA) under the Environment (Protection) Act, 1986 and to declare it as an authority under the Act for regulation and control of ground water development. The Honourable Court has further directed that the CGWA should regulate indiscriminate boring and withdrawal of ground water in the country and issue necessary directions with a view to preserving and protecting the ground water.

In pursuance of Supreme Court orders the Government of India has constituted the Central Ground Water Authority under sub-section (3) of the Environment (Protection) Act, 1986 in 1997 for purposes of regulation and control of ground water development and management. Under the said notification the CGWA has been granted the powers to, amongst others, regulate and control, manage and develop ground water in the entire country and to issue necessary directions for this purpose. The areas of activities of the Central Ground Water Authority are:

- Notification of areas for regulation of ground water development in severely overexploited areas in the country
- Regulation of ground water abstraction by industries in over exploited/critical areas in the country
- Registration of drilling agencies for assessment of pace of development of ground water and regulation of well drilling activities
- Representation in the National Coastal Zone Management Authority and other Expert Committees of the Ministry of Environment & Forests
- Undertaking country-wide mass awareness programmes and training in rain water harvesting for ground recharge

The CGWA therefore has a wide ranging mandate to regulate ground water use in the country. Yet, as in the case of enforcing regulation under state ground water legislation it too has achieved little so far in regulating ground water use in India.

5.3. The demand side management – participatory aquifer management

5.3.1. Andhra Pradesh farmer managed ground water systems, India

Andhra Pradesh has piloted an alternate approach to demand side management of ground water through community mobilization and action under the APWELLS and APFAMGS projects. The Indo-Dutch APWELL Project was implemented in seven drought prone districts of Andhra Pradesh from 1995 to 2003. The Andhra Pradesh State Irrigation Development Corporation (APSIDC) was the main implementing agency. In the last year of implementation the project was transferred to the Panchayat Raj and Rural Development Department for possible upscaling. NGOs were involved in community mobilizing and capacity building.

The long-term objective of the project was to improve the living conditions of small and marginal farmers, through sustainable and environmentally sound interventions. The project also strove to make women farmers as equal partners with male farmers in agriculture and related activities. The immediate objective of the project was to provide ground water irrigation facilities for small and marginal men and women farmers. The farmers formed Water User Groups (WUGs) for construction, operation, and maintenance of the ground water irrigation systems. Clusters of WUGs formed Borewell User Associations (BUAs) which were legally registered, for training, inputs, agro-processing, and generation of profit. Important components of the project were ground water resources development where feasible, land-and-water management by the users, extension and training, activities for gender integration and institutional development, environment management, and monitoring and evaluation.

The achievements of the APWELL Project were that it operated in 370 villages in 7 districts, bringing irrigation facilities to about 35,000 acres of land belonging to about 14,500 small and marginal farmer families. They were formed into 3,450 Water User Groups (WUGs) and given trained in operation and maintenance of bore wells as well as group management and water sharing. Extensive capacity building programs were conducted in sustainable agriculture including INM and IPM. The women farmers were organized into 600 SHGs active in thrift and savings and income generation activities. Finally, the WUGs were formed into 250 BUAs for organizing common activities of WUGs. In later assessments, it has been observed that most of these WUGs and BUAs had been converted into Rythu Mitra Groups (RMGs).

APWELL had designed, planned and implemented Participatory Hydrological Monitoring (PHM) and allied activities among its WUGs aiming at demand side management of ground water systems through Participatory Ground water Management (PGM). As a first step, it started not only involving non-APWELL farmers in a target village, but also entered into new villages where the project had not developed ground water irrigation systems. The basin level initiative at the Upper Gundlakamma Basin, Prakasam District, was based on the experience from the PHM pilot. Gundlakamma initiative in itself was to be a pilot on a basin scale to gain in-depth knowledge on promoting people managed ground water system. It was recognised that PHM was very important for a dry land farmer in resource poor regions of AP because a farmer there not only spent more money on construction and annual maintenance but might even end up with a defunct well. The main lessons from the APWELL Project may be summarized as follows:

- Access to water by small and marginal farmers improves their productivity and they rise above poverty line
- Small and marginal land holdings (as small as one acre) can become productive with availability of water and proper inputs
- Participatory ground water management is a viable concept if introduced in conjunction with ground water development, agricultural production, institutional development and capacity building of farming communities
- All stakeholders and water users need to be involved in participatory ground water management

The Andhra Pradesh Farmer Managed Ground water Systems (APFAMGS) Project is a logical extension of APWELL project. While the latter was centred on the creation of water facilities for poor and marginal farmers, APFAMGS' focus is on developing capacity of ground water users in managing their resource in a commonly sustainable way for crop production. The experience of ground water management and PHM gained through APWELL fully informs the conceptual design and implementation set-up of APFAMGS and is the basis upon which the new project is built.

The project promotes participatory ground water management through the platform of Farmer Water Schools that facilitates experiential learning of different cultivation techniques and cropping patterns linked to the use of ground water resource. This is achieved through intensive capacity building and progressive development of the Farmer Field School (FFS) concept into the Farmer Water School (FWS). A key element in the FWS is the crop water budget session at the start of the Rabi season, particularly as a decision-making tool for farm families to adopt alternative agricultural practices, suiting the availability of ground water. Participatory Ground water Management is addressed by the following steps:

- Participatory Hydrological Monitoring – the farmers are equipped to record the ground water level and rainfall data, analyze the seasonal and daily fluctuations for understanding the ground water behaviour
- Environmental Viability Assessment – the farmers are equipped to assess the likely recharge of ground water on the basis of topography and land use in the given unit. The farmers are also equipped with the skill to assess the quantity of ground water being utilized as per existing cropping pattern and other usage. A water balance is arrived at to understand whether the recharge is less, more or equivalent to usage. This highlights the environmental viability and sustainability of current practices and assists in identification suitable practices
- Crop Water Budgeting – Once the farmers are able to assess ground water availability and seasonal water balance, they are provided with information to identify the crops according to water availability. Thus the crops is identified as per water budget

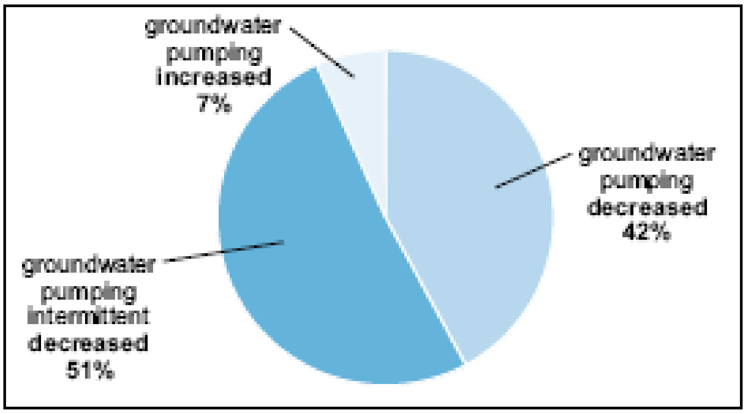
The APFAMGS project has been successful in meeting its challenges and achieving its expected results (AFPRO, 2006). Farmers understand the seasonal occurrence and distribution of ground water in their habitations and in their hydrological units as a whole and are able to estimate seasonal recharge, draft and balance. Farmers are capable of collecting and recording rainfall and associated ground water data. They have mastered the concept of ground water as a shared resource and are willing to manage it for the collective benefit. This has been achieved through a strong focus and investment on capacity building and through the process of demystification of concerned science without compromising on its basic scientific principles, which has created a strong empowering effect on the beneficiaries.

The project also works on the supply side management of ground water resource through artificial ground water recharge structures. Though limited in scope it has been in some ways successful in improving ground water availability in the project area.

An independent evaluation of the APFAMGS carried out by the GW-MATE, World Bank in 2009 shows significant successes by the project. The study was carried out using the APFAMGS Project database (which exhaustively covers the project area), remote sensing information and a farmer survey commissioned from the University of Hyderabad. The findings of the study are (Garduo, H. et al. 2009. 12-13):

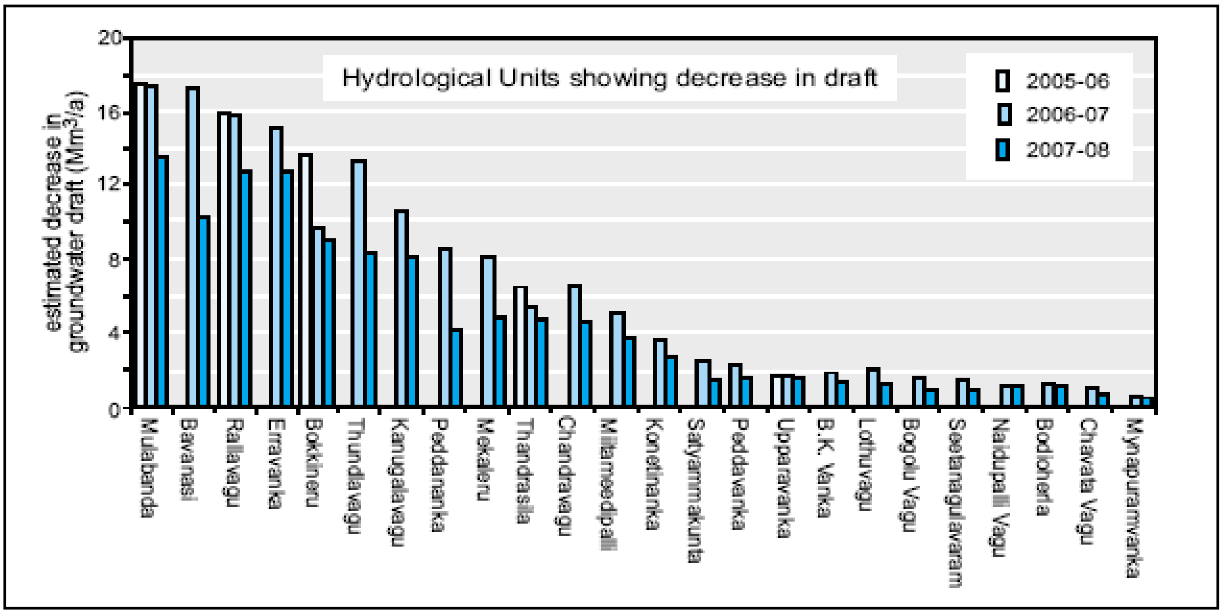
- In a majority of the project areas, the interventions have succeeded in beginning to build a link between water availability and water use for agriculture – in the years when water availability is low at the beginning of the rabi season (either due to low rainfall and consequently low recharge, or due to high ground water abstractions in the kharif season decreasing availability for the rabi season), ground water use has been reduced counter to the normal behaviour whereby water availability in the aquifers is not a factor influencing ground water use, and aquifer depletion often worsens in drier years – and this path-breaking achievement can be understood in terms of the impact of ground water availability information on farmer decision making
- The reductions in water use in these areas are achieved by a combination of crop diversification and water-saving irrigation methods – in effect six of the eight hydrological units sampled reported a reduction in the area under high-water-use crops, and the cumulative reduction of 43% during 2 years in rabi paddy area contrasts with the total area under rabi paddy in Andhra Pradesh which increased 5%

Figure 9: Groundwater pumping pattern



- The remote sensing analysis for one selected HU showed that area under high water use crops (>1000 mm) decreased by almost 11% from 2004-05 to 2007-08, whereas area under the low water use crops (<375 mm) increased by roughly the same amount
- In terms of cumulative water abstractions, 42% of the HUs have consistently reduced the rabi draft over the three years of project operation, while 51% have reduced the draft intermittently, and only 7% have witnessed an increase in ground water draft during this period. The figure below shows the behaviour of HUs where ground water draft has decreased.

Figure 10: HUs with decrease in ground water draft



- This impact is unprecedented, in terms of reductions actually being realized in ground water draft, and in terms of the geographic extent of this impact, covering dozens of aquifers and hundreds of communities – while these results are preliminary and pose a number of questions on how exactly this impact has been achieved, they do indicate that APFAMGS may be the first example globally of large-scale success in ground water management by communities
- Moreover, project area farmers have not sacrificed profitability to reduce water use; on the contrary they have consistently improved their profitability with the Net Value of Outputs per ha nearly doubling during the project period compared to inferior and much more erratic results in similar non-project areas

APFAMGS project has hence done a commendable job in demystifying the science of ground water dynamics for the farmers and trained them in monitoring ground water status in their villages for collective decision making on its use. This has empowered the farmers and provided sustainability and stability to their ground water based livelihoods. However, the project approach is very intensive with need for continuous and sustained training and capacity building of the farmers. It requires a dedicated team of trained professionals to support implementation on a regular basis. Although the information about the project, its achievements and learning are quite well documented and disseminated no attempt has been made to replicate it in any other state of the country. Neither has the project been owned up by the concerned governments in Andhra Pradesh – Rural, Agriculture and Ground water Departments or scaled up to cover mare ground water communities[58]. This has led some critics of the project to argue that while it may have succeeded in parts of Andhra Pradesh the project methodology is too abstract and complex to replicate elsewhere.

5.3.2. The Consejos Téchnicos de Aguas (COTAS) Mexico

The Consejos Téchnicos de Aguas (COTAS – Technical Water Councils) in Mexico are one of the few examples worldwide where user-regulation of ground water abstraction has been seriously attempted. Aquifer depletion is a major concern in the arid and semi-arid regions of Mexico, where ground water is a significant source for drinking water, irrigation and industrial use. Of 647 aquifers identified in 1999 by CAN (Comision Nacional del Agua, National Water Commission), 99 were over-exploited, a three-fold increase from 32 in 1975.

Data from the 1990s from the CNA indicate that the annual abstraction was in the order of 4,621 hm^3/annum, whilst the annual recharge was 3,980 hm^3/annum, giving an annual deficit of 641 hm^3/annum. More recent studies indicate the deficit might now be as much as 1,336 hm^3/annum.

As a consequence of the over-exploitation of ground water, the ground water levels have fallen and seepage flow from the aquifers to the rivers has ceased. Ground water levels have been estimated to be falling at the rate of 2.06 m/year on average. As a result of the falling ground water levels users are drilling deeper wells and the traditional shallow wells (norias) are running dry. Wells between 200-400 m depth are common, with some reports of wells 500 to 1,000 m deep. As well as increased pumping costs, there has been compaction of the aquifers in some regions, with land subsidence of 2-3 cm per year.

In Guanajuanto (a state of Mexico) the driving force behind the decline in the ground water levels has been irrigation. Since 1960 the ground water irrigated area has grown from 24,000 ha to over 250,000 ha in the 1990s, with a large proportion of the ground water area being developed for commercial agriculture.

As a result of this rapid expansion of ground water extraction several attempts have been made by the Mexican government to control the situation. The key features of this process are summarised below:

- The 1884 civil code clearly stated that the owner of overlying land was free to prospect and use water underlying his land
- Article 27 of the Constitution states that water is a national property. However as it did not differentiate between surface and ground water the 1884 civil code on ground

[58] The PGM approach has been adopted in the World Bank assisted Andhra Pradesh Community Based Tank Management Project for implementation in the PIM context. However, even in this project the number of WUAs covered under PGM is only about a 1000.

water held. In 1945 the Constitution was amended to allow the Federal Government to regulate the use of ground water in public interest

- A ground water law was passed in 1948 and updated in 1956 to increase government control over ground water abstraction. The 1972 Federal Water Law specified that the SRH (the government irrigation agency) should identify over-exploited aquifers (vedas) and regulate ground water pumping by issuing permits, as well as drawing up rules and procedures for reducing abstractions

Thus Mexico has a robust ground water law, though the regulations for the 1948 and 1972 laws were never issued and the laws not enforced. Regulations for the 1956 law were issued and though the vedas were identified the restrictions on pumping was not enforced. A large part of this was the inability to quantify what the safe yields were for aquifers placed under the veda. Thus whilst the government had strong legal provisions for control of ground water, it was weakly applied. In truth the restriction of ground water extraction were subordinate to the key drivers of economic growth and political stability.

In addition to the weak enforcement of the Vedas, the widespread availability of electricity at relatively cheap prices contributed to the increase in the levels of ground water pumping. A special reduced tariff is applied to electricity for agriculture in Mexico, which is subsidized by the Federal Government. Despite efforts to raise the tariff in 1994 the Mexican government was unable to push it through the Congress due to the powerful agricultural lobby. The Federal and State governments then tried additional measures, such as subsidized programmes for precision land levelling, conversion of open earth channels to buried pipes and conversion from furrow and basin irrigation to sprinkler and drip irrigation. However, though these measures led to water savings this was not reflected in a reduction of ground water pumping as farmers merely cropped a larger area or cropped a more water intensive commercial crop with the available water.

In a further effort to reduce ground water pumping from 1996 onwards the Guanajuanto state government formed COTAS. The concept of aquifer management groups had arisen following an agreement signed in 1993 between the five states in the Lerma-Chapala basin to limit ground water abstraction. An initial action programme to form Aquifer Preservation Groups was formulated and attempted, but failed. Following a rather protracted route, fourteen COTAS were later formed covering the whole state of Guanajuanto.

The COTAS were not however fully representative of all pump owners and rather it was initially formed with perceived leaders with the hope to expand to cover all pump owners later. This however proved to be difficult, as the COTAS were not perceived as being designed and owned by the user. An additional factor was that for political reasons the COTAS had been established by CEASG (Guanajuanto State Water and Sanitation Commission) not the water resources agency, CNA. This resulted in rivalry between the two organisations to the detriment of the objectives of the COTAS programme.

Between 2000 and 2006 CEASG, funded from the state budget, initiated several measures to improve the COTAS. This involved developing ground water models, piloting trials to test and then demonstrate measures to reduce ground water extractions and training and awareness rising of ground water users. The number of members of the COTAS increased from 225 in 2000 to 8,610 in 2000 (out of a potential 18,000 users). Whilst the COTAS have become accepted as a body to assist ground water users with technical advice it has no legal power to manage ground water. These remain with the CNA who refuse to delegate such powers to the COTAS. As a result the larger ground water extractors deal directly with the CNA and bypass the COTAS.

Despite recognition in the 1950s that ground water abstraction needed to be regulated, ground water abstraction continues unabated in the Lerma-Chapala basin. A variety of measures have been attempted, including strengthening legislation, providing subsidies to ground water users to improve the efficiency of water use and the formation of ground water users associations. For a variety of reasons none of these measures has been successful, leaving policy makers to continue to look for workable mechanisms to control and limit the ground water overdraft in Mexico.

6. Legal aspects of ground water management

6.1. Legal framework for right to ground water

Absence of clear definition of ground water ownership in India is perhaps the major factor that has led to the present levels of unsustainable ground water use. Under Indian common law there is no property in ground water until it has been the object of an ‘appropriation’ for example by being pumped from a bore hole. The right to ground water use are therefore tied to land ownership. Individual landowners have the right to construct wells in whatever manner they desire and extract as much as they can. This practice has its origin in the “Dominant Heritage” principle in the Transfer of Property Act IV, 1882 and the Land Acquisition Act, 1894. Therefore, the owner of the land is the de facto and de jure owner of ground water underneath. The amount of water that is legally possible to extract does not depend on the amount of land owned. Any landowner can abstract any amount of water. However, having sunk a well or borehole, such a landowner has no legal right or interest in the water beneath his land. Consequently he cannot take legal action against anyone else whose actions interfere with the supply of water to his well or borehole. This approach is commonly known as the doctrine of ‘capture’, a doctrine that still applies in many jurisdictions beyond ground water. In essence it creates an ‘open-access’ regime.

It is also argued that the Indian Easement Act, 1882 links ground water ownership to land ownership and this legal position has remained intact since then. In the Act ‘easement’ is defined

“*as a right which the owner or occupier of certain land possesses, as such, for the beneficial enjoyment of that land to do and continue to do something, or to prevent and continue to prevent something from being done, in or upon or in respect of certain other land not his own.”*

An ‘easement’ is, hence, mostly an agreement between neighbours and an easement so created leads, according to Section 7(a) of the Act, to restrictions of certain basic rights. One such is the exclusive right of every real property owner to enjoy and dispose of this, and of all the products thereof. As real property chiefly denominates land, and ground water legally is seen as a naturally inherent part of land, ground water must hence be termed as real property – and not as a chattel. This and other relevant provisions of the Act establish a rule of ‘absolute ownership’ over all there is below the surface of the earth of each landowner. The Act, however, makes a distinction between water flowing in ‘defined channels’ under ground and percolating water. The landowners are perceived to have an unlimited right to appropriate whole of the latter (Section 7-g).

“*The right of every owner of land to collect and dispose within his own limits of all water under the land which does not pass in a defined channel and all water on its surface which does not pass in a defined channel.”*

The definition of the right, therefore, suggests that if a land owner extracts too much water and lowers the water table the neighbours have the right to prevent him from doing it[59]. Thus there appears to be limits to an individual's right to exploit ground water under the Indian Easement Act, 1882.

6.2. Ground water regulation legislations

As already mentioned, in 1969 the Ministry of Agriculture had drafted a model Ground water (Regulation and Control) Bill and circulated it to the state governments for suitable action. The salient points of the model bill were:

- The state governments were to acquire powers to restrict the construction of ground water abstraction structures (including wells, bore wells, tube wells, etc) by individuals or communities for all uses except drinking water
- For discharging the various functions to be acquired by the government under legislation, a Ground water Authority was to be constituted by each state
- This Authority would review applications for sinking wells for purposes other than domestic use, keeping in view the purpose for which water is to be used, existing competitive users and the availability of ground water,
- Individuals or organizations engaged in the business of sinking wells and tube wells to be registered with the Authority, which is to be vested with powers to cancel permits/licenses if their activities contravene the norms laid by the Authority,
- This Authority was to be provided with complete legal support to enforce the different provisions. It was also provided that the orders issued by the Authority would fall outside the purview of Civil Courts and that Civil Courts were to be barred from granting injunctions on any decision taken by the Authority.

However, the Bill did not find support from the states and no government took any action on it. Then in 1992 a modified Ground water (Regulation and Control) Bill proposed now by the Ministry of Irrigation was again circulated to the states for action. This was reviewed again in 2005 to include provisions regulation, development and augmentation of ground water sources. The main provisions of the Model Bill were:

Constitution of a Ground water Authority by each state to discharge the various functions under the legislation, comprising of a Chairman, a representative of the Central Ground water Board, representatives of the concerned state government departments and knowledgeable persons in matters relating to ground water. The authority should also be supported by technical persons and other staffs considered necessary for enforcing the legislation.

- The State governments acquire power to restrict construction of ground water abstraction structures by individuals or communities for all purposes including drinking and domestic use.
- The Authority can declare any area to be a 'notified area' if it is of the opinion that controlling and regulating ground water extraction and use of ground water in that area is necessary.
- Anyone (except small and marginal farmers) wishing to sink a well for any purpose within the notified area must obtain a permit from the authority. Such applications for permit are to be considered by the Authority keeping in view, the purpose for which

[59] Here the interpretation is the ground water aquifer is considered as water under the land passing in a defined channel.

water is to be used, availability of ground water, existence of other competitive users, long-term ground water level behaviour, and other relevant factors.

- Every existing user of ground water in the State should apply to the Authority for grant of a Certificate of Registration recognizing its existing use and authorizing the continued use of ground water. The Authority is vested with the power to cancel any permits, registrations or licenses if necessary.
- The Authority could take up steps to ensure that exploitation of ground water resources does not exceed the natural replenishment to the aquifers. Wherever, there is a mismatch, steps could be taken to ensure augmentation of ground water resources in addition to regulatory measures.
- The Authority should upkeep the data-base on ground water related information.
- To improve ground water situation, the Authority may identify the recharge worthy areas in the State and issue necessary guidelines for adoption of rain water harvesting for ground water recharge in these areas.
- The Authority should take steps for promotion of mass awareness and training programs on artificial recharging of ground water through different government, non-governmental or educational institutions.
- The Authority should be provided with complete legal support to enforce the various provisions of the legislations and the Civil Courts are barred from granting injunction on any decision taken by the Authority

Between 2000-03 a number of states like Maharashtra, Gujarat, Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal formulated and enacted legislation that provisioned for regulation of ground water extraction.

Parallel to this legislative process, the Supreme Court through its orders related to cases pertaining to protection of ground water pollution directed the government to take action on regulating ground water. In the case Vellore Citizens Welfare Forum vs. Union of India (1996) the Supreme Court of India had passed an order regards ground water regulation, specifically pollution, where it had issued directions to the Government of India to set up of Central Ground Water Authority (CGWA) under the Environment (Protection) Act, 1986 and to declare it as an authority under the Act for regulation and control of ground water development. Interpreting the Environment (Protection) Act, 1986 the order said

"The main purpose of the Act is to create an authority or authorities under Section 3(3) of the Act with adequate powers to control pollution and protect the environment."

The order then goes on to say

"Keeping in view the scenario discussed by us in this judgment, we order and direct as under: The Central Government shall constitute an authority under Section 3(3) of the Environment (Protection) Act, 1986 and shall confer on the said authority all the powers necessary to deal with the situation created by the tanneries and other polluting industries in the State of Tamil Nadu. The Authority shall be headed by a retired judge of the High Court and it may have other members - preferably with expertise in the field of pollution control and environment protection - to be appointed by the Central Government. The Central Government shall confer on the said authority the powers to issue directions under Section 5 of the Environment Act and for taking measures with respect to the matters referred to in Clauses (v), (vi) (vii) (viii) (ix) (x) and (xii) of sub-Section (2) of Section 3."

In pursuance of Supreme Court orders the Government of India in 1997 constituted the Central Ground Water Authority under sub-section (3) of the Environment (Protection) Act, 1986. It also notified that the CGWA was granted the powers to regulate and control, manage and develop ground water in the entire country and to issue necessary directions for this purpose. The areas of activities of the Central Ground Water Authority are:

- exercise of powers under section 5 of the Environment (Protection) Act, 1986 for issuing directions and taking such measures in respect of all the matters referred to in sub-section (2) of section 3 of the said Act
- to resort to the penal provisions contained in sections 15 to 21 of the said Act
- to regulate and control, management and development of ground water in the country and to issue necessary regulatory directions for this purpose
- exercise of powers under Section 4 of the Environment (Protection) Act, 1986, for appointment of officers

As a consequence of these two parallel processes the country now has ground water control and regulation legislations and a designated authority to enforce and monitor it. However, as mentioned earlier, the enforcement of the provisions of the legislation and the powers of the authority is more in the breach. As has been said about many laws of the country *"the problem is not in enactment but in enforcement"*.

Moreover, there is another grave side of the ground water control and regulation legislations. In practice and in interpretation of the provisions of the Indian Easement Act, 1882 the legal system of ground water access in India is the "Right to Capture". Under this system, owners of land has the absolute right to abstract ground water in quantities that is not limited by the overlying land owned. However, a strict implementation of the regulatory provisions of the ground water legislations could lead to change the access system to that of "Right of First Appropriation", which is that access to ground water is on a first-come-first-served basis. As the will and administrative outreach of the designated authority to control and regulate existing ground water uses is limited the enforcement would then solely focus on moderating new demand for use of ground water.

6.3. Ground water legislation and "Public Trust Doctrine"

A third legal aspect in ground water management relates to the constitutional mandate of the government to regulate ground water. Since the Indian Constitution does not anywhere specifically mention the word "ground water" such a mandate is not clear in terms of direct powers conferred to it. Here an implicit basis for the mandate of the government to regulate ground water and especially control its use by individuals is derived from court interpretation of the powers of the State with respect to the country's natural resources and Article 21 of the Constitution "Protection of life and personal liberty".

In the case M C Mehta vs. Kamal Nath (1996) and Others the Supreme Court had interpreted the powers of the State with respect to the country's natural resources in terms of the "Public Trust Doctrine". It opined that

"Our legal system - based on English common law - includes the public trust doctrine as part of its jurisprudence. The State is the trustee of all natural resources which are by nature meant for public use and enjoyment. Public at large is the beneficiary of the seashore, running waters, airs, forests and ecologically fragile lands. The State as a trustee is under a legal duty to protect the natural resources. These resources meant for public use cannot be converted into private ownership."

This pronouncement by the Supreme Court that the Public Trust Doctrine *"is a part of the law of the land"* has been followed up with other orders of the Supreme Court strengthening this view. In the M.I. Builders Pvt. Ltd. Vs. Radhey Shyam Sahu (1999) the Supreme Court hitched the Public Trust Doctrine to the constitutionally guaranteed "Right to Life" under Article 21. The Supreme Court noted that *"this Public Trust Doctrine in our country, it would appear, has grown from Article 21 of the Constitution"*. That is to say, the Public Trust Doctrine was invoked anew by the Supreme Court specifically to protect the fundamental rights of the citizen enshrined in the Indian Constitution.

But what are the implications of the Public Trust Doctrine on right to property in India? Takacs (2008) argues that *"It ...appears that putting the Public Trust Doctrine in service of constitutionally guaranteed environmental rights puts not only new strictures on government, but also places new constraints on private property rights in India".*

According to Takacs (2008) the implication of the Public Trust Doctrine on private property rights are:

- The Indian Constitution mandates a fundamental right to life
- Two decades and dozens of court cases interpret this constitutionally provided right to mean that environmental harms themselves are proscribed in order to serve the fundamental right to life
- To prohibit private acts that threaten environmental resources essential to safeguard the right to life, the Indian Supreme Court has repeatedly cited the "polluter pays principle and the precautionary principle" as emerging norms of international environmental law
- The Public Trust Doctrine is asserted to buttress the government's ineluctable responsibility to protect the right to life and the ancillary rights that serve the fundamental right
- Private rights of action against private or government parties are permitted to vindicate the fundamental and corollary rights
- The Indian Constitution requires an affirmative "fundamental duty" of every citizen of India "to protect and improve the natural environment including forests, lakes, rivers, wild life, and to have compassion for living creatures"

Hence, the combination of court enshrined environmental rights in service of fundamental right to life and the Public Trust Doctrine has now cast the "rights" private property owners enjoyed before in a new circumscribed way.

Since the case M C Mehta vs. Kamal Nath (1996) pertained to surface flow the question now is "Is the Public Trust Doctrine applicable to extraction of ground water by a land owner from his land?" This question has been addressed specifically in the two cases of Perumattty Gram Panchayat vs. State of Kerala (2003) and the Hindustan Coca Cola Beverages (P) Ltd vs. Perumatty Gram Panchayat (2005) brought before the Kerala High Court.

The case Perumattty Gram Panchayat vs. State of Kerala (2003) pertains to the dispute between Perumatty Gram Panchayat and Hindustan Coca Cola Beverages (P) Ltd where the Gram Panchayat decided not to renew the licence of the Coca Cola factory in 2003. Excessive exploitation of the ground water and consequential environmental problems and drinking water scarcity were given the reasons for non renewal of the license. On appeal by Coca Cola, when the Government of Kerala ordered the Gram Panchayat to constitute a team of experts to conduct a detailed investigation into the allegation and to take a decision based on the investigation report the Gram Panchayat filed a writ petition before a Single Bench of the Kerala High Court against the order on grounds that the protection and preservation of the of the water resources is the mandatory duty of the Gram Panchayat and the government had no authority to interfere. Hence, the core question before the High Court was the power of the Gram Panchayat to control the ground water resources in its jurisdiction.

While delivering the order in favour of the Gram Panchayat, the Single Bench of Kerala High Court referred to the order of the Supreme Court on M C Mehta vs. Kamal Nath (1996) case and the concept of “Public Trust Doctrine” enunciated in it and said

“In view of the above authoritative statement of the Hon'ble Supreme Court, it can be safely concluded that the underground water belongs to the public. The State and its instrumentalities should act as trustees of this great wealth. The State has got a duty to protect ground water against excessive exploitation and the inaction of the State in this regard will tantamount to infringement of the right to life of the people guaranteed under Article 21 of the Constitution of India. The Apex Court has repeatedly held that the right to clean air and unpolluted water forms part of the right to life under Article 21 of the Constitution. So, even in the absence of any law governing ground water, I am of the view that the Panchayat and the State are bound to protect ground water from excessive exploitation.”

The above order of the Kerala High therefore clearly lays down the right and obligation of the government to restrain use of ground water if it causes harm to others.

However, in a later order by a Division Bench of the Kerala High Court in 2005 in the case Hindustan Coca Cola Beverages (P) Ltd vs. Perumatty Gram Panchayat (2005) this interpretation of right and obligation of the government to restrain use of ground water was overturned. Having been aggrieved by the order of the Single bench of the Kerala High Court both the Gram Panchayat and Hindustan Coca Cola Beverages (P) Ltd filed appeal. The Company argued that the Single bench has been wrong in saying that the ground water in a piece of land does not belong to the owner of the land but to the public.

The Division Bench of the Kerala High Court accepted the contentions of the Company and gave the order in its favour as thus

“We have to assume that a person has the right to extract water from his property, unless it is prohibited by a statute. Extraction thereof cannot be illegal. We do not find justification for upholding the finding of the learned Judge that extraction of ground water is illegal. .... We cannot endorse the finding that the company has no legal right to extract this 'wealth'. If such restriction is to apply to a legal person, it may have to apply to a natural person as well. Abstract principles cannot be the basis for the Court to deny basic rights, unless they are curbed by valid legislation. Even reference to mandatory function, referred to in the third schedule of the Panchayat Raj Act, namely "Maintenance of traditional drinking water sources" could not have been envisaged as preventing an owner of a well from extracting water therefrom, as he wishes. The Panchayat had no ownership about such private water source, in effect denying the proprietary rights of the occupier and the proposition of law laid down by the learned Judge is too wide, for unqualified acceptance.”

The order of the Division Bench of the Kerala High Court, hence, not only discredited the right and obligation of the government to restrain use of ground water if it causes harm to others it also disapproved the reasoning of public trust doctrine as abstract principles the basis for the Court to deny basic rights. The Division Bench therefore recognized ground water as a “private water resource” and accepting the proposition that the land owner had “proprietary right” over it had the right to extract the ground water from his/her land as a basic right.

The Perumattty Gram Panchayat has now petitioned the Supreme Court on the orders of the Division Bench of the Kerala High Court on which the orders of the Supreme Court is still pending.

So does the government have the right and obligation to restrain use of ground water if it causes harm to others as claimed in the Report of the Experts Group on "Ground water Management and Ownership" in page 17 (Planning Commission, 2007). A contrary view is expressed in the report Water Law and Policy in India: Reforms and Capacity Building by the Environment Law Research Society (2010)

"The application of the public trust doctrine may influence the type of rights and privileges that can be claimed over surface water. However, the applicability of the doctrine to all sources of water is not yet clear" (ELRS, 2010, p. 6).[60]

7. Ground water quality

7.1. Arsenic in ground water

This section briefly addresses the question posed by the National Planning Commission on ground water quality and arsenic. – "Do we know enough about arsenic in ground water? Is it true that we still do not understand what triggers the occurrence of arsenic in ground water as scientists from Bangladesh recently told me? What is the state of knowledge on this internationally?"

Arsenic is both toxic and carcinogenic. The most significant forms of natural exposure to humans are of inorganic forms of arsenic dissolved in drinking water. Arsenic poisoning can be a slow process, with symptoms taking between 5 to 15 years to be revealed. The main treatment is provision of safe drinking water, with WHO recommended safe limits of below 0.01 mg/l of arsenic.

Smith et al (2000) described the consequences of elevated levels of arsenic in ground water in Bangladesh as "The largest poisoning of a population in history". Estimates by Ravenscroft et al (2009) put the figure of those affected as over 100 million in northern India, China, Myanmar, Nepal, Vietnam, Pakistan and Cambodia.

A significant amount of research has been carried out on the occurrence and causes of arsenic in ground water, including by the British Geological Survey (BGS) who carried out research into arsenic contamination in ground water in Bangladesh in the late 1990s (www.bgs.ac.uk/arsenic). Useful additional information on arsenic contamination and ground water in general can be found on the World Bank GW-MATE website (http://water.worldbank.org/water/node/83769).

A useful recent summary of the prevalence and chemistry of ground water arsenic is given in Science (Fendorf et al, 2010). The main source of arsenic within the Himalayas is thought to be eroding coal seams and rocks containing sulphide minerals. When exposed to the air these the arsenic in these minerals is oxidised and the arsenic transferred to secondary phases including iron (Fe) hydroxides, oxyhydroxides and oxides, collectively referred to as Fe oxides (Lowers et al, 2007; Kocar et al, 2008).

[60] The Supreme Court has extended the scope of the application of the public trust to ground water (State of West Bengal v. Kesoram Industries Ltd. 2004). This, however, may need to be re-confirmed in a more ground water specific case since the court discussed this point in the context of a case on the power of the legislature to impose taxes on land.

The process whereby arsenic is converted into soluble form in ground water has been much studied, with the conclusion that "Destabilizing arsenic on these Fe oxides is now recognized as a key step in the widespread contamination of ground water, with other phases possibly playing a subordinate role" (Fendorf et al, 2010). There are three environmental requirements for ground water arsenic concentrations to increase: (i) water saturation, which limits diffusion of atmospheric oxygen; (ii) a limited supply of sulphur; and (iii) a source of organic carbon to drive microbial dissolution of Fe oxides. A water table within 5 metres of the surface provides a suitable environment for dissolution of arsenic into ground water.

Fendorf et al. (2010) state that "*The availability of organic carbon as a driver of microbial reduction is possibly the most prominent outstanding issue limiting our ability to predict the distribution of arsenic in ground water*". The issue is the likely source and distribution of organic carbon, which can originate from a number of sources. In principal the amount of arsenic which will be released from aquifer sediment depends on the amount of reactive carbon and the availability and amount of arsenic in the sediment. Research from Nepal, West Bengal, Bangladesh, Cambodia and Vietnam suggests rapid release of arsenic in shallow ground water, and more gradual release at depth.

By transporting dissolved arsenic as well as other contributing elements, such as dissolved organic carbon, sulphate and oxygen ground water flow plays a key role in the distribution of arsenic. Ground water pumping can significantly alter natural ground water flow patterns and recharge cycles, exposing sediments to a regime of drawdown and recharge which might not have occurred in the natural state. With overuse there is a significant risk that aquifers with low levels of arsenic contamination (due to release from the parent sediment material) can see a rise in the concentrations of soluble arsenic. The paper by Fendorf et al. (2010) that more research be conducted in selected locations to study the occurrence of organic matter, arsenic reactivity and evaluation of the local hydrology. The paper strongly recommends against pumping from deeper aquifers for irrigation purposes in case this compromises the low arsenic qualities of these aquifers, instead these aquifers should be preserved for drinking water only.

In summary substantial research has been carried out on arsenic contamination of ground water, though more research is required in order to improve the predictability of occurrence of high levels of arsenic contamination. Measures need to be taken to protect sources of drinking water which are currently within safe limits, in particular to limit the abstraction levels to that required for drinking water. In this context deeper aquifers, which generally have lower levels of arsenic contamination, should not be compromised by pumping for irrigation.

8. Proposals for reforms

Given the extent and trend in ground water depletion observed over a large part of the country actions are required both at the supply side and demand side of ground water use. Supply side augmentation, as mentioned is already happening through artificial recharge and watershed development. There is a need to scale up these efforts on a regional and basin scale. However, the scale of artificial recharge is a function of the land area over which recharge is carried out. Given the pressure on land it is doubtful whether land is such large scale can be spared for only recharge. Hence, artificial recharge, while an important action in ground water management, will remain the minor component of the basket. This of course does not preclude redesigning the watershed development programme to be implemented over a basin or sub-basin scale instead of a micro-catchment (as is the current practice) to produce aquifer or regional level recharge impacts.

The other set of options relate to demand side management of ground water use. Here there are three approaches possible. First, pro-active regulation of ground water extraction using available or reformed legal regimes. Second, using the ground water energy nexus to control ground water extraction and third, community action to regulate ground water use. In this, while a combination of the latter two approaches may be found politically and logistically a more easy option, for a more sustained sustainable ground water management, especially in those regions where ground water extraction has reached ground water mining status, strict regulation and control of ground water extraction under the various legal and legislative provisions may be the only real option.

8.1. The demand side management – ground water regulation through legislations

- Revise the ground water regulation and control legislations to facilitate pro-active regulation not only in unsafe areas but in all areas
- Explore options under the Public Trust Domain and Easement to provide mandate for ground water regulation
- All states to enact such ground water (regulation) legislation as defined above and strictly enforce it
- Develop the capacity and resources of the authority designated under the ground water legislation to regulate ground water.
- Enforcement of ground water regulation legislations may be tightened using remote sensing and IT enabled monitoring systems to track location of extraction devices; monitor volume of water pumped through remotely monitored pre-installed electronic micro-chips in pump sets programmed to record pump operation.

8.2. Agricultural demand side management – a comprehensive model

In the power sector, Agricultural Demand Side Management (Ag DSM) consists of those methodologies and technologies that influences consumer behaviour and modify consumption patterns. The goal is to reduce peak demand, shift the time when electricity is used or reduce the total amount of electricity consumed. Above we have described a number of ways for achieving this. It is proposed that a synergistic combination of these options in a comprehensive model could become the possible solution to the electricity ground water nexus in the country.

This comprehensive Ag DSM model proposition is that by replacing inefficient irrigation pumps with high efficiency pumps, the amount of electricity needed to pump irrigation water can be reduced by 40% to 50%. If the savings is sustained and the cost of the electricity thus saved exceeds the cost of the new pump set over its useful life, plus related O&M costs, there will be a net economic gain. A state government could then experience an economic gain if the amount of subsidy required for the power sector were to be reduced by more than the new investment and O&M costs in the Ag DSM project.

Immediate measures to conserve power and ground water simultaneously are imperative for sustainability, safeguarding the livelihoods of people and food security. Efforts to save power through distribution reforms and agricultural demand side management are necessary to improve the efficiency of power use in the sector. A number of studies conducted and research reports indicate that most of the agriculture pump sets are operating far below their achievable efficiencies. There may be many reasons for this sub-optimal performance. Some of the main reasons are:

- The new pump set installation in the field is guided by the advice of the local dealer/electrician/ mechanic/neighbour and they are not necessarily as per any prescribed standards
- The purchase of any new pumping installation – if purchased under bank finance, is guided by the IS: 10804 and this standard is hard to be understood by the farmers
- The pumps during their operation fail at least twice a year and when they are rewound, the efficiency drops down further
- the power factors are low and are further affected each time the motors are rewound

Pumps may also face the risks of burning etc. if the quality of power supply is not optimal. This can put a heavy burden of repair on the farmer. Therefore the supply side reforms like conversion to HVDS and separation of feeders are necessary before going for the replacement of pumps to make the system sustainable. The efficient pumping system creates a risk of excess drawl of ground water and can cause environmental concerns. The Gujarat experience from separation of feeders shows that post separation, quality power supply was provided for 8 hours. The pumping hours were thus limited to 8 hours only in contrast to previous practice of using the phase splitter and using power for 15 to 18 hours. Thus quality power supply for limited hours, which is sufficient for the crops, could save the ground water.

Power management goes beyond power supply alone. Advantages of conversion to HVDS are too visibly experienced to be ignored. Moreover, conversion to HVDS is one of the instrument to reduce the distribution losses and thus assist substantially to fulfil the regulatory requirement of reduction in T&D losses. Conversion to HVDS is now included as a standard activity under the Multi Year Tariff (MYT) filings by the utilities. HVDS conversion is thus institutionally owned by the utilities. Same is the case with the separation of the feeders.

A set of activities are immediately required to be taken up at the farmer’s end to improve the overall efficiency of power utilisation. Adoption of frictionless foot valves and pipes, fixing of power factor correcting capacitors, use of energy efficient pump sets and use of appropriate capacity pumps are some of the activities required to be implemented by farmers for improving power efficiency. Farmers can also be involved in discussion for peak load management and rostering.

In case of ground water the farmer needs to be made aware of rainfall pattern, the fluctuations in ground water level in a demystified way through the process of Participatory Hydrological Monitoring. Ground water recharge and usage can also be assessed with farmer as part of Environmental Viability Assessment to make them understand the viability of continuing existing practices like drilling of new bore wells and cropping patterns.

Other on-farm set of activities would include adoption of water efficient application methods like sprinkler/drips, adoption of water efficient agronomic practices and raising crop according to crop water budgeting depending upon the availability of ground water.

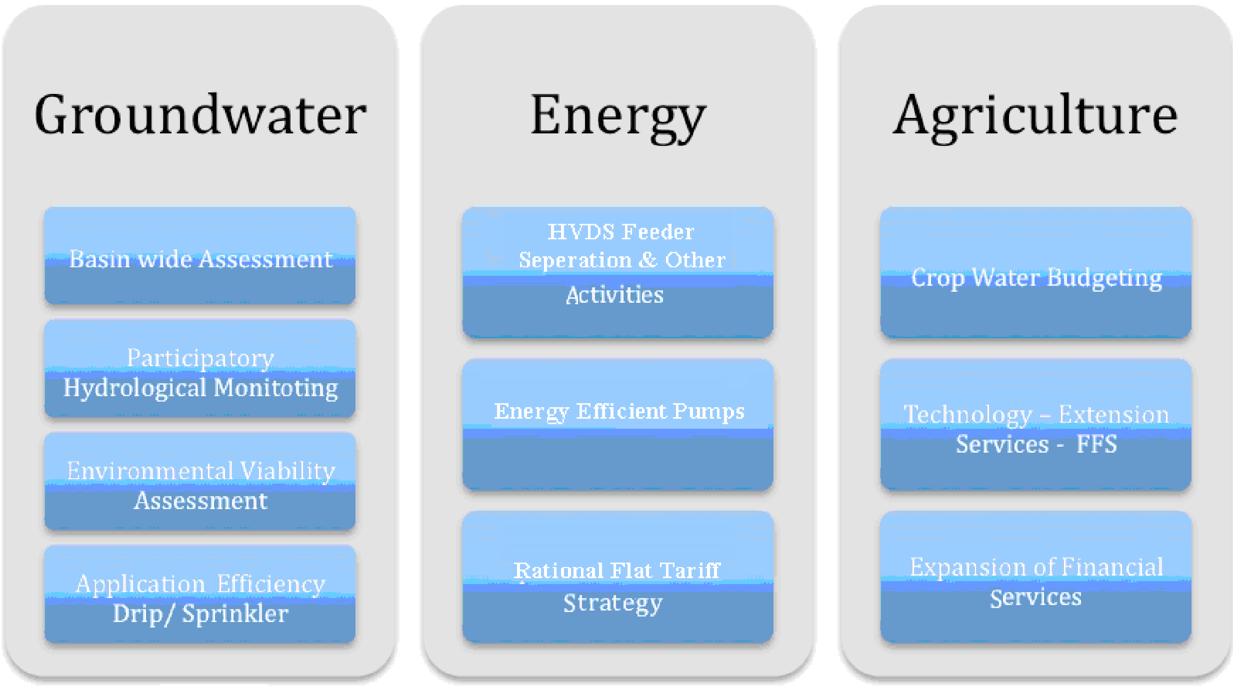
The activities to be implemented under a comprehensive Ag DSM Model therefore would be:

1. Separation of Feeders and HVDS
2. Rational flat tariff strategy
3. Replacement of pumps and improving efficiency and management of pumping system

4. Participatory Ground water Management (PGM)
5. Agriculture Extension and Marketing Services (AES)
6. Improving Water Application Efficiency

While the HVDS and separation of feeders are owned by the power utilities, the challenge of institutional ownership arises in case of conversion to efficient pump sets, adopting the improved farm practices and ground water management. The ownership of ground water and pump sets rests with the individual farmers and is closely linked. Any sub optimal management practice of ground water and power by farmers adversely impacts these precious resources adversely with adverse environmental implications. The comprehensive model to addresses these concerns in an integrated fashion can theoretically be presented as in Figure 11 below.

Figure 11: Comprehensive Model for Ground Water Energy and Agriculture

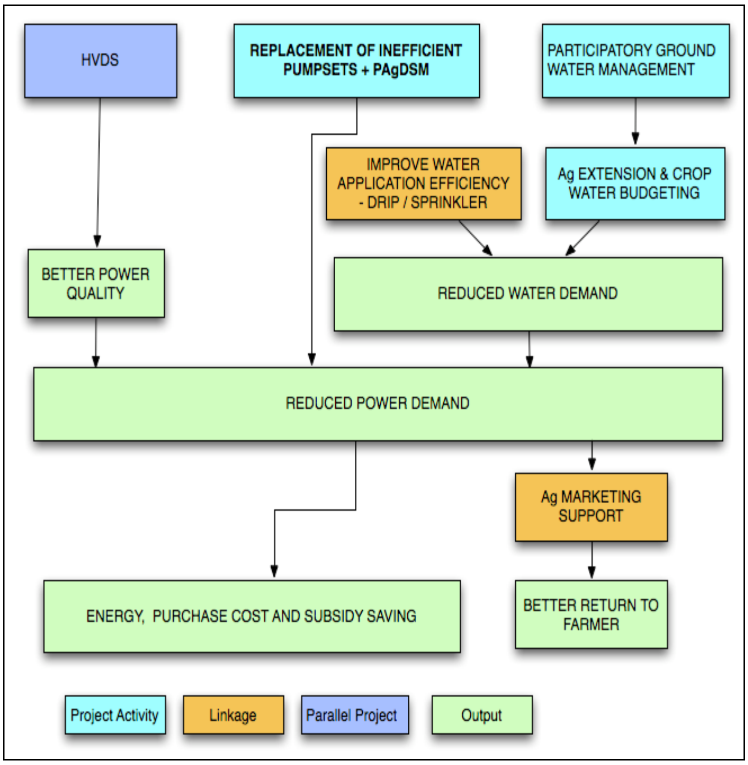


A necessity of administrative integration arises in the model from the fact that all these interventions are administratively managed by different departments. However, the farmer is the sole recipient of ground water, power and agriculture related inputs and thus it would make sense to approach the farmer with a comprehensive package of ground water, power and on-farm activities in a project mode. This would not only enhance the effectiveness of the efforts through synergy but would also save resource from duplication.

It is anticipated that the power use efficiency gains through investment in infrastructure modernisation for better supply can be multiplied with adoption of comprehensive demand side management at the farmer's end. It is therefore proposed that pump replacement, ground water management, and agriculture extension related activities be implemented in an integrated manner in the areas where the HVDS and separation of feeders has been completed and thus the investment in efficient system of distribution that is on supply side is already made.

The basic conceptual design of the model is given in Figure 11 below. The approach is innovative in concept but as yet untested. Pump replacement was proposed about a decade back but not implemented in scale on account of various institutional and implementation related difficulties. There are different stakeholders involved in the model such as state and central government departments, BEE, electricity regulators, manufacturers, farmers, financial institutions, etc. It is envisaged that the present model provides the wherewithal for implementing an effective Ag DSM project in the country, of course suitably modified to the specific policy, socio-economic and institutional environment in each state.

Figure 11: Conceptual design of the comprehensive Ag DSM model



The legal and statutory basis of the model is given in Figure 12 below.

Figure 12: The legal structure of the comprehensive Ag DSM model

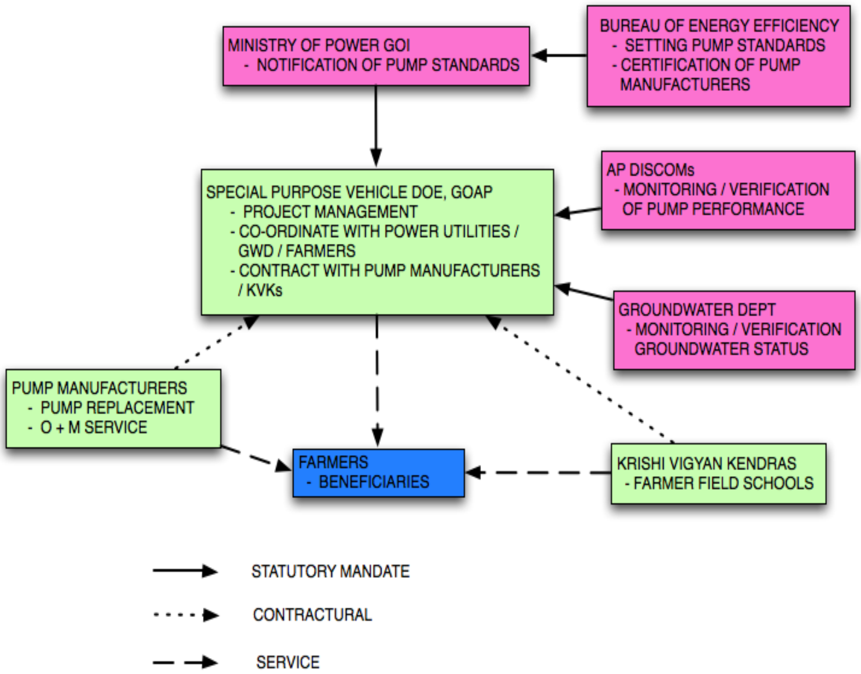


Table 10: The logical framework for the comprehensive Ag DSM model is provided below.

Narrative Summary	**Variable Indicators**	**Means of Verification**	**Risks and Assumptions**
OBJECTIVE			
To enhance energy use efficiency in selected ground water based irrigation areas, reduce ground water demand through ground water and crop management for sustainability	Reduction in agricultural power use by 40% in project area Stabilization of ground water use for irrigation within sustainable limits for the ground water unit	Power Monitoring and Verification Protocol (Data record in micro-chip embedded in pump sets) PGM records Piezometeric records of ground water monitored by Ground water Department	State government continued to support the project objectives
OUTPUTS			
Component 1: Separation of agricultural feeders and conversion to HVDS			
Agricultural power feeder lines and domestic power feeder lines separated	Domestic power supply and agricultural power supply to villages on separate feeders	DISCOM Progress reports	State Electricity Regulatory Authority and DISCOMs willing to make the investment
Agricultural power feeders converted to HVDS	Agricultural pump sets connected to HVDS feeder lines	DISCOM Progress reports	State Electricity Regulatory Authority and DISCOMs willing to make the investment
Component 2: Rational flat tariff strategy			
Rational flat tariff strategy	Power supply schedule for	DISCOM records	DISCOMs develop the

Narrative Summary	Variable Indicators	Means of Verification	Risks and Assumptions
for agricultural power supply implemented	agriculture matched to the pattern of farmer demand Agriculture power supply schedule pre-announced and adhered to	Field studies	capacity and human resources to plan rational scheduling of power as per farmer demand
Agricultural power supply quality improved	Agricultural power supply infrastructure maintained Power supply at uniform voltage and frequency Reduced incidences of pump or motor burn outs	DISCOM records Field studies	DISCOMs adopt a quality service provider attitude as its mission and vision
Progressive flat tariff structure implemented	Flat tariff structure based on pump power (HP)	DISCOM records	Farmers willing to accept the revised tariff structure
Component 3: Participatory Agricultural DSM			
Inefficient pumps replaced with efficient pumps	Replacement of poor quality agricultural pump sets with efficient agricultural pump sets	Contract signed between farmers and pump manufacturers	Farmers are willing to have their existing pump sets replaced
Enhanced awareness and capacity of the farmers in utilizing power efficiently for ground water based irrigation in the intervention area	Number of Ag DSM awareness and training programs conducted for the farmers	Field studies	Farmers willingness to participate in the project Ag DSM awareness and training program
Proper operation and maintenance of efficient pump sets	Number of replaced pump sets working efficiently and showing requisite saving of power	Power Monitoring and Verification Protocol (Data record in micro-chip embedded in pump sets)	Farmers and pump manufacturers are carrying out proper O&M of replaced pump sets
Reduced power use in ground water based irrigation in the intervention area resulting in energy and funds saving	Amount of power saving showed by the replaced pump sets	Power Monitoring and Verification Protocol (Data record in micro-chip embedded in pump sets)	Farmers and pump manufacturers are carrying out proper O&M of replaced pump sets
Component 4: Participatory Ground water Management			
Enhanced capacity of the farmers in utilizing ground water efficiently in the intervention area	Number of PGM and PHM training program conducted for the farmers	Field studies	Concerned government department and NGOs have requisite capacity to conduct training
Sustainable exploitation and stabilization of the ground water aquifer in the intervention area through a suitable cropping pattern	Adoption of suitable crops by farmers based on crop water budgeting	Field studies	Farmers willing to shift to suitable cropping patterns
Increased ground water use efficiency in irrigation in the intervention area	Increase in duty in ground water irrigation (area irrigated per unit of ground water)	PGM records Piezometeric records of ground water monitored by Ground water Department	
Component 5: Agricultural Extension Service			
Enhanced production and productivity of farm produce	Increase in productivity and production of main crops in project area	Annual agricultural survey Field studies	Farmers able to access good quality agri-inputs
Increased income to the	Increase in farm income	Annual agricultural survey	Farmers able to access

Narrative Summary	**Variable Indicators**	**Means of Verification**	**Risks and Assumptions**
farmers from farm produce through better marketing linkages for inputs and outputs		Field studies	and effectively utilize marketing information and linkage
Component 6: Improving water application efficiency			
On farm improved water application technologies adopted – micro irrigation methods, agronomic practices, etc.	Area under drip and sprinkler irrigation methods Increase in duty in ground water irrigation (area irrigated per unit of ground water)	Field studies PGM records Piezometeric records of ground water monitored by Ground water Department	Farmers able to access available credit and subsidies for micro irrigation
ACTIVITIES			
Component 1: Separation of agricultural feeders and conversion to HVDS			
Survey of rural power feeder lines and preparation of feeder separation plan	Procurement and financial plan for feeder separation	Detailed Project Report	
Implementation of feeder separation plan for rural power feeders	Domestic power supply and agricultural power supply to villages on separate feeders	DISCOM records	
Survey of rural agricultural feeder lines and preparation of HVDS conversion plan	Procurement and financial plan for HVDS conversion	Detailed Project Report	
Implementation of HVDS conversion plan for agricultural feeder lines	Agricultural pump sets connected to HVDS feeder lines	DISCOM records	
Component 2: Rational flat tariff strategy			
Prepare and implement power supply schedule for agriculture matched to the pattern of farmer demand	Cropping plan and crop water requirement Power supply schedule for agriculture	Rational flat tariff Plan of DISCOM	
Maintenance of agricultural power supply infrastructure	Power supply at uniform voltage and frequency Reduced incidences of pump or motor burn outs	Field studies	
Prepare and implement flat tariff structure based on pump power (HP)	Tariff collection records	DISCOM records	
Component 3: Participatory Agricultural DSM			
Performance Assessment & Baseline of Present Pumps	Rate of flow of water Static head Energy used in pumping water	Baseline record of existing pump sets	
Analysis of Financial Viability of Replacement	Units saved per Annum Project area viability	Baseline record of existing pump sets	
Selection List of Viable Pumps	Units saved per Annum Project area viability Willingness of farmer to replace pump set	Baseline record of existing pump sets Signed Contract between farmer and pump manufacturer	
Replacement of pump sets	Number of pump sets replaced	Work completion report of pump manufacturer	

Narrative Summary	**Variable Indicators**	**Means of Verification**	**Risks and Assumptions**
		Field verification	
Monitoring Performance of Replaced Pumps - chips	Power savings by replaced pump sets	Power Monitoring and Verification Protocol (Data record in micro-chip embedded in pump sets)	
Training of Local Mechanics in Pump Repair	Number of O&M training programs conducted for the local mechanics	Field studies	
Component 4: Participatory Ground water Management			
Environmental Viability Assessment	Number of PPGM Groups conducting water balance studies	PGM records Project Annual Progress Report	
Participatory Hydrological Monitoring	Number of PPGM Groups conducting PHM	PGM records Field studies	
Crop Water Budgeting	Number of PPGM Groups conducting crop water budgeting	PGM records Field studies	
Capacity Building of Project Staff	Number of PGM training programs conducted for project staff - 6 modules	Field studies	
Mobilization and Formation of PPGM Groups	Number of PPGM Groups formed	Field studies	
Awareness, Training and Capacity Building of PPGM Groups	Number of PGM training programs conducted for PPGM Groups - 6 modules	Field studies	
Linkage with Drip and Sprinkler Schemes	Number of drips and sprinklers installed	Field studies	
Component 5: Agricultural Extension Service			
Farmers' Field Schools	Number of FFS conducted for farmers	Field studies	
Linkage for Better Market Information and Access	Number of Agreements signed between PPGM Groups and agri-service agencies	Field studies	
Component 6: Improving water application efficiency			
Supply of drip and sprinkler irrigation systems to farmers	Area under drip and sprinkler irrigation methods	Field studies	
Farmers' Field Schools on agronomic practices for on farm water management	Number of FFS conducted for farmers	Field studies	

Source: The present study

The implementation of an Agricultural Demand Side Management project will require participation and coordination of a number of government departments and agencies both at Central and State Government level. These will range from the Power Department, BEE, Electricity Regulators, Central and State Ground water Authorities, DISCOMs, Agriculture Department, Ground water Department among others. This raises the question of the identity of the parent department who would be responsible for the overall implementation of the project. In terms of financial costs maximum allocation will be related to power (feeder separation, HVDS conversion, pump replacement, operation of rational flat tariff). On the other hand, in terms of operational aspects agriculture and ground water will dominate (PGM, agricultural extension, micro irrigation). Perhaps a consortium of the concerned departments may be made responsible for implementation of the project. Conversely, a Special Purpose Vehicle with an energy servicing company (ESCO) structure and mandate under the Power Department may be considered. The SPV-ESCO structure, which has been proposed in the JICA funded AgDSM project study for Andhra Pradesh mentioned earlier, has the advantage of accessing finances resources through a PPP model. The SPV-ESCO can co-ordinate with the Power, Agriculture and Ground water Departments and the DISCOMs in implementation of the project.

At the Central Government level, if feasible, the Planning Commission itself could be the coordination agency for the project.

At the same time, pump replacement cannot be a perpetual activity. While the inefficient pumps are replaced under the project, measures need to be initiated to prevent installation of the new pumps, which are inefficient. To this end and to address some other externalities, following recommendations are made with a view that the replacement of the old inefficient pumps through project like this and the regulation of new pumps being installed should become a national agenda.

- BEE recently has announced a program for Agricultural Demand Side Management under which it proposes to promote replacement of pumps through a public-private partnership. BEE has selected Maharashtra, Gujarat, Rajasthan, Haryana, Punjab, Andhra Pradesh and Karnataka as the seven pilot states for the programme and is preparing Detailed Project Reports for the selected states. The DPRs are expected to lay down BEE’s recommendations for appropriate legal framework and conducive policy environment for the implementation of the programme. Once this happens, the statutory provisions and institutional means for implementation of Ag DSM in the country will be available.
- Ministry of Power, Government of India - BEE has already announced the standards and labelling programme for energy efficient agriculture pumps. Based on these standards and labelling programme the Ministry of Power, GoI can notify pump sets as ‘an appliance” under section 14 of Energy Conservation Act 2001 that would permit manufacture of only pumps of the certified standards. Notifying pumps as an appliance under section 14 of Energy Conservation Act 2001 is essential for the long term sustainability of Ag DSM else the new pumps installed by farmer would continue to be inefficient requiring replacement. The present model is to rectify a past malady, which should not be allowed to perpetuate. Consequently, for a permanent and sustainable solution to this problem, a parallel action of advocating notification of agricultural pumps as an appliance under section 14 of Energy Conservation Act 2001 needs to be taken up with the Ministry of Power, GoI.
- Power Finance Corporation/Rural Electrification Corporation (PFC/REC) - The PFC/REC is implementing the Accelerated Power Development and Reforms Program (APDRP) of GoI under which it is promoting distribution sector reforms in those states that have committed themselves to power sector reforms under the Electricity Act, 2003. Ag DSM could be included as a component under the APDRP for financing. The component could be advanced to those states that have already implemented the core power distribution sector reforms of reduced AT&C losses, brought about commercial viability in the power sector and reduced outages and

interruptions and are at the stage in which they can accrue the combined benefits of supply side distribution reforms and Ag DSM gains.

- Inefficient Pump Manufacturers - There are large number of local manufacturers who manufacture the pumps that are energy inefficient. Supply of efficient pump through limited number of large pump manufacturers would adversely impact these small, scattered and local manufacturers. If left with no option for survival, these manufacturers would act at cross-purpose to Ag DSM objectives. It is therefore proposed to provide opportunity and incentives to these manufacturers to upgrade their manufacturing process and to be a partner in energy efficiency initiatives.
- Repair after Warranty period - Though local mechanics will get trained in proper repair of the efficient pumps and field study indicates that farmers have repaired efficient pumps maintaining their efficiency, it is possible that repair to the pumps subsequent to the warranty period may result in lower efficiency and thus loss in the projected gains. Therefore a system would need to be developed for safeguarding against such eventualities.

8.3. Restructuring CGWA and SGWA

- CGWB and SGWB should coordinate with legal experts and law department to reinforce its enforcement powers for regulation and control of ground water and also take up the study on need for legislative and other legal reforms to provide it with such a mandate
- CGWB and SGWB should develop the technical and institutional capacity and human resources for pro-active implementation of regulation and control of ground water under the various available legislative regimes
- CGWB and SGWB should establish effective coordination with the Power Department and DISCOMs to utilize the electricity ground water nexus as an effective ground water management tool
- CGWB & SGWB should establish partnership with research institutions and NGOs on ground water research to design a pilot project on Participatory Ground water Management and Aquifer Management Associations
- CGWB & SGWB should initiate the process of formulation of required policy, legislative and programme support to incentives Participatory Ground water Management and Aquifer Management Associations
- Planning Commission and CGWB should issue national guidelines and initiate a National Pilot Project on Participatory Ground water Management and Aquifer Management Associations (in line with the RRR Project for MI tank restoration it did under the 10th Plan)
- CGWB & SGWB should develop the technical and institutional capacity and human resources to support implementation of Participatory Ground water Management and Aquifer Management Association projects
- SGWB should formulate projects in partnership with NGOs and other technical agencies to pilot Participatory Ground water Management and Aquifer Management Association in their states based on the national guidelines issued
- SGWB should establish partnership with NGOs and other civil society organizations to support mobilization and organization of ground water farmers

- SGWB should develop information and data management systems and capacity to service the ground water information requirements of PGM and AMA projects.
- SGWB should establish an information and data servicing centre to make available regular and up dated ground water monitoring data to ground water user groups and aquifer management association to facilitate decision making at their level
- CGWB & SGWB should carry out scientifically designed studies on the process and impact of participatory Ground water Management and Aquifer Management Association pilot projects to identify the policy, legislative and programme support required to scale up the pilots

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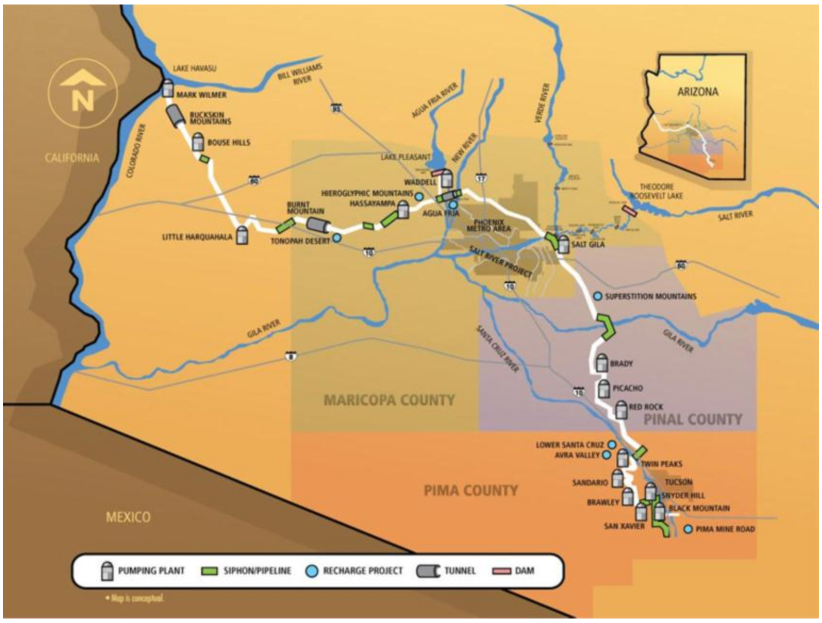
Appendix A1: International Experience

Several examples of surface and ground water management are provided in the case studies given below.

A1.1 Central Arizona Project (CAP)[61]

Figure A1.1: The Central Arizona Project



The Central Arizona Project (CAP) is a 539 km long system of reservoirs, pump stations, canals and pipelines with the capacity to transport 1.85 billion cubic metres (BCM) of water annually from the Colorado River in the west of Arizona to the Pima, Pinal and Maricopa counties in south-central Arizona (Figure A1.1). The project was conceived for two main reason: (i) for Arizona to make use of its full allocation from the Colorado River, and (ii) to move away from a historical dependence on ground water in certain regions in the State. After years of legal battles the project was authorised under the Bureau of Reclamation's Colorado River basin Project Act of 1968. Construction commenced in 1973 and was completed in 1992 at a cost of some US$ 5 billion.

Over the period 1953-1968 ground water withdrawals in SE Arizona averaged 4.5-5.0 MAF[62]/year (5.6-7.4 BCM^2/year), compared to a natural recharge of some 1.5 MAF (1.9 BCM/year). Under the threat of withdrawing federal finance for the CAP the Carter Administration pressurized Arizona into signing the Ground water Management Act in 1980. The Act has the aim of eliminating the ground water overdraft in the region by 2025 and establishing annual extractions in balance with recharge.

Under the Act surface water from the CAP can be either substituted for established ground water abstraction or it can be used to recharge the ground water. Water rights are at the core of the process[63], with water being traded between users both spatially and temporally. The Central Arizona Water Conservation District (CAWCD) has been established to purchase from the Bureau of Reclamation the 1.5 MAF (1.9 BCM) allocated to the CAP from the Colorado River. CAWCD then sells this water to end users who include municipalities, industry and water management organisations. Initially it was planned that Irrigation Districts

[61] *Source: Grout, Cyrus and Mark Svendsen. 2010. Water transfers and sales in the Western United States: Selected case studies. Report prepared for The Gakushuin Women's College, Tokyo, Japan, May.*

[62] MAF – million acre-feet. BCM – billion cubic metres

[63] In Arizona rights to surface and ground water are based on the prior appropriation doctrine, with different sets of regulations governing surface and ground water. The regulations are administered by the Arizona Department of Water Resources (ADWR).

would purchase CAP water but though 9 Districts signed up in the initial stage they have not taken up this option as it is cheaper to pump from ground water. Pumping from ground water costs between US$15-33 per acre-foot (AF) whereas CAP water costs in the region of US$133 per AF[64]. This has resulted in a realignment of the mechanisms for using the CAP water and reducing the ground water abstractions as it was planned that 60-80 percent of the CAP water would be used for irrigation, thereby making serious reductions in ground water extractions.

Those purchasing CAP water (mainly municipal and industrial users) either use the water to meet their current needs or they can “bank” the water and earn ground water storage credits. They do this either by directly recharging into an aquifer at an Underground Storage Facility (USF) or by transferring the water to an Irrigation District for them to use in lieu of pumping ground water. These Irrigation Districts need to be registered with the ADWR as a designated Ground water Saving Facility (GSF). The ADWR administers the ground water credits scheme and provides permits for recharging CAP and treated effluent water to the aquifer as well as licensing abstractions. Most USF facilities are financed and constructed by developers or cities to recharge ground water from treated effluent as well as CAP water. Phoenix has 42 USFs recharging some 750,000 AF per year into the aquifer.

In this way the purchaser of CAP water gains ground water storage credits which can be redeemed at any time in the future by pumping from ground water. The CAP allocations and ground water credits, however, can only be used within a designated Active Management Area (AMA)[65]. The driver for municipal and industrial users to store ground water is that under the Ground water Management Act new urban development is only permitted if the entity can demonstrate that it has a 100-year supply of water.

Another entity, the Arizona Water Banking Authority (AWBA), was created in 1996 to store any unused component of Arizona’s Colorado River water entitlement. Its main objective as described in its Plan of Operations (AWBA, 2009) is to develop long-term storage credits to (i) provide assured supplies to municipalities and industry during Colorado River water short periods and CAP service interruptions; (ii) help meet the water management objectives of the state Ground water Act; (iii) meet the state’s obligations in the settlement of Indian water rights claims. The AWBA is funded by property taxes, ground water withdrawal fees in AMAs using CAP water, and in some years the state general fund. The AWBA uses these funds to purchase CAP water and the cost of water storage at USFs.

Where water is sold to a GSF the AWBA purchases the water from the CAWCD at a (current) price of US$ 133 per AF. It then sells this water to an Irrigation District GSF at a price which is competitive with that for pumping from ground water. This varies in the range US$ 14 per AF in Tuscon AMA to US$ 33 per AF in Phoenix and Pinal AMA. AWBA will then sell the stored ground water at a rate between US$ 100 and US$ 118 per AF.

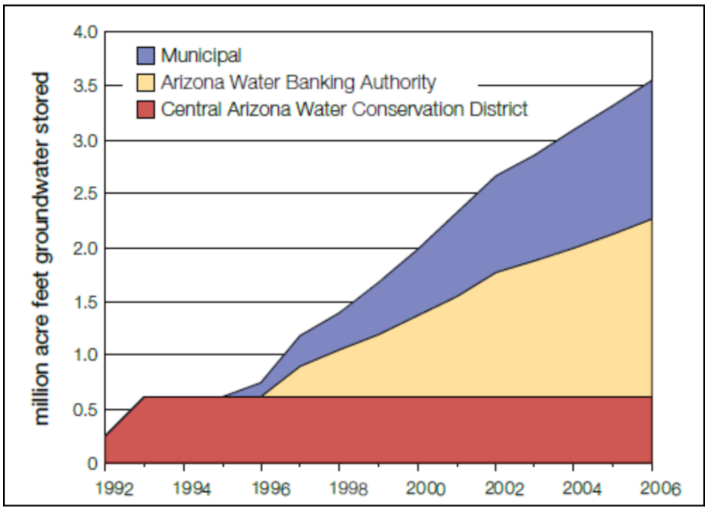
The AWBA accounts for the majority of accumulated long-term storage credits. Altogether over 3.5 MAF (4.3 BCM) of water has been “stored” in GSFs (Figure A1.2), and a further 1.9 MAF (2.3 BCM) has been directly recharged though USFs.

[64] The price of water to all CAP users was determined based on current operation and maintenance costs. However, the capital cost element required to pay for the construction of the project was substantially higher for municipal users than for agricultural users.

[65] Active Management Areas (AWAs) are designated areas in the State with a heavy reliance on natural ground water supplies.

A further entity, the Central Arizona Replenishment District (CAGRD) was established by CAWCD in 1993. This financially independent entity was created to assist landowners and water providers to demonstrate that they had an assured water supply under the state's new Assured Water Supply (AWS) Rules which became effective in 1995. Under these rules the water user as to demonstrate that they have a sufficient water supply for the development for the next 100 years. Individual entities join the CAWCD who then commits to recharge ground water on their behalf. The scheme is paid for though a property tax on the members.

Figure A1.2: Cumulative storage in GSFs (Medgal, 2008)



Summary

What has materialised in the CAP region is a situation where surface (CAP water) and ground water supplies are managed for two main sets of users, agriculture and urban. Thus the state of Arizona has developed mechanisms for exchanging current surface water supplies for future ground water withdrawals, thereby augmenting the allocation of surface and ground water amongst users and over time.

The CAP initiative demonstrates a mix of technical development (the physical network and its operation and maintenance) coupled with institutional reform (the Ground water Act and establishment of associated management entities). It also demonstrates the important role played by the Federal government which contributed with authorisation and funding of the CAP coupled with an insistence that the state enact ground water legislation focussed on the long-term management and replenishment of the depleted aquifers.

A1.2 Deschutes River Conservancy (DRC[66])

The Deschutes River Conservancy (DRC) is one of the more active members of the Columbia Basin Water Transactions Program (CBWTP), which began operating in 2002 to assist organisations engaged in water transfers from agriculture to environment and other uses. The Deschutes river is a tributary of the Columbia river and provides water for 8 Irrigation Districts, serving a total of 100,000 ha. The 8 Irrigation Districts abstract some 90 percent of the available river flow, with serious consequences for the river ecosystem.

The DRC was formed by the local Irrigation Districts, native American tribes and the Environment Defence Fund, with the primary aim to purchase unused water rights from the Irrigation Districts and return the flow in-stream. The DRC makes both temporary and permanent transactions for water, though the later are far less common. Under temporary

[66] *Source: Grout, Cyrus and Mark Svendsen. 2010. Water transfers and sales in the Western United States: Selected case studies. Report prepared for The Gakushuin Women's College, Tokyo, Japan, May.*

transactions water is leased either (i) on an annual basis; (ii) through a 5-year lease, or (iii) through a split season lease where the water is transferred for in-stream use for part of the year.

The DRC also "purchases" water for in-stream use by improving the efficiency of water use within the Irrigation Districts. As the soils in the upper Deschutes region are of volcanic origin and thus highly porous lining of canals or putting canals into pipelines can save considerable amounts of water, up to 50 percent of the transient flow. The DRC finances these projects, which have costs between US$ 5 to US$ 20 million, and returns the saved water to in-stream use, with the water rights of the Irrigation District being permanently reduced by the saved amount.

A further initiative by the DRC has been the creation of the Deschutes Water Alliance Bank (DWA Bank), which was established to provide adequate water of agriculture whilst making additional water available for in-stream flows and expanding central Oregon cities. The DWA Bank originated from a U.S. Geological Survey (USGS) study in 1998 which showed that ground water abstraction in the upper Deschutes basin was having a detrimental impact on in-stream flows in the lower reaches. The State of Oregon placed a moratorium on new ground water licenses in the upper basin, whilst at the same time setting in place a system by which a new permit for ground water abstraction could be obtained if the applicant obtained and retired an existing (downstream) surface water abstraction right. Through this process overall streamflows in some sections have improved by as much as 27 cubic feet per second (0.76 m^3/sec).

Summary

The DRC is an example where different stakeholders, including the Irrigation districts, have come together to improve the efficiency of irrigated agriculture and to release water for other uses. The process requires accurate flow determination throughout the year, a trusted agency and an appropriate legal framework, including water rights and licensing of abstractions. With the DWA Bank there is the recognition, backed up by scientific measurement and assessment, of the inter-relationship of the ground water aquifer and downstream river flows, with mechanisms developed to control and mitigate the impact of new abstractions.

A1.3 The Edwards aquifer of South-Central Texas, USA[67]

The Edwards limestone aquifer of south-central Texas is one of the most permeable and productive aquifers in the United States. The aquifer extends approximately 240 km in length, 10-15 km in width and ranges from 120 to 300 metres thick. The aquifer is well known for its artesian flow and discharges through a number of large springs with flows varying from 5-10 m^3/s. The total annual discharge from the aquifer is of the order of 874 million cubic metres (MCM), with 400 MCM/year of water abstracted by wells and some 474 MCM/year discharging from springs. The median estimated total recharge to the aquifer is estimated as 865 MCM/year, with a range between 52 to over 2,470 MCM/year (EAA, 2009).

Management of the Edwards Aquifer is the responsibility of the Edwards Aquifer Authority (EAA). The EAA was established in June 1996 under the 1993 Edwards Aquifer Authority Act, with the EAA being given broad powers to regulate withdrawals from the Edwards

[67] *Source: Schindel, Geary M. 2011. The Edwards Aquifer of South-Central Texas, USA. Paper to the international Roundtable Discussion on Agriculture and Water in Pakistan, Islamabad, Pakistan, 8-9 March, organised by the World Bank, Food and Agricultural Organisation, USAID and the Royal Netherlands Embassy.*

Aquifer (EAA, 2011). The Act had been brought into existence as a result of a lawsuit filed in 1993 by an environment group against the United States Fish and Wildlife Agency (USFWA). The lawsuit was filed as a result of increasing concern that two of the major springs, the Comal and San Marcos Springs, would cease to flow within 10 years if abstraction rates continued as they were. The lawsuit was also supported and funded by industrial interests in the Guadalupe River basin which depended on the river water fed by Edwards Aquifer springs. The lawsuit argued that the USFWA should regulate abstractions from the Edwards Aquifer in order to limit withdrawals in order to protect endangered species. The Federal judge ruled in favour of the plaintiff and declared that the State of Texas must regulate abstractions from the aquifer and the EAA was formed under the EAA Act.

Under the Act the EAA is required to:

- protect the water quality of the aquifer;
- protect the water quality of the surface streams to which the aquifer provides stream flow;
- achieve water conservation;
- maximize the beneficial use of water available for withdrawal from the aquifer;
- protect aquatic and wildlife habitat;
- protect species that are designated as threatened or endangered under state or federal law;
- provide for in stream uses, bays, and estuaries;
- protect domestic and municipal water supplies;
- protect the operation of existing industries;
- protect the economic development of the State;
- prevent the waste of water from the aquifer; and
- increase recharge of water to the aquifer.

The EAA is governed by 17 Board Members of which the 15 voting members are elected from districts. One of the two non-voting members is appointed by the South Central Texas Water Advisory Committee (SCTWAC), the other is appointed by the County Judge Executive from Medina or Uvalde counties. Voting members are elected for a four-year term, with elections held every two years such that the composition of the Board is staggered between existing and new members. Directors represent agricultural, industrial, domestic, municipal, spring, recreational and downstream users groups (EAA, 2010).

The EAA Act requires that unless directed by the EAA Directors the permitted withdrawals from the aquifer are limited to no more than 450,000 acre-feet (555 MCM) per calendar year until 2007. From 2008 this amount is to be reduced to 400,000 acre-feet (493 MCM), unless increased by the Board of Directors. Under the Act the historical water use is to be honoured and that an allocation of 2 acre-feet per acre of land be allocated for irrigated land. An analysis of the historical water rights found that the demands for irrigated land totalled 572 acre-feet, which resulted in the Texas Legislature increasing the water permits to 572,000 acre-feet but instituting measures (the Critical Period Management Program) for restricting abstractions during critical low flow periods.

The EAA has a full-time staff of 75 personnel to carry out its administrative, professional and technical functions (EAA, 2010b). There are four teams – the Executive team, the Administration and Operations team, the Aquifer Management team and the Communications and External Affairs team. The Executive team comprising the General Manager, Public

Policy Officer and Executive Assistant is responsible for oversight of the EAA, in particular policy development. The Administration and Operations team are responsible for the daily administrative and operation functions, including the management of ground water withdrawal permits, and related compliance and enforcement. This team is also responsible for the financial, human resource and maintenance functions. The Aquifer Management team are responsible for the study, protection and enhancement of the aquifer through research data collection and regulatory programmes. The Communication and External Affairs team are responsible for maintaining and increasing public awareness on issues related to the aquifer.

The EAA has a number of programmes/activities which include:

Permits Programme: Under the Act the EAA is tasked with issuing ground water withdrawal permits. Permit holders are permitted to buy, sell or lease the water rights given under the permit, which has resulted in a lively water market in some locations. To date some 100,000 acre-feet of water has been purchased by municipalities from irrigators[68]. The EAA charges for the permits, with the agricultural use charge regulated under the law at US$ 2/acre-foot/year. Charges for industrial and municipal use are set by the EAA, and are currently (2011) US$ 39/acre-foot/year. The total income to the EAA is US$ 13.3 million/year. All withdrawals have to be metered (volumetric), with meters being checked periodically by EAA staff. Under the Act water for domestic and livestock use, which amounts to some 3-5 percent of the total abstracted, is not metered.

Aquifer Management Programme: Under this programme all permitted and domestic water wells are registered and well drilling operations managed and monitored. In addition the EAA administers the water quality regulations, including inspection of storm water retention structures within the aquifers recharge zones.

Research and Data Collection Programme: The EAA's research and data collection activities are defined in the Aquifer Science Research Plan (ASRP). Data are collected for rainfall, recharge, discharge and water quality from a network of 70 rain gauges, 30 stream gauging stations, and 250 well sites. The research activities include tracer testing, surface geophysics and borehole hydrophysics to help define aquifer properties. The data are used to support the EAA's research programme, including the development of aquifer recharge and ground water models. The programme produces a Hydrological Data Report each year which provides information on aquifer levels, precipitation, recharge estimates, ground water discharge and use, and water quality testing results. Associated with all this work is an education initiative to raise awareness and understanding about the aquifer and its current and future situation.

Enforcement Programme: The Administration and Operations (A&O) team are responsible for the Enforcement Programme which prepares cases against violators of the Authority's regulations. The cases are presented to the Directors who make the final enforcement decisions. As part of the enforcement programme the A&O Team carry out the following tasks: well meter inspections; check well construction; check water pollution abatement plans; check geological assessments prepared for land development and inspect storm water treatment systems for maintenance. The A&O team do not perform permit review or inspections of on-site sanitary waste treatment systems.

Administration Programme: The Administrative Programme oversees the collection of aquifer management fees, as well as performing personnel and administrative functions for

[68] Irrigators are permitted 2 acre-feet per acre, but can only sell 1 acre-foot. This ensures that the land can still be irrigated should the owner sell the land at some time.

the Authority. It also oversees the production of the Authority's Strategic Plan and drafts the annual budget for the Board of Directors.

Critical Period Management Programme: During drought conditions the Authority prepares a Critical Period Management Programme as defined in the state statute and Authority's rules. The intent of these rules is to slow the decline of aquifer levels and to protect spring discharges. Selected Index Wells and the flows from two springs are used to monitor critical levels. If levels are critical reductions in pumping are implemented depending on the index levels, with reductions ranging from five to forty percent of the annual pumping permits.

Ground water Conservation Plan. By statute the Authority is required to develop effective and enforceable conservation and reuse programmes for the aquifer. The Ground water Conservation Plan (GCP) promotes year-round conservation measures, and seeks to guide permit holders in the preparation of their own GCPs.

Summary

The establishment of the Edwards Aquifer Authority shows a pragmatic response to a developing crisis brought about by the declining ground water levels in the aquifer. The Authority was established as a result of legal action by a group of concerned stakeholders which forced the State of Texas to enact the EAA Act and establish the EAA Authority. The Authority has been adequately staffed and funded, with funds totalling some US$ 13 million per annum coming from issuing ground water withdrawal permits. Through a number of programmes the Authority issues ground water permits, monitors ground water abstraction at well sites, enforces EAA regulations, carries out short and long-term research and runs an education programme to raise awareness about the aquifer.

A1.4 Ground water use and management in Spain

With a land area of just over 500,000 square km Spain is the most arid country in Europe. It has an average precipitation of some 700 mm/year, with a low of 100 mm/year in the Canary Islands and over 2,000 mm/year in the more humid northern region. Average potential evapotranspiration is around 700 mm/year, with potential evapotranspiration being higher than precipitation in significant parts of the country. Average stream flow is about 110 km^3/year, of which 80 km^3/year is surface runoff and 30 km^3/year is ground water (Llamas and Garrido, 2007). There are good aquifers in about one-third of the country, with some 411 formally identified aquifers covering an area of 180,000 km^2 (Llamas et al, 2001). The estimated natural recharge to these aquifers ranges between 20 and 40 km^3/year with an average of 30 km^3/year.

Total water use in Spain is some 36 km^3/year, with the main uses being irrigation (67 percent), urban domestic and industrial water supply (14 percent) and other independent uses (19 percent). With a population of 43 million the average water use is around 3000 m^3/person/year, though this can be as low as 200-300 m^3/person/year in some regions. The quantities of ground water being used for these different purposes over recent years is summarised in Table A1.1. The large variation in the urban water use is due to dry years when the proportion drawn from ground water rises.

Table A1.1: Estimation of ground water consumption in Spain

Use	Volume abstracted (MCM/year)	Percentage of total water abstracted (surface and ground water)
Urban	1,000 – 15,000`	~20%
Irrigation	4,000 – 5,000	~25%
Industrial and cooling	300 - 400	~5%
Total	5,500 – 6,500	15-20%

Source: Llamas et al, 2001.

Spain has 3.25 million hectares under irrigation, divided as shown in Table A1.2. In general sprinkler and drip irrigation are more common in the regions were ground water is used. The surface irrigation systems have been mostly developed by government, whilst the ground water systems are mainly farmer-developed and managed, with farmers bearing the full costs of drilling, pumping and distribution[69]. Though of a smaller area than the surface water systems the ground water-supplied systems are highly productive, often using higher technology methods of application (sprinkler and drip) and providing greater control over the supply of the irrigation water. A study carried out in Andalusia in 1998 (Hernádez-Mora et al, 2001) showed that ground water can be over 5 times more productive per unit of water consumed[70] (Table A1.3). Thought the productivity of ground water use is impressive it must be borne in mind that the crop types for surface and ground water fed systems are often different, with ground water use being mainly used for high-value and labour-intensive crops such as vegetables.

Table A1.2: Breakdown of the irrigated area in Spain

Water source	**Area (ha)**	**Proportion (%)**
Surface water	2,218,291	68.3%
Ground water	896,840	27.6%
Inter-basin transfers	95,156	2.9%
Water returns	23,499	0.7%
Reuse	12,144	0.4%
Desalinized	271	0.01%
Total irrigated	**3,246,201**	**100%**
of which:		
Flood irrigation	59%	
Sprinkler	25%	
Drip irrigation	17%	

Source: MAPYA, 2001

Table A1.3: Comparison of surface and ground water irrigation use in Andalusia, southern Spain

Indicator	**Unit**	**Irrigation water source**			**Ratio ground water/ surface water**
		Ground water	**Surface water**	**Total**	
Irrigated area	ha	210,000	600,000	800,000	0.35
Average abstraction at source	m^3/ha/year	4000	7400	6500	0.54
Productivity of water	€/m^3	2.16	0.42	0.72	5.1
Employment generated	EAJ/10^6 m^3	58	17	25	3.4

€ 1 = US $1.3 EAJ – Equivalent Annual Job. The equivalent of 1 person working full-time for 1 year
Source: Hernádez-Mora et al, 2001)

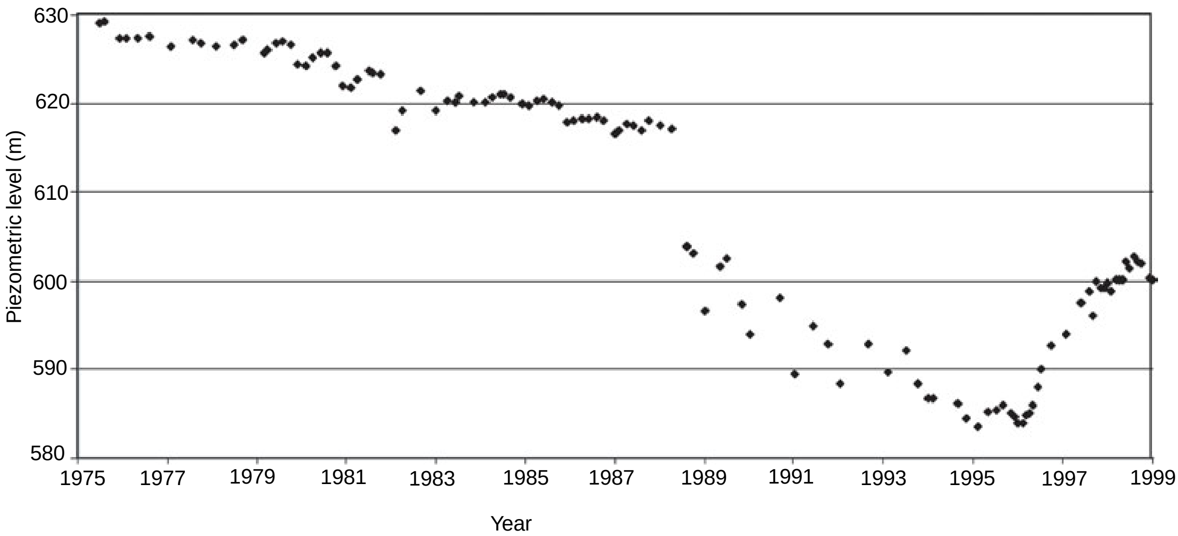
[69] Surface water irrigation has mostly been driven by civil engineers within the Ministry of Public Works (subsumed into the Ministry of Environment in 1996) whilst ground water has been promoted, since the 1950s, by the Ministry of Agriculture.

[70] The analysis was based on average volumes of water applied to groups of fields. Conveyance losses from the source to the fields were not quantified, but can be significant for surface irrigation systems.

In the water supply sector ground water is the key source of potable water in rural areas and on the islands. Medium and small municipalities with populations less than 20,000 people obtain 70 percent of their water supply from ground water (MIMAM, 2000). In some coastal regions the dependency on ground water for potable water is even higher.

Increasingly ground water development is being constrained by concerns over adverse ecological impacts of declining water tables and spring flows (Llamas, 1992). The disappearance of wetlands and the drying up of sections of rivers has led to calls to regulate and control ground water abstractions. In the 1990s the Upper Guadiana basin suffered a dramatic decline in ground water levels due both to abstractions and drought (Figure A1.2). This decline resulted in severe conflicts between irrigation farmers, water officials, environmental groups and government conservation officials which have been ongoing for the last 20 years. Management efforts to mitigate the adverse impacts of the water table decline have had mixed results thus far (Bromley et al, 2001).

Figure A1.2: Decline in the water table elevation, Upper Guadina catchment, Spain (from Martinez-Cortina, 2001 as cited in Hernández-Mora et al., 2001)



Until 1985 ground water in Spain was in the private domain. In 1985 the government enacted a new Water Act which declared all ground water to be in the public domain, with every new ground water abstraction requiring a permit. Under the Act ground water developments made before 1January 1986 are considered private property and can continue to abstract water but must be registered with the relevant basin agency, as must all wells, galleries and springs. Unfortunately the legislators and water authorities underestimated the number of existing ground water abstraction points and have not been able to provide sufficient resources to register them all. Thus the total number of abstraction points is unknown, as is the total volume abstracted. Government has initiated two programmes to create an inventory of all the water rights in the country, one in 1995 called ARICA which cost €60 million and another in 2002 called ALBERCA with a budget of €150 million. The ARICA initiative failed, the ALBERCA initiative is ongoing.

In 1999 the 1985 Water Act was amended to allow for trading in water rights (of both surface and ground water) with the intention of creating greater flexibility. This legislation does not affect the ground water domain too much as users who developed ground water abstraction system before 1986 were already able to buy or sell their water rights as private property.

Though Spain has a long history of collective management of common pool resources, such as the Water Court of Valencia (*Tribunal de las Aguas de Valencia)* it has not, to date, been that successful with the formation of ground water users associations (*Comunidades de Usuarios de Aguas Subterráneas)*. The 1985 Water Act preserved the rights and responsibilities of the 6000 or so *Comunidades de Regantes* (Surface Water Users Associations) which are legally registered entities of public right, and which have large part been successfully operating for many years[71]. Under the 1985 Act Ground water Users Associations were required to be formed when an aquifer was legally declared as over-exploited. In 1987 the Guadiana River Water Authority declared two major aquifers, the western La Mancha and Campo de Montiel, legally over-exploited. The two aquifers cover some 7,500 km^2 with an irrigated area of over 200,000 ha. Ground water users associations were only formed in 1994 with a plan to reduce the abstraction of ground water with the support of generous subsidies from the European Union. Despite this a significant number of farmers continue to drill illegal boreholes and are not reducing the quantity of ground water that they abstract. Difficulties have been encountered in getting the ground water users associations to function, with only 2 out of the planned 17 associations being operative (López-Gunn, 2003; Llamas, 2003; Hernández-Mora and Llamas, 2001; Llamas *et al*., 2001). As recognized by the White Paper on Water (MIMAM, 2000) the problem stems largely from the top-down approach adopted to the formation of the ground water users associations. Under the 1999 revision to the 1985 Water Act and the 2001 Law of the National Plan there are measures proposed to address these issues and to form self-sustaining, community based associations for the management of the dwindling ground water resources.

Summary

Since the 1950s when the Ministry of Agriculture first started promoting the use of ground water for irrigation the area served has increased significantly. There is no doubt that ground water has made, and continues to make, a significant contribution to social and economic development in Spain. However, growing levels of abstraction and declining water levels are an increasing area of concern, as are the failure of a number of initiatives to curb abstractions and better manage the aquifers. The situation is summed up by Llamas and Garrido (2007):

> *"Even after the enactment of the 1985 Water Act the control of the old and new water wells in the Segura catchment area is rather scarce. The situation can accurately be described as one of administrative and legal 'chaos' ...... For example, the official White Paper on Spain's Water.... admits that in this region only about 2500 water wells out of more than 20,000 drilled are legally inventoried by the Segura Water Authority."*

Thus even in a developed country such as Spain management of ground water is proving difficult and problematic. A further concern is the failure to date of endeavours to engage with local communities in ground water management, despite wide and successful experience in the country with *Comunidades de Regantes* (Surface Water Users Associations).

[71] These entities come under the jurisdiction of the Ministry of the Environment, and are subsidized with public funds, mainly for maintenance of the I&D infrastructure.

A1.5 COTAS – Aquifer Management Councils, Mexico[72]

The *Consejos Téchnicos de Aguas* (COTAS – Technical Water Councils) in Mexico are one of the few examples worldwide where user-regulation of ground water abstraction has been seriously attempted. The study of these Councils will help to answer the following questions posed by the National Planning Commission:

- What would be the best institutional design for Aquifer Management Associations (AMAs)?
- What would be their interface with the statutory ground water bodies?
- How best could the AMAs be part of river basin planning?

Aquifer depletion is a major concern in the arid and semi-arid regions of Mexico, where ground water is a significant source for drinking water, irrigation and industrial use. Of 647 aquifers identified in 1999 by CNA, 99 were over-exploited, a three-fold increase from 32 in 1975. There are 40 aquifers in the Lerma-Chapala basin with upper layers composed of lacustrine and alluvial materials with lower layers of basaltic rocks and rhyolite tuff. The aquifers are recharged through rainfall infiltration, surface runoff and deep percolation from irrigation. Data from the 1990s from the CNA indicate that the annual abstraction was in the order of 4,621 hm^3/annum whilst the annual recharge was 3,980 hm^3/annum, giving an annual deficit of 641 hm^3/annum. More recent studies indicate the deficit might now be as much as 1,336 hm^3/annum.

The most serious over-exploitation is faced in the Guanajuanto state in the Middle Lerma region, where the annual deficit is around 1,200 hm^3, measured against an annual extraction of around 4,100 hm^3 and an annual recharge of 2,900 hm^3. As a consequence of the over-exploitation of ground water the ground water levels have fallen and seepage flow from the aquifers to the rivers has ceased. Ground water levels have been estimated to be falling on 2.06 m/year on average. As a result of the falling ground water levels users are drilling deeper wells, and the traditional shallow wells (*norias*) are running dry. Wells between 200-400m depth are common, with some reports of wells 500 to 1,000 m deep. As well as increased pumping costs, there has been compaction of the aquifers in some regions, with land subsidence of 2-3 cm per year.

There have been many (unsuccessful) attempts made to limit over-abstraction of ground water in the state. Worldwide research (Blomquist, 1992) has shown that it is difficult to regulate ground water for a number of reasons:

- It is a fugitive and invisible resource, making it difficult to monitor who is pumping what quantity;
- Ground water is extracted by numerous, often small, widely dispersed pumps controlled by many individuals who have a high incentive to maximise returns to cover their investment costs;
- Permit systems are prone to corruption, and establishing ground water rights are more difficult than for surface water;
- Attempting to reduce ground water use curtails the economic benefits derived by the user.

[72] This information is taken from a Wester, Philippus. 2000. Shedding the waters: Institutional change and water control in the Lerma-Chapala Basin, Mexico. The (many) references provided in this publication have not been repeated herein.

In this context the mindset of the users seems to be to pump every possible drop as long as you can and worry about the consequences later.

The difficulty with having so many spatially-dispersed users is that it is difficult to organise them to have a common purpose.

In Guanajuanto the driving force behind the decline in the ground water levels has been irrigation. Since 1960 the ground water irrigated area has grown from 24,000 ha to over 250,000 ha in the 1990s, with a large proportion of the ground water area being developed for commercial agriculture. During this period the surface irrigated area has increased from 135,000 ha to 180,000 ha. The initial development was by the federal government in ground water development, both for irrigation and urban use, but this changed between 1960 and 1980 when agriculture in the region changed with a move towards livestock and poultry production. More alfalfa was grown, requiring ground water as surface irrigation supplies were only available for five to six months per year. As a consequence of the agricultural boom thousands of wells were sunk, funded by farmers themselves. A second boom came in the 1980s with the advent of production of fresh and processed fruit and vegetables for export, with these products being primarily irrigated from ground water. As a consequence of these two booms the number of ground water wells has increased from some 10,000 in 1982 to around 17,000 in 2000.

As a result of this rapid expansion of ground water extraction several attempts have been made to control the situation. The key features of this process are summarised below:

- The 1884 civil code clearly stated that the owner of overlying land was free to prospect and use water underlying his land;
- Article 27 of the Constitution states that water is national property. However as it did not differentiate between surface and ground water the 1884 civil code on ground water held. In 1945 the Constitution was amended to allow the Federal government to regulate the use of ground water in the public interest;
- A ground water law was passed in 1948 and updated in 1956 to increase government control over ground water abstraction. The 1972 Federal Water Law specified that the SRH (the government irrigation agency) should identify over-exploited aquifers (*vedas*) and regulate ground water pumping by issuing permits, as well as drawing up rules and procedures for reducing abstractions;
- Thus Mexico had a robust ground water law, but the regulations for the 1948 and 1972 laws were never issued, and the law not enforced. Regulations for the 1956 law were issued, but though *vedas* were identified the restrictions on pumping were not. A large part of this was the inability to quantify what the safe yields were for aquifers placed under *veda*. Thus whilst the government had a strong legal for control of ground water, it was weakly applied. In truth the restriction of ground water extraction were subordinate to the key drivers of economic growth and political stability;

In addition to the weak enforcement of the *vedas* the widespread availability of electricity at relatively cheap prices contributed to the increase in the levels of ground water pumping. A special, reduced tariff is applied to electricity for agriculture which is subsidized by the federal government. Despite efforts to raise the tariff in 1994 even President Salinas was unable to push this through Congress due to the powerful agricultural lobby. Despite electricity pricing being a strong tool to regulate ground water pumping Congress was not able to apply this measure, despite the obvious need and the failure of other, weaker measures to control over-exploitation, such as the creation of the *vedas*. The federal and state governments then tried additional measures, such as subsidized programmes for precision land levelling, conversion of open earth channels to buried pipes and conversion from furrow and basin irrigation to sprinkler and drip irrigation.

However though these measures led to water savings this was not reflected in a reduction of ground water pumping as farmers merely cropped a larger area with the available water. In addition more efficient irrigation application facilitated the introduction of higher value crops, creating a yet greater desire on the farmer's part to use ground water. Farmers interviewed by Wester in 1999 and 2000 admitted that the investments in irrigation equipment had resulted in them pumping more water rather than less!

In a further effort to reduce ground water pumping from 1996 onwards the state government formed COTAS (Technical Water Councils). The concept of aquifer management groups had arisen following an agreement signed in 1993 between the five states in the Lerma-Chapala basin to limit ground water abstraction. An initial action programme to form Aquifer Preservation Groups was formulated and attempted, but failed. Following a rather protracted route, fourteen COTAS were formed covering the whole state of Guanajuanto.

The COTAS were not, however, fully representative of all pumpers, rather it was initially formed with perceived leaders with the hope to expand to cover all pumpers. This however proved to be difficult, as the COTAS were not perceived as being designed and owned by the user. An additional factor was that for political reasons the COTAS had been established by CEASG (Guanajuanto State Water and Sanitation Commission), not the water resources agency, CNA. This resulted in rivalry between the two organisations, to the detriment of the objectives of the COTAS programme.

Between 2000 and 2006 CEASG, funded from the state budget, initiated several measures to improve the COTAS. This involved developing ground water models, piloting trials to test and then demonstrate measures to reduce ground water extractions, and training and awareness raising of ground water users. The number of members of the COTAS increased from 225 in 2000 to 8,610 in 2000 (out of a potential 18,000 users). Whilst the COTAS has become accepted as a body to assist ground water users with technical advice it has no legal power to manage ground water, this remains with the CNA who refuse to delegate such powers to the COTAS. As a result the larger ground water extractors deal directly with the CNA, and bypass the COTAS.

Summary

Despite a recognition in the 1950s that ground water abstraction needed to be regulated ground water abstraction continues unabated in the Lerma-Chapala basin. A variety of measures have been attempted, including strengthening legislation, providing subsidies to ground water users to improve the efficiency of water use and the formation of ground water users associations. For a variety of reasons none of these measures has been successful, leaving policy makers to continue to look for workable mechanisms to control and limit the ground water overdraft.

Appendix A2: Indian Experience

A2.1 Andhra Pradesh Farmers Managed Ground water Systems Project[73]

Andhra Pradesh has piloted an alternate approach to demand side management of ground water through community mobilization and action under the APWELLS and AP APFAMGS projects. The Indo-Dutch APWELL Project was implemented in seven drought prone districts of Andhra Pradesh from 1995 to 2003. The Andhra Pradesh State Irrigation Development Corporation (APSIDC) was the main implementing agency. In the last year of implementation the project was transferred to the Panchayat Raj and Rural Development Department for possible upscaling. NGOs were involved in community mobilizing and capacity building.

The long-term objective of the project was to improve the living conditions of small and marginal farmers, through sustainable and environmentally sound interventions. The project also strove to make women farmers as equal partners with male farmers in agriculture and related activities. The immediate objective of the project was to provide ground water irrigation facilities for small and marginal men and women farmers. The farmers formed Water User Groups (WUGs) for construction, operation, and maintenance of the ground water irrigation systems. Clusters of WUGs formed Borewell User Associations (BUAs) which were legally registered, for training, inputs, agro-processing, and generation of profit. Important components of the project were ground water resources development where feasible, land-and-water management by the users, extension and training, activities for gender integration and institutional development, environment management, and monitoring and evaluation.

The achievements of the APWELL Project were that it operated in 370 villages in 7 districts, bringing irrigation facilities to about 35,000 acres of land belonging to about 14,500 small and marginal farmer families. They were formed into 3,450 Water User Groups (WUGs) and given trained in operation and maintenance of bore wells as well as group management and water sharing. Extensive capacity building programs were conducted in sustainable agriculture including INM and IPM. The women farmers were organized into 600 SHGs active in thrift and savings and income generation activities. Finally, the WUGs were formed into 250 BUAs for organizing common activities of WUGs. In later assessments, it has been observed that most of these WUGs and BUAs had been converted into Rythu Mitra Groups (RMGs).

APWELL had designed, planned and implemented Participatory Hydrological Monitoring (PHM) and allied activities among its WUGs aiming at demand side management of ground water systems through Participatory Ground water Management (PGM). As a first step, it started not only involving non-APWELL farmers in a target village, but also entered into new villages where the project had not developed ground water irrigation systems. The basin level initiative at the Upper Gundlakamma Basin, Prakasam District, was based on the experience from the PHM pilot. Gundlakamma initiative in itself was to be a pilot on a basin scale to gain in-depth knowledge on promoting people managed ground water system. It was recognised that PHM was very important for a dry land farmer in resource poor regions of AP because a farmer there not only spent more money on construction and annual maintenance but might even end up with a defunct well. The main lessons from the APWELL Project may be summarized as follows:

[73] Source: AFPRO, 2006. A Systematic Assessment of Community Based Ground water Management Experiences in Andhra Pradesh. Hyderabad, Action for Food Production & APFMAGS Project Profile

- Access to water by small and marginal farmers improves their productivity and they rise above poverty line
- Small and marginal land holdings (as small as one acre) can become productive with availability of water and proper inputs
- Participatory ground water management is a viable concept if introduced in conjunction with ground water development, agricultural production, institutional development and capacity building of farming communities
- All stakeholders and water users need to be involved in participatory ground water management

After the completion of the APWELL project in March 2003, the PHM pilot was developed into a new project, i.e., Andhra Pradesh Farmers Managed Ground water Systems project (APFAMGS), which is being implemented in the same districts with the selection of villages based on ground water hydrological unit. The APFAMGS project started in 2003 August, with the assistance of The Royal Netherlands Embassy and was later taken over by FAO in July 2004.

Hence, the Andhra Pradesh Farmer Managed Ground water Systems (APFAMGS) Project is a logical extension of APWELL project. While the latter was centred on the creation of water facilities for poor and marginal farmers, APFAMGS' focus is on developing capacity of ground water users in managing their resource in a commonly sustainable way for crop production. The experience of ground water management and PHM gained through APWELL fully informs the conceptual design and implementation set-up of APFAMGS and is the basis upon which the new project is built.

The specific objectives of the project are:

- Create a band of skilled human resources to take up task of ground water management
- Make farmers vigilant to ground water dynamics and consequences of over exploitation
- Share concerns of farmers affected by ground water over exploitation and ensure appropriate remedial action
- Extend popular concept of participatory management of water resources to ground water users
- Institutionalize community management of ground water for dealing with issues related to sustainable ground water management
- Facilitate formation of Ground water Management Committees (GMC) made up of well owners to monitor ground water levels, rainfall and discharge.
- Promote Crop Water Budgeting (CWB) as a tool to empower farmers for deciding appropriate crop system matching the available ground water.
- Adopt Farmers Field School (FFS) approach for promoting ecofriendly farming system
- Empower community to take up appropriate initiatives in ground water recharge measures.

The project is being implemented in 650 villages in seven drought prone districts of Mahabubnagar, Kurnool, Nalgonda, Prakasam, Kadapa, Anantapur and Chittoor. In each district, a few streams are selected based on technical criteria. Each stream basin is being considered as a hydrological unit and each unit covers minimum of one village and a maximum of 20 villages. The project is being implemented in 62 hydrological units.

The major Activities of the project are:

1. Establishing hydrological monitoring networks
   - Rain gauge stations
   - Observation wells – Monitoring water levels and discharge
2. Capacity building of farmers
   - Data collection,
   - data recording
   - crop water budgeting
3. Efficient water management practices
   - Use of water saving devices
   - Switching over to low water consumption crops
   - Practicing water efficient irrigation systems.
4. Artificial recharge measures
   - Construction of check dams, Drilling of injection wells
   - Desilting of tanks
5. Enhanced Agricultural production
   - Farmers field schools(FFS)
   - Participatory technology development (PTD)
   - Farmer Training Teams (FTT)
   - Training cum production centres
   - On farm demonstrations
     - Soil and water conservation
     - Nutrient management
     - IPM
     - Alternate land use system
     - Farmer Scientist workshops
6. Gender integration
   - Gender assessment study
   - Mainstreaming Gender
   - Awareness on gainful employment
7. Community based Institutions - Ground water management committees (GMCs)

   - Habitation level
   - Hydrological Unit level
   - NGO level networking.
   - State level networking
8. Linkages
   - Ground water & Agriculture Departments.
   - Scientific Research Organisations

The institutional design of the project is rather complex. One nodal NGO – BIRDS – has signed the agreement with FAO as the executing/implementing agency with another eight partner NGOs also participating in implementation. The project receives continuous technical support from a Technical Support Team, World Education and others. The modality of implementation of the project however allows flexibility of execution with FAO playing a guidance and financial oversight role.

The project promotes participatory ground water management through the platform of Farmer Water Schools that facilitates experiential learning of different cultivation techniques and cropping patterns linked to the use of ground water resource. This is achieved through intensive capacity building and progressive development of the Farmer Field School (FFS) concept into the Farmer Water School (FWS). A key element in the FWS is the crop water budget session at the start of the Rabi season, particularly as a decision-making tool for farm families to adopt alternative agricultural practices, suiting the availability of ground water. Participatory Ground water Management is addressed by the following steps:

- Participatory Hydrological Monitoring – the farmers are equipped to record the ground water level and rainfall data, analyze the seasonal and daily fluctuations for understanding the ground water behaviour
- Environmental Viability Assessment – the farmers are equipped to assess the likely recharge of ground water on the basis of topography and land use in the given unit. The farmers are also equipped with the skill to assess the quantity of ground water being utilized as per existing cropping pattern and other usage. A water balance is arrived at to understand whether the recharge is less, more or equivalent to usage. This highlights the environmental viability and sustainability of current practices and assists in identification suitable practices
- Crop Water Budgeting – Once the farmers are able to assess ground water availability and seasonal water balance, they are provided with information to identify the crops according to water availability. Thus the crops is identified as per water budget

The project also works on the supply side management of ground water resource through artificial ground water recharge structures. Though limited in scope it has been in some ways successful in improving ground water availability in the project area.

APFAMGS Project has already exceeded its original targets of creating a band of 3000 men and women farmers to understand ground water systems and 6500 farm families enabled for adoption of alternative agricultural practices suiting the availability of ground water. The specific achievements of the project are:

- About 28,000 men and women farmers having been trained through FFS-FMGS on alternative agricultural practices are in a position to understand ground water systems
- 10,340 farm families enabled for adoption of alternative agricultural practices suiting the availability of ground water (against a target of 6,500)
- 559 community based institutions established for alternative management of ground water resources with equal representation and participation of women and men covering 640 habitations
- Several water use efficiency initiatives like mulching, bunding, improved irrigation methods, large scale promotion of water saving devices etc. have been taken up by farmers

A systematic study of the project was conducted by AFPRO, Hyderabad during the second half of 2006. Data was collected from 30 villages reflecting a range of aquifer types and socio-agronomic conditions in the project area and villages without the project. The sample included 8 APWELL villages, 6 APWELL villages where APFAMGS has continued its activities, 10 villages which were newly selected for APFAMGS activities, one CWS village (CWS is implementing a community ground water management project in this village independent of APFAMGS) and 5 villages with substantial ground water use but not under any ground water management project. Information from 15 ground water users from each village was obtained to quantify important socio-economic parameters for the assessment of effectiveness of interventions. The study team also interviewed farmers as well as officials of various relevant departments of the GoAP. Data collected related to communication and awareness strategy, community participation, ground water management by community, watershed implementation, agriculture among others.

The study findings showed that APFAMGS project has been successful in meeting its challenges and achieving its expected results (AFPRO, 2006). Farmers understand the seasonal occurrence and distribution of ground water in their habitations and in their hydrological units as a whole and are able to estimate seasonal recharge, draft and balance. Farmers are capable of collecting and recording rainfall and associated ground water data. They have mastered the concept of ground water as a shared resource and are willing to manage it for the collective benefit. This has been achieved through a strong focus and investment on capacity building and through the process of demystification of concerned science without compromising on its basic scientific principles, which has created a strong empowering effect on the beneficiaries.

An independent evaluation of the APFAMGS carried out by the GW-MATE, World Bank in 2009 shows significant successes by the project. The study was carried out using the APFAMGS Project database (which exhaustively covers the project area), remote sensing information and a farmer survey commissioned from the University of Hyderabad. The findings of the study are (Garduo, H. et al. 2009. 12-13):

- In a majority of the project areas, the interventions have succeeded in beginning to build a link between water availability and water use for agriculture – in the years when water availability is low at the beginning of the rabi season (either due to low rainfall and consequently low recharge, or due to high ground water abstractions in the kharif season decreasing availability for the rabi season), ground water use has been reduced counter to the normal behaviour whereby water availability in the aquifers is not a factor influencing ground water use, and aquifer depletion often worsens in drier years – and this path-breaking achievement can be understood in terms of the impact of ground water availability information on farmer decision making

- The reductions in water use in these areas are achieved by a combination of crop diversification and water-saving irrigation methods – in effect six of the eight hydrological units sampled reported a reduction in the area under high-water-use crops, and the cumulative reduction of 43% during 2 years in rabi paddy area contrasts with the total area under rabi paddy in Andhra Pradesh which increased 5%

- The remote sensing analysis for one selected HU showed that area under high water use crops (>1000 mm) decreased by almost 11% from 2004-05 to 2007-08, whereas area under the low water use crops (<375 mm) increased by roughly the same amount

- In terms of cumulative water abstractions, 42% of the HUs have consistently reduced the Rabi draft over the three years of project operation, while 51% have reduced the draft intermittently, and only 7% have witnessed an increase in ground water draft during this period. The figure below shows the behaviour of HUs where ground water draft has decreased.

Figure A2.1: Groundwater pumping pattern

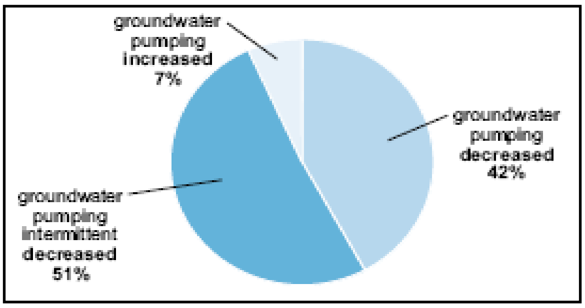
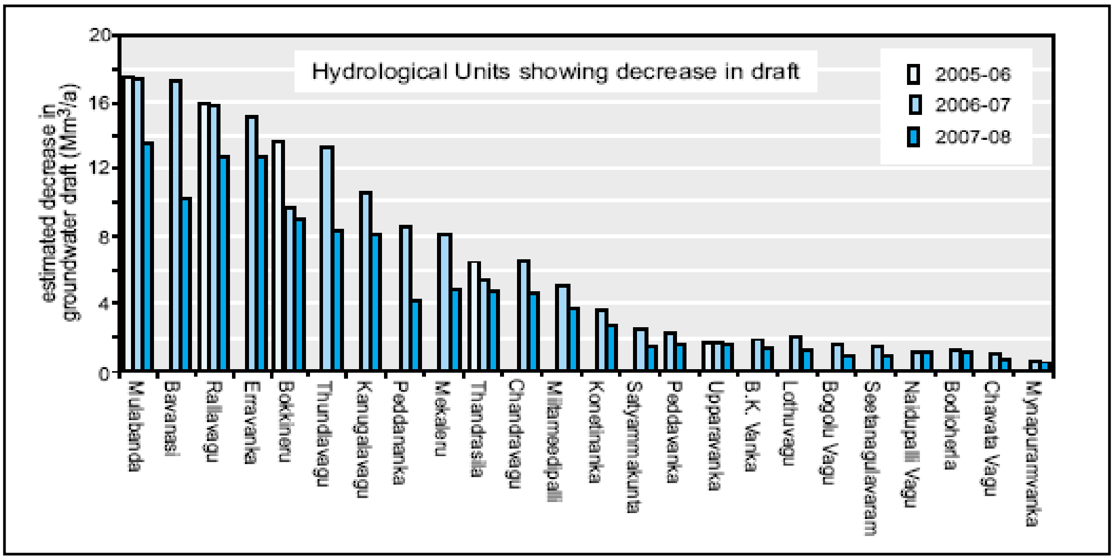


Figure A2.2: HUs with decrease in ground water



- This impact is unprecedented, in terms of reductions actually being realized in ground water draft, and in terms of the geographic extent of this impact, covering dozens of aquifers and hundreds of communities – while these results are preliminary and pose a number of questions on how exactly this impact has been achieved, they do indicate that APFAMGS may be the first example globally of large-scale success in ground water management by communities
- Moreover, project area farmers have not sacrificed profitability to reduce water use; on the contrary they have consistently improved their profitability with the Net Value of Outputs per ha nearly doubling during the project period compared to inferior and much more erratic results in similar non-project areas

APFAMGS project has hence done a commendable job in demystifying the science of ground water dynamics for the farmers and trained them in monitoring ground water status in their villages for collective decision making on its use. This has empowered the farmers and provided sustainability and stability to their ground water based livelihoods. However, the project approach is very intensive with need for continuous and sustained training and capacity building of the farmers. It requires a dedicated team of trained professionals to support implementation on a regular basis. Although the information about the project, its achievements and learning are quite well documented and disseminated no attempt has been made to replicate it in any other state of the country. Neither has the project been owned up by the concerned governments in Andhra Pradesh – Rural, Agriculture and Ground water Departments or scaled up to cover mare ground water communities[74]. This has led some critics of the project to argue that while it may have succeeded in parts of Andhra Pradesh the project methodology is too abstract and complex to replicate elsewhere.

[74] The PGM approach has been adopted in the World Bank assisted Andhra Pradesh Community Based Tank Management Project for implementation in the PIM context. However, even in this project the number of WUAs covered under PGM is only about a 1000.

A2.2 Jyotirgram Scheme and Ground water Management in Gujarat[75]

The flat tariff system for agricultural connection introduced in 1988 in Gujarat by the Gujarat Electricity Board produced major benefits for farmers using ground water irrigation. The flat tariff expanded ground water irrigation and increased the utilization of tube wells in the state. Since the marginal cost of electricity to tube well owners was zero, they aggressively sold water to their neighbours, typically marginal farmers and share-croppers unable to afford their own tube wells. Competition among sellers pared down the prices of pump irrigation service in local informal water markets, which greatly benefited the poor. However, the ill-effects of flat tariff were serious too. It led to ground water over-exploitation. Also most seriously, flat tariff became sticky and gradually increased GEB's losses in supplying power to agriculture. Farmer lobbies strongly opposed government efforts to raise flat tariff, leading to mounting losses to the GEB on account of agriculture.

Given the circumstances, the government had no option but to gradually reduce the power supply to agriculture. During the 1980s, farmers got 18-20 hours of 3-phase electricity/ day; this came down to 10-12 hours by 2000. Moreover, power supply came with low voltage, often during the nights and with frequent tripping damaging motors.

Normally, single-phase power that can run domestic appliances was provided 24 hours, but 3-phase power required operating tube wells was restricted to 10-12 hours. To beat this system, farmers everywhere in Gujarat began using capacitors to convert two or even single phase power into 3-phase power to run their tube wells. This reduced the voltage downstream which affected the village community, while tube wells continued to operate unhindered for 18-20 hours/day.

It was commonly argued that the way out of this imbroglio was to meter tube wells, improve the amount and quality of power supplied to farmers, and charge metered tariffs. However, taking this route would resurrect the logistical problems of metering, the original cause for Gujarat shifting to flat tariff in the first place. This would also attract massive farmer opposition making it difficult for the government to travel that course. Instead, an alternate solution of separating feeders supplying power to tube wells from other rural feeders was adopted by the state government. This was the Jyotirgram Scheme.

Jyotirgram Yojana (JGY) was launched initially in eight districts in Gujarat on a pilot basis and later extended to the entire state covering all of Gujarat's 18,000 villages by 2004. This was a massive operation, which involved laying a parallel rural transmission network across the state at an investment of Rs. 1,170 crores. Feeders supplying agricultural connections were bifurcated from those supplying commercial and residential connections at the sub-station itself. Pre-JGY, at the lowest level of 11KV, feeders served a group of 2-5 villages wherein all connections (domestic, agricultural as well as commercial) were through this feeder. Post-JGY, however, the feeders were bifurcated into agricultural and non-agricultural feeders. This meant that certain feeders only served farm consumers and connections while the rest served the domestic and commercial customers. Rural Gujarat thus rewired witnessed two changes:

[75] Source: Shah, T. & Verma, S. 2008. Co-management of electricity and ground water: an assessment of Gujarat's Jtotirgram Scheme Economic and Political Weekly, 43(7): 59-66

Shah, T. Gulati, A. Hemant, P. Shreedhar, G. and Jain, R. C. 2009. Secret of Gujarat's agrarian miracle after 2000. Economic and Political Weekly, 44(52): 45-55

- The villages began to be provided with a 24-hour power supply for domestic use, schools, hospitals and village industries
- Farmers began getting 8 hours of daily power supply at full voltage on a pre-announced schedule - every village received agricultural power during the day and night in alternate weeks that are pre-announced

For common villagers, JGY has resulted in a tremendous improvement in the quality of daily life. For a long time before the JGY, rural life and village industry were afflicted with an unpredictable, frequently interrupted power supply that was also of low quality. Post JGY, power cuts, which were endemic, have become almost non-existent, and so have voltage fluctuations. Further, JGY has helped to bridge a major divide between rural and urban life. An improved power supply has led to better drinking water supply for longer hours, improved street lighting, use of television, radio, kitchen gadgets and fans. JGY also paved the way for better functioning of schools, primary health centres, dairy co-ops and communication services.

JGY also had major impact on the tube well owners. They were both beneficial and adverse. Four major changes brought by JGY that the farmers welcomed were:

- *Continuous power supply*: Before JGY, numerous tripping in farm power supply made it impossible for farmers to keep their irrigation schedules. Frequent tripping wasted water and power; motors suffered increased wear and tear; and tube well owners, water buyers as well as hired labourers suffered forced idle time during the power outages. By providing power with greater continuity and fewer interruptions, JGY has benefited farmers.
- *Full voltage*: Low and fluctuating voltages, in part due to the rampant use of *capacitors* by farmers was another problem. This resulted in the frequent burn out of motors and high wear and tear. Post-JGY, there was no need for capacitors due to regulated power supply, which besides improving voltage also helped to improve order and discipline in electricity use in agriculture
- *Reliability and predictability*: Before JGY, farmers could never know in advance precisely when power would be supplied and withdrawn. Tube well owners and their customers were always on tenterhooks, waiting all day for power to come so they could begin irrigation. Auto switches were widely used on tube wells, which got switched on as soon as the power supply started. After the JGY, farmers get their ration of 8 hours of power during a fixed time schedule, known to everyone, during day and night in alternate weeks, making irrigation scheduling easier for tube well owners and their customers
- *New connections*: When the JGY was completed, Government of Gujarat lifted the virtual embargo on new tube well connections and began offering new connections in a planned manner, depending upon the availability of ground water and power. In parts of Saurashtra, where a profusion of check dams and recharge structures has increased recharge to the hard-rock aquifers, new connections were released. This was also the case in some parts of central and south Gujarat.

However, the negative sentiment for JGY among farmers is stronger and more widespread than the positive feeling. Farmers were dissatisfied with rationing of power supply. Particularly peeved were tube well owners in the ground water abundant areas who operated their tube wells for up to 18-20 hours daily and practiced informal water markets. Now they are forced to make do with just 8 hours and drastically reduce the amount of water they sold. Vibrant water markets, which are central to Gujarat’s ground water irrigation economy and also essential for the viability of tube well investments, started shrinking now. The brunt of the shrinking impact of JGY on ground water market fell on the water-buying marginal farmers, tenants and landless farm labourers. This large section of Gujarat's agrarian poor depended upon tube well owners to sell them reliable irrigation at an affordable price. With drastic diminution in pump irrigation sales, the agrarian poor are left in the lurch:

- Ground water markets shrank, and irrigation access to buyers declined
- Pump irrigation prices in cash sales post-JGY increased 40-60 % or more everywhere
- Landless labourers cultivating leased land faced reduced availability of irrigation
- They also faced reduced opportunities for farm work as the total irrigated area declined

However, against its original objectives of improving the rural power scenario and the viability of the Gujarat Electricity Board (GEB), JGY has proved to be an outstanding intervention. During the past five years, Gujarat has emerged as one of the best performing states in the management of its power sector. The GEB, with its annual losses falling from Rs. 2,200 crores in 1999-2000 to Rs 475 crores in 2002-03 and further in later years, is turning around. Government figures suggest that farm power use on tube wells has fallen from over 15.7 billion units/year in 2001 to 9.9 billion units in 2006, a nearly 37 % decline. This has resulted in halving the aggregate farm power subsidy, from US$ 788 million in 2001-02 to US$ 388 million in 2006-07.

Has the JGY had any beneficial impact on ground water management in Gujarat. To answer this question we need to first answer whether there has been any significant improvement in the ground water situation in the state. Analysis of data available from the Central Ground Water Board on the decadal fluctuation of ground water level in the ground water monitoring observation wells in the state is given in the Table below.

Table A2.1: Decadal fluctuation of ground water

Monitoring Period	No. of Wells showing Rise			No. of Wells showing Fall			Total No. of Wells	
	0-2 m	2-4 m	>4 m	0-2 m	2-4 m	>4 m	Rise	Fall
May 2009	248	118	82	199	52	35	448	286
August 2009	247	93	87	195	67	53	427	315
November 2009	262	86	63	223	53	53	411	329
January 2010	238	81	39	222	86	75	358	383

Source: Central Ground Water Board 2010, Ground Water Scenario of India 2009-10

The Table shows that period pre and post monsoon 2009-10 the number of wells showing rise of water level compared to the decadal average (1999-2009) has reduced from 448 in May 2009 to 358 in January 2010. At the same time the wells showing fall in water level compared to the decadal average has increased from 286 in May 2009 to 383 in January 2010. This shows that only about 50% of the observation wells show water level improvement from before to after the implementation of the JGY. Further, it is also of concern that even during and just after the 2009 monsoon (August-November 2009) the number of wells showing water level increase kept decreasing from the pre-monsoon May 2009 level.

Could the rise in water level observed in about half the observation wells be due to JGY. For this we need to consider the geographical distribution of the wells that show water level rise. Available data indicate that it may not be so.

The Government of Gujarat Taskforce on Managed Aquifer Recharge has estimated that while the expansion in ground water irrigation in Saurashtra, Kachchh and north Gujarat region of the state has over the past four decades created an accumulated ground water deficit of nearly 30 bmc, well and tube well irrigation in central and south Gujarat has created virtually no ground water deficit. In 2008 alone, over 800,000 electric tube wells pumped some 9 bmc of ground water for irrigation in these three regions. Hence, most of accumulated ground water deficit in the state is concentrated in here. The Taskforce also estimated that these regions accounts for 75% of the total 1,200 crores kWh of electricity that Gujarat uses for ground water extraction annually.

So while a specific study of the impact of JGY on the ground water levels is not available, indirect evidences indicate that JGY may not have been the only cause towards improving the ground water status in the state unlike as in the case of agriculture power consumption where there is clear evidence that it has significantly decreased the consumption. Moreover, Shah (2009) himself argues that the reasons for ground water status improvement in some regions of the state are a succession of good monsoons; investment in ground water recharge through decentralized rainwater harvesting and ground water recharge works; support to micro-irrigation; a key role played by surface water bodies in sustaining ground water by recharging the aquifers through seepage; and improved quality of power supply post-JGY.

This indicated that while JGY may be an essential condition for the improvement of ground water status in Gujarat it is not a sufficient condition. Moreover, agricultural feeder separation in other states like Maharashtra, Punjab and Andhra Pradesh do not seem to have impacted improvement in ground water status in these states.

National Water Resources Framework Study

River Basin Planning

Working Paper No.6:

Water Resources Management

Martin A. Burton and Rahul Sen

Contents

Questions raised

With regard to the water resources management the following questions were asked by the Planning Commission:

Institutional reforms

- How can we visualise river basin planning happening in India?
- What are the institutional requirements for this to become possible?
- What are the data requirements for this to become possible?
- What are the human resource capacity requirements for this to become possible?

Roadmap for reform

- What is the process through which this can happen?
- What kind of roadmap can we propose for river basin planning in India given the dismal experience so far?
- Is it better to begin with sub-river basin planning?

1. Introduction

This paper outlines a proposed approach to water resources management based on river basin planning and management. The paper addresses the following questions posed by the National Planning Commission:

(i)How can we visualise river basin planning happening in India?

(ii)What are the institutional requirements for this to become possible?

(iii)What are the data requirements for this to become possible?

(iv)What are the human resource capacity requirements for this to become possible?

(v)What is the process through which this can happen?

(vi)What kind of road-map can we propose for river basin planning in India given the dismal experience so far?, and

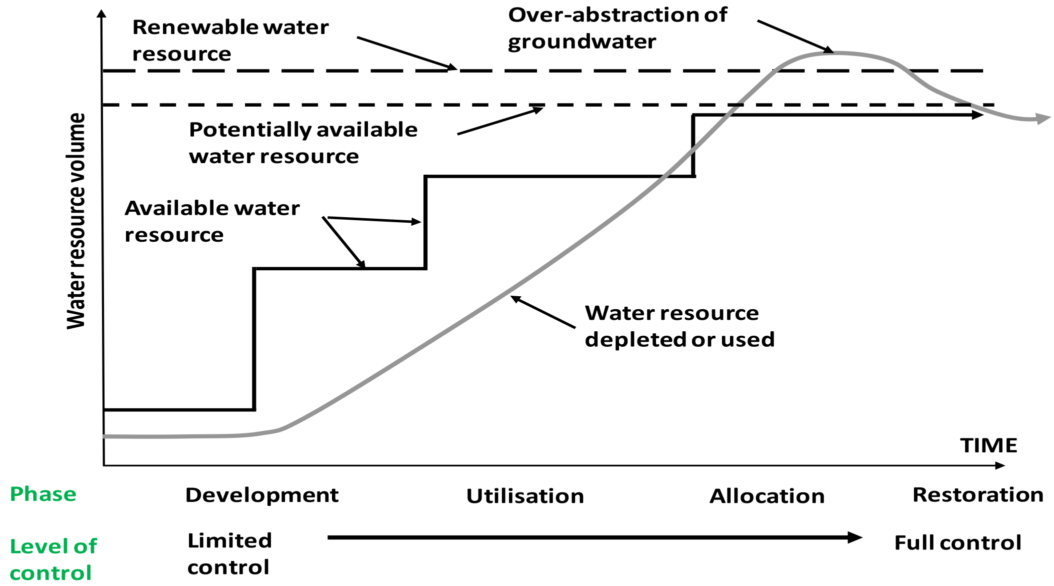
(vii)Is it better to begin with sub-river basin planning?

The paper first presents an overview of water resources planning and management before moving on to discuss how water resources planning and management might be addressed in India.

2. Water resources planning and management

As populations have grown in many countries the pressure on their water resources has increased. In the early stages (Figure 1) additional supplies were developed to match the growing demand, mostly through the construction of physical infrastructure such as dams, barrages, canals and the like. In arid countries irrigation works, conceived, designed and built by civil engineers dominated the water resources domain, with, in general, over 70 percent of the abstracted quantities of water being used for this purpose.

Figure 1: Phases in river basin development (modified from Molden et al, 2001)

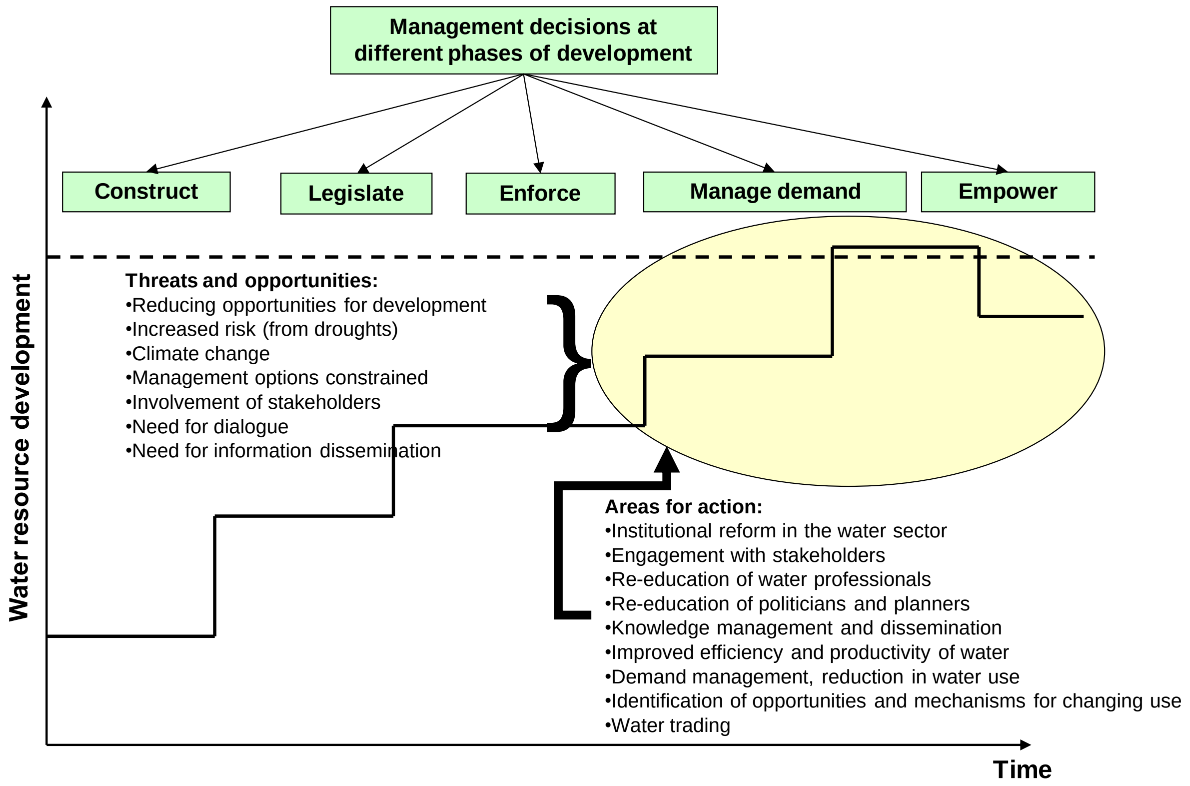


Over time, however, several important changes have taken place:

- Most of the suitable land for irrigated agriculture has been developed;
- The developed water resources have reached the annually renewable limit;
- The urban, industrialised sector has grown significantly, making significant contributions to economic development;
- Pollution from urban industrial and agricultural waste products has increased, not only reducing the quality of river water but requiring increased base flows if pollutants are to be diluted to safe levels;
- Competition for water between sectors has increased significantly.

In this context the need for better planning and management of water resources becomes imperative, it is no longer possible to build a way out of water scarcity situations. As one moves up the water resources development curve supply-side solutions give way to alternative solutions, including demand management, institutional and organisational reform (Figure 2).

Figure 2: Changing opportunities and decisions as river basins face closure (Burton, 2010)



At this time there is increased interest in management solutions that bring together the various stakeholders into an integrated planning, allocation and management framework. The benefits of such integrated management approaches include:

- Better utilisation of the available water resources;
- Reduction in conflict;
- More intensive, and safe, reuse of wastewater;
- Improved water quality, of benefit to both the natural and human environment;

- Recovery of depleted groundwater resources through conjunctive use and management of surface and groundwater resources;
- Inclusion of a wider range of stakeholders, leading to wider social acceptance and adoption of demand management approaches and techniques, and provision of a voice for the natural environment;
- A forum for discussion and formulation of approaches to address crisis situations, either naturally occurring (drought, floods, etc.) or man-made (increasing consumption, pollution, declining groundwater levels, etc.)

Despite the apparently obvious benefits of a more integrated approach to river basin management, there are constraints to its implementation:

- There is a need for genuine collaboration across administrative and sectoral divides;
- Planning and decision-making can be more complex and time-consuming;
- Costs may be significant;
- Some stakeholders may be required to relinquish their power base "to the common good", or to change their role;
- Decision-making is more transparent and accountable, with development opportunities open to greater scrutiny by a wider range of concerned and representative parties.

2.1. RBM, IWRM or WRM?

A distinction needs to be drawn between the different terms used in relation to water resources management. *River basin management (RBM)* is the older and more general term and relates predominantly to the management of water resources incorporating man-made hydraulic systems and the natural environment within the boundaries of a river basin. *Integrated water resources management (IWRM)* is a more recent term which gained popularity in the 1990s and is defined by the Global Water Partnership (TAC, 2000) as:

> *"IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems".*

IWRM implies a wider economic development process for land, water and human resources, and covers both surface and groundwater resources. RBM on the other hand is less ambitious in its objectives, seeking to manage the potential and developed water resources in relation to the natural and human demands placed upon it.

The management unit for both RBM and IWRM is based on hydraulic boundaries, the basin or sub-basin. *Water resources management (WRM)* is a broader term which does not imply management on the basis of hydraulic units or boundaries, though it may well incorporate such boundaries/units into its management processes. As a broader term WRM covers all water resources surface and groundwater resources, and may extend to coastal margins. Thus in this way a State in India might be responsible for water resources management within the state boundaries incorporating several river basins and aquifers to which it applies either river basin management or integrated water resources management principles and practices.

2.2. Governance of river basins

As river basins approach closure there is a need for better management of the available resources. In this context the governance[76] of water resources becomes an issue. Governance includes (i) the process by which those in authority are selected, monitored and replaced; (ii) the capacity of government to effectively manage its resources and implement sound policies; and (iii) the respect of citizens and the State for the institutions that govern economic and social interactions among them (Kaufmann, 2000). According to Kaufmann good governance comprises six inter-connected elements:

- Voice and accountability;
- Political stability;
- Government effectiveness;
- Lack of regulatory burden;
- Rule of law;
- Control of corruption.

Poor governance is evident in many ways: preferential treatment for certain individuals; lack of representation by disadvantaged groups; withholding of data; inscrutable processes and procedures; lack of incentives and recognition for innovative public sector personnel; unwillingness to change and adapt to external influences. Increased transparency, accountability and participation are core elements in improving governance.

Quality of governance is the single most important factor influencing institutional change in the water resources sector, affecting policy formulation, legislation, resource allocation, rule enforcement and adjudication (Svendsen et al, 2005a). As governance processes, procedures and practices, whether formal or informal, are so imbedded in existing water resources management systems they are difficult, but not impossible, to change. In many instances, such as with the irrigation management transfer process in Mexico, they are prompted by a crisis, in the case of Mexico a national debt crisis in the mid-1980s.

2.3. Functions, actors and stakeholders in the management of river basins

In defining governance mechanisms it is necessary to identify the functions that need to be performed and the actors involved. A study by the International Water Management Institute (IWMI) in 1999-2002 looked at the governance mechanisms for three "closed[77]" river basins (the Gediz in Turkey, the Lerma-Chapala in Mexico and the Olifantes in South Africa). In the course of the study the analysis was broadened to include river basins in the USA, Australia, Germany, France, Vietnam and Indonesia (Abernethy, 2000).

The study established a framework (Burton, 1999; Svendsen et al, 2001) for analysing the various functions (Table 1) and actors involved in river basin management. The matrix (Figures 3 and 4) identifies who does what, where, to what purpose and how well in relation to the identified functions involved in river basin management. The matrix thus serves to show:

- The functions covered, with some estimation of the degree of coverage;

[76] Governance – the exercise of authority through formal and informal institutions, traditions and understandings for the common good.

[77] A *closed basin* is one where all available water is allocated and used. An *open basin* is one where there is still uncommitted flow available for use.

- The functions not covered;
- The number and role of the various actors involved, and the need for coordination;
- The number of stakeholders involved, indicating the degree of representation in basin governance.

Figure 3 indicates the level of activity by each actor/organisation whilst Figure 4 provides more detail by showing the type of activity carried out by each actor/organisation.

Table 1: Essential functions for river basin management

Function	Description
1. Plan	The formulation of medium to long-term plans for management and development of water resources in the basin, by which the water demands of different sectors are brought in line with water supply.
2. Allocate water	The mechanisms and criteria by which bulk water is apportioned among the different users.
3. Distribute water	The activities executed to ensure that allocated water reaches its point of use.
4. Monitor water quality	The activities executed to monitor water pollution and salinity levels.
5. Enforce water quality	The activities executes to ensure that water pollution and salinity levels remain below accepted standards.
6. Protect against water disasters	Activities executed concerning flood and drought warnings, prevention of floods, emergency works and drought preparedness.
7. Protect ecology	Activities undertaken to protect associated ecosystems.
8. Construct facilities	Activities executed for the design and construction of hydraulic infrastructure.
9. Maintain facilities	Activities executed to maintain the serviceability of the hydraulic infrastructure in the basin.

Source: Svendsen et al, 2005a

The two examples presented in Figures 3 and 4 for the Gediz Basin in Turkey and the Lerma-Chapala Basin in Mexico clearly show different governance mechanisms in place in the two basins, with the obvious difference being the presence of a river basin council and aquifer management councils in the Lerma-Chapala Basin. The Lerma-Chapala case study shows a broadening of the water resources governance structures, whilst the Gediz Basin case study shows a very limited degree of river basin management, the main focus being on irrigation.

There are parallels here between Turkey and India where the water resources development has been driven by the irrigation sector, in the case of Turkey by the DSi (State Hydraulic Works) and in India by the Irrigation Department. DSi is now a state agency under the Ministry of Environment and Forestry.

Figure 3: Identified key actors and essential basin management functions in the Gediz Basin, Turkey

Key Actors	Surface Water									Groundwater							Wastewater					
	Plan (basin-level)	**Allocate Water**	**Distribute Water**	**Construct Facilities**	**Maintain Facilities**	**Monitor Quality**	**Ensure Quality**	**Protect Against Flooding**	**Protect Ecology**	**Plan (basin-level)**	**Allocate Water**	**Withdraw/Distribute Water**	**Construct Facilities**	**Maintain Facilities**	**Monitor Quality**	**Ensure Quality**	**Plan (basin-level)**	**Allocate/Distribute**	**Construct Facilities**	**Operate/Maintain Facilities**	**Monitor Quality**	**Enforce Quality**
DSi	○	●		●	●	●		●	○	○	●		●		●				●	○		
Irrigation associations			●	○	●															○		
Other irrigators		○	●	○	●						○	●	●	●								
GDRS				●									○									
MoE						○			○												○	
Local governments												●	●	●					○	●		
Industries											○	●	●	●					●	●		
Provinces (MoI)																						○
NGOs																						
Bank of the Provinces (IB)																			●			

● Indicates activity ○ indicates limited activity Note: Surface water is used only for irrigation and environmental purposes

DSi – State Hydraulic Works; GDRS – General Directorate for Rural Services; MoE – Ministry of Environment; Local government – locally elected urban governments (municipalities and villages); MoI – Ministry of Interior; NGO – Non- governmental organisation (environmental).

Source : Svendsen et al, 2005b

Figure 4: Identified key actors and essential basin management functions in the Lerma-Chapala Basin, Mexico

	Surface Water									Groundwater							Derivative Water					
Key Actors	**Plan (basin-level)**	**Allocate Water**	**Distribute Water**	**Construct Facilities**	**Maintain Facilities**	**Monitor Quality**	**Ensure Quality**	**Protect Against**	**Protect Ecology**	**Plan (basin-level)**	**Allocate Water**	**Withdraw/ Distribute Water**	**Construct Facilities**	**Maintain Facilities**	**Monitor Quality**	**Ensure Quality**	**Plan (basin-level)**	**Allocate/Distribute**	**Construct Facilities**	**Operate/Maintain Facilities**	**Monitor Quality**	**Enforce Quality**
Ministry of Environment	Reg			Reg			Reg		Reg		Reg										Reg	Reg
CNA National Headquarters	Aut	Aut		Aut	S	S	S	S	S	S	Aut		Aut		S		S		Aut		S	S
CNA Regional Office	E	E/S	S	S	S	S/E	S/E	S	E	S	S		S		S		S		S/A	S	S/E	E
River Basin Council	Rep	Rep		Rep					A		Rep						Rep		Rep	A		
CNA State Office	A	E	S	E	S	E	E	E			E	S	S		E				E		E	E
State Water Commissions	E/A	A	A	E/A	S/A			S/A	A	A	A		E	A	E		A		S/A	A		
CNA Irrigation District Office			E	E	Aut																	
WUAs Irrigation Districts	Rep		E	Rep	E							E						Aut				
WUAs Irrigation Units			E		E							E										
Aquifer Management Councils (COTAS)	Rep								A	A	Rep		A									
Municipal Water Supply Utilities			E	E	E			E				E	E	E	E			Aut	E	E	E	
Industries												E	E	E					E	E		
NGOs	A								A													
Irrigators			E									E	E	E				E				

E – Execute S- Supervise A- Advise Aut - Authorize Reg - Regulate Rep - Represent

Source: Wester et al, 2005

2.4. Enabling conditions for effective river basin management

As well as identifying the main functions and actors engaged in river basin management and water resources development it is important to identify the enabling conditions that are present to facilitate good governance and management of the river basin. These enabling conditions are set out in Box 1.

Political attributes relate to representation of different interests and a balance of power between the different users and uses. The balance between the various interest groups differs in each country and varies over time. In India for example the focus has been on irrigation, this balance is now shifting to the urban/industrial sectors. One of the sectors which is often poorly represented is the environment, though in Europe and the USA there are powerful interest groups operating through NGOs (such as WWF) which have had a significant impact on water resources management. It is not healthy if the balance of power is one-sided.

Box 1: Enabling conditions for good governance of river basins

Political attributes
- Representation of interests
- Balanced power

Informational attributes
- Process transparency
- Information availability
- Information accessibility

Legal authority
- Appropriate institutions
- Adequate powers

Resources
- Human
- Financial
- Institutional
- Infrastructural

Source: Svendsen et al, 2005

Fundamental to the process of more transparent, accountable and participative river basin management is accessibility to reliable and up-to-date data and information. Too many government agencies have endeavoured to retain their power base and protect their own interests by restricting access to data and information. The recent enactment of the Right to Information Act 2005 in India for example, has been a significant step forward in making government more open and transparent in this regard.

To ensure representative governance organisations require the legal right to exist and function under the law. These legal rights and responsibilities usually include: the right to exist; the right to legal personality; the right to set, collect and utilize membership fees; the right to set, collect and utilize fees to cover prescribed operational costs; the right to maintain a bank account, enter into contracts, take legal action (if required) and represent the membership in dealings with third parties. With these rights are legally prescribed responsibilities, including: procedures for election of representative leadership; transparency and accountability to members; procedures for adequate representation of members.

A variety of human, financial, institutional and infrastructural resources are required for good governance. The form and elements of these resources may change over time. The ability to respond to these changes, particularly in the human resource domain, is a measure of the robustness of the governance mechanisms and processes.

2.5. River basin management organisations

Following on from the provision of an enabling environment is the need for organisations to manage water resources. Depending on the circumstances there may be one or more such organisations, and they may be organised on administrative or hydraulic boundaries. As water becomes an increasingly scarce resource there is considerable logic in water management organisations moving from administrative to hydraulic boundaries. In this context management entities have been established based on river basin and aquifer boundaries. Mostert et al (2000) identified three forms of river basin management –

authoritarian in which management is organised on hydraulic boundaries with one organisation in control, *coordinative* in which the basin is recognised as a management unit but existing government organisations participate in decision-making and management. The third form is management by existing organisations but without coordination. There are variations on these forms, for example in Kyrgyzstan there is one entity, the National Water Administration, designated as the responsible agency for river basin management. However the National Water Administration reports to the National Water Council, a body chaired by the Prime Minister comprising representatives of all concerned government agencies with the responsibility for setting policy and overseeing the activities of the National Water Administration.

Examples of the authoritarian or centralised form are the Tennessee Valley Authority (TVA) in the USA, the Mahaweli Development Authority in Sri Lanka and the Environment Agency in England and Wales. An example of the coordinative or decentralised form is the Murray-Darling Ministerial Council comprising representatives from the four concerned states with an associated executive body, the Murray-Darling Commission. Another is the River Commissions in France with national and local government and users representatives setting water policy which is then implemented by a Water Agency. In the USA river basin management is achieved through a relatively large number of committees and working groups, with legislation and legally-binding negotiated agreements forming a key part to the management process.

Appendix A2 provides brief case studies of two river basin management organisations in France and a case study of the Environment Agency which is responsible for the water resources management in England and Wales. In France the State owns the large hydraulic infrastructure but delegates this responsibility to SARs (Regional Development Companies). These companies manage, operate and maintain the water resources systems (rivers, canals, water supply networks) within their designated operational boundaries, under the supervision of the Ministry of Environment and the Ministry of Agriculture. The companies hold long-term (75 year) concessions from government for the management of these systems. In England and Wales the Environment Agency (EA) is responsible for management of surface and ground water resources. The Agency is responsible for: flood protection; licensing of water abstraction from rivers and groundwater; pollution control; amelioration of contaminated land; and creating an improved awareness of the natural environment. Over 70 percent of the Agency's funding comes from charges or levies raised on flood protection and water licensing.

3. Current issues and practices with water resources planning and management in India

3.1. Governance and policy

India has a federal system of government with responsibility for water management vested in state governments, though management can revert to the Union in the public interest. The ownership and management of water are covered in the Constitution under Entry 17 in the State List, Entry 56 in the Union List and Article 262. Entry 17 makes water a state responsibility, subject to Entry 56 which allows the regulation and development of interstate rivers by the Union if declared by Parliament to be in the public interest. Article 262 grants Parliament the right to legislate over matters in Entry 56, and gives it primacy over the Supreme Court (ADB, 2007).

At the Union level water policy comes under the National Water Resources Council, which is chaired by the Prime Minister with membership comprising concerned Union Ministers/Ministers of State, Chief Ministers of all states and Lieutenant Governors/Administrators of Union Territories. A National Water Policy was formulated in 1987 by the Council and revised and updated in 2002. The 1987 policy called for conjunctive use of surface and groundwater, integrated water resources planning and management in river basins and consideration of inter-basin transfers to address water deficits in some basins. It also advocated revision of water charges to cover operation and maintenance costs, and increased participation by users in irrigation and watershed management.

The 2002 National Water Policy recognised that water is a scarce and precious resource and set out the broad principles that should govern the management of the country's water resources. In particular it emphasised the need for planning, management and development of water resources on a hydrologic unit basis, together with multi-sectoral, multi-disciplinary and participatory approaches. It recognises that existing institutions at various levels in the water sector will need to be reorganised/restructured or created to address current and future needs. In this context it argues for the establishment of appropriate river basin organisations to plan and manage water resources in the basin or sub-basins, with the scope and power of these agencies being decided by individual states.

3.2. River basins in India

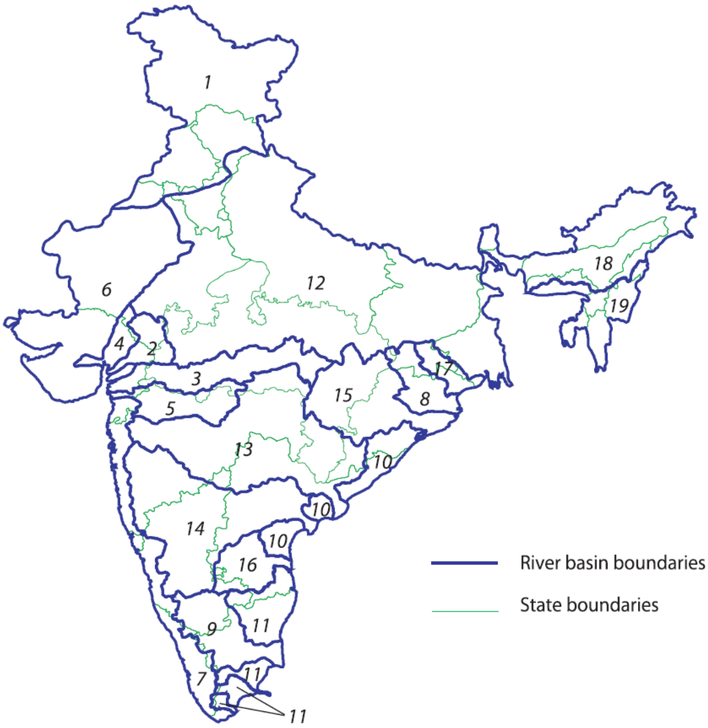
India has 19 major river basins (Figure 5, Table 2), of which the Ganga-Brahmaputra-Meghna is the largest, covering some 34 percent of the total area. This river basin has three major rivers, the Ganga, Brahmaputra and the Meghna which all converge together before discharging into the Bay of Bengal. The Ganga is the largest river, with a catchment area of 861 km^2, a length of 2,525 km and a population of over 370 million people. It is also one of the most densely populated river basins, supporting over 450 people per square kilometre.

There are four other large basins (the Indus, Godavari, Krishna and Mahandi rivers), eight medium-sized basins (the westward flowing Sabarmati, Narmada, Tapi and Mahi, and the eastward flowing Subarnarekha, Pennar, Cauvery and Brahmani-Baitarani). The remaining basins can be grouped into four drainage areas (Amarasinghe et al, 2004):

- The westward flowing rivers (WFR1) of the Kutch and Saurashtra regions in Gujarat and the Luni;
- The westward flowing rivers (WFR2) of the rivers south of the Tapi basin;
- The eastward flowing rivers (EFR1) comprising small and medium-sized rivers between the Mahanadi and Pennar basins;
- The eastward flowing rivers (EFR2) comprising small and medium-sized rivers between the Pennar basin and the Kanakumari in the far south.

The population distribution across the basins is varied, both in terms of the total population and the population density. The Ganga basin covers 27 percent of the total catchment area and support 40 percent of the total population, whilst five other large basins (the Krishna, Brahmaputra, Godavari, Mahanadi and Indus) cover 46 percent of the total catchment area but support only 30 percent of the total population. As can be seen from Table 2 the population density varies from a low of 140 persons/km^2 to a high of 521 persons/km^2, with the majority of the population in each catchment living in rural areas and dependent on agriculture for their livelihoods.

Figure 5: River basins of India



1. Indus
2. Mahi
3. Narmada
4. Sabarmati
5. Tapi
6. Westerly flowing rivers – Group 1 (WFR1)
7. Westerly flowing rivers – Group 2 (WFR2)
8. Brahmani and Baitarani
9. Cauvery
10. Easterly flowing rivers – Group 1 (EFR1)
11. Easterly flowing rivers – Group 2 (EFR2)
12. Ganga
13. Godavari
14. Krishna
15. Mahanadi
16. Pennar
17. Subarnarekha
18. Brahmaputra
19. Meghna

Source: Amarasinghe et al, 2004

Table 2: Key data for river basins in India

	No[a].	River basin	Catchment area[b]	Length of river	Population		
					Total[c]	Density	Rural pop.
			km^2	km^2	millions	No./km^2	% of total
		All basins	3,191		932	282	74
		17 basins[d]	2,995		888	301	73
Westerly flowing rivers	1	Indus	321	1,114[e]	48.8	140	71
	2	Mahi	35	583	6.7	324	77
	3	Narmada	99	1,312	17.9	160	79
	4	Sabarmati	22	371	6.0	521	54
	5	Tapi	65	724	17.9	245	63
	6	WFR1	56	-	58.9	425	72
	7	WFR2	378	-	51.9	166	57
Easterly flowing rivers	8	Brahmani and Baitarni	52	1,164[f]	16.7	204	87
	9	Cauvery	81	800	32.6	389	70
	10	EFR1	87	-	19.2	293	74
	11	EFR2	100	-	39.0	484	60
	12	Ganga	861	2,525	370.2	449	75
	13	Godavari	313	1,465	76.7	186	85
	14	Krishna	259	1,401	68.9	253	68
	15	Mahanadi	142	851	27.2	202	80
	16	Pennar	55	597	14.3	189	78
	17	Subarnarekha	29	395	15.0	347	76
	18	Bramhaputra	194	916	33.2	161	86
	19	Meghna	42	-	10.0	160	82

Notes:

a. Refer to map given in Figure 1.
b. Source: CWC (2002).
c. Source: UN (1999).
d. All the basins except the Brahmaputra and Meghna.
e. The length of the Indus river within Indian territory.
f. The length of the Brahmani river alone is 799 km.

WFR1 - Westerly flowing rivers - Group 1
WFR2 - Westerly flowing rivers - Group 2
EFR1 - Easterly flowing rivers - Group 1
EFR1 - Easterly flowing rivers - Group 2

Source: Amarasinghe et al, 2004

The distribution of the states by river basin is presented in Table 3. In some cases, such as Punjab it looks fairly straightforward as the entire state lies within one basin, the Indus. However the Indus basin covers seven states, making river basin planning and management on a basin level complicated. For other states, such as Madhya Pradesh, the state has to liaise with a large number of other states (7 No.) on the Ganga, as well as needing to liaise with other states on six other basins as well.

Table 3: Area (in percentages) of Indian states in different river basins

State	River basin																			
	Indus	Mahi	Narmada	Pennar	Sabarmati	WFR1	WFR2	Brahmani and Baitarni	Cauvery	EFR1	EFR2	Ganga	Godavari	Krishna	Mahanadi	Subarnarekha	Tapi	Bramhaputra	Meghna	Number of river basins in State
Andhra Pradesh	-	-	-	17	-	-	-	-	-	20	5.1	-	28	29	-	-	-	-	-	5
Arunanchal Pradesh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	1
Assam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90	9.8	2
Bihar	-	-	-	-	-	-	-	8.9	-	-	-	84	-	-	0.1	7.4	-	-	-	4
Goa	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-	-	1
Gujarat	-	6.5	5.9	-	12	69	4	-	-	-	-	-	-	-	-	-	2.1	-	-	6
Haryana	30	-	-	-	-	-	-	-	-	-	-	70	-	-	-	-	-	-	-	2
Himachal Pradesh	90	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	2
Jammu and Kashmir	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Karnataka	-	-	-	4	-	-	14	-	17	-	2.8	-	3	59	-	-	-	-	-	5
Kerala	-	-	-	-	-	-	93	-	5.7	-	1	-	-	-	-	-	-	-	-	3
Madhya Pradesh	-	1.9	20	-	-	-	-	0.3	-	-	-	47	14	-	16	-	1.5	-	-	7
Maharashtra	-	-	1	-	-	-	12	-	-	-	-	-	47	22	-	-	18	-	-	5
Manipur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	1
Meghalaya	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	62	2
Mizoram	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	1
Nagaland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69	31	2
Orissa	-	-	-	-	-	-	-	23	-	15	-	-	11	-	45	6.2	-	-	-	5
Punjab	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Rajasthan	5.3	4.6	-	-	1	54	-	-	-	-	-	34	-	-	-	-	-	-	-	5
Sikkim	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	1
Tamil Nadu	-	-	-	-	-	-	6.1	-	37	-	56	-	-	-	-	-	-	-	-	3
Tripura	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	1
Uttar Pradesh	0.2	-	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	2
West Bengal	-	-	-	-	-	-	-	-	-	-	-	81	-	-	-	7.6	-	11	-	3
Others (Territories)	1	-	-	-	-	0.4	5.2	-	1.4	-	3	90	-	-	-	-	-	-	-	6
Number of states in basin	6	3	3	2	2	2	6	3	3	2	4	7	5	3	3	3	3	6	6	

Source: Amarasinghe et al, 2004

IWMI (Amarasinghe et al, 2004) estimates that the volume of internally renewable water resources (IRWR) in India is some 1,287 km^3, whilst the volume of the total renewable water resources (TRWR) are 1,887 km^3. The IRWR is the summation of the internally generated surface runoff (1,236 km^3) and the volume of the groundwater resources (431 km^3) less the overlap of groundwater and river flow (380 km^3). The overlap is the amount of water from groundwater contributing to the base flow of rivers. The TRWR is the IRWR plus the flow arising outside the national borders, some 600 km^3.

However not all the TRWR is available for use. For example on the Brahmaputra and Meghna the TRWR is 633 km^3, but only 4 percent of this flow is potentially utilizable due to its location (Table 4). Overall the potentially utilizable water resource (PUWR) for all basins is 1,033 km^3, some 55 percent of the TRWR. This comprises 690 km^3 (37 percent of

TRWR) of surface water and 343 km^3 (18 percent of TRWR) of groundwater. There is a wide range of water resources availability per capita, ranging from a low of 409 m^3 per person in the river basins comprising WFR1 to a high of 2,448 m^3 per person in the Narmada basin (Table 4).

It is important to note the relative PUWR figures for surface and groundwater resources, with utilizable surface water almost twice that of groundwater. Thus whilst there are many advocating greater use of groundwater for irrigation, the majority of the renewable water resource comes from surface water.

Table 4: Renewable and utilizable water resources of river basins

	No[a].	River basin	Total renewable water resource (TRWR)	Potentially utilizable water resource (PUWR)[b]				Water resources available per capita	
				Surface water	Ground water[c]	Total	Percentage from groundwater	TRWR	PUWR
			km^3	km^3	km^3	km^3	%	m^3	m^3
		All basins	1,887	690	343	1,033	33%	2,025	1,108
		17 basins[d]	1,253	666	308	975	32%	1,411	1,098
Westerly flowing rivers	1	Indus	73.3	46	14.3	60.3	24%	1,501	1,235
	2	Mahi	11	3.1	3.5	6.6	53%	1,649	990
	3	Narmada	45.6	35	9.4	43.9	21%	2,542	2,448
	4	Sabarmati	3.8	1.9	2.9	4.8	60%	631	797
	5	Tapi	14.9	14.5	6.7	21.2	32%	831	1,183
	6	WFR1	15.1	15	9.1	24.1	38%	257	409
	7	WFR2	200.9	36.2	15.6	51.8	30%	3,871	998
Easterly flowing rivers	8	Brahmani and Baitarni	28.5	18.3	3.4	21.7	16%	1,703	1,296
	9	Cauvery	21.4	19	8.8	27.8	32%	656	852
	10	EFR1	22.5	13.1	12.8	25.9	49%	1,169	1,346
	11	EFR2	16.5	16.7	12.7	29.4	43%	423	753
	12	Ganga	525	250	136.5	386.5	35%	1,418	1,044
	13	Godavari	110.5	76	33.5	109.8	31%	1,441	1,431
	14	Krishna	78.1	58	19.9	77.9	26%	1,133	1,130
	15	Mahanadi	66.9	50	13.6	63.6	21%	2,463	2,341
	16	Pennar	6.3	6.3	4.0	10.9	37%	440	762
	17	Subarnarekha	12.4	6.8	1.7	8.5	20%	829	568
	18	Bramhaputra	585.6	24.3	25.7	48	54%	17,661	1,448
	19	Meghna	48.4	1.7	8.5	10.2	83%	4,830	1,018

Notes:

a. Refer to map given in Figure 5.
b. Source: CWC (2002).
c. The volume of potentially utilizable groundwater resources is the volume of groundwater replenished from normal natural discharge
d. All the basins except the Brahmaputra and Meghna.

Source: Amarasinghe et al, 2004

3.3. Water resources issues in India

There are two main issues related to water resources in India today, water availability and water quality. For the country as a whole the total available water resources may look adequate but this belies serious water shortages in many basins and sub-basins. Allied to a shortage of water is the growing issue in of poor water quality as pollutants in domestic, industrial and agricultural wastewater cannot be diluted by low in-stream flows.

The International Water Management Institute (IWMI) looked at the issue of spatial variation of water availability in India (Amarasinhe et al, 2004) and concluded the following:

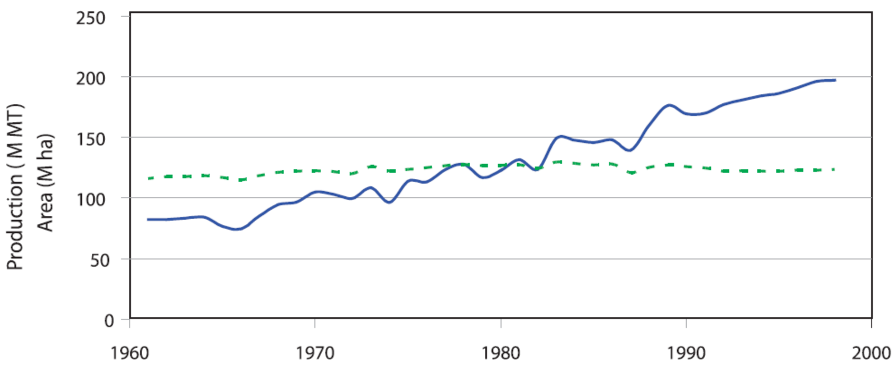
- The availability and demand for water resources in India show substantial spatial and temporal variations. Analysis of current water supply and demand in river basins show that some river basins are physically water-scarce due to a number of reasons: (i) inadequate availability of water in the basin; and (ii) excessive development (largely for irrigation). The water shortage is exacerbated by over-abstraction of groundwater resources;

- 88 percent of the Indian population live in basins with some form of water scarcity or food production deficit. There is a high dependency on some river basins for production of grain to match shortfalls in other basins. The Indus, for example, provides 85 percent of the grain production deficits of 15 other river basins. Any change in the production levels from the Indus basin will have far-reaching consequences on other river basins and states in India. Hira and Kheera (2000) conclude that unless there is a substantial increase in water productivity the production surplus of the Indus will decrease;

- The irrigation sector dominates water abstraction. In the Indus basin for example it accounts for 97 percent of all withdrawals from surface and groundwater resources. Increasing demand from the growing urban and industrial sectors, and concerns for the environment will reduce the share of water withdrawn for irrigation;

- Crop production has increased significantly since the 1960s (Figure 6), with increases in cropping intensity and crop yields making a significant contribution to this growth in production. Though the cultivable area of all crops in India has remained much the same at around 142 million hectares over the period 1965-1995 the gross sown area (net sown area x cropping intensity) has increased by 16 percent, with expansion and intensification of cropping on irrigated land being the major factor in the increase in the overall cropping intensity. Two major questions are: (i) how can irrigation contribute in the future to increasing the cropping intensity in river basins with available water resources; and (ii) how can cropping intensity (and production levels) be increased in water-scarce river basins in the absence of an increase in the net irrigated area;

Figure 6: Area and production of grain crops, 1965-1995



Source: Amarasinghe et al, 2004

- Groundwater irrigation has increased from around 40 percent of the net irrigated area in the 1960s to around 57 percent in 1995. Much of this expansion has occurred in water-scarce river basins, increasing the groundwater overdraft in many aquifers. The expansion of groundwater irrigation, and its sustainable management, are critical issues for future water management;

- Groundwater consumes around 44 percent of the total volume of water abstracted for irrigation but contributes 57 percent of India's irrigated area. Due to its accessibility[78] near to the point of use the productivity of groundwater is 1.2 to 3.0 times higher than that for surface water;

[78] Accessibility can be measured in terms of spatial and temporal dimensions – in the physical proximity to the crop as well as the temporal ability to apply water as an when required by the crop.

- How the utilizable water resources will be managed in each river basin will have a significant impact on the national and state food self-sufficiency. At the core of the discussion is "How much more irrigation is required in the future?";
- Future growth of population, urbanization and income will have a marked effect on the nature and location of food demand;
- Future growth of water demand for domestic, industrial and environmental use will impact the irrigation sector. In water-scarce river basins water will need to be transferred from the irrigation sector to the domestic and industrial sectors;
- The needs of freshwater ecosystems are rarely considered when measures are formulated to meet the increasing demands for irrigation, domestic and industrial water;
- The water productivity of grain crops varies markedly across river basins and differs from that of non-grain crops. Typically the water productivity of grain crops is in the order of US$0.13 per m^3 of evapotranspiration and evaporation whilst for non-grain crops it is in the order of US$0.35 per m^3 of evapotranspiration and evaporation. The value of crop production could be substantially increased by the reallocation of irrigation water from grain to non-grain production;
- Current levels of productivity of water in India are poor; <u>there is a substantial opportunity for improving water productivity.</u> Possible measures include: (i) changing or improving crop varieties; (ii) substituting low water productive crops for high water productive crops; (iii) introduction of deficit, supplemental or precision irrigation techniques; (iv) improving agronomic practices; (v) improving water management; (vi) sustainable use of saline or poor quality water; and (vii) optimizing costs and benefits of non-water inputs. Improvements in these areas would result in water savings and reduce the need to the development of additional water resources[79];

As well as looking at the water resources availability the IWMI study looked at the crop production in each basin (Table 5). The analysis of the river basins was carried out on the basis of water accounting (Molden 1997) to understand the sources and uses of water in each basin with four indicators being developed to assess the severity of the water scarcity and crop production deficits:

- Degree of development (DD) — Shows the degree of development in the basin. It is defined as the ratio of the primary water supply to potentially available water resources. High values indicate physical water scarcity.
- Depletion Fraction (DF) — Indicates the proportion of developed water lost to the basin (e.g. through evaporation, crop evapotranspiration, etc.) which is not available for other uses.
- Groundwater Abstraction Ratio (GWAR) — This is the ratio of the groundwater withdrawals to groundwater availability and shows the degree of development of the groundwater resources. High figures in a basin indicate that some aquifers will be over-abstracted.

[79] In water-scarce river basins such measures are being applied as a matter of necessity; there are no additional water resources to be developed.

- Crop production surplus/deficit as a percentage of consumption — This indicates the degree to which a basin is satisfying its internal crop demands. The total production includes both rain-fed and irrigated production. Positive figures indicate production available for export to other basins; negative figures indicate the scale of imports from other basins.

Table 5: Indicators of water scarcity and food production surplus for river basins, 1995

	No[a].	River basin	Degree of development (DD)	Depleted Fraction (DF)	Groundwater Abstraction Ratio (GWAR)	Crop production surplus/deficit as a percentage of consumption Total	Grain	Non-grain	Cluster
			%	%	%	%	%	%	
		All basins	41	86	51	0.5	0.1	0.6	
		17 basins[b]	43	93	55	-0.2	0.1	-0.3	
Westerly flowing rivers	1	Indus	84	93	70.0	66	226	-15	2
	2	Mahi	65	96	60.0	-27	-14	-33	3
	3	Narmada	20	94	30.0	-16	36	-42	3
	4	Sabarmati	67	95	91.0	-25	-45	-15	3
	5	Tapi	31	96	49.0	-29	-37	-26	3
	6	WFR1	132	92	194.0	-30	-32	-29	1
	7	WFR2	22	94	40.0	5	-56	37	3
Easterly flowing rivers	8	Brahmani and Baitarni	26	92	55.0	61	15	85	5
	9	Cauvery	43	93	52.0	-8	-19	-3	3
	10	EFR1	45	86	24.0	46	35	52	5
	11	EFR2	64	92	46.0	-9	-10	-9	3
	12	Ganga	44	93	55.0	-9	-17	-5	3
	13	Godavari	27	92	36.0	-9	-6	-11	3
	14	Krishna	41	95	42.0	-11	-14	-9	3
	15	Mahanadi	21	89	26.0	90	57	106	5
	16	Pennar	91	91	64.0	1	19	-8	2
	17	Subarnarekha	42	91	50.0	23	5	33	3
	18	Bramhaputra	11	77	4.0	15	14	15	4
	19	Meghna	15	82	3.0	9	-41	34	4

Notes:
a. Refer to map given in Figure 5.
b. All the basins except the Brahmaputra and Meghna.

Source: Amarasinghe et al, 2004

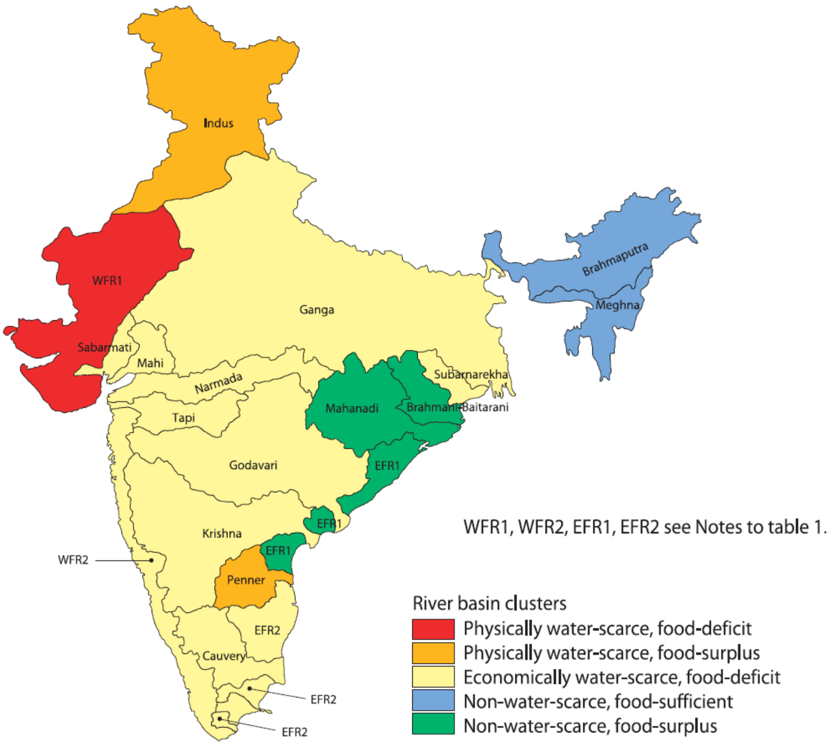
In the analysis the river basins were categorised into five clusters with similar characteristics (Table 6, Figure 7). This grouping serves to highlight the differences between each basin, and to emphasise the need for different strategies to address the issues faced in each basin. It also shows the need for a national approach to the twin issues of food security and water resources development.

Table 6: Definition of clusters

No.	Cluster	Description	Consequences	River basins
1.	Physically water scarce, food-deficit basins	This group is physically water-scarce, has high groundwater depletion and a high dependence on food from other basins. The group has 6 percent of the population and 4 percent of the grain and non-grain production.	These basins will have no alternative but to transfer water from agriculture to other sectors. Food dependency on other basins will increase.	WFR1
2.	Physically water scarce, food surplus basins	This group has high levels of water resources development (mostly for agriculture), high depletion rates of groundwater but matched by high levels of food production and surplus. The group has 7 percent of the population and covers 22 percent of the grain and 5 percent of the non-grain production for the country.	A large proportion of the virtual water of the basin is being transferred to other basins. This is substantial, with one tonne of non-rice cereal needing about 1,500 m^3 of water for production, and rice requiring 7,000 m^3 of water. Water scarcity is a consequence of over-development for agriculture, further development will be unsustainable. Water transfers will have to take place from agriculture to other sectors, adversely affecting food production	Indus, Pennar
3.	Economically[80] water scarce, food-deficit basins	This group has high production deficits. Eleven of the basins in this group have 75 percent of the population but produce only 62 percent of the grain crop and 72 percent of the non-grain crop. The basins are, in general, under-developed with an average degree of development of 39 percent. Some rivers are physically water-scarce, whilst others have adequate resources to meet current and future needs. Groundwater depletion is a problem in some basins, but not as severe as in Clusters 1 and 2.	Most basins in this group will either have to increase the water available for agriculture or increase food imports. <u>A major part of the food deficit could be eliminated by raising the productivity of water from its current very low level</u>.	Mahi, Narmada, Sabarmati, Tapi, WFR2, Cauvery, EFR2, Ganga, Godavari, Krishna, Subarnarekha
4.	Non-water scarce, food-sufficient basins	These basins have only 5 percent of the population and contribute 4 and 6 percent of grain and non-grain production respectively. These basins are characterised by a surplus of water resources and have a very low degree of development, low depletion fractions, low groundwater use and some crop production surpluses. Availability of cultivable land, rather than water resources are the limiting constraint in these basins.	Limited opportunities for further agricultural development in the basin. Development not limited by the water resource.	Brahmaputra, Meghna
5.	Non-water scarce, food surplus basins	Though these basins have a relatively high depletion factor they are relatively undeveloped in terms of surface and groundwater resources. They support 7 percent of the population, with a surplus production contributing 8 percent and 13 percent of the total grain and non-grain production respectively.	Water scarcity not an issue, further opportunities available for agricultural development.	Brahamani and Baitarani, EFR1, Mahanadi

[80] Economically water-scarce indicates that there is water available but that the infrastructure (dams, barrages, canals, boreholes, etc.) has not yet been developed to exploit the water resource.

Figure 7: River basins categorised according to water scarcity and food surplus/deficit



Source: Amarasinghe et al, 2004

A further study by IWMI in 2007 (Amarasinghe et al, 2007) looked at India's water future to 2025-2050, specifically to make estimates for the water demand for agriculture, domestic and industrial uses in 2025 and 2050. The study used the PODIUMSIM model[81] which has four major components: (i) crop demand: (ii) crop production; (iii) water demand; and (iv) water accounting. The model assumed continuation of recent trends (i.e. business-as-usual, BAU) together with some analyses with variation of some of the key drivers.

The main findings of the report are summarised below and in Box 2:

- The BAU assumes that the net sown area (rainfed and irrigated) will remain the same at around 142 million hectares, but irrigation expansion will increase from 41 to 55 percent over the period 2000-2050. The majority of the increase will come from expansion of groundwater irrigation, assisted by groundwater recharge programmes. Surface water systems are anticipated to grow from 17 Mha to 27 Mha up to 2025 and remain much the same thereafter;
- It is anticipated that the supremacy of grain crops will diminish from the present 71 percent to 56 percent by 2025 and then to 54 percent by 2050. The growth rate of the grain yield will continue to decrease, but not at such a fast rate as in the last two decades[82];

[81] The PODIUMSIM (Policy Dialogue) model was developed by IWMI as tool for simulating alternative scenarios for future variations of food and water demands (http://podium.iwmi.org/podium/).

[82] The report considers that there remain significant opportunities for crop yields to be increased, provided that appropriate mechanisms can be found, such as micro-irrigation, improved water delivery, rain-water harvesting, etc.

- Efficiencies of groundwater are assumed to increase by 10 percent from the present 65 percent average by 2050, whilst surface water efficiencies are assumed to increase from the current low of 30-40 percent to around 50 percent;
- Domestic and industrial water demand are anticipated to increase. Domestic demand will increase due to higher per capita usage and greater coverage from the current average of 31 m^3/person/year to 61 m^3/person/year in 2050. Industrial water demand is anticipated to increase significantly, from the current 42 m^3/person/year to 102 m^3/person/year in 2050. As a result of this increased usage the quality and quantity of flows in some rivers will be at dangerously low levels, and action will be taken by various parties to establish minimum flow requirements (MFR) for certain rivers and river reaches;
- Following these assumptions total water demand under the business-as-usual (BAU) scenario is anticipated to increase 23 percent by 2025 and 32 percent by 2050 (Table 7). Irrigation withdrawals will increase by 2025 but reduce from 2025 to 2050. Domestic and industrial withdrawals will increase substantially over the period, from 34 billion cubic metres (Bm^3) and 42 Bm^3 to 101 Bm^3 and 161 Bm^3 for domestic and industrial use respectively, reflecting the changing demographic and economic development in the country.

Table 7: Business-as-usual scenario water projections, 2000-2050

Sector	2000		2025		2050		Percentage increases from	
	Total Bm^3	% from groundwater	Total Bm^3	% from groundwater	Total Bm^3	% from groundwater	2025	2050
Irrigation	605	45	675	45	637	51	12%	5%
Domestic[a]	34	50	66	45	101	50	94%	197%
Industrial[b]	42	30	92	30	161	30	119%	283%
Total	680	44	833	43	900	47	23%	32%

a. Domestic withdrawals include demand from livestock

b. Industrial withdrawals include colling needs for power generation

Source: Amarasinghe et al, 2004

- Under the BAU the water withdrawals are sufficient to meet most of the food needs by 2050 (Table 8) with total grain needs estimated to be 2 percent more than the estimate demand of 377 million metric tonnes (Mmt). Feed grain needs are anticipated to rise as a result of changing to maize for feeding livestock. However the value of non-grain crops will be less than the projected demand by some 5.4 percent in 2025 and some 6.3 percent in 2050, resulting in a net shortfall in the value of production between supply and demand of 4 percent.

Table 8: BAU crop demands and production surpluses or deficits

Crop category	Demand			Production supluses (+) or deficits (-) as a percentage of demand		
	2000	2025	2050	2000	2025	2050
Food grains (Mmt)	173	230	241	-	-	-
Feed grains (Mmt)	8	38	111	-	-	-
Total grains (Mmt)	201	291	377	2.8	0.2	2.0
Grains (billion US$)	52	73	90	3.3	0.4	3.4
Non-grains (billion US$)[1]	106	198	284	-9.4	-5.4	-6.3
Total (billion US$)	158	272	374	-5.2	-3.9	-4.0

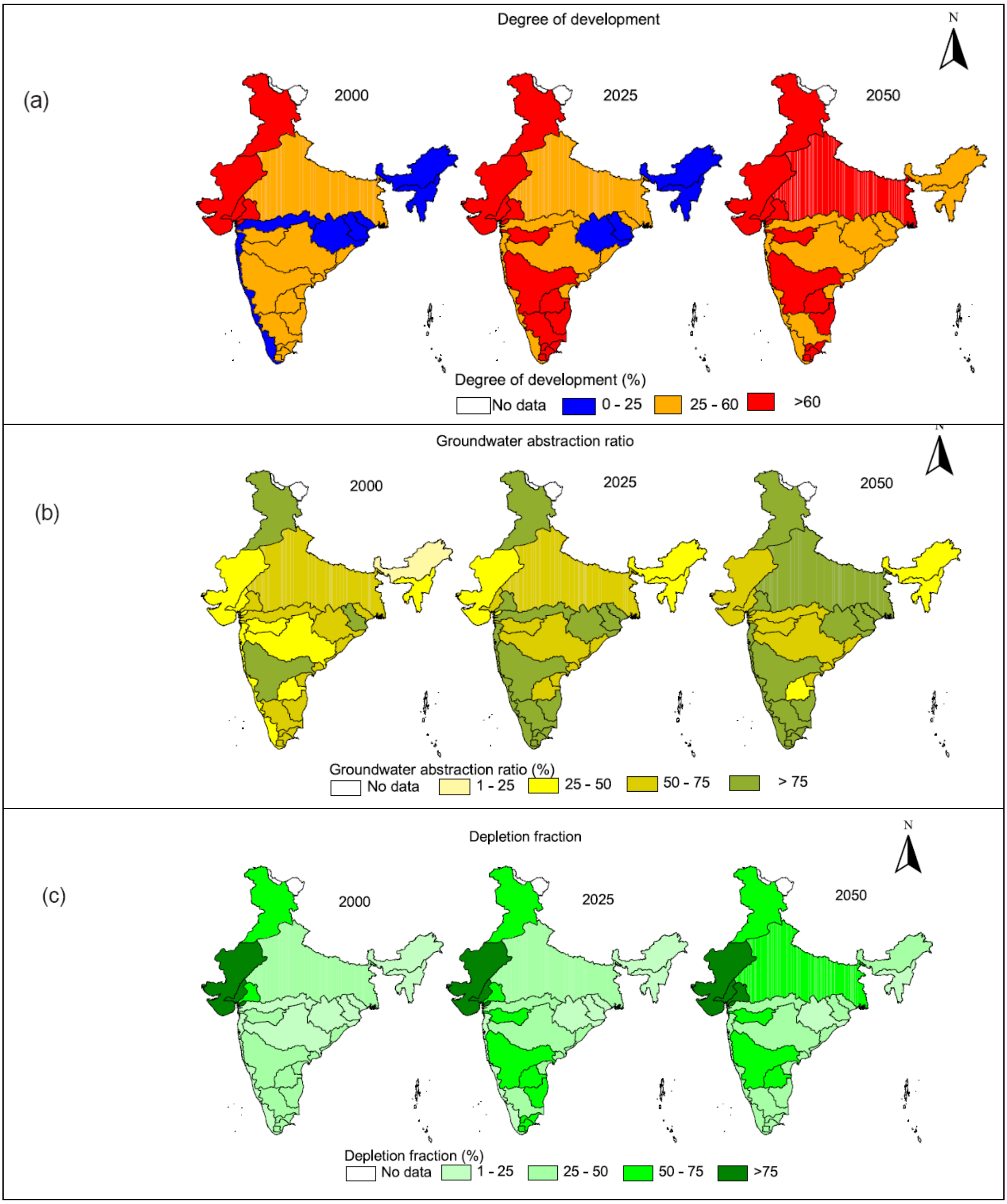
[1] The value is expressed in terms of average export prices in 1999, 2000 and 2001.

Source: Amarasinghe et al, 2004

- As a result of the growth in demand for water many rivers will be physically water-scarce by 2050 (Figure 8). Development of 10 river basins, with 75 percent of the total population, will be well over 60 percent by 2050. These basins will have developed all of the potentially utilizable water resources; water reallocation (and possibly conflict) between sectors will be a common occurrence in these basins. In many basins groundwater, with the current levels of recharge and groundwater use patterns, will be in severe crisis. Solutions proposed to address this water scarcity are: (i) to increase crop productivity for each unit of water used ("more crop per drop"); (ii) to increase groundwater resources through artificial recharge; (iii) to concentrate on economic activities where the value of water is very high[83]; or (iv) to transfer water from water-rich basins.

[83] The value of water can be assessed in a variety of ways, including in terms of wealth created, livelihoods supported whether rural or urban), votes obtained, basic needs (food security) and protection of the environment.

Figure 8: Indicators of growing water scarcity, 2000 -2025



Source: Amarasinghe et al, 2007

Box 2: Key findings of IWMI 2007 report on India's water future, 2000-2050 (Amarasinghe et al, 2007)

On water demand and supply the business-as-usual (BAU) scenario projects:

- The total water demand to increase from 680 in 2000 to 833 Bm^3 by 2025, and 900 Bm^3 by 2050 (increases of 22 and 32 percent respectively);
- The degree of development, the ratio of the primary water withdrawals to the potentially utilizable water resource (PUWR) will increase from 37 percent in 2000 to 52 and 61 percent in 2025 and 2050 respectively;
- Nine river basins, comprising 75 percent of the population, will be physically water-scarce by 2050 (i.e. the degree of development will be greater than 60 percent);
- Withdrawals for industrial and domestic sectors will grow, to account for 54 and 85 percent of the additional demand by 2025 and 2050 respectively;
- Groundwater withdrawals will increase from 303 Bm^3 in 2000 to 365 and 423 Bm^3 by 2025 and 2050 respectively. The groundwater abstraction ratio will increase from 60 percent to 74 and 84 percent respectively; and
- Ten river basins, home to 80 percent of the population, will see their groundwater tables declining considerably by 2050 (i.e. the groundwater abstraction ratio will be greater than 75 percent).

On food demand the business-as-usual scenario projects:

- The non-grain products to provide more than 50 percent of the nutritional intake by 2050;
- The feed grain demand to increase rapidly, from 8 Mmt in 2000 to 38 and 111 Mmt by 2025 and 2050 respectively;
- The food grain demand to increase slowly, from 178 Mmt in 2000 to 230 and 241 Mmt on 2025 and 2050 respectively;
- The per capita grain availability to increase from 200kg in 2000 to 210 and 238 kg/person in 2025 and 2050 respectively;
- The total grain demand to increase from 201 Mmt in 2000 to 291 and 377 Mmt by 2025 and 2050 respectively;

On food supply the business-as-usual scenario projects:

- Overall production surpluses of grain crops, but substantial imports of maize and pulses and exports of rice and wheat, with the maize import being primarily for feeding livestock;
- Production deficits of non-grain crops and substantial imports of (edible) oil crops;
- Overall production deficits of all crops to increase from 5 percent of the total demand in 2000 to 9 percent by 2050;
- The gross irrigated area to increase from 76 to 117 Mha during the 2000-2050 period, with the share of groundwater coverage increasing from 43 (56 percent) to 70 Mha (60 percent) over the same period.

Other findings:

- The BAU projections are significantly different from the demand projections of the National Commission for Integrated Water Resource Development (NCIWRD; GoI, 1999). The NCIWRD assumes that surface irrigation dominates future irrigation development, with a surface to groundwater abstraction ratio of 55:45 compared with the BAU estimate of 40:60. With higher irrigation efficiencies and water productivity the BAU scenario irrigation demand is much lower than the NCIWRD projections;
- The BAU projections are based on current trends. Improvements in crop productivity from the current relatively low levels offer the greatest scope for meeting the need for food and animal feed. If the current yield growth levels can be maintained, as opposed to the gradual decline assumed in the BAU scenario, the irrigation requirement can be reduced by 10 percent;
- Further research is required to identify regions and localities with low and high yields, and low and high potential for increasing the productivity of water, allied to investment in extension measures to close the performance gap between actual and potential crop yields and water use efficiency and productivity;
- Expansion of groundwater irrigation is a key driver of agricultural production and growth in water demand. Measures need to be identified and investment provided to facilitate groundwater recharge. Micro-irrigation technologies offer significant opportunities for increasing yields and water productivity;
- Much of the additional demand for domestic and industrial demand will be met from surface water, either from savings made in the irrigation sector or from development of additional resources. The growth is estimated as 20 Bm^3 each decade over the next 50 years. The extent of the additional development will depend on improvements made in crop water productivity.

3.4. River Basin Organisations in India

Entry 56 in List I of the Constitution provides the legal framework for establishing inter-state management of water resources within river basins. In 1956 the government passed the River Boards Act which allowed for the formation of river basin authorities. Under the Act a state government has to request the Government of India to establish a River Board, as yet no state government or group of state governments has made such a request, preferring to use the Inter-State Water Disputes Act (1956) to address inter-state water resources issues. A further reason that no state government has requested the formation of a River Board is that with the formation of the River Board the state's control over its water resources in that basin would come under the jurisdiction of the River Board.

Despite the above, some 13 river basin boards or organisations have been formed (Table 9). The legal instruments to form these organisations have included: (i) specific acts, such as for the Damodar Valley Corporation (DVC) or the Brahmaputra Board; (ii) formation as a result of a Tribunal decision between disputing states under the Inter-State Water Disputes Act; (iii) specific state acts, notifications or memorandums of understanding between states. The main functions of these boards includes flood control, implementation of multipurpose projects, allocation of water resources as prescribed by Tribunals and preparation of basin and regional plans for water resources development.

Table 9: Current river basin organisations in India

River basin organisation	Year estab-lished	Purpose/Functions	Type of organisation	Organisational structure
The Damodar Valley Corporation	1948 1955	Development of the river valley (4 dams plus irrigation canals/drains), operation and maintenance (O&M) of the system, flood control.	Corporation	Corporate (delegation of powers through line agencies)
Tungabhadra Board	1955	Completion of the Tungabhadra Project, operation and maintenance. Allocation of water according to Tribunal between AP and Karnataka.	Advisory Committee/ Board	Single tier. Board has four members .
Bhaka-Beas Management Board	1976	Administration, operation and maintenance of the Bhakra-Nangal project.	Advisory Committee/ Board	Two tiers – under the Chair are power, irrigation and finance wings.
Cauvery River Authority	1998	Allocation of water amongst riparian states according to Tribunal's award.	Imposed by Tribunal	Single tier. Five member board, with Prime Minster as the Chair. Other members are the Chief Ministers of the four riparian states. Union Minster of Water Resources is the Secretary to the board.
Ganga Flood Control Board	1972	To monitor and manage floods in the Ganga and tributaries.	Advisory Committee/ Board	Single tier. 19 member board headed by Union Minister of Water Resources.
Bansagar Control Board	1976	For implementation of the Bangsar Dam and associated works.	Advisory Committee/ Board	Single tier. Board headed by Union Minister of Water Resources. Executive Committee for management of day-to-day matters.
Brahmaputra Board	1980	Preparation of master plan for flood control.	Advisory Committee/	Single tier. Autonomous statutory body. 21-

			Board	member board. General manager responsible to the board.
Narmada Control Authority (NCA)	1980	Implementation of Tribunal decisions for water allocation and power generation.	Imposed by Tribunal	Single. 15-member board, with an engineer employed as the secretary to the board.
Rajasthan Canal Board	1958	Implementation of the project and allocation of irrigation water.	Advisory Committee/ Board	Two tiers – standing committee and a financial advisor. 12-member board.
Upper Yamuna River Board	1994	Allocation of utilizable surface water flow.	Advisory Committee/ Board	Single tier. 11-member board.
Betwa River Board		Implementation of the Rajghat Dam project and sharing of water as per the Memorandum of Understanding between UP and MP.	Advisory Committee/ Board	Three tiers – Board, Executive Committee and High-level Committee. Board headed by the Union Minister of Water Resources. Executive Committee headed by CWC Chair.
Krishna-Godavari Commission	1961	Review of available supplies in the basin to determine extent of possible future demand and supply.	Advisory Committee/ Board	Commission. Closed after submitting final reports, as planned.
Sone River Commission	1980	Collecting data and preparing basin-level plans.	Advisory Committee/ Board	Commission. Closed after submitting final reports, as planned.

Source: ADB, 2007

The current water boards are dominated by government agencies; there is little or no representation by water users. The boards are generally single tier organisations with a Chairman who is either an engineer from the Irrigation Department or the Central Water Commission (CWC) or a Minister.

3.5. Examples of river basin management

(i) The Bhavani Basin, Tamil Nadu

The Bhavani River is the second longest and fourth largest tributary of the Cauvery River. The basin area of 6,154 km^2 covers three states - Tamil Nadu (87 percent), Kerala (9 percent) and Karnataka (4 percent). There are a number of sub-basins within the basin, including the Siruvani, Kundah, Kallar and Moyar rivers. The main hydraulic features of the basin comprise 15 hydropower reservoirs, the Lower Bhavani reservoir and its associated irrigation project (LBP – 85,000 ha) and three long-established canal systems, the Arakkankottai (2,740 ha), Thadapalli (7,060 ha) and Kalingarayan (6,300 ha). There are a number of other smaller irrigation systems, making the total irrigated area in the basin some 122,000 ha over of a total cultivated area (rainfed and irrigated) of nearly 177,000 ha.

The population in the basin in some 2.6 million, with approximately 62% employed directly or indirectly in agriculture. There are a number of small industries in the basin, including tanneries, dying and bleaching units, tea factories, textiles, sugar mills and distilleries, paper and board manufacturers amongst others. The breakdown in water consumption is 101.8 million cubic metres per year (Mm^3/year) for agriculture, 53.6 Mm^3/year for industry and 41 Mm^3/year for domestic use, making a total abstraction of some 196 Mm^3/year.

The basin is facing a number of challenges[84]:

- Scarcity of water resources to match demand;
- Growing demand from all sectors, with demand outstripping supply available;

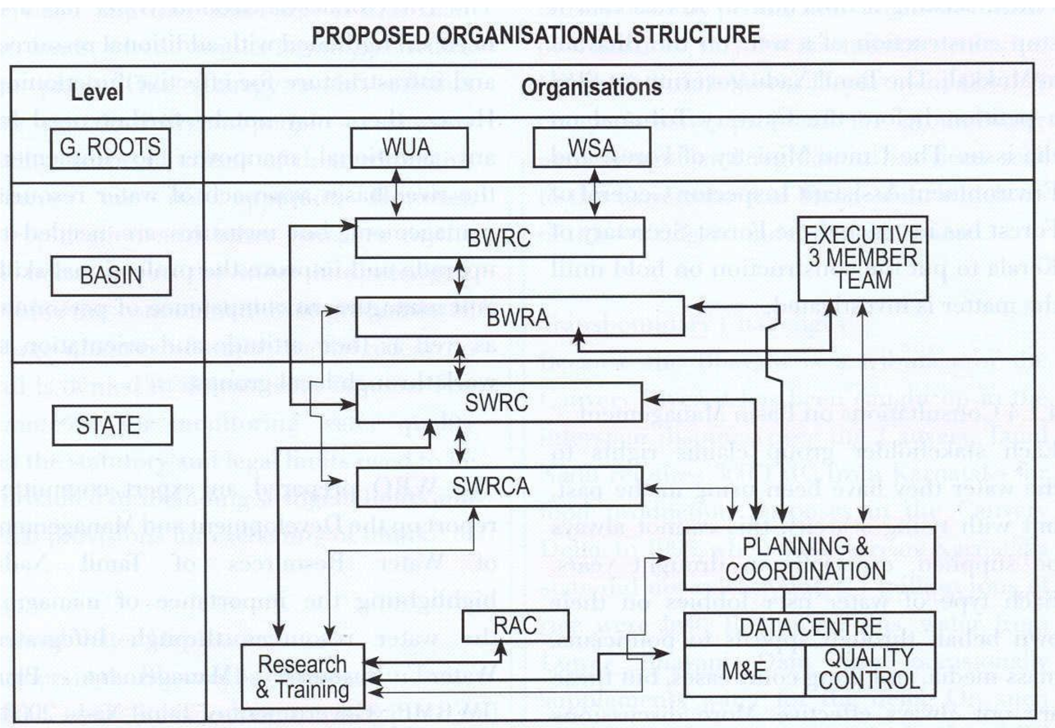
[84] These challenges are not unique to this river basin, similar challenges are currently being encountered in many other river basins in India

- Competition between established and newer irrigation systems;
- Competition between irrigation, industrial and domestic users and uses;
- Authorised and unauthorised lift irrigation direct from the river;
- Interstate and inter-basin conflict over water resources;
- Environmental degradation and pollution of surface and groundwater from industrial and domestic wastewater;
- Falling water tables;
- Conflict over water quantity and quality throughout the basin.

The river basin comes under the authority of the Water Resources Department, though as the former Irrigation Department their focus is on irrigation rather than the broader remit of water resources management for all uses and users. It is reported to have an inadequate focus on development and management of the river basins and groundwater (ADB, 2007). The WRD has recently been restructured into four regional units managing the 17 river basins in the State, and the Directorate of Groundwater has been strengthened with additional resources and infrastructure. A significant amount more is required to upgrade and improve the professional skills and management competency of the staff in both organisations (ADB, 2007).

In 2003 the WRD formed a committee to review the management of water resources in Tamil Nadu (Government of Tamil Nadu, 2003). The committee proposed a three tier organisational structure at state, river basin and field level (grass roots) for coordinating and directing the activities of the concerned agencies (Figure 9). The functions of the different bodies presented in Figure 9 are summarised in Table 10.

Figure 9: Organisational structure proposed by the Government of Tamil Nadu for water resources management



Source: Government of Tamil Nadu, 2003, in ADB, 2007.

Table 10: Structure proposed by Government of Tamil Nadu for water management at river basin level

Level	Organisation	Functions
State	State Water Resources Council (SWRC)	State-level apex body responsible for policy setting and direction for water resources management. The Chair is the Chief Minister, with five cabinet ministers and five nominated members.
	State Water Resources Council Authority (SWRCA)	Secretariat to the SWRC, responsible for guiding and overseeing basin planning and implementation, coordination at state level of concerned organisations, refining water policies and management processes, guiding research and development, conducting M&E and special studies.
River Basin	Basin Water Resources Councils (BWRCs)	Basin Water Resources Councils would be established for each of the 17 river basins. The Council would comprise representatives from WUAs, municipalities, NGOs, industry, District Collectors, politicians and representatives of the water agencies within the basin. The BWRCs would prepare a river basin plan, and meet at regular intervals to review progress in implementing the plan.
	Basin Water Resources Authority (BWRA)	The BWRA would be the executive body of the BWRC and would comprise three members with fixed-term appointments and a number of support staff for the effective functioning of the unit. The BWRA would liaise with various line departments and agencies and report to the SWRCA
	Water Users Associations (WUAs) and Watershed Associations (WSAs)	Would be responsible for operation and maintenance of their respective systems and would represent their members' interests on the Basin Water Resources Council.

Source: Government of Tamil Nadu, 2003, in ADB, 2007.

(ii) Baitarani Basin, Orissa

The ADB is supporting a civil society water resources management initiative in Orissa, the Baitarani River Basin Initiative. The initiative seeks to "work toward inclusive and futuristic basin water resources management (IFBRM) for sustainable basin livelihood and resilient basin ecosystem health" (ADB, 2007). As a civil society initiative the exercise seeks the active participation of all sectors and stakeholders in anticipating and planning for the future. The initiative seeks to promote innovation and use of indigenous knowledge and governance structures whilst sharing information amongst all stakeholders.

The initiative is in the initial stages of development, and will face serious difficulties in trying to manage the active participation of such a diverse group of stakeholders across a large distance. It is proposed that the Water Resources Department could take on the role of organiser or leading partner in the Initiative, with the active participation of other stakeholders. At the basin level it is intended that the basin institution will take up the roles of governance, coordination, monitoring and arbitration, while the various government departments will be responsible for management functions. It is argued by the proponents that placing responsibility for making recommendations for resource allocation in the hands of basin departments, NGOs and academics will enable the basin-level institution to more effectively carry out its monitoring, regulatory and dispute settlement functions.

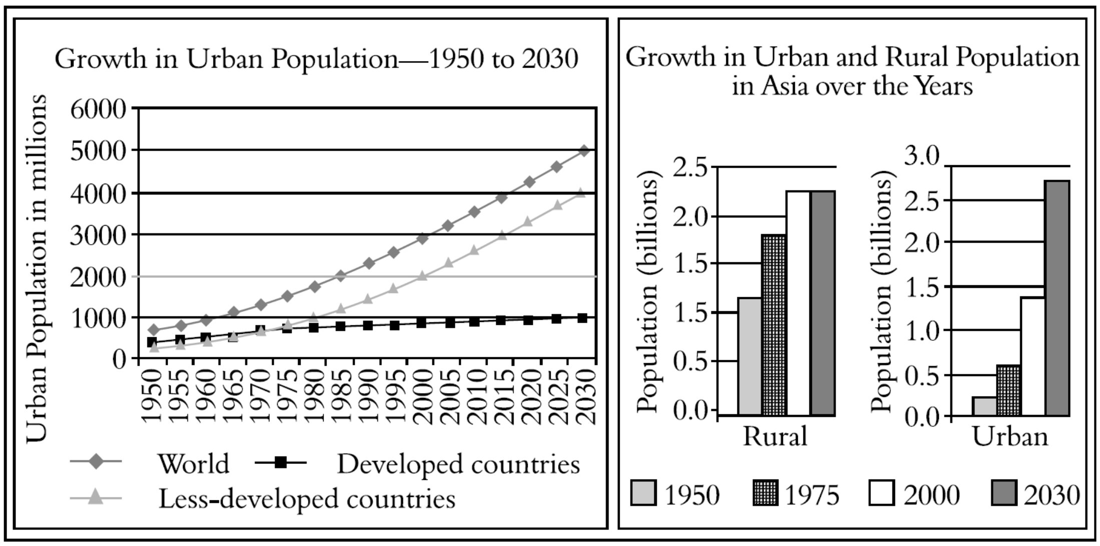
3.6. Summary discussion

The discussion above has outlined the growing pressure on India's water resources and the need for action to avert water crises in river basins and sub-basins. The analysis has emphasised the fact that different river basins are in different stages of development and are facing different situations with regard to the key determinants of total population, population density, surface and groundwater availability and level of development. Each basin will require a different range of measures to address these issues. The analysis has looked at the macro level, it has not looked at the situation in sub-basins or river catchments, which may differ from that found in the basin overall. In some cases the situation at the lower catchment level may be more severe than that for the basin as a whole, requiring very localised solutions to pressing problems.

Some of the key issues arising from the analysis are:

- There is a need to move from agri-centric planning to planning which takes account of water resources requirements for all uses, including agriculture, domestic, industry and environment;
- The population is growing and the trend is for a significant part of that growth to be in the urban rather than the rural areas. Though agriculture and the rural economy will remain an essential and fundamental base for employment and livelihoods for many people, it cannot support and adequately sustain the future population growth. Adequate water resources will need to be allocated to provide for domestic use in urban areas, and to develop the industries that will be required to provide employment and support livelihoods. Using demographics projection data from the UN (UN, 2002) Mohan and Dasgupta (2004) argue that the twenty first century will be the "Asian urban century". This is based on analysis of the data (Figure 10) which show that in Asia the urban population will have increased from 0.25 billion in 1950 to an estimated 2.8 billion in 2030. In India this would mean 40 percent of the population would live in urban centres by 2030, increasing to between 48-60 percent by 2050 (Verma and Phansalkar, 2007);

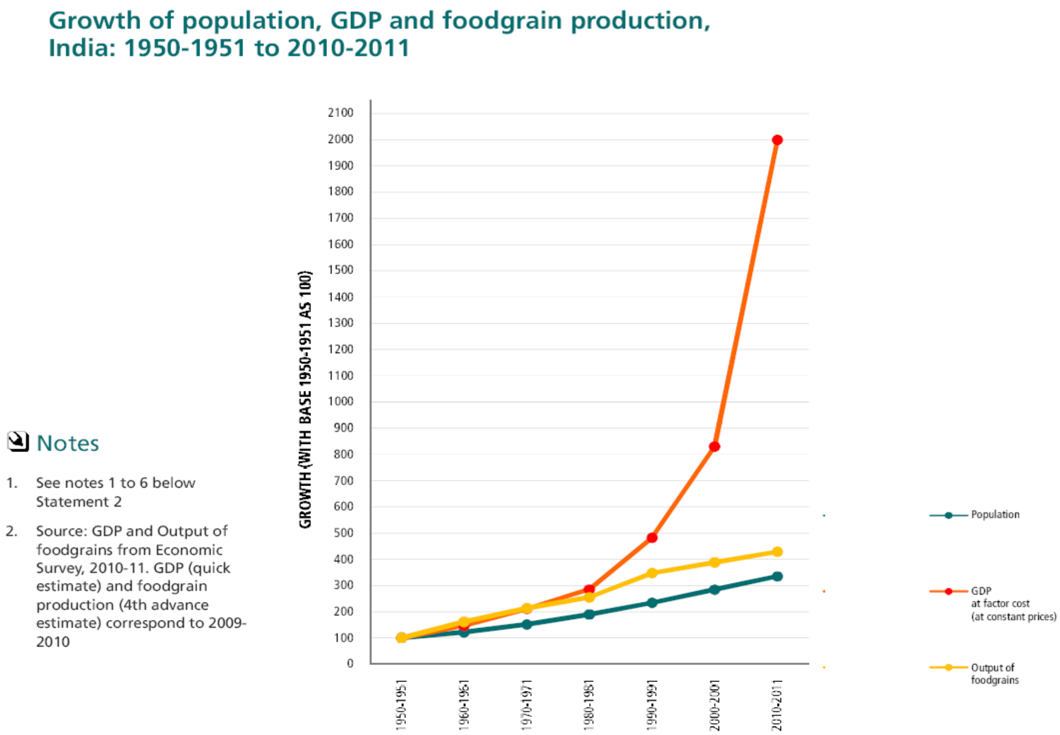
Figure 10: Growth in urban population, 1950-2030



Source: UN 2002; Mohan and Dasgupta, 2004

Figure 11 also points towards the growing importance of the urban and industrial sectors in the Indian economy. Whilst agricultural production has just managed to keep up with the population growth the GDP has risen sharply since 1980/81. This sharp increase cannot be attributed to the agricultural sector; its growth has been relatively stagnant over the last 30 years. Urban-based economic activity, industry and the service sectors, is the most likely contributor to this change in the GDP, reflecting in turn increased employment and levels of income for a significant section of the population.

Figure 11: Population growth, GDP and food grain production, 1950-2011



Source: ORGCC, 2011

- Several river basins are already over-developed in terms of their water resources, and more basins are heading that way. In these basins there is physically no more water available, the utilizable limit has been reached. In the cases where groundwater levels are falling the utilizable limit has been exceeded. There is a growing case for better management of existing water resources rather than new construction to be at the heart of future approaches;

- Water resources management to date has been characterised by parochial self-interest, mainly by the irrigation sector. Due to initially abundant water resources this situation has been allowed to develop to the extent where other sectors are being squeezed and restricted in their development. In water-scarce basins this situation is no longer either acceptable or sustainable, wider and more inclusive planning and management of the available water resources is required;

- In river basins which are approaching water-scarcity consideration needs to be given now to options for further development of the remaining utilizable resources. Given that the urban and industrial sectors are predicted to grow in size and water demand it is prudent to reserve sufficient future development for these uses, rather than for any new irrigation. As is already the case in water-scarce river basins water is being taken out of the agricultural sector for other uses; it is far better to pre-empt this situation in other basins by planning ahead;

- There is a clear and pressing need for a professional approach to the management of water resources as a whole. Either the existing Irrigation Departments need to be reorientated and restructured in order to be a professional water resources management organisation catering for all water uses and users, or a new water resources management organisation needs to be created in each State to manage water resources, leaving the Irrigation Departments to continue with their focus on irrigation;

- There is a need for a long-term vision on water resources management in India, and a need for political initiative and support to manage the transition from the current to future institutional and organisational structures;
- Within the context of better water resources management clear objectives and principles need to be set, including setting the irrigation sector targets for agricultural production and water productivity and an expectation that the irrigation sector will take seriously the need to conserve water and use it more productively;
- In the context of holistic management of water resources far more needs to be done to acknowledge, support and encourage the conjunctive use of surface and groundwater resources. The old paradigm of the state providing irrigation water through surface irrigation systems needs to change to one in which the relative benefits of surface water and groundwater are recognised and brought together so as to optimise agricultural production, water use and energy consumption[85];
- As has been demonstrated there are differences between river basins in terms of their need to import or ability to export agricultural production. For this reason a national approach is required to coordinate and address water resources and food production issues;
- Much of the water resources development to date has been large-scale and top-down by government. The groundwater explosion, and the significant contribution that this private sector led development has made to agricultural production, the rural economy and individual livelihoods is an example of the contribution that individuals can make to the water resources and agricultural sectors. As set out in the 1997 and 2002 National Water Policies far more needs to be done to engage with stakeholders and to harness their energy and resources;
- The analysis herein and by many researchers has been from the food production perspective with urban and domestic use included as secondary items. An analysis from the industrial and domestic supply sectors might look quite different.

4. How can we visualise river basin planning happening in India?

4.1. Approach and principles

Section 3 has discussed the current situation in relation to water resources development and management in India. It has highlighted the growing crisis in many river basins, and the need for better water resources management to cope with the growing water scarcity.

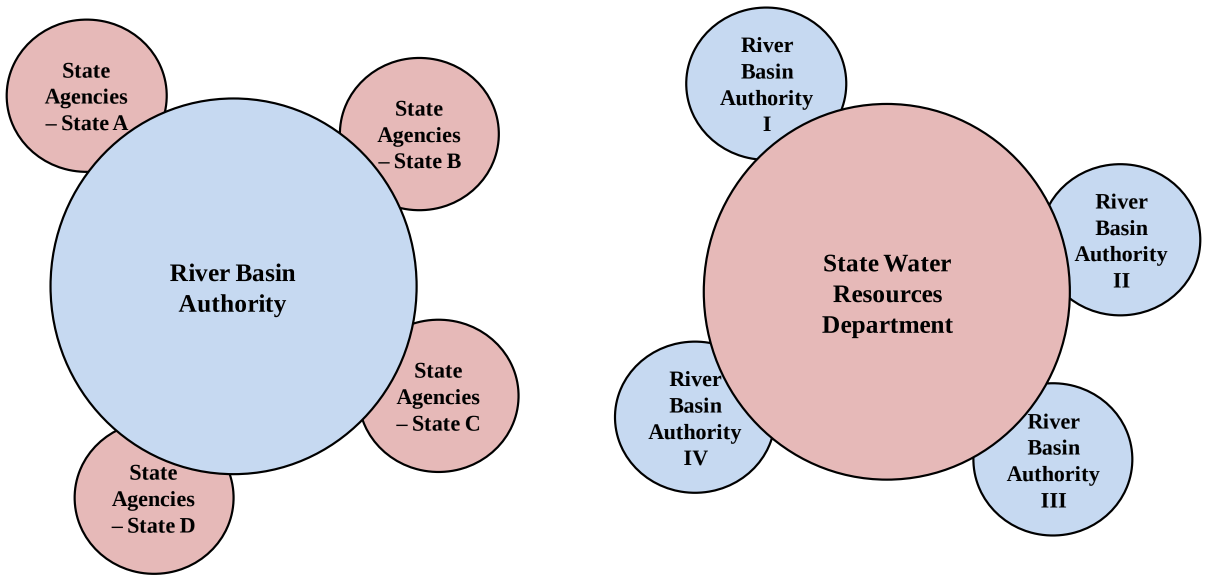
The big question is how to cut the cake, should water resources be managed by river basin authorities or by state agencies? Figure 12 shows the relative role of the two approaches. In Case A the river basin authority (RBA) has the responsibility for planning and management of

[85] For example in some locations it may be more economic for government to support farmers with the development of their groundwater resources rather than constructing a large surface irrigation system.

water resources within the river basin and coordinating with the state water resources agencies to implementing the RBA's plans. In Case B the state agencies are responsible for water resources management within their administrative boundaries, but work with RBAs to coordinate the planning and management of the water resources in each river basin.

Based on experience to date it seems unlikely that the states will relinquish their control over the water resources within their boundaries, and therefore Case B is the more likely scenario, in the short to medium term at least.

Figure 12: Options for water resources management in river basins and states



Case A
River Basin Authority the main authority

Case B
State Water Resources Department the main the main authority

The following sections outline an approach to water resources management in each state, comprising an organisational framework, definition of functions, identification of actors and stakeholders and data requirements.

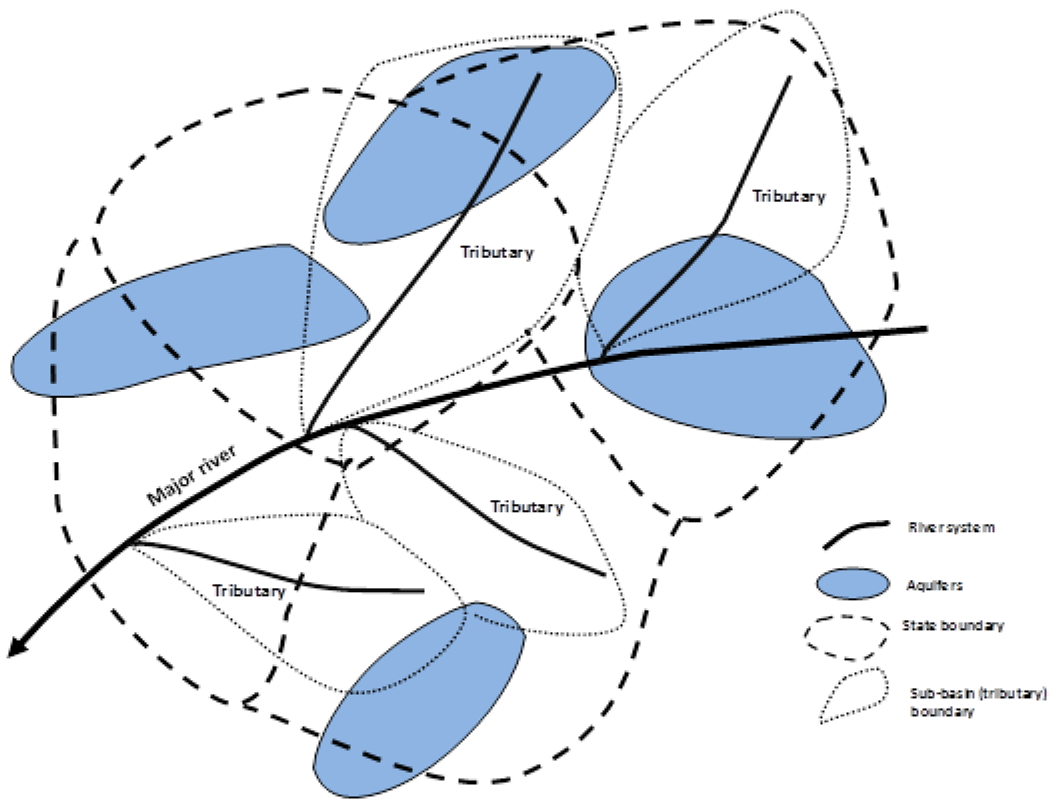
The approach is founded on the following understandings and principles:

- Following the discussion above the state needs to take primary responsibility for water resources management within its administrative boundaries;
- Due to the significant inter-connectedness of water resources between neighbouring states, both for large river basins as well as for smaller river catchments and groundwater aquifers, water resources management by the state should be based on river basins and hydraulic boundaries, and will thus require collaboration and cooperation between states;
- To gain the support and compliance of water users water resources management should be based on a participatory approach, with a far greater role and voice given to water users;

- Water resources management should cover both surface and groundwater resources and should encompass all uses and users of water, including agriculture, urban, industrial, hydropower, navigation and the environment;
- Water resources management should be separated from irrigation service delivery, with the water resources management entity focussing on the broader needs in water resources planning and management, and the irrigation entity focussing on service delivery and improving performance of existing irrigation systems;
- Much of the discussion on river basin organisations talks about coordinating water resources planning and management amongst states and state agencies, rather than actually managing the water resource. It is preferable to first start with improving the control and management of the resource.

The complexity of the situation is summarised in Figure 13 which shows the possible inter-relationship of state, river and aquifer boundaries. These inter-relationships can be quite complex, requiring significant levels of cooperation and liaison between the various parties involved in managing the surface and groundwater resources. In this context it will be as important for the State to liaise and work with the stakeholders in the tributary catchments as with those in the major river basin.

Figure 13: Possible inter-relationships of state, river and aquifer boundaries



4.2. Organisational structure

Figure 14 outlines a proposed model for organising water resources management in each state in India. The model is based on a governing council comprising the key stakeholders in each state, with an executive arm responsible for implementation of policy and the day-to-day management of water resources. This structure is not unlike that being proposed for Tamil Nadu as outlined above in Section 3.5 (i).

The competencies of the various bodies set out in Figure 14 are outlined in Table 11. The proposed model separates water resources management from service delivery. In this context the current Irrigation Department (ID) would be renamed and restructured to become the Irrigation Services Department (ISD) with responsibility for the planning, construction and management of irrigation and drainage systems. Along with other water users the ISD would obtain licenses from the State Water Administration for the irrigation systems for which it is responsible. In states where the Irrigation Department (ID) has been renamed the Water Resources Department (WRD) the water resources management functions will be retained in the WRD and the irrigation service functions assigned to the ISD.

Figure 14: Proposed organisational structure for water resources management in each state

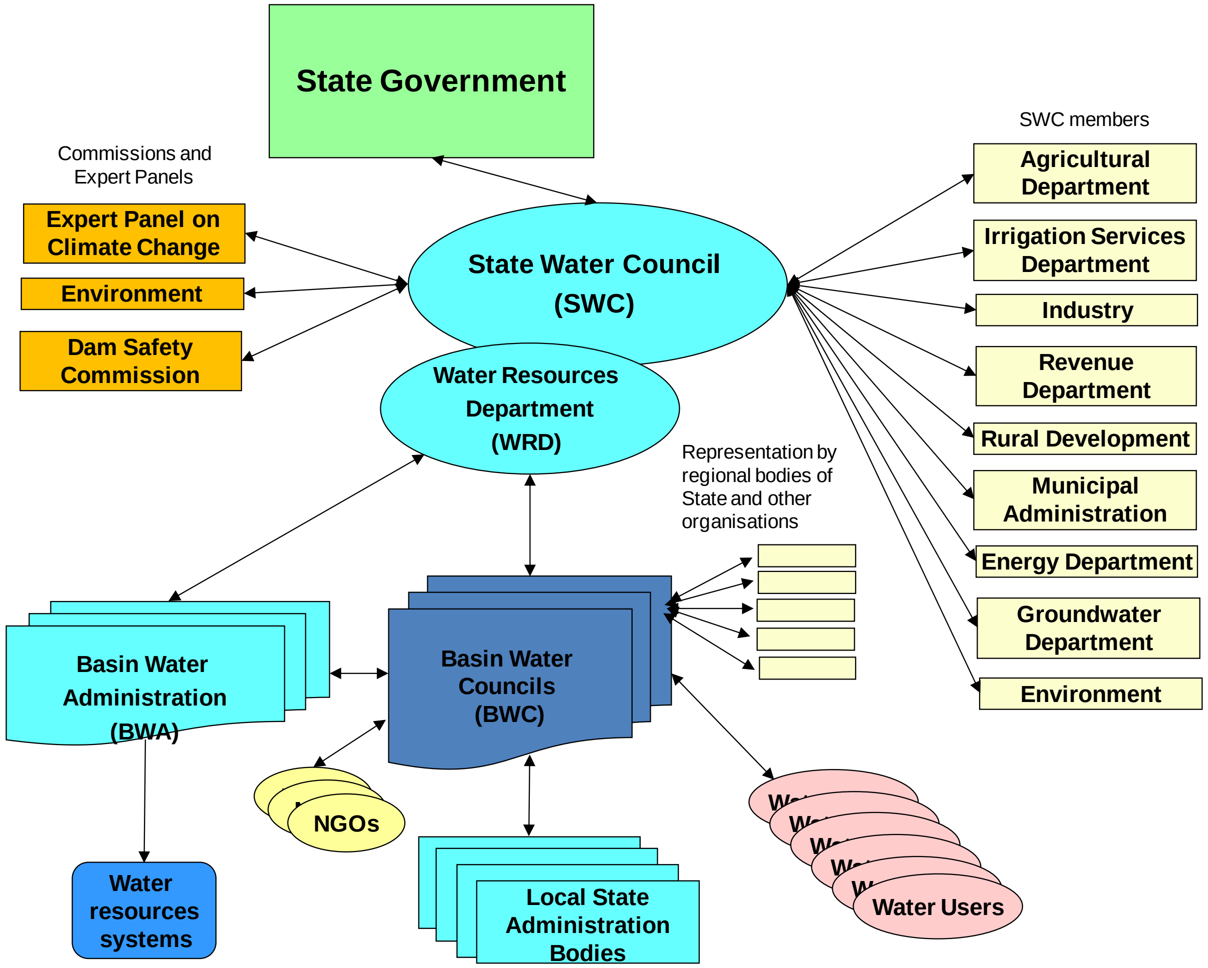
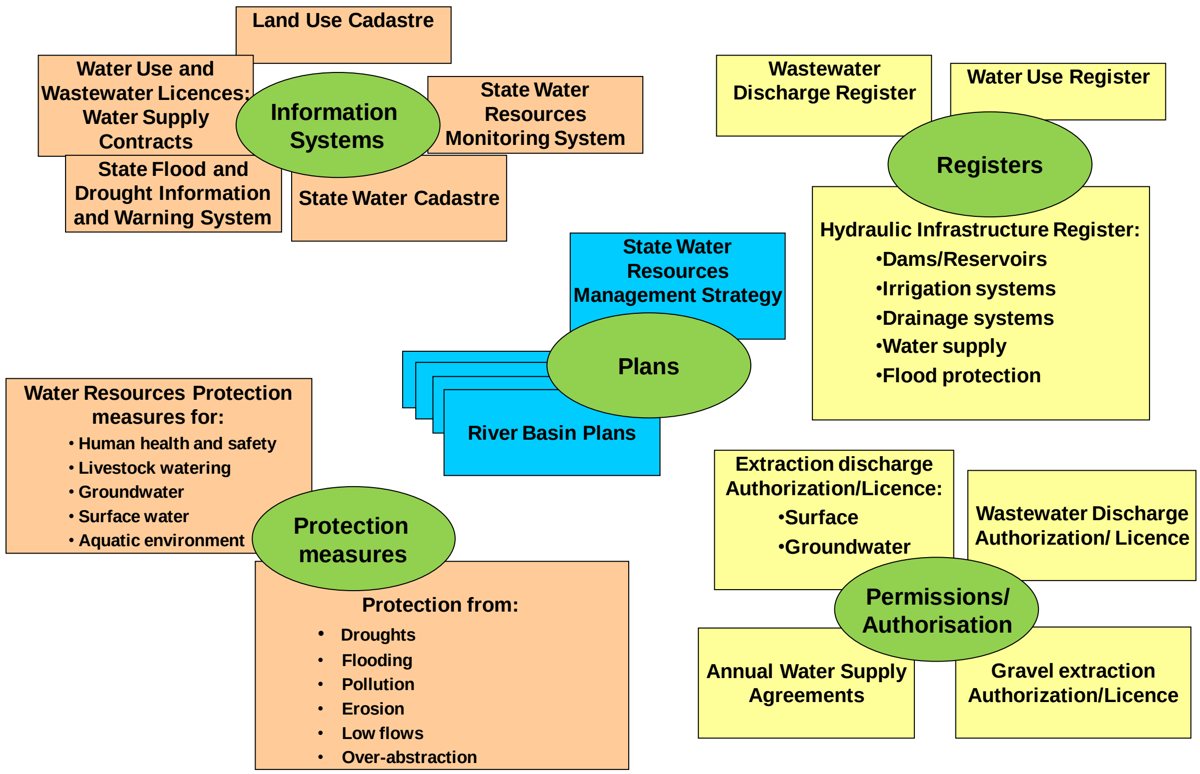


Table 11: Competencies of the various bodies involved in the proposed water resources management model

Body	Competencies	Remarks
State government	• Establishment of the State Water Council (SWC); • Approval of the regulations of the Basin Councils; • Designating authorized bodies for the implementation of water resources management within the state; • Approval of the boundaries of principal basins, sub-basins and catchments as recommended by the SWC.	
State Water Council (SWC)	• Coordination of the activities of ministries, agencies and other state bodies in regard to water resources management, its use and protection; • Preparation of a Water Resources Management Plan • Preparation of regulations related to water resources management for submission to state government; • Oversight of the Water Resources Department; • Identify principal basins, sub-basins or catchments and establish Basin Water Councils for the purpose of improving coordination and basin water management.	• The Chief Minister is the Chair of the SWC; • The Heads of the participating government agencies are members of the Council together with representatives of water users and civil society; • The Council meets at least once per year; • The Council is entitled to obtain from other ministries and organisations such data, information and technical support as is reasonably required in the preparation of the Water Resources Management Plan.
Basin Councils	• Establish a representative council of water resources stakeholders; • Prepare draft Basin Plans for submission to the State Water Council; • Co-ordinate activities in the water resources sector within the basin.	• Chaired by the Head of the Basin Water Administration; • Meets periodically in the initial 1-2 years to formulate the Basin Plan, thereafter 1-2 times each year ; • The relevant Basin Water Administration (BWA) acts as the secretariat to the Basin Water Council
Water Resources Department (WRD)	• Act as the secretariat to the State Water Council; • Subordinate units of the WRD, the Basin Water Administrations, to act as the secretariat to the Basin Water Councils; • Manage and regulate the use of water resources, including surface and ground waters; • Carry out tasks so as to protect the water resources from pollution, degradation and depletion; • Identify and establish protection zones where required, and implement measures for protection; • Identify and map all water sources (rivers, springs, aquifers, etc.) and their boundaries; • Establish and maintain up-to-date a water resources information database; • Carry out planning activities related to water resources development and management; • Monitor the water resources of the state, including monitoring discharges, abstractions, wastewater disposal, levels of pollution, etc.; • Approve and license water abstraction from rivers, stream and designated aquifers.	• The Basin Water Administrations (BWA) are the territorial branches of the WRD implementing the functions of the WRD within designated basins, sub-basins or catchments. • Operating costs of the WRD and BWAs to be covered, either in full or in part, by licences and permits.

The Water Resources Department would be a central player in the proposed framework, with responsibility for the implementation of the state's Water Resources Management Plan and the day-to-day executive implementation of the designated water resources management functions. The main functions are summarised in Figure 15. The functions include: (i) preparation and oversight of water resources and basin management plans; (ii) authorisation and licensing of water abstraction from, and wastewater disposal into, water bodies; (iii) protection of water resources from pollution, degradation and depletion; (iv) maintaining of information systems on water use, water use licenses, wastewater discharge permits, pollution levels, aquifer volumes and water levels, river and stream discharges; water abstractions; wastewater disposal; (v) maintaining registers on water use, wastewater disposal, and hydraulic infrastructure (on river/stream/drainage courses and aquifers).

Figure 15: Key functions of the Water Resources Department



River Basin Councils would play an important role in bringing together the various parties to formulate Basin Plans. It is important that River Basin Councils be constituted at the right level in order to be relevant to stakeholders. If the basins are too big (such as the Ganga for example) they are too far removed from their constituents on the ground. In Madhya Pradesh, for example, there are ten identified river (sub-) basins[86], all of which save one are part of inter-state

[86] These are: Mahi, Chambal, Sind, Betwa, Ken, Tons, Sonn, Narmada, Wainganga and Tapi. All save the Sind are part of larger inter-state river basins.

river systems. These ten sub-basins form relevant hydrological units on which to form River Basin Councils in MP.

The River Basin Plans would detail key elements of the basin (geography, hydrology, land use, demography, surface and groundwater water resources, economic structure, sectoral development, employment by category, etc.) and prepare a development plan for the currently and future available water resources. The plan would need to take account of external factors such as possible changes over time in upstream or downstream water use, climate change, etc.

4.3. What are the institutional requirements for this to become possible?

For planning and management of river basins to be effective, as discussed in Section 2.4, certain enabling conditions need to be met. There is a need for buy-in to the process from politicians and senior government civil servants, followed by new water resources legislation which, amongst other things, provides users with legal title to a specified quantity of water under specified conditions. It is interesting to note that no state in India has specific legislation for water resources management, rather water resources management is based around (often outdated) irrigation and drainage acts.

The institutional requirements for effective water resources management are thus:

- Support from politicians and senior civil servants to some of the core principles;
- A Water Resources Act which:
    - establishes the above proposed organisational framework for planning, management and regulation of a state's water resources;
    - establishes rights to water and conditions of use;
    - covers both surface and groundwater;
- An apex coordination body, the State Water Council, responsible to the state government for water resources policy and strategy;
- An executive body which is responsible to the State Water Council for water resources management;
- Separation of (water) resource allocation and resource delivery functions, with the Water Resources Department allocating available water resources to the various users and service providers;
- Identification and delineation of river basin or sub-basin boundaries in the state and formation of consultative bodies in the form of River Basin Councils to engage local stakeholders in water resource planning, allocation and management.

4.4. What are the data requirements?

Table 12 shows the typical water uses, information uses and users in a river basin. Water uses can be categorized into watershed use, in-stream use, extractive use or environmental use. Some use, such as irrigated agriculture or forests, depletes (through evaporation) the water available in the basin. Other uses, such as hydropower, fisheries and navigation, are not extractive and can complement environmental uses. Information uses can be many and varied, and can be categorized into development and master planning, water sharing and allocation, operational management and research. Users of information include government agencies, regulatory and management authorities, companies, groups and associations, and individuals. With modern technology (i.e. the Internet) it is now as easy for an individual to have access to data as for a government official.

Key data required for water resources/river basin planning and management is presented in Table 13. The importance and relevance of the data required changes over time. For example in Europe there is increasing focus on the environmental quality for water (e.g. the EU Habitats Directive and the Water Framework Directive). These changing needs are summarised in Figure 16, which shows that as a basin develops over time the type of data collected and the use to which it is put changes.

The minimum dataset required for water resources planning and management in each state will include:

- Mapping of all water resources (surface and groundwater)
- River and stream flow measurements;
- Lake/reservoir water levels and volumes;
- Groundwater levels and quality in aquifers;
- Details of all water abstractions (type of abstraction, use, location, quantities abstracted, etc.);
- Wastewater discharges into water bodies (volumes, location, type, quality, etc.)
- Periodic water quality measurements in all water bodies;
- Periodic sediment measurements in rivers;
- Flood levels, flows and areas inundated.

Table 12: Typical water uses, information uses and users within a river basin

Water Uses	
Watershed water uses	• Lakes/reservoirs • Forests • Natural vegetation
In-stream water uses	• Hydropower • Recreation • Navigation • Fisheries
Extractive water uses	• Irrigation (Surface/Groundwater) • Potable water (Surface/Groundwater) • Industrial water, including mining (Surface/Groundwater)
Environmental water uses	• Aquatic, wetlands and floodplain environment and ecology • Drainage disposal • Waste dilution and disposal • Repelling salinity intrusions • Erosion control
Information Uses	
Development and master planning	• Planning and forecasting • Decision-making in relation to resource development and protection
Water sharing and allocation	• Resource management and allocation • Allocation of water rights • Rule formulation • Pricing • Dialogue with, and amongst, users
Operational management	• Flow control and regulation • Flood control, protection and warning • Effluent control • Monitoring and evaluation (abstractions, effluent levels, environment, etc.) • Infrastructure asset management • Conflict resolution
Research	• Water resources, irrigation, environment, ecology, etc.
Information Users	
Government	• Ministries of: Water Resources, Irrigation, Agriculture and Livestock, Energy, Hydrology and Meteorology, Health, Environment and Natural Resources, Fisheries, Forestry, Navigation and Marine Transport, Planning and Development • Legislatures • State, regional or local government • Municipalities
Regulatory and management authorities	• River boards, river basin councils, drainage boards • Regulatory bodies (rivers, groundwater, environment, etc.) • Courts
Companies, groups and associations	• Industry (manufacturing, services, mines, forestry, etc.) • Associations (irrigation, rural water supply, environmental lobbies, etc.) • Universities, research centres and training centres • Development agencies and agents • NGOs
Individuals	• Domestic household users • Irrigation farmers • Livestock owners • Recreators

Source: Burton and Molden, 2005

Table 13: Summary of key data for water resources/river basin planning and management

Physical data
- Latitude/Longitude
- Catchment area
- River channel length
- River slopes
- Land use types and areas
- Land slopes and areas
- Soil types and areas
- Aquifers (numbers and areas)

Demographic data
- Total population (past, present and projected)
- Population densities
- Population by location (urban/rural)
- Population by work type
- Attainment levels for education (by age and gender)

Institutional
- Development policy
- Water policy
- Water law
- Environmental law
- Land tenure
- Stakeholders – roles and responsibilities
- Water rights

Economic
- National GNP
- Regional or basin GNP
- Average basin per capita GNP

Hydrometric data
- River discharges
- River water levels
- River flood peak discharges
- River base flows
- River sediment load
- River water quality
- Lake/reservoir water levels
- Lake/reservoir volumes
- Lake/reservoir water quality
- Lake/reservoir water temperature
- Lake/reservoir surface evaporation
- Volume of water imported/exported to/from basin

Meteorological and climatic
- Sunshine/radiation hours
- Wind speed
- Air temperature – average/max/min
- Humidity
- Evaporation
- Precipitation
- Precipitation intensity

Groundwater
- Groundwater levels
- Groundwater quality
- Aquifer yields and quality
- Estimate annual groundwater recharge

Agricultural
- Cultivable area
- Irrigable area
- Irrigated area
- Irrigation water abstractions (surface/groundwater)
- Drainage return flows – quantity
- Drainage return flows – quality
- Number of landholders
- Population dependent on irrigated agriculture
- Value of irrigated agricultural production

Potable and wastewater
- Abstraction quantity (Surface/ groundwater)
- Abstraction quality
- Return flow – quantity
- Return flow – quality
- Number of people supplied

Industrial
- Abstraction quantity (Surface/ groundwater)
- Abstraction quality
- Return flow – quantity
- Return flow – quality
- Number of people employed

Navigation
- River water levels
- River discharges
- River channels and depths

Hydroelectric power
- Generation capacity
- Discharge requirements and timing
- Maximum discharge requirements and timing
- Minimum discharge requirements and timing

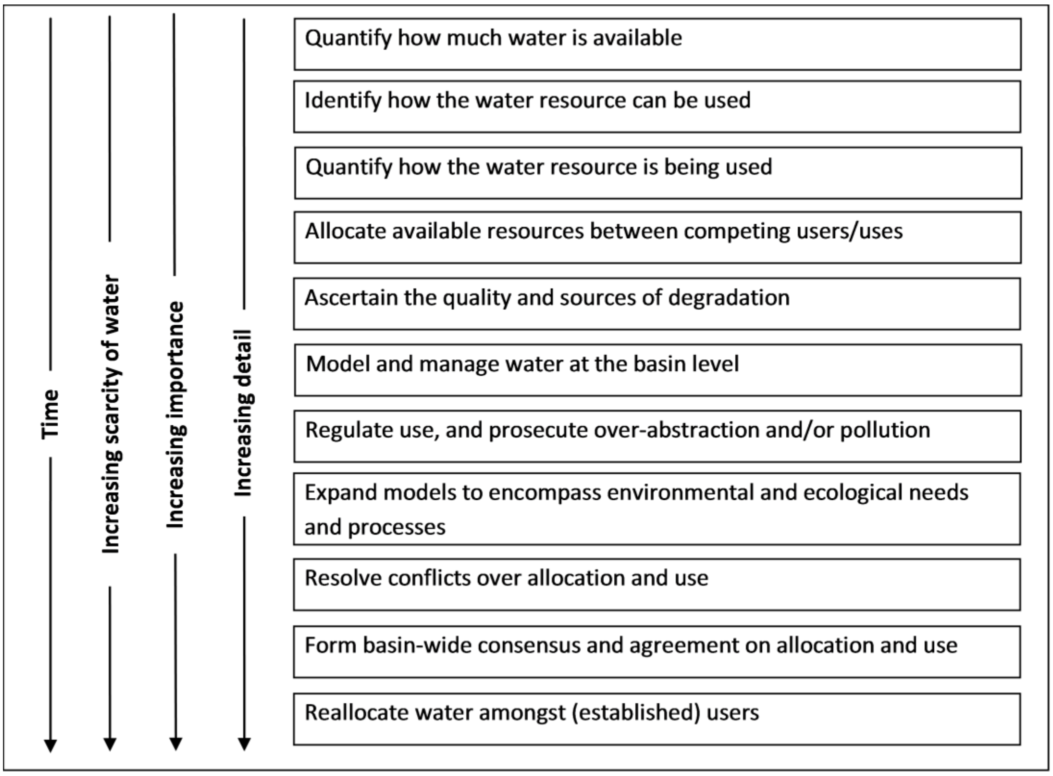
Environmental
- Minimum flow requirements
- Critical flow periods and demands
- Protected areas and water demands
- Required water quality standards

Recreational
- Minimum flow requirements
- Critical flow periods and demands
- Protected areas and water demands
- Required water quality standards

Tourism
- Minimum flow requirements
- Critical flow periods and demands
- Protected areas and water demands
- Required water quality standards

Source: Burton and Molden, 2005

Figure 16: Changing focus for data and information over time within a river basin



Source: Burton and Molden, 2005

4.5. What are the human resource capacity requirements for this to become possible?

A possible organisational structure for the Water Resources Department is outlined in Figure 17. The organisation comprises two main wings, the State Water Council secretariat responsible for liaising with the SWC and ensuring that its recommendations are put into practice, and the Water Resources Management Division. The Water Resource Management Division has five main units:

- Water Resources Planning;
- Water Resources Management;
- Water Permissions;
- Water Resources Regulation;
- Information Systems.

These units (except the Information Systems Unit) are mirrored in the Basin Water Administration offices which will be at the "coal face" of interacting with water users. Table 14 presents an indicative outline of the possible staffing in the WRD based on this structure. The actual numbers will vary from state to state depending on the number and size of basins, and the complexity of the water resources situation. Under this framework the Water Resources Regulation Unit would be responsible for oversight of the tariffs set by the irrigation and water supply organisations. The Regulatory Unit would be responsible for ensuring that the service fees were fair and reasonable, and that the irrigation and water supply organisations are providing adequate levels of service and adequately maintaining the physical infrastructure.

Figure 17: Outline structure of the proposed State Water Administration

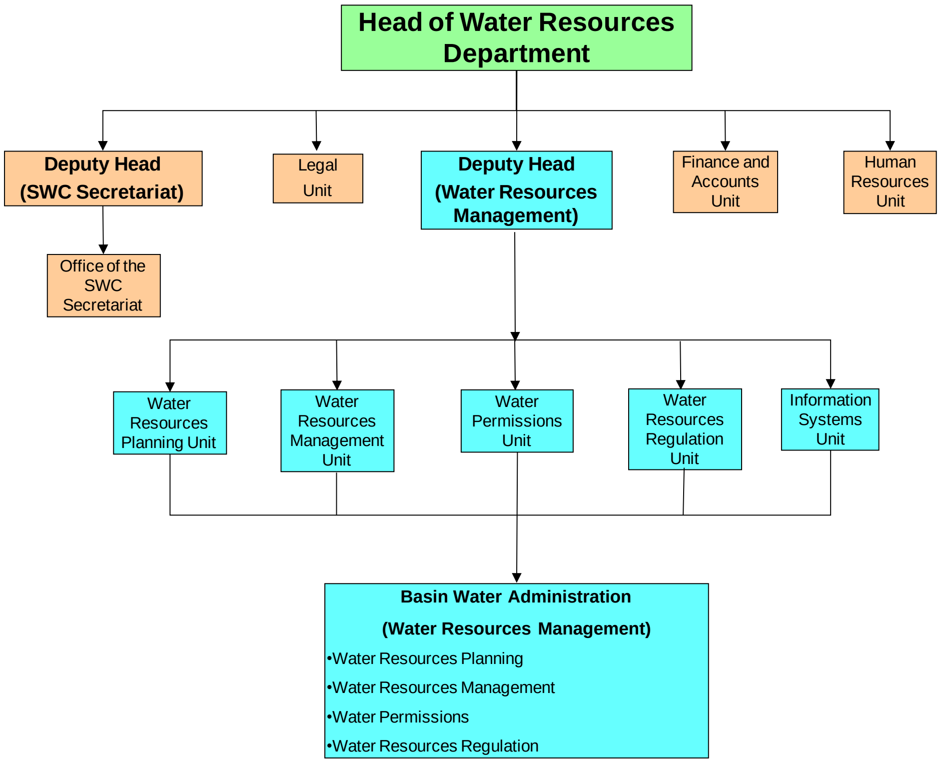


Table 14: Outline staffing numbers for the proposed Water Resources Department

Unit	Professional staff (No.)	Administrative staff (No.)	Technician staff (No.)
Head, WRD	1	1	-
Deputy Head, SWC Secretariat	1	1	-
Office of the SWC Secretariat	3	6	1
Legal Unit	2	4	-
Deputy Head, Water Resources Management	1	1	-
Water Resources Planning Unit	6	4	2
Water Resources Management Unit	8	6	4
Water Permissions Unit	4	4	2
Water Resources Regulation Unit	4	6	2
Information Systems Unit	3	3	1
Basin Water Administration offices (10 No.[1])			
Water Resources Planning Unit	2	4	4
Water Resources Management Unit	6	6	10
Water Permissions Unit	2	10	2
Water Resources Regulation Unit	2	4	6
Total	**45**	**60**	**34**

Note: [1] The number of Basin Water Administration offices in each state will depend on the number of designated basins or sub-basins in the state.

In the short to medium-term there will be a need for a significant amount of training and capacity building in the WRD in the principles and practise of water resources management Allied to this will be the need to build capacity in the universities to strengthen education in water resources planning and management, with existing specialist courses being strengthened and new courses established in a wider range of universities.

4.6. What is the process through which this can happen?

The basic river basin planning and management functions are currently being carried out by a range of organizations in each state. In AP in an effort to coordinate these different organisations a State Water Management Committee has been formed with a remit covering policy and reforms, regulation and performance and convergence (Appendix A1.1). In a similar manner to the structure outlined in Section 4.2 the I&CAD Department provides technical support to the Water Management Committee. In Maharashtra a State Water Council (Appendix A1.2) has been convened under the Maharashtra Water Resources Regulatory Authority Act, 2005 to approve the Integrated State Water Plan submitted by the State Water Board.

For the management structure outlined in Section 4.2 to be adopted the following needs to happen:

- The concept of water resources management incorporating river basin planning and management needs to be accepted as the way forward for effective water resources management;
- Water resources management needs to be clearly separated from irrigation development and management;
- Senior personnel in the Irrigation Department need to accept the concept of separating water resources management from irrigation (and drainage) service delivery;
- A Water Resources Act needs to be promulgated (though movement towards the above structure, initially within the Irrigation/Water Resources Department may be possible for the short-term through government ordinances). This can incorporate elements of the Maharashtra Water Resources Regulatory Authority Act but will necessarily be broader in its remit and functions;
- The proposed Water Resources Department needs to be established and adequate numbers of staff employed and trained.

4.7. What kind of road-map can we propose for river basin planning in India given the dismal experience so far?

In the initial instance the essential river basin management functions can be carried out within the Irrigation Department. This can be achieved by creating three divisions within the ID: (i) water resources planning and management; (ii) irrigation system management and (iii) planning, design and construction of new schemes. A government ordinance would be required to facilitate this reorganisation, and to permit the Irrigation Department to employ suitable cadres of staff (water resource planners, hydrologists, geologists, hydrogeologists, etc.). At a later date (but not too much later) the new format WRD can be formally established under a state Water Resources Act and the ID staff in the water resources planning and management division moved across to form the core of the WRD and the remaining staff in the ID assigned to the renamed Irrigation Services Department.

State Water Councils can be established in a similar manner to those already established in Maharashtra and AP but with remits along the lines outlined above.

Once there is a functioning water resources planning and management unit within the existing ID then River Basin Councils can be formed and Basin Plans prepared.

4.8. Is it better to begin with sub-river basin planning?

As previously mentioned it is considered important to start at the sub-basin level with river basin planning and management for the following reasons:

- It brings decision-making closer to the key stakeholders on the ground (irrigation water users, municipalities, local industries, etc.);
- It is easier to set up and establish sub-river basin councils and consultative fora;
- Plans for sub-basins can be brought together to prepare plans for the whole basin;
- State governments are more likely to support localised in-state planning and management if this is based on in-state (sub-) basins.

5. Conclusions and proposals for reform

5.1. Conclusions

This working paper has outlined the water resources situation in individual states in India and provided information from a number of studies on water resources development and management in the country. It is clear that there is increasing pressure on available water resources, more so in some states than in others. The per capita availability of water is decreasing, and several river basins and sub-basins have reached or are close to their utilizable limit of water resources. Irrigation has been the dominant user of water resources over the last 100 years, but the limit for irrigation has been reached in some basins and sub-basins, whilst the demand for urban and industrial water is increasing dramatically. In water-scarce river basins water is being transferred from agriculture to the urban sector to satisfy drinking water needs. Increasing pressure is also being exerted by the industrial sector for increased access to water resources in order to grow businesses and support employment. In all the discussion the environmental needs are currently poorly supported, with the consequence that the quality of many rivers is declining markedly.

It is no longer possible to apply engineering measures alone to solve the growing water crisis. Far more attention needs to be paid to management, for which significant institutional reform is required. This paper has outlined in broad terms a possible institutional framework for water resources management in India. The framework is state-focussed incorporating river basin management principles and participatory processes.

The approach proposes the establishment of State Water Councils as the apex body in each state, made up of both governmental and non-governmental organisations and individuals. The Council would have a well-resourced executive body which would be responsible to the Council for surface and ground water resources management, including, *inter alia*, preparation of State water resources plans, permissions and authorisation for water use and wastewater discharge, and responsibility for protection of water resources. It is proposed that River Basin Councils are formed and linked in to the institutional and organisational framework for water resources management in the state. It is believed that such a structure satisfies the good governance criteria set out in the first part of the paper and ensures that the necessary water resources planning and management functions are executed in a professional, transparent and accountable manner. The approach also ensures that civil society, not only government departments, is engaged in the process.

5.2. Proposals for reforms

The following are the key elements of the proposals for reform:

- Acceptance by politicians and senior government personnel that for many river basins management rather than construction is the way forward;
- Water resources management to be state-focussed incorporating river basin management principles and practices;
- State governments to commit to the need for water resources management, and the need to separate water resources management from (mainly irrigation) water delivery;
- State governments to establish a State Water Council with responsibility for consultation and formation of water policy, supported by an adequately resourced professional water resources management department (the WRD);
- Water resources planning and management to be more participatory, with participation by non-governmental organisations and individuals in the State Water Council and on River Basin Councils;
- River Basin Councils (RBCs) to be formed in sub-basins and river catchments, with responsibility of preparing River Basin Plans, liaising and partnering with the WRD and RBCs in neighbouring states;
- State governments to prepare and enact new water resource planning and management legislation (Water Resources Act) to support the institutional structures required for a modern framework for water resources management;
- Under the Water Resources Act water abstraction and discharge of wastewater into water bodies to be licensed and regulated, with abstraction and discharge entitlements being provided for defined terms;
- Provision of adequate financial resources to establish a professional Water Resources Department, with funds for staffing, equipment and materials and, in the initial years, significant training and capacity building;
- Provision of adequate financial resources to restructure the Irrigation Department to form the Irrigation Services Department focussed on sustainable management, operation and maintenance and performance enhancement of existing irrigation systems.

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Appendix A1:Related national experience

A1.1 Institutional reforms for water management in Andhra Pradesh

The Government of Andhra Pradesh has set into motion reforms in its water resource management institutional setup. At present it is concentrated at the state and the community level in putting together a policy making and administrative structure in the government such as establishment of a Water Management Committee and restructuring of the Irrigation and Command Area Development Department and in strengthening the farmers' organizations like the Water Users Association, the Distributary Committee and Project Committees[87].

A1.1.1 Water Management Committee

Currently, several departments are engaged with water resources in the state, resulting in a fragmented approach towards water resources development. This leads to problems in planning and coordination. The convergence and coordination among the various departments and other water-user agencies is therefore essential. To facilitate this, the Government of Andhra Pradesh has established and notified a Water Management Committee for the State. It is the apex body at the State level competent to take decisions on policy and reforms, regulation and performance and convergence on water related issues. The functions of the Water Management Committee are:

1. Policy / Reforms

- Review implementation of the State Water Policy
- Setting guidelines for and review institutional reforms for efficient water resource management for the various water user departments
- Setting guidelines for research and analysis in water resource management for future policy formulations and reforms

2. Regulation and Performance

- Fixing rates for various water uses
- Setting guidelines for and review development of water management plans for the various water user departments
- Fixing norms for quality on water related infrastructure and services
- Setting norms for water quality and water pollution, especially related to industrial waste water
- Fixing norms and procedures for operation and maintenance of water resources infrastructure both by departments and user organizations
- Fix norms for apportionment of water tax and royalties collected by Irrigation Department to various agencies for O&M of irrigation systems
- Setting guidelines for and review conjunctive use of ground water and surface water in command areas
- Setting guidelines for and review managing water logging/salinity problems including salinity ingression
- Fixing norms for and review performance of the Technical Group

3. Convergence

- Setting guidelines and review harmonizing existing policies, executive orders and rules related to water resource management issued by different departments
- Setting guidelines and review harmonizing water management plans for the various water user departments

[87] Reforms related to Water Users Organization are discussed in another paper.

The Chief Secretary to the Government of Andhra Pradesh is the Chairperson of the Water Management Committee and the Principal Secretary, Irrigation & CAD Department is the Convener. The other members include Principal Secretaries of the Agriculture, Revenue, Industry, Rural Development, Municipal Administration and Energy Departments, other Secretaries of I&CAD Department, Engineer-in-Chiefs – Irrigation & Hydrology, CMD, AP GENCO, Engineer-in-Chief (IW) and Director, Ground Water Department. The CAD&WM Wing of the I&CAD Department provides technical support to the Water Management Committee.

The Water Management Committee has met on a number of occasions to take important policy decisions related to improving water resources management in the State including on establishing a Water Regulatory Commission in the state, restructuring of the I&CAD Department, water tax and royalty, operation and maintenance of irrigation projects and plough back of water tax to WUAs, etc.

A1.1.2 Irrigation and Command Area Development Department

The present I&CAD Department has been restructured to constitute of a Projects Wing, a Minor Irrigation Wing and a Command Area Development and Water Management Wing:

- The Projects Wing – creation of new major and medium irrigation potential through the existing setup of regional secretaries and engineering staff. Utilization of Water Resources Development Corporation as an SPV for professional management of the construction programme. It shall also be responsible for operationalizing the resettlement and rehabilitation policy of the state in coordination with other concerned departments
- The Minor Irrigation Wing – responsible for implementation of the state's strategy for development of minor irrigation, including promotion of livelihood based approach to poverty reduction and empowerment and participation of women, landless and other vulnerable and marginalized sections in irrigation management. Creation of new potential would continue with existing state unit setup whereas, the revival, restoration of existing water bodies will be through a SPV in accordance of national framework
- The CAD&WM Wing – for management of command area, management of farmers' organization, training and capacity building for PIM, research for policy and reforms, knowledge management and monitoring, MIS and GIS

Realization that the state is fast reaching the stage of completing water-development infrastructure for the dependable water and future expansion of irrigated areas would largely be possible only through water savings in the existing irrigation projects the emphasis is now shifting on to O&M of the system and infrastructure. Therefore, the I&CAD Department now requires expertise in addition to civil, mechanical, electrical and electronic engineering in institutional development, capacity building, irrigated agriculture, performance measurement etc. Moreover, as conditions for participation by the farmers in irrigation management has been created by completion of elections for all three tiers of farmer's organizations under the APFMIS Act, there is the need to put in place a system and process that would support and facilitate these organizations to become empowered and discharge the responsibilities as prescribed to them in the APFMIS Act. In view of the above, as a first step, the CAD & WM wing has being re-structured as follows:

- Water Use Efficiency, Water Audit and Benchmarking Unit
- Institutional Development and Capacity Building Unit
- Operation and Maintenance Unit

- Irrigated Agriculture Unit
- Geographical Information Management Unit

Each Unit has developed its own programme and strategy with clear deliverables that would be executed through annual action plans. All the Units converge at the Commissioner CAD level for strategic management. The units take up necessary operational research and studies to arrive at evidence based learning for strategy and policy development. Each unit has been provided staff with the requisite skill sets either by appropriately training department staff or by hiring experts from the market.

A1.1.3 State level Committee for Integrated Water Planning and Management

The Government of Andhra Pradesh has constituted the State level Committee for Integrated Water Planning and Management (SCIWAM) to function as the Technical Committee advising the Government and Commissioner, CAD on matters related to integrated water planning and management, including reviewing and improving water use efficiency covering all major and minor river basins in the state. Initially, SCIWAM is focusing on irrigation water primarily but progressively will expand its mandate to all water usage from the rivers in the state.

The chairman of the Committee is Engineer-in-Chief - I.W. The other members of the Committee are Engineer-in-Chief, Projects (I), Engineer-in-Chief, Projects (II), Chief Engineer, Inter State and Water Resources, Chief Engineer, CADA, Chief Engineer, GRIP Operation, APTRANSCO, Chief Engineer, (Projects) APGENCO, Representative from the office of the Commissioner, Agriculture and Chief Engineers of Concerned Projects. The Superintending Engineer, P&M Cell, Hyderabad is the Convener of the Committee.

The functions of the Committee are as follows:

1. To monitor the flows in Godavari, Krishna, Pennar, Vamsadhara and other rivers in the State and estimate availability of water in them on a seasonal basis
2. To review and approve the seasonal operational plans for supply of water to the various agencies involved in usage according to their allocations made by the Government and priorities set out in the State Water Policy prepared by the concerned Project Authorities
3. On a fortnightly basis to review and approve adjustments to the seasonal operational plans submitted by the concerned Project Authorities on the basis of monitoring of inflows and outflows into the major irrigation projects
4. Annually to review the performance of the seasonal operational plans and the efficiency in use of irrigation water and its agricultural opportunity costs on the basis of the Water Audit and Benchmarking analysis submitted by the concerned Project Authority of its irrigation project at the end of the cropping seasons and make recommendations for improvement
5. Annually to identify the irrigation staff showing exceptional performance and/or improvement so that the Government and Commissioner, CAD can recognize their services publicly as 'Sarvashrast Jal Probandhks'
6. To monitor the flood water flows in Godavari, Krishna, Pennar, Vamsadhara and other rivers in the State and plan steps to be taken for flood management during the floods, i.e., from June to November.
7. To advise the Government and Commissioner, CAD on drafting or guidelines / Standard Manuals including methodology, information requirement and source, data management system for decision support and staff capacity and deployment for
   - Monitoring of river flows and estimation of water availability
   - Preparation of seasonal operational plan for irrigation projects and its adjustment based on monitoring of inflows and outflows in the irrigation project

- Performance review of operation plan
- Measuring the efficiency of irrigation water use and its agricultural opportunity cost
- Monitoring and management of flood water flows during the flood season

8. To advice and make recommendations to the Government and Commissioner, CAD on the issue listed above for necessary action.

The Committee meets during the second fortnightly of June and October every year to finalize respectively the Kharif and Rabi operational plans for supply of water to the various agencies involved in usage. There after the committee meets at fortnightly intervals or as often as necessary to monitor the inflows and outflows in all the major irrigation projects and review and suggest any modifications to the operational plans. During very critical periods the committee day to day monitors the situation to regulate the daily operation of the concerned projects.

The SCIWAM Committee has started function from 2010 Kharif season and has been responsible for managing irrigation during the Kharif and Rabi season during the year 2010-11.

A1.1.4 Command Area Development Committee

Government of Andhra Pradesh has taken a number of steps for providing regular operation and maintenance budget to the farmers organization, their capacity building and assessing performance of the irrigation projects for improving the overall agricultural productivity in the State. A seasonal work book methodology is being implemented for regular evaluation of the previous season's performance and planning for the next season.

The project wise proposals for operation and maintenance as prepared by the farmers' organizations and engineers concerned are being received at Commissioner, CAD for Category A & B through the computerized Work Tracking System. Additionally, work proposals are sanctioned at respective Chief Engineer level for O&M works and deferred maintenance that should be covered under B Category. It is necessary that all these proposals are verified to ensure that the necessary operation and maintenance works and deferred maintenance works are taken up under Category A of tax re-plough and other plan and non plan grant normally classified as Category B.

A Quality Control process has also been established by the Government to monitor the quality of the O&M and deferred maintenance works executed.

To coordinate and monitor the O&M and deferred maintenance works GoAP has constitutes a Command Area Development Committee. The Committee consists of the Engineer-in-Chief – AW as the Chairman and has Chief Engineer, CDO, Chief Engineer, CADA, Engineer-in-Chief / Chief Engineer of concerned project as member. The Executive Engineer, CADA is the Convener or the Committee.

The functions of the Committee are:

1. To scrutinize the project wise plan and non plan budget availability; rationalize it as per the need of the project; review the operation and maintenance and deferred maintenance proposals received from the project; and approve the annual action plan of operation and maintenance and deferred maintenance for each project that would include works to be taken up under water tax re-plough, Category B and other plan and non plan grant with respective Head of the Departments.
2. To monitor periodically the quality control being carried out, ayacut being development, area transplanted, etc., of the irrigation project.

The Committee meets regularly to review the operation and maintenance budget expenditure to the performance of each project and the ayacut created and stabilized under new projects.

The Committee was established in early 2010 and has coordinated and monitored the O&M works during the year 2010-11.

A1.2 Institutional Reforms for Water Management in Maharashtra

A1.2.1 State Water Council

The Government of Maharashtra has notification under Section 15 of the Maharashtra Water Resources Regulatory Authority Act, 2005 constitution of a State Water Council with the following powers:

- Approving, with such modifications as deemed necessary, the draft of the Integrated State Water Plan submitted by the State Water Board within a period of six months from the date of submission of draft Integrated State Water Plan keeping in view the directives given by the Governor for removal of regional imbalance. The water plan so approved by the Council shall become "Integrated State Water Plan".
- The Council may review the Integrated State Water Plan after every five years from the date of its approval by it.

The State Water Council consists of the following members:

a. the Chief Minister - *ex officio* President
b. the Deputy Chief Minister - *ex officio* Vice President
c. the Minister, Water Resources - *ex officio* Vice President
d. the Minister, Water Resources (Krishna Valley and Kokan Irrigation Development Corporation) - *ex officio* Member
e. the Minister, Agriculture - *ex officio* Member
f. the Minister, Water Conservation - *ex officio* Member
g. the Minister, Water Supply - *ex officio* Member
h. the Minister, Finance and Planning - *ex officio* Member
i. the Minister, Urban Development - *ex officio* Member
j. the Minister, Industries - *ex officio* Member
k. the Minister, Environment - *ex officio* Member
l. the Minister (Representative for Marathwada region) - *ex officio* Member
m. the Minister (Representative for Vidarbha region) - *ex officio* Member
n. the Minister (Representative for Rest of Maharashtra) - *ex officio* Member
o. the State Minister, Water Resources - *ex officio* Department Member
p. the State Minister, Water Resources (Krishna Valley and Kokan Irrigation Development Corporation) - *ex officio* Member
q. the Secretary, Department Water Resources - ex officio Member
r. the Secretary, (Command Area Development Authority), Water Resources Department - *ex officio* Member Secretary

The members of the Council at serial numbers (l), (m) and (n) are nominated by the Chief Minister from among the Cabinet Ministers.

A1.2.2 State Water Board

The Government of Maharashtra has notification under Section 16 of the Maharashtra Water Resources Regulatory Authority Act, 2005 constitution of a State Water Board with the following powers:

- The Board shall prepare a draft Integrated State Water Plan on the basis of basin and sub-basin wise water plans prepared and submitted by the River Basin Agencies

- The Board shall submit its first draft Integrated State Water Plan to the Council for its approval within six months from the date on which this Act is made applicable in the State
- The Board shall, while preparing the draft Integrated State Water Plan, consider the directives of the State Water Policy

(2) The State Water Board shall consist of the following members:

(a) the Chief Secretary of the State - *ex officio* President
(b) the Principal Secretary, Planning Department - *ex officio* Member
(c) the Principal Secretary, Finance Department - *ex officio* Member
(d) the Secretary, Water Conservation Department - *ex officio* Member
(e) the Secretary, Water Supply Department - *ex officio* Member
(f) the Secretary, Urban Development Department - *ex officio* Member
(g) the Secretary, Energy and Environment Department - *ex officio* Member
(h) the Secretary, Water Resources Department (Command Area Development Authority) - *ex officio* Member
(i) the Secretary Agriculture Department - *ex officio* Member
(j) Divisional Commissioners of all Revenue Divisions in State - *ex officio* Member
(k) the Secretary, Water Resources Department - *ex officio* Member Secretary

Appendix A2:Related international experience

A2.1 Case Study 1: France – Water resources management and the Neste System[88]

In Southern France water resources are managed at four levels: the State, the large catchment, the large system and the individual level. The key roles and stakeholders at these different levels are summarized in Table A2.1 below.

Table A2.1 Key roles and stakeholders at different levels in water resources management in southern France

Level	***Key actors and roles***
State level	*According to the 1992 national Water Law it is not the State's responsibility to ensure the operational management of water resources, except for very large rivers. Its role is to ensure the regulation of water use, and to update the rules for water use and management. The State is also the owner of large hydraulic works for irrigation, but delegates their management to SARs (Regional Development Companies). The State thus supervises the maintenance and the best use of the physical assets for the benefit of society, and is responsible for regulation and law enforcement in relation to water resources. The key actors on behalf of the State are the Ministry of Environment, which is responsible for policing powers to enforce allocation and use rules (in terms of water quality and quantity), and the Ministry of Agriculture, which represents the State as the owner of the infrastructure, is responsible for monitoring the maintenance of the physical infrastructure by the concessionaire, the CACG (see below).*
Catchment level	*At the catchment level there is a Basin Committee (described as a "water parliament") where users, local authorities and government are represented. The Basin Committee is responsible for conserving and protecting the water environment, and setting water management policy. It develops, in collaboration with the State Administration, the long-term water policy plan. The executive body of the Basin Committee is the Water Agency, which is responsible for oversight of abstraction and pollution. The Water Agency fines those contravening the regulations, and also contributes to modernization and improvements in control to effect water savings. They do not have direct responsibility, however, for water management; this is the responsibility of the CACG.*
Large system level	*At the large system level water management is delegated to the Regional Development Companies (SARs). Their mission, held under concessionary title from the State, is the development and operation of the hydraulic projects and systems. They are responsible for the day-to day management of the water resources, for all uses. Their statutes are similar to those of private companies, applying principles of sound management and economic efficiency. There function is, however, wholly public, and the majority of their shareholders are public bodies, with agricultural users being represented on the Board. Through the SARs local authorities have control of the strategic resource for the public good, whilst stakeholders have a voice in the management of the water resource. The SARs are governed by their concession contracts and statutes for sustainable development and management of a public service, focused on:* ▪ *Quality and continuity of water service;* ▪ *Equity when water is to be shared between users;* ▪ *Sustainability with adequate provisions for long-tern maintenance of the assets;* ▪ *Transparency and accountability in the management and actions of the Board.* *Since the introduction of the SARs in the 1950's they have been very successful in balancing resources and needs through integrated water management, despite the relative scarcity of water in the region. As a result water shortages and conflicts amongst users are no longer a concern. In the initial stages SARs were well subsidised by the State, though now they cover their costs from the payments of their customers. These costs include adequate allowance for finance to cover the costs of maintaining and replacing the hydraulic assets that are the backbone of the enterprise.*
Small system level	*Small system level irrigators are gathered together in associations that owns and/or manages common assets and resources. These associations are based on a legal framework developed in the 19th century, which provides all the authority necessary to manage the irrigation system. The Authorized User Association's (ASAs) statutes are public and require them to act for the public good, particularly in regard to their accounting systems. Costs are shared in proportion to the involvement of each landowner, and is generally a function of their irrigated area. The ASAs are generally self-sustaining and self-reliant for financing, operating and maintaining the irrigation systems, though in some cases they take recourse to using the services of the SARs for design and/or maintenance contracts.*
Individual level	*Farmers are independent entities in the system looking to optimize the management of factors affecting production for their households. Key objectives include ensuring a minimum income level, maximising profits, minimizing risks, improving the quality and quantity of their products and ensuring the sustainability of the key resources of land and water. As the cost of water is generally high there is a need for high levels of performance and high value-added crops.*

[88] Source: Tardieu, Henri. 2005. Water management for irrigation and environment in a water-stressed basin in Southwest France. In Irrigation and River Basin Management: Options for Governance and Management, Ed. M. Svendsen, CABI Publishing, Wallingford, UK.

The Neste system is managed under a concession by the Compagnie d'Aménagement des Coteaux de Gascogne (CACG), of the above mentioned SARs. The characteristics of the system are set out briefly below:

Location

- *Located in the region bordered by Toulouse to the east, Agen on the north, Tarbes on the west and the Mediterranean to the south*
- *A 10,000 km^2 basin with 650 mm average annual rainfall*
- *Surface water is the only source of water for rural, urban and industrial users due to lack of a groundwater resource*

Water users

- *Fish, wildlife and tourism require some 250 million m^3/year to augment low flows*
- *13 million m^3/year are required by 200,000 inhabitants*
- *On average 70-95 million m^3/year is required by 3000 irrigators irrigating 51,000 ha*
- *A further 10,000 ha waiting list exists for irrigation contracts*

Water resources

- *The Neste Canal diverts 250 million m^3/year of the natural flow of the Neste river*
- *Some 100 million m^3/year are stored – 48 million m^3 in reservoirs with HEP and 52 million m^3 in lakes*
- *The river network managed totals some 1300 km*

Monitoring systems

- *Supply is monitored through remote control and monitoring equipment on 200 river flow meters, 40 dam and canal control gates and 150 pumping stations*
- *Demand is continuously monitored through 1500 individual water meters (which are checked 3-4 times per year), 6000 meters on collective networks and 150 pumping stations.*

As discussed above the CACG has the responsibility for management of the water resources and service delivery for irrigation and domestic and industrial water supply. Each user signs a contract with CACG guaranteeing that the abstraction is balanced by an equivalent upstream replenishment. The contract states a maximum diversion flow and a subscribed total volume of abstraction. The fee rate is in two parts:

- Part one is a function of the permitted flow (€50 per litre/sec.),
- Part II, *the over-consumption price*, is a function of the volume consumed above the quota (€0.10/m^3 above the quota of 4000 m^3)

If the authorized flow for one hectare is 1 l/s and the volume quota is 4000 m^3 then the user may take water at this rate at a price of €50 for a total of 1110 hours. If the user exceeds the volume quota then they must pay an additional fee at the rate of €0.10/m^3. Thus a reasonable minimum flow is guaranteed at a reasonable price (effectively €50/ha, or €0.012/m^3) but there is a significant step change in the unit price above this minimum (an almost eight-fold increase in the unit price of water). This has the desired effect of introducing economy, efficiency and productivity in water use amongst irrigation farmers.

The contract also stipulates the penalties for the user, such as for withdrawing water above the allocated flow rate or the lack of a water meter, and for the CACG in case it is forced to reduce the quota.

As demand exceeds supply a waiting list is prepared of those wanting to have a water supply. The allocation is decided by the Neste Commission, which involves all stakeholders from the five Départements. The Commission also meets before the irrigation season to determine the anticipated water availability for the season (based on the volume in the reservoirs). This is *especially important when the stored reserves are low. During the irrigation season the water meters are continuously monitored and if the quota is exceeded then a warning letter is sent to the irrigator.*

The management performance is assessed at the end of the season in terms of meeting or exceeding the environmental flows, the volumes subscribed to by irrigators and water savings made in the system. Since this management system was installed in 1990 failure to supply the required environmental flows has been rare, only 1-2 days/year over a limited reach, compared to drying up of long reaches of river before. This benefit has been gained by reducing the irrigation quotas 4 years in 10, and in 3 years out of 10 irrigators have not been permitted to exceed their quotas irrespective of extra payments. Since introducing the automated management systems there has been an estimated saving of 20% of the managed volume. There has also been a considerable reduction in the almost daily intervention required by the Prefect to control over-pumping from canals and improvement in the amount of fee recovery, particularly in relation to the fee element required to sustain the system's infrastructure (valued at some €540 million.

A2.2 Case Study 2: France – Society of the Canal de Provence

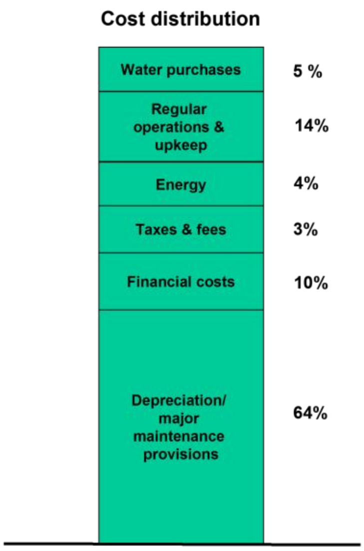
In southern France water resources, irrigation and drainage systems are managed by Regional Development Agencies (SARs). These agencies were established in the 1950s to develop and manage the scarce water resources, which were the major factor limiting agricultural development. One such Agency is the Society of the Canal of Provence (SCP).

The SCP was established the Ministry of Agriculture under a legal framework responsible for "*the creation and operation of the hydraulic infrastructure needed for the development of the Provençal Region*". The SCP was formed under a 75-year concession that included:

i) The construction and operation of storage reservoirs (3 reservoirs with storage capacity totalling 250 Mm^3)
ii) The construction and operation of primary and secondary canals and associated structures (main conveyor totalling 250 kms, 148 km of tunnels, 4000 km of pipes varying from 100 mm to 2000 mm diameter, 70 on-line storage reservoirs of capacity 100 m^3 to 3 Mm^3, 45,000 farm turnouts and many pumping stations)
iii) The operation and maintenance over the long-term of all infrastructure

Under the SCP a total volume of 660 Mm^3 at a maximum flow of 40 m^3/s is diverted and stored to supply some 60,000 ha, over 100 towns with a total of some 3 million inhabitants, and local industry.

The SCP was established as a private and public capital company in which the majority of the capital belongs to public entities. The legal framework requires the SCP to manage the water resources and infrastructure in the public interest: *continuity*, *equity*, *sustainability* and *transparency* are keywords which serve to ensure quality service provision and minimise costs.



The company is managed by an executive body responsible to the Board of Administrators. The Board of Administrators comprises representatives of the regional authorities, and representatives of agriculture and banks. The Board of Administrators is responsible for reporting and liaising with Government on matters associated with the management, operation and maintenance of the SCP. The accounts are audited by the Ministry of Finance.

The SCP was established to finance and build the hydraulic systems, with some subsidy from government (45%) and the remainder from commercial loans. The cost of construction, operation and maintenance is recovered from water users, with different tariff rates being applied to agricultural, domestic and industrial water users. The charge is divided into two parts:

- a system charge
- a consumption related charge

The system charge is a *fixed fee* which corresponds to the expenditure that has to be made in order to provide water to the customer, and a *variable fee* which covers the variable costs which are related to the volume of water consumed. Water delivered to towns or industries is measured and charged at 0.3 Euros/m^3 (0.36 US$/$m^3$) whilst irrigation water is measured and charged at about 0.08 Euros/m^3 (0.10 US$/$m^3$).

A key feature of the tariff system is that it covers the capital repayment, and sustainable O&M costs. For the O&M costs the Ministry of Agriculture has calculated the amounts required for corrective maintenance, preventative maintenance and provision for capital replacement. The capital replacement cost takes the form of an annual rate expressed as a percentage of the cost of canals and structures.

The SCP has been able to make considerable efficiency savings in water consumption over the years, reducing average water consumption from 15-30,000 m^3/ha to 3,000 m^3/ha. This has largely been achieved through computer-controlled canal flow regulation, and farmers modernizing their application systems from gravity supply to pressurised irrigation systems.

A2.3 Case 3: England and Wales – Environment Agency[89]

The Environment Agency (www.environment-agency.gov.uk) is the primary public body protecting and improving the environment in England and Wales. The Agency's role includes: flood protection; licensing water abstraction for irrigation; domestic water supply and industry; pollution control; amelioration of contaminated land; and creating an improved awareness of the natural environment.

The Environment Agency was created under the Environment Act in 1995 as a non-departmental public body (NDPB) vested with statutory, duties, responsibilities and powers. As a non-departmental body operating at arms length from government its management is give the freedom to exercise its statutory responsibilities within a clearly define framework. The operating budget for 2003/4 is some £805 (US$ 1,465) million, with some 73% coming from flood defence levies and other charging schemes (including licensing of water for irrigation). The remainder comes from Government in the form of grants. The Agency employs some 11,000 people.

The Environment Agency is a non-departmental public body (NDPB). Legally, the Board constitutes the Agency and is directly responsible to Government Ministers for all aspects of the Agency's organisation and performance. It is through Ministers that the Agency is accountable to Parliament. The Board consists of 15 Members including the Chairman and Chief Executive.

The Board Member for Wales is appointed by the National Assembly for Wales. The remaining Board Members are appointed by the Secretary of State for Environment, Food & Rural Affairs, except for the Chief Executive who is appointed by the Board with the approval

[89] Source: Environment Agency web site (www.environment-agency.gov.uk) and associated publications

of the Secretary of State. The Board members are non-political, and are appointed based on their experience and high standing in the community in relation to environmental issues. A former Chairman of the Board, Sir John Harman, was a Board Member for several years, prior to which he was a County Councillor and a director of several companies. A former Chief Executive, Barbara Young, had previously held posts as the Chairman of English Nature (1998 to 2000), Chief Executive of the Royal Society for the Protection of Birds (1991 to 1998) and Vice-Chairman of the BBC (1998 to 2000).

Ministers expect the Board to ensure that the Agency fulfils its statutory duties, in the light of the guidance and directions which they provide, and to ensure that the organisation operates with propriety, regularity, economy, efficiency and effectiveness. The Board meets six times per year - once in London, once in Bristol (where the Agency's Head Office is located) and four times in the English Regions and Wales.

The Board delegates the Agency's day-to-day management to its Chief Executive and staff. A team of eight directors is chaired by the Chief Executive. They oversee and co-ordinate the formulation of national policies for Environmental Strategy, Environmental Protection, Water Management, Operations, Finance, Legal Services, Personnel and Corporate Affairs activities. Each Agency region also has its own regional director.

In each region, three committees advise the Agency about the operational performance of its functions, regional issues of concerns and regional implications of national policy proposals. These committees are the Regional Fisheries, Ecology and Recreation Advisory Committee (RFERAC), Regional Flood Defence Committee (RFDC) and the Regional Environment Protection Advisory Committee (REPAC). There is also an advisory committee for Wales.

Regional committee members are appointed under statutory membership schemes designed to achieve representation from a wide range of the Agency's stakeholders. All REPAC meetings are advertised locally and the public is able to attend.

Over 70% of the Environment Agency's funding comes from charges or levies that they raise. When the Environment Agency sets its charges, statutory requirements and Government guidance must be considered. The Agency applies general principles that have been established to ensure that charges fairly reflect the costs of regulating an operator or providing a service. The Environment Agency receives directions through legislation and is given guidance by the Department for Environment, Food & Rural Affairs (Defra) and other Government departments on the way it manages its finances. The legislation specifies the Agency's duties and responsibilities and the activities for which it must recover its costs through charges. In setting these charges the Agency is governed by a number of principles:

Ring fencing: The Environment Act 1995 requires that income, derived from charges, may only be spent on the activities from which it is raised. The Financial Memorandum through which Defra supervises financial controls, also states that income, other than grant-in-aid, must be applied only to the function to which it relates. This means that charges relating to one type of permit cannot be used to cross subsidise the activities relating to another type of permit.

Relevant Costs: The Environment Act 1995 states that income recovered through charging schemes is that which: "*...taking one year with another, needs to be recovered to meet revenue and capital costs and expenses, which the Environment Agency incurs in carrying out its functions, as the Secretary of State (SoS) may consider appropriate to attribute to the carrying out of those functions in relation to activities to which environmental licences relate."*

This means that: deficits or surpluses incurred in any one financial year are offset during the following financial year; all costs and expenses associated with granting and monitoring of environmental licences must be recovered; income raised through charges must only be applied to the function to which it relates; and any changes to specification of costs deemed attributable to the Agency's functions must be approved by the Secretary of State.

Cost recovery: The recovery of all costs associated with granting and monitoring of environmental licences and maintenance of capital assets, including office charges, personnel and associated management costs, operation costs, maintenance costs, asset replacement costs.

Cost attribution: Costs are attributed to individual charging schemes (such as for licences for water abstraction for irrigation) in line with established principles to ensure that equitable charges are made.

Balances: Surplus income or deficit from a charging scheme is taken into account when annual charges are set for the subsequent financial year (i.e. non-profit making)

Cost reflectivity: Charges should be a fair reflection of the cost of regulation.

Water resources legislation in England and Wales

The law relating to water companies in England and Wales is contained principally in the **Water Industry Acts 1991 and 1999** and the **Water Act 2003**. Also relevant are the **Water Resources Act 1991** as amended and other national and European environmental legislation, particularly the **Water Framework Directive** 2000/60/EC, now being implemented.

Legislation for water in England and Wales dates from Victorian times, when Acts of Parliament were passed to give local authorities, statutory boards and companies the powers they needed to provide water and sewerage services to expanding centres of population. The scope of this legislation was increased and consolidated through both world wars but without fundamental change.

Then, in 1963, the **Water Resources Act** was passed. For the first time the abstraction and impounding of water resources became regulated on a regional basis.

The 1963 Act created 'River Authorities' with responsibility for enforcing the law relating to water resources, river pollution, land drainage, fisheries and water space recreation. This was the beginning of river basin management.

The administration of water law remained local until the **Water Act 1973**, which created ten regional water authorities whose areas were defined by river basins. These authorities had overall responsibility for water supply, sewage disposal and river basin management. They were, however, also required to work to some extent through the statutory water companies and the local authorities.

Privatisation of the ten water authorities' water supply and sewerage functions came with the **Water Act 1989** and with it transfer of the river functions to a newly created National Rivers Authority (NRA). The NRA was later to be subsumed within the Environment Agency (**Environment Act 1995**). Still, however, much of the substantive law remained unchanged.

Since 1989 water law in England and Wales has been consolidated and to some extent updated by the following Acts of Parliament:

The Water Industry Act 1991 as principally amended by the Water Industry Act 1999 and the Water Act 2003. This deals with such matters as:

- the appointment and economic regulation of water and sewerage companies, and licensed water suppliers, by the Water Services Regulation Authority (Ofwat);
- water supply and sewage disposal powers, and duties of the companies and suppliers;
- drinking water quality obligations of water companies and licensed water suppliers, and the enforcement of those obligations by Defra and the Drinking Water Inspectorate;
- charging powers of water companies and the control of charges by Ofwat;
- protection of customers and consumers by Ofwat and the Consumer Council for Water; and
- retail and common carriage competition.

The Water Resources Act 1991 as principally amended by the Water Act 2003. Among other things, this provides for the regulation by the Environment Agency of:

- water resource management, abstraction and impounding; and
- water quality standards and pollution control.

Water and sewerage companies have to take into account other national legislation and EC environmental directives as they relate to regulation by the Environment Agency of waste, land contamination, protected areas, air quality, flood defence, fisheries and water space amenity. The companies now also have regard to the qualitative and quantitative water standards imposed via ‘River Basin Management Plans’ under the **Water Framework Directive** 2000/60/EC.

National Water Resources Framework Study

Regulatory Framework

Working Paper No.7:

The Role of the Water Regulator in Water Resources Management

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Contents

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Questions raised

Questions raised by the Planning Commission with regard to the role of the water regulator in water resources management are as follows:

Role of regulator

- Should there be a regulator at a national level or a separate one in each State?
- What should be the functions of a regulator?
- What should be the human resource profile of a regulator?

Independence of regulator

- What should be the degree of independence of the regulator from government or rather what should be the precise nature of the relationship between regulator and government?

Case study: MWRRA

- What can be learnt from the experience of the MWRRA so far?

1 Introduction

In 2005, with the encouragement and support of the World Bank, Maharashtra adopted legislation for the establishment of a water regulator in the form of the Maharashtra Water Resources Regulatory Authority (MWRRA). Since then a number of other States have adopted similar legislation providing for the establishment of water regulators. This process has received support from the Centre: the adoption of legislation for the establishment of an 'independent water regulatory authority' is conditionality for the release of water sector grants in accordance with the recommendations of the Thirteenth Finance Commission.

After describing the Maharashtra legislation and the experience of the MWRRA so far (and briefly outlining the water resources regulator legislation of certain other States) this paper seeks to provide answers to the following specific questions: (a) what should be the functions of a water regulator?; (b) should there be a regulator at the national level or a separate one in each State?; (c) what should be the degree of independence of the regulator from government (or alternatively what should be the precise nature of the relationship between regulator and government)?; and (d) what should be the human resource profile of a regulator?

In fact, as will be seen, the discussion of question (a) on the functions of a water regulator implicitly raises the fundamental question: is the establishment of a water regulator actually necessary and/or useful at this time? The answers provided to the subsequent questions (b) to (d) are thus necessarily conditional on how the fundamental question is answered.

2 The MWRRA

The MWRRA was established in August 2005 following the adoption of the Maharashtra Water Resources Regulatory Authority Act (the 'MWRRA Act') and became operational in mid 2006. Its head office is located in Mumbai.

2.1 The tasks of the MWRRA

The tasks or functions of the MWRRA are set out in s. 11 of the MWRRA Act, the marginal note of which states 'Powers, functions and duties of Authority'.

Section 11 is, by any standards, rather lengthy. It sets out a long list of powers and functions over the course of 23 paragraphs and numerous sub-paragraphs. Section 11 is, unfortunately, also one of several examples in the MWRRA act of poor legislative drafting in that it not only describes the powers and functions of the MWRRA but also creates vitally important rules and principles fundamental to the proposed mechanisms for water management that are generally not described elsewhere in the act.[91]

The process of identifying the tasks of the MWRRA is further complicated by s. 12 of the MWRRA Act which imposes a long list of duties on the MWRRA under the heading 'General policies'. This list contains a mixture of what appear to be policy statements, in the form of desirable outcomes, together with substantive legal rules. Sections 11 and 12 of the MWRRA Act are reproduced at Appendix A1.

Nevertheless, notwithstanding the long list of tasks contained in s. 11, the principal activities of the MWRRA relate to: (i) tariff setting; (ii) entitlements; and (iii) project clearance.

[91] Given that these rules and principles create quasi property rights they should strictly speaking be specified in separate sections in some detail, rather than simply included among the tasks of the MWRRA.

Tariff setting

Tariff setting has to date been the main task of the MWRRA, with the first Tariff Order issued in 2010. It is important to note that the MWRRA focuses on the bulk water tariff meaning the tariff at which water is to be supplied to different users (industry, agriculture and domestic) as described in the Maharashtra Water Resources Regulatory Authority (Fixing Criteria for and Issuance of Tariff Orders for Bulk Water) Regulations, 2010, Section 2 – Definitions, paragraphs (e), (f) and (g):

> (e) 'Bulk Water' means any water supplied by flow or lift to Agricultural/ Domestic/Industrial Users from reservoirs/canal systems in the State constructed and operated by the Water Resources Department (WRD) or Irrigation Development Corporation (IDC) or made available to these users by WRD / IDC by flow or lift from regulated rivers and their tributaries flowing in the State or from natural bodies or lakes. It also includes supplies drawn by water utilities /entities/ for its /their own use from dams /storages constructed and operated by them or obtained for its / their own use by flow or lift from natural bodies or lakes through structures constructed and operated by them.
>
> (f) 'Bulk Water Tariff' means the tariff levied on bulk water users by the Water Resources Department on volumetric basis, as per the tariff order issued and in force on the date of levy.
>
> (g) 'Bulk Water Users' means Agricultural Users, Domestic Users and Industrial Users that are supplied Bulk Water.

The relevant statutory provisions are contained in paragraph (d) of s. 11 of the MWRRA Act which requires the MWRRA to:

> 11 (d) "to establish a water tariff system, and to fix the criteria for water charges at sub-basin, river basin and State level after ascertaining the views of the beneficiary public, based on the principle that water charges shall reflect the full recovery of the cost of irrigation management, administration, operation and maintenance of water resources projects[92]".

The meaning of this sentence is not entirely clear. Is the task of the MWRRA to establish the overall framework for tariff setting, including the criteria, and then to set the actual tariffs? Or to devise the system and criteria and then to refer the matter to the state government? In fact the MWRRA does both and draft criteria have been published on its website.

Paragraph (d) certainly contains some rather progressive thinking. It includes a requirement for public consultation, differential criteria at sub-basin, river basin and State levels and the requirement of full cost recovery for "irrigation management, administration, operation and maintenance". However the focus is very much on irrigation and irrigation systems constructed and managed by the Water Resources Department, it is not clear what responsibility the MWRRA has for full recovery of management, administration, operation and maintenance costs in the tariff setting for domestic and industrial users.

[92] This phrasing is a further example of the lack of distinction between irrigation and water resources projects (which in has a broader connotation and will include dams for domestic and industrial supply, hydropower, etc.).

Entitlements

The second main task of the MWRRA to date is the establishment of formal legal entitlements to water within irrigation/water supply schemes. The provisions in the MWRRA Act on entitlements are somewhat complex and not always entirely consistent.

The basic idea of creating formal legal entitlements to water is not wrong. It creates the basis for legal and financial accountability and certainty. Bulk water entitlements for irrigation can be issued by the River Basin Agency (on behalf of the MWRRA) to Water Users' Associations at the primary unit level, Distributory level and Canal or Project level. Water management entities, including Water Users' Associations, managing an aggregate of entitlements on behalf of a group of entitlement holders can be issued an Aggregate Bulk Entitlement. Individual Water Entitlements are not issued to individual water users except for individual lift irrigation schemes, bore-wells, tube-wells or other facilities for extraction of sub-surface water. Even though the entitlements only last for five years the Act also anticipates that they may be traded.

Project clearance

The third main task currently undertaken by the MWRRA is the clearance of new projects. This task is described in s. 11 (f). The main responsibility of the MWRRA in this respect is to ensure that proposals at the sub-basin and river basin level are in conformity with the Integrated State Water Plan and also with economic, hydrologic and environmental viability as well as the State's formal obligations with regard to inter-state rivers.

Other tasks

Apart from these three main tasks, the MWRRA is also charged with a long list of other functions including the administration and management of interstate water resources apportionment on river systems within Maharashtra (para. (c)), the promotion of efficient water use and minimisation of wastage... (para (q)), the establishment of various databases (paras. (s) and (t)) as well as any other powers and functions that may be prescribed (para (w)).

Some of these functions include the development of a range of somewhat important policies. These include setting down the criteria for the modification of Entitlements (para. (h)), fixing the criteria for trading water Entitlements of Quotas (para. (i)), establishing a regulatory system for the water resources of the state, including surface and ground waters (para. (n)) and to establish a system of enforcement, monitoring and measurement of Entitlements (para. (o)).

2.2 The structure and resources of the MWRRA

The MWRRA Act provides that the MWRRA is to be a legal entity with three members: a chairperson and two other members, one with expertise in water resources and the other with expertise of water resources economics. These are full time positions for a three-year term renewable once. All three members are appointed by a selection Committee headed by the Chief Secretary of the State.

As already noted the MWRRA is a new organisation. Apart from the three members who comprise the MWRRA, who are engaged for three-year terms, all of the other employees, of which there are currently 20, are engaged on short-term (six month) contracts. They are not government servants and do not enjoy pension rights. Staff turnover is high, and consequently the, as yet short, 'institutional memory' of the MWRRA is further limited.

At present the MWRRA is entirely dependent on the state government for financial support. Apparently sometimes payments have been delayed and salaries have gone unpaid. The MWRRA is in no position to stand up to government departments.

2.3 The performance of the MWRRA

The MWRRA is clearly still a rather new organisation that has started to become functional over the last couple of years. In a sense it is too early to assess the performance of the MWRRA against its own stated objectives. Clearly efforts are being made to implement the act. The MWRRA has not be idle and its achievements are described in the following paragraphs.

In terms of its specific tasks, the first tariff order was due to be issued in 2010 on the basis of an analysis of the tariff criteria mentioned above.

In terms of the allocation of entitlements, as at March 2010, out of 3,000 irrigation projects in Maharashtra, the MWRRA had only been able to issue entitlements in respect of 129 (under the auspices of a World Bank project). Given the short time since which the MWRRA has been functioning this seems an admirable achievement.[93] But it still leaves some 2,800 projects to go. Moreover, progress with the establishment of WUA Federations, notwithstanding some welcome success stories, is slow. So what happens in the meantime? And whether or not WUA federations are established, what happens if a WUA does not receive water in accordance with its Entitlement. What is the role the MWRRA in dispute resolution? What entitlement to compensation might a WUA have? What role would the WRD play in such dispute? Arguably an approach based on the conclusion of comprehensive bulk water supply contracts between the WRD and WUAs would offer the potential to create a more legally robust solution. Moreover the entitlements only last for five years which is probably too short a period for investment planning purposes and the water security of the entitlement holders.

In terms of project approval the idea of an independent approval mechanism for new projects is not bad. The problem though is what happens if there is a dispute. Who has the final say in practice, the WRD or the MWRRA? Disputes, one way or another, are inevitable and indeed the first litigation began in February 2010. In this case a group farmers challenged a unilateral decision of the Maharashtra Water Resources Department (WRD) to re-allocate water from agriculture to a power station notwithstanding that this would represent a modification of the cleared project.

Behind this case lies a bigger issue. On the one hand there is significant pressure from industry for more water. At the same time, in budgetary terms the main focus of the WRD is on construction, rather than maintenance or rehabilitation. How should the MWRRA fit into this picture? How can it second guess the plans and proposals of the WRD? How will it allow for growing demands in the different sectors over time? While there is no suggestion that undue political pressure is currently being placed on the MWRRA, the likelihood of political tensions is clear. The question then arises as to the extent to which the MWRRA can stand its ground as an independent water regulatory authority against the state government or the WRD.

[93] Notwithstanding the absence of formal transition provisions in the act providing for the phased introduction of the entitlement regime, the MWRRA has sensibly adopted a step by step approach. The phased introduction of reforms is a fundamental requirement of water legislation that seeks to promote serious reforms. Its absence in the MWRRA act is yet another example of poor drafting and design.

From both a drafting and public administration perspective, it seems somewhat inappropriate to confer such tasks on an un-elected body. Even if the MWRRA was a richly resourced organisation, which it is currently not, the sheer scale of the tasks given too it would be somewhat overwhelming.

2.4 Water regulators in other states

Water regulator legislation adopted by other States includes the Uttar Pradesh Water Management and Regulatory Commission Act of 2008 (the 'UP regulator act') and the Andhra Pradesh Water Resources Regulatory Commission Act of 2009 (the 'AP regulator act'). Other States have adopted or are in the process of adopting similar legislation. A comparison of the Maharashtra and AP regulatory acts is provided in Appendix A2.

Although clearly influenced by the MWRRA Act, the Uttar Pradesh and Andhra Pradesh legislation contains certain differences. As its name implies, for example, the UP regulator act provides for the establishment of a 'commission' rather than an 'authority'. Moreover this UP commission comprises five rather than three members. Nevertheless its tasks will be broadly similar to those of the MWRRA.

The AP regulator act also provides for the establishment of a 'commission' albeit one with three members (including the chairperson). However its tasks are significantly different to those of the MWRRA. In outline these are:

(i) to determine the water requirements of various categories of water use sectors including the requirements of individual WUAs based on approved cropping patterns;

(ii) to determine adequate operation and maintenance costs for water projects which the State is then bound to provide;

(iii) to promote the efficient use of irrigation water by various means; and

(iv) to promote the efficient use of water resources and the minimisation of wastage by fixing, and ensuring, the implementation of, 'water quality management standards relating to water resource management, service provision, waste water disposal, water resource protection etc.' as well as 'supporting and aiding the enhancement of water quality'.

3 What should be the functions of a water regulator?

Before examining what should be the functions of a water regulator, the first question, logically, is why is an independent water regulator necessary? To examine this question it is useful to consider international experience as well as experience in other sectors.

3.1 International experience

In terms of international practice the idea of a water <u>resources</u> regulator, as opposed to a water regulator, is rather unique. Water regulators are not un-common. They are generally found in the utility sector where private operators are involved. Private sector bulk water suppliers are extremely rare, if not largely non-existent[94]. Because water supply and sanitation services are a monopoly and because private operators will seek to maximise

[94] Nascent experiences in Morocco are often cited as an example of successful public private partnerships ('PPPs') in the irrigation sector. In fact these initial projects are really still in the experimental stage. First signs are apparently not entirely negative but it is far early to adjudge the Moroccan experience of irrigation sector PPPs a success.

profits a regulator is needed. Further information on the regulatory role in the water supply sector is provided in Appendix A3.

The United Kingdom's regulator, OFWAT (the Water Services Regulation Authority), which was established in connection with the privatisation of UK water companies in 1989 is a well known example of a water sector regulator.[95]

A key task of such types of regulator, which are almost exclusively established in the (private) water supply and sanitation sector, is to oversee the charges made by the service provider to the consumers. It is important to note that it is not the regulator that sets the tariffs, but the service provider. The basic task of the regulator is to ensure that tariffs levels enable the private operator to cover maintenance and investment costs[96] and also to make a profit, while at the same time ensuring that consumers can afford to purchase those services. At the same time the regulator seeks to ensure that the services provided are adequate for the needs of consumers (in terms of water quality, pressure, response times in the case of system failures and so on). In general the service provider submits a proposal to the regulator setting out the tariffs and how it is built up. The regulator checks the proposal and approves or makes alternative recommendations for the tariff level that should be set.

In cases where services, are provided by a state or municipally controlled entity the need for a regulatory body is less compelling. Regulatory bodies are not generally considered necessary in this context, partly because the entity does not seek to make a profit, but more so because they are politically accountable to the electorate.

Regulators are, of course, found in other utility sectors in other countries including electricity supply and telecoms but again this is only usually once the private sector are involved. In several countries in Eastern Europe and Central Asia (Georgia, Azerbaijan, Kyrgyzstan) with recent legislation establishing Water Users Associations a WUA Regulatory Authority has often been established due to the public interest nature of WUAs. The purpose of a Regulatory Authority in this context is to ensure the proper and lawful operation of the WUA and its physical and financial assets, and to ensure that the rights of the WUA members are being respected.

As regards both water resources management and irrigation/bulk water supply it is fair to say that the Maharashtra approach in creating a specific regulator is unique in global terms. This is not to suggest that water resources legislation in other countries does not provide for the setting of tariffs for the supply of bulk water through an irrigation/water supply scheme or even for the abstraction and use of 'raw' water from rivers and lakes. But a specific regulator is not needed for this with the relevant decisions usually being taken within government given that water is a public not a private resource.

3.2 Other regulatory commissions in India

Other regulatory commissions do of course exist in India such as the Central Electricity Regulatory Commission as well as the Telecoms Regulatory Authority. There is however a significant difference between those sectors and the irrigation sector, namely the possibility of competition within the sector as indicated in the mission statement of the Central Electricity Regulatory:

[95] Ofwat is specifically referred to as an example in an earlier World Bank water sector strategy.

[96] In the UK the government was keen to ensure, through the regulator, that the private water companies did not run down the assets ("asset stripping") through under-investment, leaving the customer (or government) to fund a major improvement programme at a later date.

> To promote competition, efficiency and economy in bulk power markets, improve the quality of supply, promote investments and advise government on the removal of institutional barriers to bridge the demand supply gap and thus foster the interests of consumers.

But while it may be possible to promote efficiency and economy in the irrigation/bulk water supply sector there is no question of competition. There are no private sector actors seeking to maximise their profits at the expense of consumers. This brings us to the next question….

3.3 What is the purpose of the water regulator?

In seeking an answer to this question, a good starting point is the report of the 13th Finance Commission, paragraph 12.38 of which provides as follows:

> Surface water irrigation is also in urgent need of policy correction. The problems here stem from poor maintenance of irrigation networks, poor recovery of user charges from farmers which then feeds back into poor maintenance, and overstaffed irrigation administration departments such that expenditure on irrigation does not deliver commensurate benefits in terms of services delivered. This then feeds back into poor collection compliance. The perverse incentive in the crop-specific rate structure has already been alluded to, in terms of encouraging cultivation of water-intensive crops in water scarce regions.

These observations seem to be correct. After all poor maintenance and low recovery rates are unfortunately a feature of the irrigation/bulk water supply sector in India (and other countries) resulting in a vicious circle of neglect, poor service delivery and poor levels of agricultural production. The reasoning in the following paragraph, though, is not so easy to follow:

> Thus, the third of our grant provisions is for the purpose of <u>incentivising states to establish an independent regulatory mechanism for the water sector and improved maintenance of irrigation networks[97].</u> With improved maintenance and delivery, simultaneous enhancement of recovery is necessary for an input which is publicly provided, but is excludable and rival, and therefore, amenable to user charges that cover (normatively assessed) maintenance. Since so many of the problems in this sector stem from lack of systematic attention by technically qualified people to the issue of the structure and level of user charges, the grant provision is conditional on setting up by states of an independent Water Regulatory Authority by 2011-12. The Maharashtra Water Resources Regulatory Authority set up in August 2005 serves as a possible model for consideration by other states. It is expected that an independent body of this kind would incentivize water user associations that would self-regulate the use of water among members and decentralize maintenance of water bodies, with funding locally recovered from users, so improving compliance with cost recovery.

In particular, it is not at all clear what the link is between improved recovery rate and system maintenance and the establishment of an independent regulator. In particular why should an improved tariff structure formulated by technically qualified people in itself lead to improved maintenance and service delivery let alone incentivized water user associations (WUAs)? The problem is significantly more complex than that.

The basic problems identified by the 13th Finance Commission are correct. Irrigation networks are poorly maintained and poor levels of user charges from farmers does feed back

[97] Underlining provided here for emphasis, not underlined in original report

into poor maintenance. However this is only part of the problem, other components include a lack of focus on service delivery by the irrigation department, very poor linkages between the fee paid and the service delivered, payment of water charges into the general exchequer rather than system specific accounts, lack of transparency and accountability to water users of how the water charges are spent.

From the foregoing it is apparent that states are being required by the 13th Finance Commission to establish Water Regulators as part of a process "to improve maintenance of irrigation networks". There is nothing mentioned about regulation of water resources and competition between water uses and users. A more appropriate title to satisfy the Commission's needs would have been to request the establishment of an Irrigation Services Regulator, rather than a Water Regulatory Authority[98].

An additional criticism of the MWRRA Act is that it does not give any indication as to the basis on which tariffs are to be set. As noted above, s. 11 of the MWRRA Act simply requires the MWRRA to 'to establish a water tariff system, and to fix the criteria for water charges at sub-basin, river basin and State level...'.

There is no reason why these issues should not be addressed in legislation. But in India in general and in Maharashtra in particular the current state level irrigation legislation is almost silent on this. Why not amend the irrigation legislation to address this issue? Why set up an independent regulator to do that?

But in any event leaving these points aside even if tariffs were set at the theoretically ideal level the problems would not go away. Instead it is necessary to look at the real reasons and the real reforms that are necessary at the state level. This can be grouped under three headings: (i) WUA legislation; (ii) irrigation legislation; and (iii) water resources legislation.

Water user association legislation

Many but not all States have also adopted WUA legislation in the form of specific WUA acts. Although there a few important differences, in terms of basic structure and overall approach, the WUA acts broadly follow the approach of the first WUA act adopted in India, the AP Farmer Management of Irrigation Systems Act, 1997. As such they acts provide for the establishment of a hierarchy of farmers' organisations or WUAs, whose members are farmers, up through a series of federations at distributary, canal and irrigation scheme level.

At a conceptual level the approach of the acts is heavily top-down. Even though WUAs are nominally democratic institutions broad and intrusive over-sight powers are conferred on the irrigation departments in general and on irrigation engineers in particular.

Moreover, the WUA acts are drafted in a complex manner and rely heavily on the use of subordinate legislation, in the form of rules adopted by the state governments. The legal framework is difficult for anyone, let alone farmers, to understand. The situation is exacerbated by the fact that WUAs do not have that their own individual charters. The effect is a 'one size fits' all legal framework that barely mentions farmers let alone their rights (imagine the Constitution of India without Part III on fundamental rights). The internal governance structures envisaged for WUAs are over simple, simplistic even, and unlikely to promote transparent governance while the provisions conferring regulatory oversight powers on the irrigation departments are grossly excessive: they are a license to interfere and second guess the decisions of WUAs.

[98] Again the Commission's oversight in this respect belies the often held perception that irrigation is water resources.

At a substantive level, the WUA acts do not empower WUAs to determine and collect their own fees[99] to cover their internal operational costs. Instead these are set by the State Governments, collected by State officials and then 'ploughed back' to the WUAs, a time consuming and bureaucratic process.

Although WUAs are a relatively new concept for India, globally they are not. WUAs have existed and proved themselves over many years in many countries around the world. The 'secret' of effective WUA establishment is accountability. WUAs work because they are directly accountable to their members. The current legal WUA framework in India prevents this. How can WUAs be accountable if they cannot even set and manage their own irrigation service fees?

Moreover in order to be accountable to their members WUAs need to hold substantive rights to be supplied with irrigation water and to use irrigation infrastructure. Although the Maharashtra and TN WUA acts do at least purport to grant such rights the relevant provisions are somewhat weak and open to interpretation. Elsewhere WUA acts ignore this issue. <u>Reading the existing WUA acts the question arises, do these acts seek to create organisations for farmers or are they a means for the irrigation departments to (try to) organise farmers?</u>

In short the current WUA legislation does not create an appropriate legal basis for WUA establishment and operation.

Irrigation legislation

The irrigation acts confer broad powers on the States, acting through their irrigation departments, to acquire land and water necessary to build irrigation schemes. The focus of the acts is almost entirely on the development and construction of new irrigation schemes. This focus is naturally reflected in the mandate, structure, budgets and ethos of the irrigation departments with their emphasis on design and construction using a top-down engineering approach that has probably not changed much since independence in terms of the broad and far reaching powers conferred on irrigation engineers. Indeed in a number of cases the legislation dates back to colonial times.

Provisions on the management, operation and maintenance (MOM) of existing schemes are largely absent as is any recognition of the role or even existence of water user associations notwithstanding the significant efforts made over recent years as regards water user association (WUA) formation.

The focus on the construction of new schemes was fully justified during the period when water resources and suitable land was there to be developed. It is far less so now that the majority of the available water resources and suitable land have been developed and the area commanded by built systems greatly exceeds any future potential new area. It is not clear why, in Maharashtra for example, some 20-30% of budget of total State budget is for the water sector (in general) out of which only 10-12% goes towards the MOM of existing irrigation systems.

In these circumstances the need for the substantive revision of the existing irrigation sector legislation is compelling. Creating a new and weak institution, the Water (Resources) Regulatory Authority, that is outside government and relies entirely on the goodwill and

[99]In fact the current charges are taxes, dating back to a time when irrigation water was taxed to recover the capital investment (construction) and the management, operation and maintenance (MOM) costs of the government run main system. There is currently no link between the MOM needs for each individual system (or part thereof , on-farm WUA managed or main system government managed) and the service fee required to cover these costs.

budget of the government to operate, to try and force a well-established and large government department such as the WRD to change direction simply cannot work. It may sound impressive and progressive, but of far more use to Maharashtra, and India for that matter would be a re-casting of the irrigation legislation to emphasise the issue of system management, operation and maintenance and to re-orientate the irrigation departments to act as service providers to the WUAs to whom they supply irrigation water. In this context irrigation service delivery by the irrigation departments has to be separated from the wider remit of water resources management for all uses and users, not just irrigation.

Water resources legislation

None of the states have comprehensive water resources legislation, meaning that the right to take water depends on a mixture of Indian common law and the rights of the irrigation departments under the irrigation acts to take and use water. In this context it has to be borne in mind that many of the irrigation acts were formulated at a time when irrigation was the dominant social, economic and political focus in the water resources sector, and at a time when supply was plentiful. Today irrigation is slipping down the priority order, being placed behind provision of supplies for domestic and industrial use. In addition there is increasing concern and attention being paid to protecting the quality of the water resources environment, placing further pressure on the planning, management and use of available water resources.

Legislation like the MWRRA Act and the establishment of water regulators like the MWRRA are not and cannot be the solution to the water resource management challenges currently faced by India.

It is true that the MWRRA Act foresees the involvement of the MWRRRA in the issuance of entitlements and the granting of project approvals. But the entitlements relate to the use of water within irrigation/bulk water supply schemes in other words after abstraction from a natural source. And at the same time a project approval is only an administrative approval it is not create a formal binding water allocation or water right.

3.4 Evaluating the need for a water regulator

The form of the questions asked by the Planning Commission at the start of this paper appear to assume that a regulator is necessary. However, from the afore going it is not clear that a water resources regulator is required, or what role such a regulator should play.

From the discussion related to the 13th Finance Commission there appears to be a degree of confusion as to the role and purpose of a regulatory authority. The Commission appears to consider it necessary to improve the maintenance of irrigation networks, and refers to the MWRRA which was established with a far wider remit.

In terms of tariff setting given that irrigation/bulk water supply is a government monopoly there is no legal reason why the criteria for tariff setting could not be specified in the irrigation legislation with tariffs being set by the irrigation department[100] or the State government. Failure to set a lawful tariff, i.e. in accordance with the matters stipulated in the act would be subject to judicial review. Is there really any need to set up an independent agency to do this, and anyway would it have the requisite knowledge and resources to correctly establish the tariff for each system?

[100]The tariff for each individual system could be relatively easily established by irrigation departments using established transparent and accountable processes such as asset management planning. This process establishes the tariff required to cover the costs of maintenance, operation and management for a given system in order to match the users' desired level of service and their ability to pay.

There might be a role for a regulator to oversee the setting of the tariff by the Irrigation Department, and the level of service provided to water users, but this would be an Irrigation Services Regulatory Authority, not a Water Resources Regulatory Authority.

But it is not only in terms of tariff setting that there is a large risk of conflict between water regulators and the irrigation department. Project clearances are another example of potential conflict between a regulator and the irrigation department. Surely project clearances should be the responsibility of the State Water Council (as constituted in the MWRRA Act), rather than an independent body? Project clearances are an essentially administrative instrument by government; they do not create legally binding water rights or water entitlements[101]. Moreover the MWRRA as a regulator is not the same as a water resources management administration or agency of the type found around the world to implement an integrated water resources management act.

In terms of the other main tasks of the MWRRA the idea of formal water entitlements is not bad as such. Water users need to have legal certainty and to be able to enforce their rights to water. However the system foreseen in the MWRRA act is extremely complex especially given that the entitlements only last for five years. But in any event water users do not simply need an entitlement in terms of a volume of water. Rather they require a service from the irrigation department in terms of the delivery of the volume of water at a specific time. The entitlement is only part of the picture. So why create a partial framework? Why not provide the complete package in a water supply contract that specifies details of both volume and service?

The MWRRA Act is, as noted, not a very well drafted item of legislation. Its shopping list approach to the functions of the MWRRA coupled with a large number of questions left un-resolved do not assist. It is also true that among the tasks of the MWRRA is listed: ‘establishing a regulatory system for the water resources of the state, including surface and ground waters’. But this is not serious. The legislators might as well have written: ‘hire a team of former IRS officers to resolve the water problems of the State’. That too simply cannot work.

In conclusion it is hard to argue that the case for a water resources regulator is fully made out.

4 Should there be a water regulator at the national level?

On the basis of the previous discussion there is no obvious reason why a national water resources regulator is necessary. Unlike the electricity and telecommunications sectors there is no national irrigation/bulk water supply market.

Leaving aside the constitutional settlement in terms of irrigation, it is clear that that sector takes place entirely at the State level. For this reason alone a national water regulator is neither necessary nor desirable. This is not, however, to suggest that a national level entity responsible for water resources management is not called for.

5 What should be the precise nature of the relationship between a water regulator and government?

Answering this question is a little tricky given the finding above that the need for water (resources) regulator is not entirely made out. Assuming, for the sake of argument, that a water regulator is necessary it will clearly need to be sufficiently independent to be able to fulfil its tasks. In particular such an entity will need to have a degree of financial autonomy,

[101] Unless the process of applying for, and receiving, a water right or entitlement is part of the process of formulation of the project.

perhaps funded through the tariff mechanism that it supervises, in order to be able to stand on its own metaphorical two feet[102].

However at the same time the democratic political process demands political accountability for the actions of entities that exercise powers on behalf of the state. This is where the problems arise in terms of the water regulator regulating the actions of, say, the irrigation department. A regulator with an advisory role, along the lines of the AP water regulator, is easier to conceive: its advice may be followed, or not. However, when a regulator is required to regulate decisions of the government the situation is more complex. So far, it must be said, in Maharashtra, there do not appear to have been any serious problems in terms of the relationship between the regulator and the irrigation department. But such problems cannot be ruled out.

The situation of the MWRRA needs to be distinguished from the more common role of a regulator, that of regulating private sector actors. In such cases the regulator is clearly acting on behalf of the state and the wider general public. There is thus far less likelihood of a direct clash between the views of the regulator and the ministry responsible for the sector in question. Of course the opportunities for disagreement cannot ruled out for legitimate (and illegitimate) reasons.

6 What should be the human resource profile of a water regulator?

The human resource profile of a water regulator evidently depends on the tasks it is to perform. As already noted the shopping list of tasks to be performed by the MWRRA suggests an extremely broad range of skill sets would be necessary of all are to be undertaken including water resources modellers, statisticians, water managers and so on. In terms of its core tasks tariff setting, entitlements and project clearances the basic skill sets necessary are economics, engineering and law.

7 Conclusions and proposals for reform

7.1 Conclusions

From the foregoing it is apparent that it is not clear what issues a water (resources) regulator is aimed at resolving. The 13th Finance Commission proposes "to establish an independent regulatory mechanism for the water sector and improve maintenance of irrigation networks". In contrast the MWRRA Act establishes a regulator with a wider remit to set tariffs and entitlements and clear projects, whilst the AP Regulatory Act focuses more on establishing irrigation water requirements, determining costs for O&M of irrigation/multi-purpose projects, setting technical standards, promoting service delivery and monitoring performance (benchmarking).

As has been argued in this paper there is no international precedence in the water resources sector for these roles being carried out by an independent regulator, and nor does it seem the logical and practical organisation to be carrying out these functions. Tariffs should be set by the service provider, albeit that there might be a role for a regulator in overseeing these tariffs. Entitlements should be carried out by a water resources management authority (such as the Environment Agency in the UK) which has the necessary technical capability, resources and data to assess the water resources available, overseen by a state water council

[102]This in particular relates to the (financial) ability to employ sufficient staff to perform the prescribed functions and tasks. The current MWRRA staffing levels and conditions are completely inadequate for the functions and tasks they are required to perform under the MWRRA Act.

made up of key stakeholders. Project clearance, by its nature contentious when water is scarce, is also a function of a state water council, not an independent water regulator.

Although the MWRRA Act contains a number of progressive features (such as addressing both surface and groundwater and providing for public consultation) and represents a bold attempt to resolve Maharashtra's water problems it is concluded that it is not the most appropriate solution to the issues currently being faced in the water resources and irrigation sectors.

Rather a reform of irrigation and WUA legislation is called for coupled with the introduction of new comprehensive water resources management acts. Other tasks currently undertaken by the MWRRA, in particular as regards the setting of entitlements and the grant of project approvals, address genuine issues but it is less clear that the MWRRA Act actually offers the most logical or appropriate solutions.

7.2 Proposals for reform

The findings of this paper on the role of a regulator in the water resources sector are linked to the analysis of water resources management detailed in Working Paper No. 6 – Water Resources Management. As discussed above the purpose and role of a regulator in the context of water resources management needs to be better understood. Rather than establish a water resources regulator the following proposals are made as an alternative framework for water resources management and regulation which, it is believed, will better cover the setting of water entitlements, tariffs and project clearance:

- Establish State Water Councils responsible for setting the water policy within each state and agreeing on future development options, proposals and projects;
- Create Water Resources Departments in each state, separate from the Irrigation (Services) Department, as the executive body of the State Water Councils;
- Create (sub) River Basin Councils to enable local stakeholders to participate in the preparation and implementation of comprehensive River Basin Plans;
- Enact state Water Resources Acts to create the above bodies and define their functions and structure. Within the Act create procedures for: integrated management of surface and groundwater resources; licensing of water allocations (water rights/entitlements), preparation of water resources management plans (covering floods and droughts); water resources data collection, processing and analysis; delineation of hydraulic boundaries (surface and groundwater);
- Update Irrigation Acts in each state to restructure the Irrigation Departments as service providers to water users, in particular to WUAs. Consider renaming the department the Irrigation Service Department. In the Act allow for changing the irrigation tax to an irrigation service fee set in collaboration with the WUAs to cover the full cost of the management, operation and maintenance (MOM) of individual systems, and define more modern methods of assessing the required service fee, such as the use of asset management planning;
- Update the WUA Acts in each state to facilitate irrigation management transfer and give WUAs more autonomy and more responsibilities, including the right to prepare their own charter, and the right to set, collect and utilise service fees to cover MOM costs;
- In the Water Resources Department establish a Regulatory Office with responsibility for monitoring the setting of service fees and the provision of services (including

performance assessment and monitoring) for the different water sectors - irrigation, domestic and industrial water supply, hydropower, etc. This office to report through the WRD to the State Water Council on the service fees set for individual systems and providers, and the related performance.

Appendix A1: Sections 11 and 12 of the MWRRA Act

11. The Authority shall exercise the following powers and perform the following functions, namely:

(a) to determine the distribution of Entitlements for various Categories of Use and the equitable distribution of Entitlements of water within each Category of Use on such terms and conditions as may be prescribed;
(b) to enforce the decision or orders issued under this Act;
(c) to determine the priority of equitable distribution of water available at the water resource project, sub-basin and river basin levels during periods of scarcity;
(d) to establish a water tariff system, and to fix the criteria for water charges at sub-basin, river basin and State level after ascertaining the views of the beneficiary public, based on the principle that the water charges shall reflect the full recovery of the cost of the irrigation management, administration, operation and maintenance of water resources project;
(e) to administer and manage interstate water resources apportionment on river systems, of the State;
(f) to review and clear water resources projects proposed at the sub- basin and river basin level to ensure that a proposal is in conformity with Integrated State Water Plan and also with regard to the economic, hydrologic and environmental viability and where relevant, on the State's obligations under Tribunals, Agreements, or Decrees involving interstate entitlements:

Provided that, while clearing the new water resources projects by the concerned for construction proposed by River Basin Agencies, the Authority shall ensure that Governor's Directives issued from time to time, relating to investment priority for removal of regional imbalance are strictly observed;

Provided further that, in respect of the projects situated in Maharashtra and Vidarbha Regions, the powers to accord administrative approval or revised administrative approval, under this clause, shall in accordance with the Governor's directives, be exercised by the concerned River Basin Agency.

(g) to lay down the criteria and monitor the issuance of Entitlements. These criteria among others shall also include the following,-

(i) The Entitlements shall be issued by River Basin Agency based on the Category of Use and subject to the priority assigned to such use under State Water Policy;

(ii) Bulk Water Entitlements shall be issued by the River Basin Agency for irrigation water supply, rural water supply, municipal water supply or industrial water supply to the relevant Water User Entities including Municipalities, Water User's Associations, Industrial Users and State agencies responsible for delivery to the respective sector or to a Sub-surface Water User's Association or entity that operates a well field of multiple sub-surface water tube wells, bore wells or other wells on behalf of multiple users;

(iii) Bulk Water Entitlements for irrigation, shall be issued by River Basin Agency, to the Water User's Associations at the primary unit level, Distributory level and Canal or Project level Associations and River Basin Agencies shall not receive Entitlements but shall act as conveyance entities for the Entitlements issued to the Water User's Associations;

(iv)Water User Entities including Water User's Associations, managing the aggregate of Entitlements on behalf of a group of Entitlement holders may be issued an Aggregate Bulk Entitlement;

(v) Individual Water Entitlements may be issued by River Basin Agency only for the construction and operation of individual lift irrigation schemes from surface water sources, bore-wells, tube wells or other facilities for extraction of sub-surface water. Such Entitlements shall be administered, registered measured and monitored by the respective River Basin Agency in close co-ordination with relevant Government agencies. Where such facilities extract water from alluvial aquifers that are conjunctive with the surface water of a basin, the issuance and operation of such Entitlements shall be conjunctively co-ordinated with the use and yield of surface water resources of the basin and shall be compatible with the overall water resource plan of the local area and the respective river basin and the sustainable use of the sub-surface water resources.

(vi) Bulk Water Entitlements shall be for a specific proportion of flow, storage or other determination of the annual yield of a water resources or facility and the Entitlement shall be measured volumetrically and with respect to time of delivery and flow rate of delivery;

(vii) The allocation of a percentage of the water available under the Entitlements of each facility, in the drainage basin or river basin shall be determined jointly by the River Basin Agencies and Water User Entities based upon the hydrology and other relevant parameters with regard to the specific basin. This allocation shall be utilised for the determination of the amount of water to be made available under each Entitlement for that specific year or runoff season;

(h) to lay down the criteria for modification in Entitlements for the diversion, storage and use of the surface and subsurface waters of the State. These criteria shall among others, include the following:-

(i) Aggregate Bulk Water Entitlements will be considered as Bulk Water Entitlements under the provisions of this Act except that they shall not be a usufructuary right and will only be adjusted by the Authority if there is a compensating change, under the provisions of this Act, to any component Bulk Water Entitlement that comprise part of the Aggregate Bulk Water Entitlement;

(ii) In the event that any Water User Entity wishes to use its category priority to mandate a change in the use or volume of any Entitlement, that entity must demonstrate in a public hearing before the Authority, that it has exhausted all attempts to conserve, increase efficiency and manage its demand of water within its, Entitlement and has exhausted all opportunities to increase its Entitlement through a transfer within the voluntary, market-based economy. If, after such a public hearing, the Authority deems such a mandated transfer, on either an annual or permanent basis, to be legal and necessary in the interest of the people of the State, the Authority shall then determine a fair and just compensation as determined by the market value of the water resource, to be paid to the Entitlement holder by the entity exercising the mandated user category preference;

(i) to fix the criteria for trading of water Entitlements or Quotas on the annual or seasonal basis by a water Entitlement holder. These criteria shall among others, include the following,-

(i) Entitlements, except Aggregate Bulk Water Entitlements, are deemed to be usufructuary rights which may be transferred, bartered, bought or sold on annual or seasonal, basis within a market system and as regulated and controlled by the Authority as established in the rules of the Authority;

(ii) Quotas of water determined by the seasonal or annual allocation assigned to an entitlement shall be volumetric usufructuary rights which may be transferred, bartered, bought or sold on an annual or seasonal basis within a market system as established and controlled by the rules of the Authority;

(iii) Bulk Water Entitlements or Quotas shall be transferable within the respective category of use as long as such transfers are compatible with the operation of the specific water resource facilities involved. Such annual transfers shall be managed and registered with the respective River Basin Agency which shall have the power to approve or deny such proposed transfers if they are incompatible with the operation of the facility or would damage the Entitlements or rights of other users within the system. The River Basin Agency may charge a nominal fee for the processing and registering such transfer but shall not participate in any compensation between Entitlement holders as a part of such transfer.

(j) Entitlements may be subject to review at intervals of not less than three years and then, only if warranted by concerns about, the sustainability of the level of allocation;

(k) Bulk Water Entitlements shall be registered by the River Basin Agency and shall be monitored by the Authority or its duly delegated competent representative;

(l) Permanent transfer of Entitlements shall only be made with the approval of the respective River Basin Agency and the Authority and in compliance with the rules of the Authority promulgated for this purpose. All approved transfers shall be entered into the registry of Entitlements of the Authority;

(m) in the event of water scarcity, the Authority, in compliance with its policy and rules for allocating such scarcity, shall adjust the quantities of water to be made available to all Entitlements and shall permit the temporary transfer of Water Entitlements between users and Categories of Users in accordance with the approval of the River Basin Agencies;

(n) to establish regulatory system for the water resources of the State, including surface and sub-surface waters, to regulate the use of these waters, apportion the Entitlement to the use of the water of the State between water using categories.;

(o) to establish a system of enforcement, monitoring and measurement of the Entitlements for the use of water that will ensure that the actual use of water, both in quantity and type of use are in compliance with the Entitlements as issued by the Authority;

(p) to administer the use and Entitlement of water resources within the State in a manner consistent with the State Water Policy to ensure the compliance of the obligation of State with regard to the apportionment of interstate waters between the State and other States;

(q) to promote efficient use of water and to minimize the wastage of water and to fix reasonable use criteria for each Category of Use;

(r) to determine and ensure that cross-subsidies between Categories of Use, if any, being given by the Government are totally offset by stable funding from such cross-subsidies or Government payments to assure that the sustainable operation and maintenance of the water management and delivery systems within the State are not jeopardised in any way;

(s) to develop the State Water Entitlement data base that shall clearly record all Entitlements issued for the use of water within the State, any transfers of Entitlements and a record of deliveries and uses made as a result of those Entitlements;
(t) to facilitate and ensure development, maintenance and dissemination of a comprehensive hydro-meteorological information data base in co-operation with the River Basin Agencies;
(u) the Authority shall review and revise, the water charges after every three years;
(v) The Authority may ensure that the Irrigation Status Report is published by the Government every year, such report shall contain all statistical data relating to irrigation including details in respect of district-wise irrigation potential created and its actual utilisation;
(w) Such other powers, function and duties as may be prescribed.

12. (1) The Authority shall work according to the framework of the State Water Policy.

(2) The Authority shall recognise the policy of empowering River Basin Agencies in accordance with the State Water Policy.
(3) The Authority shall, in accordance with the State Water Policy, co-ordinate with all relevant State agencies to implement a comprehensive hydro-meteorological data system for the State.
(4) The Authority shall, in accordance with State Water Policy, promote and implement sound water conservation and management practices throughout the State.
(5) The Authority shall support and aid the enhancement and preservation of water quality within the State in close coordination with the relevant State Agencies and in doing so the principle that ' the person who pollutes shall pay ' shall be follow.
(6) The Authority shall fix the Quota at basin level, sub-basin level or project level on the basis of the following principles :-

a. for equitable distribution of water in the command area of the project, every land holder in the command area shall be given Quota;
b. the Quota shall be fixed on the basis of the land in the command area:
Provided that, during the water scarcity period each landholder shall, as far as possible, be given Quota adequate to irrigate at least one acre of land;
c. in order to share the distress in the river basin of sub-basin equitably, the water stored in the reservoirs in the basin or sub- basin, as the case may be, shall be controlled by the end of October every year in such way that, the percentage of utilizable water, including kharif use, shall, for all reservoirs approximately be the same:
d. Subject to the condition of efficient use of water, the existing private sector lift irrigation management schemes shall be allowed to continue for a period of five years from the date of commencement of this Act and thereafter on the date that may be specified by the Government the provisions of sub-section (4) of section 14 shall apply :
Provided that, having regard to geographical conditions, different dates may be notified for different areas.
e. The Authority shall ensure that the principle of "tail to head " irrigation is implemented by the River Basin Agency.

(7) The Authority shall abide by the relevant provisions of the Maharashtra Ground Water Regulation (Drinking Water Purposes) Act, 1993.

(8) The Authority shall while framing policy, give preference to the projects so that, the physical backlog forming the basis of the financial backlog be eradicated in accordance with the Governor's directive.

(9) a. The Authority shall strive to make the water available to the drought prone areas of the State;

b. The Authority shall ensure that, the funds made available to a drought prone district are spent preferably in the areas, where irrigation facilities are less than the other areas of that district.

(10) Notwithstanding anything contained in this act, a person having more than two children shall be required to pay one and half times of the normal rates of water charges fixed under clause (d) of section 11 of this Act to get entitlement of water for the purpose of agriculture under this Act:

Provided that, a person having more than two children on the date of commencement of this Act, shall not be required to pay such one and half times water charges so long as the number of children he had on such date of commencement does not increase :

Provided further that, a child or more than one child born in a single delivery within the period of one year from such date of commencement shall not be taken into consideration for the purpose of this sub-section.

Explanation - For the purpose of this sub-section -

Where a couple has only one child on or after the date of such commencement, any number of children born out of a single subsequent delivery shall be deemed to be one entity; "child" does not include an adopted child or children.

Appendix A2: Summary of Salient Features of Andhra Pradesh and Maharashtra Water Regulator Acts

The difference between the Maharashtra state Water Regulatory Authority Act and the Andhra Pradesh Water Regulatory Commission Act is that the former primarily focuses on determining water entitlements and its trade and fixing water tariffs while the latter focuses on non-tariff regulations such as operation and maintenance, project performance, water quality and service delivery standards and its monitoring. The key features of the two Acts are compared in Table A2.1 below.

Table A2.1: Comparison of key features of the Maharashtra and Andhra Pradesh Water Regulator Acts

Sl. No.	Provision in Act	Andhra Pradesh	Maharashtra		
			Provision in Original Act (2005)	**Amendment made in April 2011**	**Remarks**
1	Equity	Ensure equitable distribution of irrigation water.	Determine the priority of equitable distribution of water available at the water resource project, sub-basin and river basin levels during periods of scarcity.		
2	Allocation/ Entitlement	Determine the water requirement for various categories of users (such as irrigation, municipal / rural drinking water / industry etc) on a yearly / seasonal basis. Determine the requirement of irrigation water for the various levels of Farmers Organizations (namely, Project Committee, Distributory Committee and Water User Association) based on the cropping pattern approved by the project authorities on a yearly / season basis and implement the same.	Determine the distribution of entitlements for various categories of use and the equitable distribution of entitlements of water within each category of use on such terms and conditions as may be prescribed. Lay down the criteria for modification in entitlements for the diversion, storage and use of the surface and subsurface waters of the State.	Sectoral allocation shall be determined by the State Government. The Regulator to determine the criteria for distribution of entitlements by the River Basin Agency.	Sectoral allocation such as agriculture, industrial and drinking is vested now with the State Government. The Regulator's powers to determine the entitlements has been modified to determining the criteria of entitlement only with the actual distribution of entitlements now vested with the River Basin Agency.
3	Trading of	Not covered.	Fix the criteria for trading of water		

Sl. No.	**Provision in Act**	**Andhra Pradesh**	**Maharashtra**		
			Provision in Original Act (2005)	**Amendment made in April 2011**	**Remarks**
	Entitlement		entitlements or quotas on an annual or seasonal basis.		
	Approval of New Projects	Not covered.	Review and clear water resources projects proposed at the sub-basin and river basin level		
4	Tariff / Cost of O&M	To determine the adequate operation and maintenance (O&M) cost of irrigation/multipurpose water projects. The State shall ensure provisions for full operation and maintenance requirements of such projects as determined by the Commission, through an appropriate budgetary support, to ensure that the quality of the service delivery is not allowed to suffer for want of systems' operation and maintenance needs.	Establish a water tariff system and fix the criteria for water charges at sub-basin, river basin and State level based on the principle that the water charges shall reflect the full recovery of the cost of the irrigation management, administration, operation and maintenance of water resources project.		
5	System Operation & Maintenance	Providing guidelines / procedures / modalities for plough back of operation & maintenance amount to the farmers' organizations for the operation and maintenance of the irrigation systems as well as standards of services.	Not covered.		
		Monitoring the technical standards for operation and maintenance, cyclical repairs and minimum	Not covered.		

Sl. No.	**Provision in Act**	**Andhra Pradesh**	**Maharashtra**		
			Provision in Original Act (2005)	**Amendment made in April 2011**	**Remarks**
		rehabilitation of irrigation system.			
		Promoting efficient management of irrigation water.	Not covered.		
6	Service Delivery	Fixing and monitoring implementation of stipulated quality standards for the services to be provided by various water resources service providers and recommend actions against violations.	Not covered.		
		Devise suitable mechanism for financial incentives / disincentives to the farmer's organizations and other water users for ensuring delivery of services to their members as per the determination.	Not covered.		
7	Quality Standards	Fixing and monitoring implementation of stipulated quality standards for management of water resources by various water users/departments and recommend actions against violations.	Not covered.		
		Fixing and monitoring implementation of stipulated quality standards for disposal of waste water by various water users and recommend actions against violations.	Not covered.		

Sl. No.	Provision in Act	Andhra Pradesh	Maharashtra		
			Provision in Original Act (2005)	**Amendment made in April 2011**	**Remarks**
		Fixing and monitoring implementation of stipulated standards for protection of all water resources in the State including pollution.	Not covered.		
8	Water Data / Audit / Bench-marking	Ensure publication of annual report on irrigation status containing all statistical data relating to irrigation including details of the project wise irrigation potential and its actual utilization, water user efficiency and productivity relating to the projects.	Facilitate and ensure development, maintenance and dissemination of a comprehensive hydro-meteorological information data base in co-operation with the River Basin Agencies.		
		Benchmarking of irrigation / multipurpose water projects to identify projects with best management practices for emulation by other projects.	Ensure publication by the government every year report containing all statistical data relating to irrigation including details in respect of district wise irrigation potential created and its actual utilization.		
		Water Audit of Irrigation / multipurpose water projects giving a systematic and scientific water account of the projects.	Not covered.		

Appendix A3: Understanding the role of the regulator in the water supply sector

In discussions over the role of regulators in the water sector a number of potential roles and activities for a regulator have been identified. The regulatory "regime" within a federal government structure will require regulatory functions being assigned to a constitutionally appropriate level of governance. This note aims to provide a succinct description of the sorts of activities that a regulator might carry out and in the context for this activity. The note is based on the role of the regulator in the water supply sector as regulators are more widely found in this sector as compared to the irrigation sector.

In India the access of water for all people and to meet all their needs for their healthy and good livelihoods is the overriding policy objective. There are many society needs for water and India is faces special challenges as the water needs of people in cities and towns starts to grow, and for those whose livelihoods depend on industrial or business employment and prosperity then the water needs of these industries are important. In addition farmers whose livelihoods depend on selling food to people living in the urban environment will depend on the prosperity of this urban and industrial sector in order to have a sustainable market for their produce. Everyone in society has a water need, and these needs are all interconnected. All people expect Government to set the conditions and policy actions that will ensure everyone's needs are met. This is the context for "regulation"; for regulation is part of the framework for providing a fair allocation of water to meet everyone's needs; it is about ensuring that if payments are to be made for water used by people that this is fair and equitable. Regulation is also about safeguarding the long term sustainability of water for ALL those that need water, and this includes the long term financial viability of organisations such as water utilities which provide infrastructure and services in cities, towns and villages.

The regulation of water and wastewater service refers to public sector control over utility service providers so that their conduct is channelled to achieve public sector objectives. Regulation can be seen, therefore, as the means of converting broad policy into effective service delivery. Without good regulation of service providers, the best of policies will fail to be implemented.

There are in the water supply area three types of regulator:

i) One that regulates a specific contract between a municipality and a private supplier (such as in a concession contract or even a management contract) and this regulator operates to supervise the contract and applies certain rules and standards when assessing prices for water supply and cost incurred by the operator;

ii) Second is a regulator, such as OFWAT in England or SISS in Chile that operates as a national organisation to oversee and adjudicate on the service fees proposed by the water utilities for water customers operating in a monopoly situation; and

iii) Third is a "softer" regulator which has no overt statutory powers but applies a regulatory pressure through various activities such as performance comparison, the provision of best practice advice and guidance and can work with water utilities to support their improvement in performance needed to meet the public policy goals in the sector. The Australian National Water Commission and the Water Services Association of Australia are examples of this latter form of regulation.

Table A3.1 shows where each type of regulatory activity is applied, and provides examples of where such regulation is carried out.

Table A3.1: Types of regulatory activity, level of application and international examples

Type of regulatory activity	**Level of governance**	**International example/reference**
Contract regulation between a private investor and supplier of water services – which covers both price setting, targets for service delivery and investment costs.	Municipal, but requires a high level of regulatory and sector expertise.	There are many examples of contracts between municipalities and private sector service providers and these contracts cover a range of different type of PPP relationships: e.g. provision of management services, concessions, infrastructure building, **Examples:** Manila Water, Philippines; Sofia Water, Bulgaria Many of the concession based contracts from the 1990s have ceased to exist because of disagreements between companies and governments over price determinations
Provision of benchmarking and performance comparisons – performance reporting.	National and can operate as "voluntary" scheme or an "obligatory" scheme. Essentially the system provides a peer review of performance aiming to provide peer pressure for improvement.	Many European countries operate a benchmarking system at national level with detailed regulation taking place at municipality level (where municipalities are the main owners of utilities). The schemes can be operated by water utility associations or by a national government commission. **Examples:** Denmark, The Netherlands, Australia, Germany, United States The main issue concerning these schemes relates to ensuring the quality and reliability of information
Centralised performance comparisons used in order to establish consumer price determinations at a national level	National level within a centralised state; involving a high degree of regulatory expertise, large volumes of data.	Takes place in very few countries where water utilities are not owned by municipalities, either singularly (France, Denmark, USA) or in aggregate form (Netherlands, Italy). **Examples:** Good examples of this highly centralised national regulation of private water and wastewater services are England and Wales, Chile, and of a public supplier, Scotland.
Provision of advisory services to support best practices that support water sector improvement	National level	Delivered by a national water commission such as the National Water Commission of Australia, but also by Associations of municipal water utilities – Netherlands, Denmark and Germany

With regard to the contract regulation between a private investor and supplier of water services it is now generally agreed that it is infeasible for most, if not all, long-term concession arrangements covering an entire water service system to function well for many years just on the basis of adjustment clauses that deal with specific events, such as changes in law. It would be very difficult – if not impossible – to devise mechanical adjustment formula (one incorporating price indexation and perhaps a price-cap-type 'X' factor) that could closely track changes in efficient costs for an entire water and wastewater system over ten or more years.

Even in the U.K. water sector, where the process of setting price caps has been in operation for over 15 years and the data is of a comparatively very high quality, this is arguably not feasible. It is therefore hard to avoid the conclusion that, for most water systems, a comprehensive price review of some kind will be needed to reset prices every few years, based on some notion (suitably defined) of what the company's costs 'should' be.

There is often great uncertainty about the condition of underground assets in the system of a water utility operator. It is extremely difficult to estimate needed improvements and their timing and to fix a realistic long-term base tariff level. The method for resetting a base tariff after better information is obtained will almost certainly involve principles relating to 'acceptable' or 'efficient' costs, or something similar, and these will often lead to thorny issues of definition and verification. Other types of initial uncertainty exacerbate these difficulties: for example, in some systems, the lack of metering (bulk meters and customer meters) can create uncertainty over the potential revenue base; and usually the lack of a good understanding of the breakdown of non-revenue water into technical losses and commercial losses presents a severe challenge to the planning of remedial actions. Uncertainty in relation to these aspects means that estimating future cost-recovery and revenue levels and the concomitant impact on tariffs cannot be carried out using precise rules alone. They will need to be supplemented by other mechanisms. But all of these problems involve largely (but not wholly) technical, as opposed to policy, questions,

In relation to benchmarking an performance comparisons in the late 1990s Bangalore's non-governmental Public Affairs Centre produced a scorecard for performance of the city's public services. The group's presentations are discussed in well-attended town hall meetings and followed up by the local media to pressure providers to improve services. The Public Affairs Centre took the initiative to extend its activities and benchmark the quality of basic services across 22 major states in India.

Consumer advocates and pressure groups can play a powerful role in mobilizing public opinion in response to published information. Independent analysis lends punch to the data by exposing poor performance public reporting makes service providers more accountable to the public and thus increases their motivation for improvement—to the benefit of the end user. Government and donor agencies can do more to encourage public performance reporting and to help guide the effective use of scarce resources. "Worst in the class" performance must not be seen as a route to additional resources but rather as a clear challenge to do better.

Related to this there are a number of national benchmarking initiatives in the water supply sector:

- Association of Dutch Water Companies (VEWIN) represents the Dutch drinking water sector. VEWIN, the Water Association of the Netherlands regularly undertakes benchmarking on behalf of its members utilities.
- Brazil National Information System for the Water and Sewerage Sector (SNIS) is the water utility performance system that includes most of water and sewerage utilities in Brazil managed by the Ministry of Cities.
- Canada National Water and Wastewater Benchmarking Initiative is a national benchmarking scheme and this website contains links to other contacts and information about benchmarking and best practice for water and wastewater utilities, representing approximately 50 percent of Canadian utilities with service population larger than 50,000 that serve 60 percent of the country's population.
- South African Association of Water Utilities (SAAWU) is a member based organization that launched a benchmarking project in April 2001. The main focus of the project was to develop a process that would enable participating organisations to

learn, share and compare information on their technical and functional operations, to improve their business performance and enhance the services they provide to municipalities.

National Water Resources Framework Study

Legal Framework

Working Paper No.8:

Perspectives on Legal Frameworks for Water Resources Management

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Contents

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Questions raised

The Planning Commission raised the following questions on the perspectives on legal framework for water resources management:

Legal reforms

- Does India need a national framework law for water resources akin e.g. to or different from the EU Water Framework Directive?
- Are there international legislations that could help India? South Africa, for instance, legally protecting basic requirements of domestic water and of the environment “reserve”?
- Does India need new groundwater legislation?
- Does India need a National Water Commission?

1 Introduction

The basic questions asked in this paper are: (a) does India need a national framework water law?; (b) does India need new groundwater legislation?; and (c) does India need a National Water Commission or similar central body? The short answer to all three questions is 'yes', albeit a yes that is subject to one or two potential caveats.

2 Existing legal framework

Pursuant to the Constitution, the Union and the States enjoy legislative competence over aspects of water resource management. In outline the Union has the right to legislate on the regulation and development of inter-State rivers while the States have competence to legislate other aspects of water management and use. Consequently the legal framework for water resources management comprises both Union (National) and State legislation.

2.1 National Legislation

To date three principal items of national water legislation have been adopted.

2.2 River Boards Act, 1956

The River Boards Act of 1956 provides for the establishment of River Boards by the Central Government on its own initiative or at the request of relevant State Governments. The functions of such boards are largely advisory, although the act also provides for the boards to prepare schemes for the regulation or development of inter-state rivers or river valleys.

Much of the act is concerned with the practical aspects of the operation of such boards (regarding such matters for example as the appointment of board members, their conditions of service, the holding of meetings etc). To date the act remains unimplemented: no river board has been established.

2.3 Inter-State River Water Disputes Act, 1956

The Inter-State River Water Disputes Act, which was adopted in 1956 (and subsequently amended), provides for the constitution of Water Disputes Tribunals to adjudicate 'water disputes' between States.

Each tribunal comprises a Chairman and two other members who are nominated by the Chief Justice of India from among persons who are judges of the Supreme Court or a High Court. The Central Government may adopt schemes for the implementation of decisions of the Tribunal which may *inter alia* provide for the establishment of an authority for the implementation of a decision of the Tribunal.

2.3.1 Water (Prevention and Control of Pollution) Act, 1974

Although the fouling of water has been punishable under the Indian Penal Code since 1873, the Water (Prevention and Control of Pollution) Act of 1974 (the 'water pollution act') is regarded as the first legal measure for water pollution control.[104] In outline the act provides for the establishment of a central Pollution Control Board (PCB) as well as state level pollution control boards, which exercise specific powers with regard to the prevention and control of water pollution.

[104] Tyagi, P.T. 'Water Pollution and Contamination' in Iyer at page 335.

Such boards have been established in each State and also undertake environmental functions on the basis of other legislation such as the Air (Prevention and Control of Pollution) Act of 1981, the sister act to the water pollution act, as well as the Environment (Protection) Act, 1986. The main regulatory control foreseen by the water pollution act is a discharge permitting system, which is based on nationally applicable effluent concentration standards.

In addition, the Water (Prevention and Control of Pollution) Cess Act of 1974 provides for the levy of a cess on the water drawn for consumption by municipal bodies and industry not by the quantity of wastes discharged by them. The pollution potential is reflected in the applicable rate of cess. There is an apparent conflict of interest as the rate of cess may contribute up to 50% of a State PCB's income.

2.4 State legislation

No State has adopted comprehensive water resources legislation. Instead the States have adopted laws that address different aspects of water use.

2.4.1 Irrigation legislation

In terms of irrigation legislation many, but not all States have irrigation acts in place (Tamil Nadu (TN) does not for example). In some States this legislation is rather old (in Uttar Pradesh (UP) the Northern India Canal and Drainage Act of 1873 still applies while in Madhya Pradesh (MP) the Irrigation Act dates back to 1931) while elsewhere more recent irrigation acts have been adopted: Maharashtra's Irrigation Act was adopted in 1976. Nevertheless whatever their vintage (and the older acts have of course been amended from time to time) the basic approach of the irrigation acts is somewhat similar.

The irrigation acts confer broad powers on the States, acting through their irrigation departments, to acquire land and water necessary to build irrigation schemes. The focus of the acts is almost entirely on the development and construction of new irrigation schemes. This focus is naturally reflected in the mandate, structure, budgets and ethos of the irrigation departments with their emphasis on design and construction using a top-down engineering approach that has probably not changed much since independence in terms of the broad and far reaching powers conferred on irrigation engineers.

Provisions on the management, operation and maintenance of existing schemes are largely absent as is any recognition of the role or even existence of water user associations notwithstanding the significant efforts made over recent years as regards water user association (WUA) formation.

In addition States tend to have legislation in place on a range of financial issues relating to payments relating to irrigation (and sometimes drainage) such as the TN Irrigation Cess Act, 1865 and the AP Water Tax Act 1988. The names of these instruments are instructive in recalling the relationship between revenue generation and irrigation.

Finally a number of States have adopted legislation on development corporations that may be state wide or focused on specific river basins.

2.4.2 WUA legislation

Many but not all States have also adopted WUA legislation in the form of specific WUA acts. Although there a few important differences, in terms of basic structure and overall approach, the WUA acts broadly follow the approach of the first WUA act adopted in India, the AP Farmer Management of Irrigation Systems Act, 1997. As such they acts provide for the establishment of a hierarchy of farmers' organisations or WUAs, whose members are farmers, up through a series of federations at distributary, canal and irrigation scheme level.

At a conceptual level the approach of the acts is rather top-down. Even though WUAs are nominally democratic institutions broad and intrusive over-sight powers are conferred on the irrigation departments in general and on irrigation engineers in particular.

Moreover, the WUA acts are drafted in a complex manner and rely heavily on the use of subordinate legislation, in the form of rules adopted by the state governments. The legal framework is difficult for anyone, let alone farmers, to understand. The situation is exacerbated by the fact that WUAs do not have that their own individual charters. The effect is a 'one size fits' all legal framework that barely mentions farmers let alone their rights (imagine the Constitution of India without Part III on fundamental rights). The internal governance structures envisaged for WUAs are over simple, simplistic even, and unlikely to promote transparent governance while the provisions conferring regulatory oversight powers on the irrigation departments are grossly excessive: they are a license to interfere and second guess the decisions of WUAs.

At a substantive level, the WUA acts do not empower WUAs to determine and collect their own fees to cover their internal operational costs. Instead these are set by the State Governments, collected by State officials and then 'ploughed back' to the WUAs, a time consuming and bureaucratic process.

Although WUAs are a relatively new concept for India, globally they are not. WUAs have existed and proved themselves over many years in many countries around the world. The 'secret' if effective WUA establishment is accountability. WUAs work because they are directly accountable to their members. The legal current legal WUA framework in India prevents this. How can WUAs be accountable if they cannot even set and manage their own irrigation fees.

Moreover in order to be accountable to their members WUAs need to hold substantive rights to be supplied with irrigation water and to use irrigation infrastructure. Although the Maharashtra and TN WUA acts do at least purport to grant such rights the relevant provisions are somewhat weak and open to interpretation. Elsewhere WUA acts ignore this issue. Reading the existing WUA acts the question arises, do they seek to create organisations for farmers or a means for the irrigation departments to organise farmers?

2.4.3 Groundwater legislation

A number of States have adopted groundwater legislation or are in the process of doing so. This topic is considered in more detail below in the Section on groundwater.

2.4.4 Water regulator legislation

A number of States have adopted or are in the process of adopting legislation for the establishment of independent water regulatory commissions based on the model of the Maharashtra Water Resources Regulatory Authority (MWRRA). The MWRRA was established in August 2005 following the adoption of the Maharashtra Water Resources Regulatory Authority Act (the 'MWRRA Act'). The main tasks of the MWRRA are tariff setting, the allocation of entitlements and the issue of project clearances. A fuller description of the MWRRA is contained in Working Paper No. 7 'The role of the water regulator in water resources management'.

2.4.5 Other water legislation

Several states have adopted legislation that relates aspects of water use and management. These include the AP Water Lands and Trees Act 2002 (WALTA) and the Tamil Nadu Tanks Act. While these instruments address aspects of water management and recognise certain important linkages their scope remains rather specific.

3 Does India need a national framework law for water resources?

3.1 Conceptualising water resources legislation

At the conceptual level it is first important to emphasize that the focus of water resources legislation is on water in the natural state, water as a natural resource before it is abstracted or diverted into irrigation schemes or water supply networks or impounded behind dams.

Second water resources legislation is concerned with the regulation of human activities that impact on water resources and/or that are (or should) be undertaken in response to natural variations in water resources. Obviously the law cannot be used to control natural phenomena.

The two basic issues that water resources legislation must address are water quantity and water quality. These two issues are intimately linked.

3.1.1 Water quantity

In terms of water quantity the primary focus of water resources legislation is the human impacts on water resources as a result primarily of the impoundment and abstraction of water (and thus its removal from the natural hydraulic cycle).

Water resources are finite. In historical times with smaller populations and abundant water resources the need to manage demand was clearly less. Simple common law rules (such as the riparian doctrine or the right of capture in the case of groundwater) were sufficient to regulate the abstraction and use of water. Supply-side measures, the development of infrastructure in the form of dams and irrigation schemes could make more water available for use.

However there are limits to supply-side measures. In India and around the world a steadily increasing number of river basins are 'closed'. All available water resources have been allocated for one use or another. There are simply no additional resources that can be exploited. The city of Chennai provides a good example: there are no additional resources available. With the impacts of climate change, economic and population growth the demand for water is only going to increase.

If additional supplies cannot be developed it becomes increasingly necessary to regulate demand in order to protect existing uses of water and as necessary to allocate or re-allocate water to new uses. In order to be effective such entitlements and allocations need to be legally binding. The process of allocating or re-allocating water among different economic sectors is by no means an easy process. Historically in

India, as elsewhere in the world, agriculture has been the main water use sector. Increased demand for water from growing megacities and from industry is beginning to change things as water use moves from relatively low value agricultural uses to meet higher value industrial and urban needs. This kind of *de facto* demand management is already happening in India as elsewhere in the world. The challenge is to ensure that demand management is introduced in a fair and rational manner. After all, apart from the need to secure rural livelihoods, which may be dependent on irrigated agriculture, the growing urban populations also need access to affordable food supplies.

Other aspects of water quantity increasingly addressed in water resource legislation, are drought and flood management.

3.1.2 Water quality

The threats to water quality are almost entirely a result of human activity, in particular pollution from industry and urban settlements. Water quality and water quantity issues are intimately linked for the simple reason that the ability of a given water body, of a given river reach, to receive and absorb pollutants without harmful consequences is obviously linked to the quantity of water in that body or reach.

If there is no water or very little water then what remains in the river or river bed is pure pollution. At the same time for a range of ecological reasons, beyond the issue of absorptive capacity, it is necessary to maintain a minimum flow. Trying to regulate water quality without taking account of water quantity issues is a recipe for disaster. At the same time the degree to which a river or water body is polluted will impact the volume of water available for human use.

3.2 International practice and experience in terms of water resources legislation

In assessing India's current water legislation it is useful to take account of international practice and experience. Some care, as always, is needed. Just as every country is unique, so is its relationship to its water resources and thus its water legislation. There is obviously no universally applicable magic formula for water resources legislation and indeed some of the examples of international practice that are endlessly mentioned (such as tradable water rights in Australia, Chile and the Western United States or the EU Water Framework Directive) are rather context specific. They may be interesting as examples and they may or may not contain value lessons for India but in any event the entire context must be understood.

Having said that, however, there is a clear global trend towards comprehensive water legislation, in the form of water resources acts or water laws that address both water quality and water quantity issues. Such legislation recognises the fact that water is a single resource and should be managed and regulated accordingly. This does not mean that the adoption of integrated water resources laws is a panacea. It is not: every law applies in a particular socio-economic context and in any case needs to be correctly implemented if it is to have the intended effect. Nor does it mean that every country has a comprehensive water resources act in place. China and the United States do not for example (however the experiences of both of those countries also offer valuable lessons for India). Nevertheless there is a clear observable trend around the world in favour of comprehensive water resources legislation.

Equally it is possible to identify a number of common features pertaining to modern water resources legislation in terms of: (i) governance mechanisms; (ii) planning mechanisms; (iii) water allocations/rights; (iv) pollution; (v) drought; and (vi) flood management.

3.2.1 Governance mechanisms

Modern water legislation typically contains detailed provisions on specific governance mechanisms for water management. This is because with increased water challenges, water resources management is increasingly a matter of process rather than a mere set of legal rules. Water resources contain legal rules of course but these legal rules increasingly also address basic governance issues such as how decisions are to be made regarding water resources management, by whom and following what process.

Such mechanisms may include formal high level inter-ministerial bodies to ensure that different sector interests are taken into account in decision making, as well as river basin based discussion and decision-making *fora*, such as river basin councils.

Increasingly river basin councils or their equivalent include representatives from other non-government stakeholders, in particular, water users and NGOs. This is important not only in terms of promoting better decision-making but also because such councils are increasingly called upon to make extremely difficult decisions regarding the allocation of water among different water user sectors (e.g. agriculture, drinking water supply, industry, power generation, the environment etc). Such decisions are more likely to be politically acceptable and thus more likely to be effectively implemented, if those impacted by them are involved in the decision-making process. There is also a trend towards a formal separation of water resources management and water resources use in terms of agency responsibility.

3.2.2 Water resource management planning mechanisms

Because water itself is a dynamic resource and because demand for water varies over space and time, water resources management is increasingly dependent on planning at the basin or sub-basin scale.

Modern water legislation typically specifies the minimum content of such plans, specifies how they are to be developed, usually in a participatory manner, and specifies their formal relationship with the decision-making process in terms of water management. Such plans are typically adopted by river basin councils or endorsed by them for adoption at a higher level (e.g. by Government).

Such plans have legal impact because decision makers are required to give effect to them in the discharge of statutory functions. A key issue assessed in water resources management plans is the allocation of water between different sectors (water supply, agriculture, industry, hydropower etc.) and the priorities for this.

3.2.3 Water allocation/rights

As already noted, growing competition for water means it becomes increasingly important to make allocations to different water use sectors as well as to individual water users. In terms of sector needs, as already noted, water resource management plans are typically used to allocate water for use by different sectors (e.g. agriculture, including water supply, industry, power generation, environment etc.).

In cases where private actors, such as companies (whether state-owned or not) need large quantities of water, the introduction of a system of water rights becomes important so as to ensure the rational use of resources as well as to safeguard investments. In its simplest conception a water right is a legal right to abstract and use a quantity of water from a natural source such as a river, stream or aquifer.

Modern water rights are typically created on the basis of an instrument such as a permit, licence or consent. Critically they specify the quantity of water. In the case of a regulated water source, water rights may specify a particular volume of water. In the case of unregulated water sources water rights are typically expressed as a share of the flow.[105] From the perspective of society water rights offer the means of making a secure and rational allocation of water among different water users and water use sectors. From the perspective of rights holders they offer legal security thus encouraging investment in the use of water.

Of long term duration (typically 10-15 years, possibly longer for major investments) an important point to note about modern water rights is that they can be seen as a form of property or quasi property right. They are use rather than ownership rights and (in a manner similar to land tenure rights) the water to which they are subject cannot be re-allocated to other users except on public interest grounds and subject to the payment of compensation (or the provision of water from an alternative source). As modern water rights are legal rights they can be enforced by the courts both against other water users and the state. The key reason why a modern water rights regime is effective is because it is somewhat self-policing as all water rights holders have an interest in protecting their individual rights. Once a new water rights regime has been put in place, use of water without a water right in circumstances where this is required is an offence. Invariably, though, legislation recognises the existence of a number of ‘free’ uses of water, such as for the basic human needs, cattle watering etc, in respect of which a formal water rights is un-necessary.

Modern water rights are typically subject to a number of conditions, both general conditions and specific to the use type or the basin in which water is used. Such conditions may include requirements to record and report water use. Breach of conditions may lead to the suspension or in extreme cases the loss of the water right which typically may also be lost if the water which is subject to it is not used for a specified period (e.g. three years). Water rights are typically recorded in a formal (legal) register with individual rights holders also holding a certificate or pass book that evidences their right.

In addition a range of other activities involving water and water courses are generally regulated either as part of a water rights regime, or at least in close co-ordination with it. These include: (a) the diversion, restriction or alteration of the flow of water within a water course; (b) the alteration of the bed, banks or characteristics of a water course, as well as the extraction of sand and gravel; (c) navigation; and (d) the discharge of waste water and pollutants.

In order to be effective it is important that water rights regimes are universal in scope, applying to state and not-state actors equally. This in turn has implications as far as governance is concerned in terms of separating water resources management functions from water supply functions in terms of irrigation and urban water supply.

[105] Of course water rights regimes invariably provide for the variation of abstraction levels, or even the temporary suspension of all abstractions, in times of low flow or drought.

3.2.4 Water quality and water pollution

Apart from providing for a permit regime for environmental discharges, modern water legislation is increasingly concerned with the minimum environmental flows necessary for healthy rivers as well as the setting of legally binding environmental quality standards for river reaches that guide discharge permitting decisions.

Such standards are set for the quality (in terms of the physical characteristics, chemistry, biology or ecology) of receiving waters. Under such an approach too, though, there is a direct link between water quantity and water quality. A range of different legal techniques, such as legally binding minimum flow requirements, are used to ensure that sufficient water remains within rivers and other water bodies to enable the compliance with such standards. To this end modern water legislation seeks to balance human and environmental water requirements.

Moreover, through river basin planning mechanisms there is an increased focus in water legislation on combating diffuse source pollution from agricultural and urban run-off.

3.2.5 Flooding

Aspects of flood management are increasingly addressed in water resources legislation in terms both of the siting and design of flood protection measures, which clearly need to be coordinated upstream and downstream in order not simply to transfer flood risk from one place to another, as well as the development of flood contingency plans and response mechanisms.

3.2.6 Drought management

Drought management is another topic increasingly addressed in water legislation in terms of long term planning as well as short-term mitigation measures, including modifications to the use of water in terms of a re-ordering of sectoral allocations.

3.3 Substantive reasons why national water legislation is needed in India

Having briefly outlined international practice and experience in terms of water resources legislation the next question is why such legislation might be needed in India.

The simple answer would be to say: to give effect to the 2002 National Water Policy. The 2002 policy observes that *'water is a scarce and precious natural resource to be planned, developed, conserved and managed as such on an integrated and environmentally sound basis keeping in view the socio-economic aspects and needs of the States*'. The policy goes on to provide for an integrated approach in terms of project design and implementation and the management of groundwater.

Quite obviously India does not currently have comprehensive water resources legislation in place at either Central or State level. Moreover not only does the existing legislation take a sectoral approach at both Central and State level, much of it is out-dated. The content of the National Water Policy, the need to follow international practice and the age of the legislation are not of themselves sufficient grounds though to make the case for water sector legislative reforms. Instead it is necessary to examine the substantive need for new legislation.

3.3.1 Water quantity

Water quantity issues in terms of water allocation arise at two levels, inter-state and state. However they are linked given that 90 percent of India's land area lies within the catchments of inter-state rivers.[106]

The most urgent challenge is to effectively coordinate the use of water on the major inter-state rivers. The River Boards Act has not been implemented and while there are a number of initiatives on inter-State river basin management there is no legal framework for comprehensive inter-State river basin management. Moreover inter-State disputes over water resource use and allocation are increasing and while of number of such disputes have been resolved over recent years by Water Disputes Tribunals established under the Inter-State Water Disputes Act, 1956 such tribunals have been criticised on a number of grounds including the slow pace of their work and the fact that their approach is overly legalistic. The allocation of the water on inter-State rivers is a key issue that will need to be addressed sooner rather than later.

At the same time the mechanisms for allocating water among different water use sectors and for individual uses (such as for irrigation) is totally inadequate. The only quasi-formal procedures that exist today at both Central and State level are the administrative project clearances. But whatever legal impacts such clearances may have in terms of the release of funds the fact remains they are not formally binding legal water rights or water entitlements.

Of course the availability of water is a key factor that is taken into account when new irrigation schemes are first proposed but given the focus of the irrigation departments on construction, given the role of irrigation schemes in 'development', given the pressures to provide water and to improve livelihoods, it is perhaps not so surprising that irrigation schemes are built that are not capable of receiving the volumes of water originally envisaged or that they negatively impact on other existing uses of water (such as canals built along contour lines that prevent the natural flow of water into ancient tanks). Moreover irrigation departments can get away with this because they are not accountable to irrigation water users or WUAs given that they are usually not legally required to deliver specific volumes of water.

In other words some form of formal water allocation regime is needed whereby legally binding water entitlements or water rights can be established and enforced. To be effective such a regime would need to be applied and administered at the national and State levels. Clearly a water rights regime would be quite different to those found in say Australia or the USA where rights to take water from rivers are held directly by individual farmers. In the case of irrigation, water rights would need to be held by the irrigation departments. This raises a further issue.

Part of the problem for the water resources sector in India is the fact that the irrigation departments are both the main users of water as well as the agency responsible for water resources management. There is a fundamental conflict of interest, one which renaming irrigation departments as water resources departments clearly does nothing to re-solve. A split is called for in terms of water resources management and water distribution and use.

An effective system of binding water allocations would also imply a number of other institutional reforms which in turn would need to be backed up in water resources

[106] World Bank *India's Water Economy: Bracing for a Turbulent Future* World Bank 2005.

legislation so as to ensure inter-sectoral coordination and a genuine role in decision making for water sector stakeholders. To work effectively such mechanisms would need to operate at the basin level both within and across State boundaries.

Finally in terms of the issue of water quantity the question of drought and flood management planning must be mentioned. There is currently neither National nor State level legislation on this topic.

3.3.2 Water quality

Water pollution is a serious problem in India. The 2009 State of the Environment (SOE) Report noted that almost 70 percent of India's surface water resources and a growing percentage of its groundwater reserves are contaminated by biological, toxic, organic and inorganic pollutants. Moreover, in many cases, the level of pollution has rendered water sources unsafe for human consumption as well as for other activities such as irrigation and industrial needs.

Major pollution sources include wastewater discharges from urban centres, many of which lack effective wastewater treatment facilities, as well as industry. While the SOE Report called for stricter enforcement of legislation governing wastewater discharges, the fact is that by itself enforcement will not be sufficient. The key problem lies in the design of the existing legal framework.

First of all the Water (Prevention and Control of Pollution) Act 1974, which focuses on 'end of pipe' discharge consents is extremely out-dated in its overall approach. Leaving aside the fact that national discharge standards can hardly be expected to work in a huge country with monsoon rainfall patterns, the fact remains that the ability of a water body to receive and disperse pollutants depends entirely on the volume of water that it contains. A discharge permit specifying a concentration of pollutants and a maximum volume of effluent that may be discharged may be sufficient to prevent pollution on a hypothetical river reach in normal flow conditions if there is only one discharge point. It will not/cannot be effective if the river is empty or if there are 50 point sources discharging an identical volume and concentration of effluent. At present the main mechanism for trying to reduce water pollution is the environmental impact assessment/environmental clearance procedure for new developments. This is an indirect and ultimately insufficient solution.

What is needed is the introduction of legal environmental quality standards that can specify minimum requirements in chemical and biological terms for water bodies (river reaches, reservoirs etc). Such standards, to be effective, need to be binding against the agency responsible for authorising discharges/managing water resources such that individual discharge consents are set so as to achieve compliance. In a particularly heavily polluted water body the discharge standards contained in individual permits may be more strict so as to ensure compliance. Similarly the conditions of individual consents may vary in accordance with the flow of water.

This approach is perfectly commonplace. However ensuring compliance can be difficult. In particular nationally applicable standards would be necessary as otherwise individual States might seek to achieve a competitive advantage (the 'race to the bottom'). This, incidentally, is how water quality standards were first introduced in the EU, not as a purely environmental objective *per se* but rather to prevent less environmentally concerned countries from achieving an unfair advantage from their lax standards. In the Indian context such standards would presumably have to be applied from and by the Centre. It is only once such types of binding standard are set that it is possible to work back and seek to remove the sources of pollution through a range of measures including investments in treatment plants.

3.3.3 The need for new legislation

On the basis of the previous paragraphs it is therefore argued that in terms of both water quantity and water quality issues new legislation is *prima facie* needed at the National level but also at the State level.

The water regulator legislation is far from sufficient in terms of creating the necessary legal basis for water resources management. It is true, for example, that in Maharashtra one of the tasks of the Maharashtra Water Resources Regulatory Authority (MWRRA) is to determined water entitlements. Such entitlements, which last for only five years, are however only those that apply within irrigation schemes. In other words they do not directly address the abstraction of water from natural sources.

3.4 Constitutional issues

Having identified the need for new legislation the question then arises as to the constitutional position as regards possible national legislation. India has what is essentially a federal constitutional settlement, although the term 'federal' is not used as such.[107] Rather India is described as a Union of States. The legislative competences of the Union, acting through the Parliament, and the States, acting through their respective Legislatures are set out in the three lists contained in the Seventh Schedule of the Constitution.

These are: List I, the 'Union List', which specifies the matters in respect of which the (Union) Parliament has the exclusive power to make laws; List II, the 'State List', which sets out the matters in respect of which the States have exclusive powers to make laws; and List III, the 'Concurrent List' which sets out the matters in respect of which both the Union Parliament and the State Legislatures may legislate. Aspects of water resources management are found in both the Union List and the State List.
The Union List includes 'Shipping and navigation on inland waterways, declared by Parliament by law to be national waterways' (entry 21) and the carriage of passengers and goods on *inter alia* national water ways in mechanically propelled vessels (entry30).
Most relevant to the topic of water resources management is entry 56 which states as follows:

> Regulation and development of inter-State rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest.

As regards the State List the most relevant entry is entry 17:

> Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of entry 56 of List I.

In other words the Union and the States both have the right to legislate aspects of water use and management, albeit as regards different aspects.

[107] Except as regards the Federal Court which pre-dates the Constitution.

In addition Article 262 of the Constitution confers an explicit power on the Union Parliament to adopt legislation for the regulation of inter-state water disputes. It provides:

> (1) Parliament may by law provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-State river or river valley.

Paragraph (2) goes on to provide that the Parliament may by law specify that no other court, including the Supreme Court, may exercise jurisdiction over such a dispute. The wording of entry 17 of List II makes it absolutely clear that irrigation and drainage, as well as 'water supplies' canals and embankments are matters of State competence. There is no real room for argument on this.

While it is a common expressed view that water is a State subject, the potential scope of its legislative competence of the Union Parliament would appear to be somewhat broad in terms of water resources management, given in particular that 90 percent of India's land area lies within the catchments of in inter-state rivers.[108]

Moreover, the precise wording of entry 17 on the State List can arguably be read so as to limit the scope of the competence of the States. Specifically, it could be argued that the notion of 'water' is qualified through the use of the words 'that is to say' to give a limited legislative competence to the State legislatures relating to the specific issues mentioned (water supplies, irrigation and canals, drainage and embankments, water storage etc). If the drafters of the Constitution had intended to give the States a broad legislative over water competence then such topics would, it could be argued, be described inclusively: using the word 'including' instead of the phrase 'that is to say'.

Moreover, support for such a broad conception of Union legislative competence can arguably be drawn from the approach of the Supreme Court in terms of water pollution, which as has already seen has been legislated on by the Union Parliament, and groundwater management. Suffice to say that whatever the theoretical scope of Union legislative competence, there has to date been little political will for the adoption of extensive water legislation at the Union level. And this point leads to the caveat discussed in Section 6 below.

4 Does India need new groundwater legislation?

4.1 Existing legal situation

The basic problems as regards groundwater over-exploitation in India are well known and will not be rehearsed here.

Part of this problem derives from the existing legal framework for groundwater abstraction and use. Under Indian common law there is no property in groundwater until it has been the object of an 'appropriation' (for example by being pumped from a bore hole). This basic common law position combined with the Indian Easements Act combine to mean that a landowner is entitled to sink a borehole or well on his land to intercept water percolating underneath his property even though the effect is to interfere with the supply of groundwater to nearby wells, springs or boreholes.

However, having sunk a well or borehole, such a landowner has no legal right or interest in the water beneath his land. Consequently he cannot take legal action

[108] World Bank *India's Water Economy: Bracing for a Turbulent Future* World Bank 2005.

against anyone else whose actions interfere with the supply of water to his well or borehole. This approach is commonly known as the doctrine of 'capture', a doctrine that still applies in many jurisdictions beyond. In essence it creates an 'open-access' regime.

Following the development of modern well drilling techniques and efficient pumps, the clear inadequacies of the doctrine of capture as a resource management tool have led to severe and growing problems of groundwater over abstraction in many parts of India (and elsewhere in the world).

Pursuant to the Constitution of India, the States have competence for the regulation and management of water within their borders, including groundwater. As noted above a number of States have in fact adopted groundwater legislation. Moreover a series of model groundwater bills have been promoted, since 1970 by the (Union) Ministry of Water Resources.

Several States including AP and TN have adopted legislation based on these model bills. The general approach of the model bills, and the subsequent acts, has been based on the command and control model based around a licensing approach for the use of groundwater and permits for well drilling.

Well drilling permits are commonly found in national legislation and can work reasonably well provided there are a limited number of well drilling rigs/operators. However groundwater regulatory regimes based on licensing are extremely difficult to effectively implement. Enforcement in a country such as India is almost impossible. It follows that the existing groundwater legislation has had little positive effect. Of course the situation is not helped by the provision at State level of free or heavily subsidized electricity for the operation of tubewells.

4.2 Alternative approaches

Far more promising are community-based approaches to groundwater management involving Panchayati Raj institutions. Detailed recommendations were prepared for the AK Aquifer north of Chennai by Chennai MetroWater in the late 1990s and other on-going initiatives in a number of States, including AP are also moving in this direction (although one key problem here though is that in the case of the hard rock aquifers found in AP it is difficult to model and predict groundwater availability).

As already noted a licence-based approach simply cannot work because of the problems of enforcement. Modern pumps are small and discrete and can be located anywhere there is groundwater. Community based approaches may work provided each individual community can be allocated a defined share of the resource. Enforcement within and among communities, although not without its challenges, may be achievable on a kind of prisoner's dilemma basis[109]. Even if water allocations seem to limit the right to abstract groundwater it is more valuable to know with some certainty how much water will be available and thus to be able to plan accordingly rather than risking sudden overdraft and total crop failure[110].

Nevertheless the fact remains that ideas for community based management of groundwater remain little more than that: ideas. So far the development of

[109] The prisoner's dilemma is a fundamental problem in game theory whereby two people might or might not cooperate depending on the options and information available to them.

[110] It is important here to note the importance of having reliable information on the quantity and quality of groundwater resources available, and the need to share this information with the various stakeholders.

groundwater legislation at State level has had few positive impacts. This does not mean that legislative reforms are unnecessary, rather that further investigations are called for.

In this connection there is clearly scope for fundamental reform of the sector and the *de facto* modification if not downright abolition of the rule of capture. This process, which has been undertaken in every jurisdiction that has undertaken reforms to ground water law, has certainly received indirect support from the finding of the Supreme Court, in the Span Motels case,[111] that the public trust doctrine forms part of the law of India.

4.3 The need for national groundwater legislation

At first sight the case for national ground water legislation is perhaps less clear. In constitutional terms groundwater appears to be *prima facie* a matter of State competence. Nevertheless the Supreme Court in another case also involving M.C. Mehta mandated the establishment of the Central Groundwater Authority on the basis of the environmental powers of the Centre and in particular the Environmental Protection Act, 1986.

Even if national groundwater legislation were to be adopted the question then arises as to what it should actually address. In particular the idea that a national groundwater act could in itself require specific actions from the States seems a little hypothetical in terms of groundwater management pending the development of effective legal groundwater management mechanisms. At the same time, though, one issue that arises concerns the nature of groundwater and its link to other water resources. With the exception of confined, so-called ‘fossil’, groundwater the fact remains that groundwater forms part of the hydraulic cycle and as such is intimately linked to surface water flows. This is why in many countries water resources legislation is concerned with both surface and groundwater resources. Conceptually therefore a strong case can be made that groundwater legislation at national and State level should regulate the use of both groundwater and surface water resources. After all, in practice, farmers and other water users very often use water from both sources.

5 Does India need a National Water Commission?

In terms of national institutions or bodies for water resources management what is needed, in the minimum, is the integration of existing bodies, such as the Central Water Commission and the National Water Council into a formal legislative framework as part of the adoption of a national water law. Clear tasks, clear responsibilities and clear legal consequences as a result of decisions are needed. However, subsequently, a national level body would be needed to assess the state of the country’s water resources as a whole and monitor the implementation of a national water programme.

A full discussion of possible institutional arrangements for the implementation of a national water resources law is beyond the scope of this paper. For this, see Working Paper 13, which analyses gaps in current institutional structures and describes how a National Water Commission could evolve over time, based on extensive consultations with stakeholders at all levels of government.

[111] India -- M.C. Mehta v. Kamal Nath, WP 182/1996 (1996.12.13).

6 Conclusions, proposals for reform and caveats

In conclusion therefore the clear finding of this paper is that yes India needs a national water resources law. Moreover the States too need to adopt water resource management legislation: the water regulator model pioneered by Maharashtra is far from sufficient in terms of water resources management. There is a strong argument in favour of including groundwater within the scope of a national water resources law even though at this stage it is not possible to make concrete recommendations as to the types of approach that will most likely lead to effective groundwater management at the State level.

A national water resources law would in turn require national institutions including a national water commission as well as a high level council not only to undertake a coordinating function but also to make the hard decisions that are invariably a feature of water resource management. Clearly such an approach would involve a number of challenges, not least by reason of the sheer scale of India's river basins. New relationships would be called for between Central and State bodies involved in water resources management.

Finally, though, the caveats. The first caveat concerns the issue of constitutionality. As argued above a strong case can be made on both inter-state and environmental grounds that the Centre enjoys the necessarily constitutional competences to adopt national water resources legislation. Nevertheless this is an issue that will inevitably require further investigation. The second caveat concerns the issue of political will and political viability. There would clearly be significant political challenges in terms of adopting and implementing national water resources legislation. Whether or not that will exists or could be developed is a question that lies beyond the scope of this paper. However from a legal and technical point of view the position is clear. National water resources legislation is necessary. India's water problems are serious and getting worse. Further disputes are inevitable. A clear, fair and transparent legal framework may well offer the best means of, if not of preventing such disputes, at least providing relatively quick and definitive solutions. The contents of the 2009 State of the Environment report make for gloomy reading in terms of the country's water resources and a national solution is called for.

National Water Resources Framework Study

Working Paper No.9:

Developing a Water Conservation Strategy for Industry

Simon Gordon-Walker

Contents

Questions raised

The Planning Commission raised the following questions about developing a water conservation strategy for industries in India:

Recycling by industry

- *Could we set a target for the proportion of water to be mandatorily recycled by Indian industry If so, what would be the instruments that could help achieve it?*
- *How can international experience in this regard help in moving Indian industry in this direction, both in terms of technologies and in terms of instruments of reform (incentives, disincentives etc)?*

International practice

- *Apparently the Chinese 12th Plan targets a 30% reduction in water consumption per unit of value added in industrial consumption? Is this or something like this, a realistic target for India? If so, what would be the instruments that could help achieve it?*

Water is a precious and everyone relies on water either directly for their health and consumption needs and indirectly to support their livelihoods either through food production or through sustaining employment as industries and companies need water for their production needs. Everyone's need for water is inter-connected, inclusive and dependent. It is therefore beholden on all citizens and the whole of society to regard water with respect and ensure its use is based on an approach that is "water-wise" and has due regard for other social needs, including the ecological need for plants and animal life that depend on water.

Due to water scarcity and pressures on the water resources in India the Indian Planning Commission wants to investigate if there are initiatives that might be adopted to support industry and urban users to take a wiser approach to their water consumption by encouraging industries to use water more sustainably. This paper will explore if the work and experience from other countries could be replicated and adapted in India to achieve a better conservation in water use outcome.

It is very important for all users to consume water in a responsible manner, to use water wisely and efficiently wherever possible. Commercial customers are a good area to focus water efficiency efforts. Within an industrial setting it may be possible to reduce water use significantly by implementing relatively simple changes. Water efficiency in industry can be achieved in two ways[112]:

- Eliminating or reducing the consumption of fresh water through alternative water-efficient technologies in various manufacturing activities, and
- Reusing and recycling the waste water from such water intense activities and making the reclaimed water available for use in the secondary activities within or outside the industry.

In most cases, water auditing of specific individual plants will be the starting point for identifying the areas where water can be saved and the most appropriate strategy/range of

[112] Sachidananda, Madhu (2010) 'Minimisation of Water Consumption in Manufacturing Industry – Centre for SMART (Sustainable Manufacturing and Reuse/Recycling Technologies).

actions to be put in place for reducing water demand and increasing industrial value added per unit of water consumed. In many cases, and because of the very characteristics of industrial processes and the potential role of recycling and reuse plan, water auditing needs to consider both water quantity and water quality aspects – the need to reduce polluting discharges to the aquatic environment or to sewage systems is often the key driver to water saving. The behavioural side of water use is considered to be a vital component of any water efficiency programme at a national or local level[113].

Examples of water efficiency programmes exist in many countries and states which are currently undergoing water stress problems; these include:

- Jordan: National Water Demand Management Policy involved the establishment of a Water Demand Management Unit (WDMU
- Australia: Sydney Water's 'Every drop counts' programme.
- United States: Within the USA there are many examples of water efficiency. These were collated in a paper entitled "Cases in Water Conservation – how water efficiency programmes help water utilities save water and avoid costs" produced by the EPA (Environmental Protection Agency
- UK: a good example of a water efficiency initiative for industry is Envirowise (http://envirowise.wrap.org.uk/uk/Topics-and-Issues/Water.html). This also provides good examples of water savings that should be expected by industry type.

The 12th Chinese Plan plans a 30% reduction in water consumption per unit of value added in industrial consumption. This is an ambitious target and their Plan does not detail exactly how this will be achieved. It is clear however, that this would be government led and would require a concerted action at all levels

India might be best placed to introduce water efficiency through regulation during a phased approach but initially a time scale would needs to be set in place which would enable sufficient planning and the development of a regulatory framework to help deliver the target. For example, if India wanted to achieve a 30% reduction in industrial consumption over 15 years (for example) then a number of actions must be undertaken to achieve this.

A phased approach with full support and buy in from industry is the best strategy for long term sustainable water resources, gradual implementation with support and guidance is more likely to yield results which will be long term. This regulatory reform could be an instrument to achieve both better regulation and realistic water efficiency reduction targets. Different solutions for different industries would require different timeframes.

To change consumption patterns through effective use of water saving technology following a systematic approach is a complex project which can involve a huge range of stakeholders including; government, social bodies, businesses, consumers, technicians (plumbers and manufacturers), public bodies and the media.

Partnerships with multinational businesses already operating within India would be excellent to develop. Corporate Social Responsibility is a form of corporate self-regulation which is

[113] Estimating the Water Savings for Baseline Water Efficiency Activities – UK Water Industry Research, 2009.

integrated into a business model[114]. Large companies which operate in India and have a CSR policy would have to adhere to wise water use.

In addition to partnerships, the development of Best Practice Guidance should be undertaken to help businesses and industries know who to improve their water use. The guidance should be relevant and easy to implement in a lowest cost economic and environmentally acceptable way. With the introduction of best practice benchmarking could also offer valuable information to industry to help them optimise their water use. Benchmarking similar industries will enable comparative water use to be made and will enable any outliers and/or good practice to be identified and disseminated.

Generally the industries that use large amounts of water include the paper & pulp, textile, leather (tanning), oil and gas, chemical, pharmaceutical, food, energy, metal and mining sub-sectors. The experience of Europe is instructive for India – as European countries have a declining manufacturing industrial base and India has a growing industrial base – the application of an industrial water saving strategy would benefit from the technological and policy perspective from Europe. In Europe it is estimated that based on the application of technical measures (e.g. changes in processes leading to less water demand, higher recycling rates or the use of rainwater) can lead to estimated savings between 15 and 90% with a global estimate up to 43% of today's water abstraction[115].

Overall, it is important to stress the different productivity of water in different industrial processes. Producing specific goods requires very different quantities of water. For example, the production of a computer chip requires 32 litres of water, while the production of a car (including all its components) requires as much as 400,000 litres of water.

Industrial grant programmes can also be incentives to the industrial sectors to invest in water saving measures. Such financial incentives can be administered at the level of water companies or cities. As an example, the city of Tempe in the USA offers financial support up to $20 000 (depending on the size of the project and expected water savings), a minimum of 15% reduction in overall water use being set as minimum target[116]
Also, eco-labelling and the application of ISO 14001 certification provides incentive to review water use and identify potential water savings. In wider Europe (44 countries), around 23, 316 companies had ISO 14001 certificates in 2002 – the largest group in the world far ahead of other regions. In the US, product certification is also applied and plays the role of incentive for industry to reduce water consumption[117].
In summary, overall, there is significant water saving potential in the industry sector.. Water savings documented in the literature stress the significant water saving potential in the industry sector. Reported water savings range from 15% to 90% of current water use, depending on the industrial sub-sector considered, the individual process investigated or the combination of water saving measures analysed. Most commonly found figures are within the 30-70% range.

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[114] Corporate Social Responsibility Europe: The European business network for CSR – http://www.csreurope.org/
[115] http://ec.europa.eu/environment/water/quantity/pdf/water_saving_1.pdf
[116] http:/www.tempe.gov/conservation/grants_industrial.htm
[117] United Nation Industrial Development Organization (2005): Water: a shared responsibility – Water and industry (Chapter 8).

1. Introduction

Water is a precious and everyone relies on water either directly for their health and consumption needs and indirectly to support their livelihoods either through food production or through sustaining employment as industries and companies need water for their production needs. Everyone's need for water is inter-connected, inclusive and dependent. It is therefore beholden on all citizens and the whole of society to regard water with respect and ensure its use is based on an approach that is "water-wise" and has due regard for other social needs, including the ecological need for plants and animal life that depend on water.

Due to water scarcity and pressures on the water resources in India the Indian Planning Commission wants to investigate if there are initiatives that might be adopted to support industry and urban users to take a wiser approach to their water consumption by encouraging industries to use water more sustainably. This paper will explore if the work and experience from other countries could be replicated and adapted for India to achieve a better conservation in water use; by understanding:

- What is meant by water efficiency in industry?
- Water recycling, water optimisation, wise water use
- Where possible what is currently done in India
- What have other leading water conservation countries done?
- What technologies, incentives, reform instruments exist?
- How can India be helped to encourage better conservation in water use?
- Regulation and information: what instruments are available to support a national policy and strategy to reduce water consumption?
- Target setting - who are the biggest savers and should specific industries be targeted?

For any policy which is being targeted for improving water conservation (technically this is about contributing to demand management), this is likely to cover five main areas each to a lesser or greater extent depending on the political circumstances and social conditions for likely success of measures. These are:

- Measures to provide education and communication to people and industry about the "why" and "how" of water saving in their use
- Measures based upon support for the distribution of water saving products for immediate use; often as a retrofit to appliances already in place
- Measures to encourage and steer manufacturers and suppliers of water using products to develop water saving products and to influence the market for these products through taxation or other policy interventions
- Measures to develop services in water auditing and waste reduction; through accreditation schemes, corporate best practice and by linking the waste of water to the broader issues of reducing waste.
- Measures which are regulatory. These can be "hard" measures such as those that could be formally imposed or set by a regulator; or they might be "soft" measures which would include voluntary reporting and actions through a trade association. Variously used in the UK, USA, Australia and across Europe are the following measures:
    - Target setting for different types of industry done in collaboration with industry trade associations, and independently audited

- Provision of guidance documents and codes of conduct endorsed by industry bodies and leading companies
- Product labeling and testing for water conservation
- New buildings controls on water use and water neutrality[118]

In any official government backed initiative to promote wise water use it goes without saying that all parts of government should have a duty to lead by example when it comes to water efficiency. Government policy should be promote the gold standard of water efficiency and thus play a leadership role by only procuring and installing water efficiency products is all of the public buildings. This would rely on policy makers to accept the importance of this and endorse it by actively adopting water efficiency measures. There should be a transparency of activities within government procurement and within public buildings. This could be carried out in conjunction with energy saving and thus have energy and water ratings for buildings.

Incentives could be used to increase the likelihood of this and one method could be to use grants and taxation rebates. A fiscal incentive could be applied to those States and local authorities, which underperform with regards to up taking water efficiency within their control. This would be a central government lever to incentivise water efficiency. Alternatively, a "frontier" type approach for building types could be implemented, with the best performing buildings given fiscal rewards for outperforming whilst all other public buildings could endeavour to move towards that goal of similar water consumption.

2. What is meant by "water efficiency" in industry?

Our rivers and their ecosystems are at risk from a range of pressures, but the compounding effects of excessive abstraction are particularly severe. Pollutants become more concentrated. Rivers slow down and drop sediment. Habitats for fish, insects, animals and plants are reduced and severely altered. Excessive abstraction effectively magnifies any other negative impact on water quality, such as pollution from road run-off; sediment, fertilisers and other pollutants from agriculture; phosphates from sewage.

Water conservation refers to reducing the usage of water and where possible the recycling of waste water for different purposes such as cleaning, manufacturing and agricultural irrigation.

Water conservation can be defined[119] as:

- Any beneficial reduction in water loss, use or waste as well as the preservation of water quality.
- A reduction in water use accomplished by implementation of water conservation or water efficiency measures; or,
- Improved water management practices that reduce or enhance the beneficial use of water. A water conservation measure is an action, behavioural change, device, technology, or improved design or process implemented to reduce water loss, waste, or use.

[118] The concept of "water neutrality" as a new approach looks at whether new demands for water required by new housing and commercial development could or should be offset in the existing community by making existing homes and buildings in the area more water efficient. In effect "water neutrality" is a more robust policy to emphasise demand management strategies.
See Environment Agency Science Report – SC080033/SR, Simon Gordon-Walker

[119] Water Auditing and Water Conservation - J Sturman, G Ho, K Mathew 2004

Water efficiency is a tool of water conservation and can be defined[120] as:

- The accomplishment of a function or process with the minimal amount of water feasible;
- An indicator of the relationship between the amount of water required for a particular purpose and the amount of water used or delivered.

There is a difference between water conservation and water efficiency although the two are used interchangeably. Water efficiency results in more efficient water use and thus reduces water demand. The value and cost-effectiveness of a water efficiency measure must be evaluated in relation to its effects on the use and cost of other natural resources (e.g. energy or chemicals).

Water efficiency differs from water conservation in that it focuses on reducing waste. A proposition is that the key for efficiency is reducing waste, not restricting use. It also emphasises the influence consumers can have in water efficiency by making small behavioural changes to reduce water wastage and by choosing more water efficient products. The purpose of water efficiency is to obtain the desired result or level of service with the least necessary water.

It is very important to consume water economically, but also to use water wisely and efficiently wherever possible. Consequently, there is a need for the water used within industry to move to-wards a sustainable and equitable consumption. Commercial customers are a good area to focus water efficiency efforts because they are likely to be predominantly metered and also because they are likely to have a large water bill and thus be even more receptive to reduce water if a financial incentive to be realised. Within an industrial setting it may be possible to reduce water use significantly by implementing relatively simple changes. Water efficiency in industry can be achieved in two ways[121]:

- Eliminating or reducing the consumption of fresh water through alternative water-efficient technologies in various manufacturing activities, and
- Reusing and recycling the waste water from such water intense activities and making the reclaimed water available for use in the secondary activities within or outside the industry.

Water recycling, water optimisation and wise water use are all viable methods of achieving a reduction in consumption.[122] The minimisation of water consumption in industry is an area which can yield significant benefits. The cost of any improvements is important as the initial expense is required before any financial savings are achieved. The payback period may result in a lack of willing for investment by management depending on the financial situation of the company.

2.1 Commercial Water Audits

Water audits can be directed to two areas to commercial customers; the domestic water component within the premises i.e. toilets, taps, urinals etc., or directed to the process itself. This would involve a mass balance of total water use and the mapping and tracing of all

[120] Ibid
[121] Minimisation of Water Consumption in Manufacturing Industry – Centre for SMART (Sustainable Manufacturing and Reuse/Recycling Technologies), Paper by Miss Madhu Sachidananda, 2010.
[122] Water UK Position statement - http://www.water.org.uk/home/policy/positions/water-efficiency

water use within the whole premises and thus the identification of areas where water use could be optimised to yield a water saving.

The model to deliver this could be in three phases[123];

- Phase 1 - A high level assessment of total water use. This would determine if the industry would benefit from a more detailed study or if domestic water saving measures are sufficient for this business.
- Phase 2 - A full, detailed assessment of total water use. This would include; analysis of domestic water use, leakage, water bill analysis and process optimisation. Detailed recommendations of how to achieve further water savings would be developed.
- Phase 3 - The delivery of the efficiency recommendations. This is implementing the recommendations made in phase 2 and would also include trying to achieve behavioural change and also the construction or retrofitting of hard measures.

An audit would also identify what training requirements are needed and the best way of achieving behavioural change within the business. The maximum water saving will be delivered when both behavioural change and hard measures are successfully adopted by the end user.

2.2 Water recycling

Reclaimed water or recycled water is using water which has already been used within the process for another use. In some cases the grey-water will require some treatment before it can be used again. The purpose of these processes (recycling and reusing) would be more sustainable due to successfully conserving water rather than discharging the wastewater after one use only.

The range of wastewater reuse applications include[124];

- Irrigation
- Industry - cooling, process water or boiler feed
- Ground water recharge
- Non-potable urban use
- Potable use

There are hundreds of different products, process and services which can address your water reuse needs for a variety of different industrial settings which will successfully reduce water use.

Depending on the nature of the industry and the quality and quantity of the water used the methods and technology associated with recycling can range from simple to complex. A simple model would be just capturing the water before discharge and directly reusing it at point source with minimal effort. A more complex model would require sophisticated treatment of the water coupled with the transportation of it to another location. In this instance an assessment must be made to determine if the expected outcomes are economically and environmentally favourable. If treatment is required this can range from simple

[123] Model supported by B and V water http://www.bvwater.co.uk/
[124] Water Reuse for efficient water resource management – US Environmental Protection Agency

settlement options to more advanced wastewater treatment technologies from physical, chemical and biological treatment, to membrane filtration and deionisation.

Rainwater harvesting is the capture of rainwater for other purposes. Most commonly this is recognised as collecting rainwater from a roof via guttering into a water butt for garden watering. This type of reuse is becoming increasingly common in the UK and several water companies offer water butts at a discounted price. Rainwater recycling can also be implemented at a large scale. For example, large buildings can collect the water from the roof area into big tanks and use it for toilet flushing. Wessex Water head office in Bath uses rainwater to flush all of the toilets within the office which holds more than 500 employees.

Rainwater harvesting requires a large collection area (typically roof area) and a holding tank for the resource until it is required. There may be a delay between the rainfall event and the demand and so the water must be stored. In some cases, depending on the residence time of the tank, treatment of the rainwater might be required to prevent it from stagnating until it is used. Treatment of rainwater will require energy use and therefore increase the carbon emissions associated with this intervention. The pumping of rainwater from an underground storage tank would also increase energy use.

Rainwater harvesting, as the name suggests, is dependent upon rainfall events and thus rainfall patterns typical of a specific area. Rainwater recycling would in theory, help to reduce water consumption during times of peak demand, as during these times gardens would be watered and previously the water for this would be obtained from the mains supply. With the installation of a water butt, the garden could be watered via this reservoir. However, this is only if the water butt is full. There is a risk that the rain water system may run empty during periods of hot dry weather and thus the reservoir (water butt) or toilet flushing system would have to be backed up from the main supply. Therefore, although a popular measure, there is an uncertainty as to how reliable the yield derived from rainfall might be long term. Although a good measure in theory for peak lopping summer demand, in practise there is a significant risk that the water butts may be empty. The same problem applies in dry years, which are used for water resource planning and applicable to the definition of water neutrality.

Greywater recycling involves collecting water from certain wastewater producing activities and using this for toilet flushing. Shower water, bath water and washing up water are examples of the types of wastewater which would be collected. This water would contain large amount of detergents and surfactants and would therefore require treatment before it could be stored and then used when required.

Small scale rainwater collection, like water butts, can be implemented easily into individual domestic properties. Larger scale units would require significant building and civil works both externally (tanks to collect the water) and internally (to install the appropriate infrastructure to be able to treat and transport the recycled water). If treatment is needed, then this entails a further level of complexity which could render the option unfeasible or uneconomic. Larger reuse systems are likely to be more appropriate to new builds rather than for retrofitting projects.

In addition to treatment technologies water targeting tools such as Water Pinch Analysis[125] and Water Cascade technologies are currently being used to minimise the freshwater flow rate within process industries. These tools enable the efficient integration of processes within industry to improve the reuse and recycling targets for water. Cascading is when water is reused within a process depending on the water quality requirements for a specific stage.

2.3 Water optimisation

Existing assets and processes can be 'optimised' to ensure that any associated water use is at minimum. Optimisation involves identifying the optimum approach to achieve particular objectives (reduced water use) at least cost, while taking account of given constraints. Optimisation techniques can be applied to the operation of existing assets or the planning of new infrastructure and can potentially save significant sums of water in both the short and long term. There are many possible applications of optimisation techniques, from water resource planning, to network operation or treatment works design.

Optimisation will require the industry to be flexible and innovative and will involve the analysis of specific drivers and constraints, but any solution for reduced water must not adversely affect the overall operation of the industry.

2.4 Wise water use and behavioural change

In parallel to conducting audits, water recycling and optimisation it is necessary to increase the awareness of water use and the need for water efficiency. In many cases the provision of water saving devices is not enough to deliver long term water efficiency. This action should be coupled with promoting the message of wise water use both at home and at work. The behavioural side of water use is considered to be a vital component of any water efficiency programme at a national or local level[126].

Commercial properties

Many interventions which can be adopted in the domestic environment can also be applicable to the commercial setting. Commercial water use can be separated into water use which is integral to the actual business itself i.e. water used within a manufacturing process, and water which is required for domestic purposes i.e. toilet flushing, drinking etc. The nature of the commercial property will also impact the water which could potentially be saved. Water audits are a popular and relatively successful way of reducing water use within a commercial setting. Audits trace water use from source to drain to deduce what happens to it and then attempts to identify those areas where its use could be optimised. This may lead to an overall reduction in use, and result in water being used more effectively and with less waste than was previously the case. Other savings could be made in the domestic side of the commercial building e.g. toilets, taps and kitchens. Aerated or infra red or spray taps could be installed in bathrooms to reduce the risk of water wastage from taps which have not been turned off. Dual flush toilets could also be fitted. It is important for a business to take responsibility to educate their employees on the importance and practices of water efficiency, and this message could possibly result in good practice within the home too. On a larger scale, commercial buildings may be suitable for large scale rainwater recycling systems. This can be for toilet flushing as discussed earlier. The water could be reused within a site, or in some

[125] Water minimisation through water pinch analysis technology – Alvarez, J. NATO Science for Peace and Security

[126] Estimating the Water Savings for Baseline Water Efficiency Activities – UK Water Industry Research, 2009.

cases could be used in areas outside of the commercial site, the commercial site being used for rainwater collection only.

These interventions can yield significant reductions in water use. With the exception of water reuse, the options are centred on wise water use and the minimisation of water waste. Commercial properties are more likely to be metered and there are companies offering their services (e.g. Envirowise) to optimise water consumption on the back of financial savings. These interventions will help to reduce average annual consumption. In addition to businesses, these options can be applied to public buildings such as hospitals, schools, etc. If heated water can be saved too, then the water and energy would be saved.

3. What is currently done in India?

Integrated water management is vital for poverty reduction, environmental sustenance and sustainable economic development. The National Water Policy (2002) envisages that the water resources of India should be developed and managed in an integrated manner. Consequently, the Ministry of Water Resources was set up for the formulation and administration of the rules and regulations and laws relating to the development and regulation of the water resources in India[127]. The Ministry of Water Resources is responsible for laying down policy guidelines and programmes for the development and regulation of country's water resources. In particular, the Ministry undertakes the overall planning, policy formulation, coordination and guidance in the water resources sector. In addition to this, the Ministry is also responsible for technical guidance and the planning and development of water resources.

Although there is a Ministry of Water Resources in place, at present in India there isn't a robust form of regulation of the water resources. The actions of the Ministry are very high level and as a result there is no regulation or licensing (for abstraction or discharging) and little monitoring or measuring of water availability. There is a lack of water quality information and mute national environmental policies which specifically concern water.

Some water efficiency may be delivered but this is likely to be by NGO's, charities and multinationals which operate in an area and they conduct water efficiency measures as part of a corporate policy. This water efficiency is small scale and in a piecemeal way, not a Government led reform which would be needed if to rationalise significantly the current level of industrial water consumption.

4. What have other countries done?

4.1 China[128]

The People's Republic of China (PRC) produces 'Five-Year Plans' which are a series of economic development initiatives. The economy is shaped by the Communist Party of China (CPC) through the plenary sessions of the Central Committee and national congresses[129]. The party plays a leading role in establishing the foundations and principles of Chinese

[127] Ministry of Water Resources, India - http://www.wrmin.nic.in/
[128] http://www.chinacp.org.cn/eng/cppolicystrategy/10th_5_water_save.htm
[129] Ministry of Water Resources, Peoples Republic of China - http://www.mwr.gov.cn/english/

communism, mapping strategies for economic development, setting growth targets, and launching reforms.

Central planning is a key characteristic of China, and one plan established for the entire country contains detailed economic development guidelines for all its regions. The areas included within the plan are:

- Economic growth
- Economic structure
- Population, resources and environment
- Public service and people's life

The population, resources and environment section of the plan states that:

- Water consumption per unit of industrial added value will reduce by 30% in five years;
- Coefficient of effective use of water for irrigation up from 0.45% in 2005 to 0.5% in 2010;

The Chinese Academy for Environmental Planning of the State Environmental Protection Administration believes that inadequate supply facilities, under-priced water and poor awareness of conservation were the major problems contributing to water resources[130]. One measure to achieve a reduction in consumption is that the Chinese government plan to raise water prices across the board to promote conservation and efficiency in a reform of the country's water price system (during the 11th Five Year Plan Period (2006-2010)). The Ministry of Water Resources believes that domestic water prices would be tiered with higher fees for heavy consumers to encourage conservation.

In addition to measures directed to domestic customers, progressive payment systems for over-quota water use for farming and industry would be developed and implemented nationwide. The government's 2005 water resources report (the first of its kind to be published) showed an average of 169m3 of water was consumed for every 10,000 Yuan in industrial added value. The government aims to cut the figure by 30% by 2010. The introduction of a more complex pricing regime is part of how to achieve this goal.

In parallel with a pricing mechanism designed to reduce consumption, a campaign to increase awareness of the need to conserve water will also be undertaken. As large users (industry) are not engaged with their water using habits it is necessary to address this and to encourage the uptake of water efficiency and conservation.

China is able to introduce measures to achieve a target to reduce water consumption and this is aided by the fact they have a have a regulatory structure in place. The Ministry of Water Resources is responsible is the executive government agency responsible for managing the water resources in China. The responsibilities of the Ministry include:

- Monitoring the use of water resource funds and fee collections for water use; recommend price, taxation, credit, and finance policies to regulate water resources
- Monitor the quantity and quality of water resources and determine pollution absorption capacities

[130] Chinese Academy for Environmental Planning - http://www.caep.org.cn/toptypeEN.asp?typeid=43

- Direct national hydrological work including rural electrification through hydropower
- Oversee the safety of reservoirs and dams, formulate standards and procedures for major water construction projects
- Direct the management of water facilities, water surfaces and coastlines and the development of large rivers and lakes

The Ministry of Water Resources (MWR) drafts policies, strategies, plans, regulations, and laws related to water resource management. This includes mediating and coordinating water resource management among various interest groups competing for China's scarce water resources. In rural areas, it provides guidelines for water pricing. In urban areas, the MWR manages a quota system to ration water according to production output value. It is also experimenting with the sale of water-use rights to balance supply and demand. The ministry targets inefficient agricultural and industrial water use caused by subsidised water prices and low wastewater discharge fees. MWR has established a conservation plan which entails saving water, developing new resources, minimising wastewater, and improving water resource-management regulations.

4.2 United Kingdom

In the UK, water companies have a statutory duty to promote the efficient use of water and as a result, water companies (in England and Wales) carry out a range of water efficiency activities with the purpose of promoting water efficiency to their customers. This water efficiency activity has been a duty under the Water Industry Act (WIA91 section 93a) since 1996[131]. To date targets for water savings have been set by water companies themselves. However, as of 1 April 2010 water companies will be working within a regime of mandatory water efficiency targets set by Ofwat (Office of Water, Regulator) for all water companies to achieve[132]. These targets can be achieved by either targeting domestic or industrial customers, but the targets must be met year on year. The water efficiency targets comprise of three key elements:

- An annual target to save an estimated one litre of water per property per day through water efficiency activity, during the period 2010-11 to 2014-15.
- A requirement to provide a minimum level of information to consumers on how to use water more wisely.
- A requirement that each company actively helps to improve the evidence base for water efficiency.

In addition to target setting, the water industry set up and funded an organisation called Waterwise to make the case for large-scale water conservation. Waterwise is a UK NGO focused on decreasing water consumption in the UK and is central authority on water efficiency information and guidance in the UK[133].

Another NGO operating in the UK is Envirowise which offers free and independent support to businesses to help them become more resource efficient and for them to save money. Since 1994, Envirowise has helped UK industry save more than £1 billion by reducing waste

[131] UK Water Industry Act 1991 - http://www.legislation.gov.uk/ukpga/1991/56/contents
[132] Ofwat Water Efficiency Targets – Good Practice Register Water and Sewerage Companies 2007 - http://www.ofwat.gov.uk/regulating/ltr_rd1507_watefftargets
[133] Waterwise - http://www.waterwise.org.uk/

early on in their organisation processes. A part of this waste minimisation strategy includes water and this advice is specifically targeted for industrial and commercial water users[134].

The Environment Agency is responsible for granting abstraction and discharge licences for the water resources in England and Wales. Before a licence is granted, an assessment is done of the likely impact of that abstraction on the environment. As a result, the water resources are closely monitored, measured and modelled to ensure that a sustainable system is maintained. All abstraction licenses will have an annual charge which is calculated by using the Agency's Abstraction Charges Scheme[135]. The charge will depend on the water use, the quantity, the source and the seasonality of the abstraction and other relevant factors. The ability to charge for water enables the regulator to make an assessment of and charge according to the value of water in that instance. In addition to this, all end users of licences granted must reduce water waste and endeavour to use water efficiently; therefore a regulatory framework in place enables tight controls over water resources for sustainable water use. In the UK

- National Symbiosis Program: A UK based organization which promotes the efficient use of resources in industry and has previously worked in water
- The UK Government publish a Water Technology list covering water using devices which contribute to water efficiency.
- Envirowise publish a range of information on industrial water use, water using devices and water conservation.
- The Watermark project which published water use and water efficiency benchmarks in 2003 for 17 categories of building.
- Environment Agency publications on water use in buildings, updated in 2008.
- Industry Trade Associations such as the Food and Drink industries group provide information and guidance on best practice in water use.

A case study example of NISP in action on water saving and energy efficiency The food and drink sector use significant quantities of water and there is often a close correlation between water use and energy use at food and drink manufacturing facilities. The Food Company, aware of the cost savings potential associated with the efficient use of water, worked to come up with ways to reduce consumption and to support implementation of improvement measures. In excess of 50 cold and hot water saving opportunities were identified evaluated and prioritised for implementation. The review identified water uses that could be eliminated, and some where measures to control flow were introduced. Results included:
- Water use reduced by 250,000m3 per annum –
- Waste water discharges costs reduced by £250,000 per annum
- Water related energy savings – the removal of hot water washing of empty cans would save 8,505,244 kWh of energy and 1,616 tonnes of CO2 per year
- Offsite energy and associated CO2 emissions associated with energy used by the utilities company in water treatment and distribution and wastewater reception, treatment and disposal will also be reduced.

[134] Envirowise - http://envirowise.wrap.org.uk/uk/Topics-and-Issues/Water.html
[135] The Environment Agency – Water charging and abstraction licences - http://www.environment-agency.gov.uk/business/topics/water/32020.aspx

The UK Government also provides funding for energy and water auditing and efficiency advice for business and these are delivered through Envirowise and the National Industrial Symbiosis Programme (NISP). Envirowise provides advice to businesses to help them reduce their energy use, water use and waste, whist NISP is a "swop shop" for waste minimisation, including waste waters. NISP is part funded by Defra through its Business Resource Efficiency and Waste (BREW) Programme. Some of the regional programmes also receive additional funding from their respective regional development agencies and other organisations.

4.3 Sydney Water: Australia

Australia has suffered long periods of drought water efficiency is very high up on the agenda as it is a real and significant issue. As a result large amounts of information on water efficiency activities exist and the matter of wise water use if of national importance and is supported and funded by the government. Australia operates a very strict water use policy in certain areas and at certain times of the year. This, coupled with innovative water pricing to further suppress consumption during times of peak demand has been successful.

In Sydney, Sydney Water (SW) implemented an 'Every drop counts' programme works with industry in the Sydney region to help them cut water use and business costs[136]. As part of this programme SW produced and advised on best practice on a wide range of water efficiency activities focussed on business water users. Sydney Water produced very detailed best practice information to encourage businesses to be water efficient, covering cooling towers, sub-metering, plant watering, urinals, toilets, commercial clothes washers, dishwashers, and hotel water audits.

In addition to this best practice guidance SW promoted a cycle of; Identifying critical actions, defining an improvement plan, implementation, performance review, whilst seeking to get joint commitment within the business and feeding the results back to Sydney Water.

5. How might industry in Indian industry be helped to encourage sustainable water use?

Outlined in an earlier section, the 12th Chinese Plan plans a 30% reduction in water consumption per unit of value added in industrial consumption. This is an ambitious target and their Plan does not detail exactly how this will be achieved. It is clear however, that this would be government led and would require a concerted action at all levels.

As mentioned in other working papers water resources in India are not measured or monitored to any extensive extent. As a result, it would be difficult to introduce a target to achieve if the baseline of what already exists is not known. If the water is not measured, then the effectiveness of any measures which have been implemented would be hard to determine. In addition, there is no licensing, nor charging for abstraction or discharges which will impact on the water quantity and quality. This will also limit the options available to introduce in terms of innovative pricing structures to further encourage wise water use.

[136] Sydney Water - Every Drop Counts (EDC) Business Program - http://www.sydneywater.com.au/Water4Life/InYourBusiness/EDCBusinessProgram.cfm

It is imperative in the near future to ensure that accurate information is collected oo what is used by the industrial sector at present so that and changes can be monitored and the most cost effective basket of water efficiency measures or strategy and be designed and implemented. Without an advanced regulatory framework it is difficult to implement stretching targets to reduce water consumption; therefore working with industry and for Government to demonstrate leadership in wise water use is going to be an important step towards developing a water-use wise culture in industry and commercial premises.

It will probably be appropriate to introduce water efficiency through regulation during a phased approach but initially a time scale would needs to be set in place which would enable sufficient planning and the development of a regulatory framework to help deliver the target. For example, if India wanted to achieve a 30% reduction in industrial consumption over 15 years (for example) then a number of actions must be undertaken to achieve this and it is likely that the easiest sector to target would be industrial as they will be most likely to have technologies for monitoring and targeting water reduction. Phase 1 of this approach may impact industry with a) a method of working with industry organization to inspect, authorise and uphold the procedures set in place for the reduction in water and b) the clear dissemination of requirements to industry.

This structured, phased fifteen year approach (5 years per phase) to implementing water efficiency would allow government organisations to be self-critical and implement changes and pass on good practice as they progress. A phased approach with full support and buy in from industry is the best strategy for long term sustainable water resources, gradual implementation with support and guidance is more likely to yield results which will be long term. The dissemination of information at an early stage is important to reduce confusion and bring water issues to the forefront. This regulatory reform could be an instrument to achieve both better regulation and realistic water efficiency reduction targets. Different solutions for different industries would require different timeframes. The introduction of Regulation would enable targets and measures to be put in place by making actions mandatory.

Further instruments which could be used to support a national policy would be to work in partnership with organisations which are already delivering similar measures. In international examples of countries which have successfully reduced water use, this has been in part delivered in conjunction with other parties.

To change consumption patterns through effective use of water saving technology following a systematic approach is a complex project which can involve a huge range of stakeholders including; government, social bodies, businesses, consumers, technicians (plumbers and manufacturers), public bodies and the media. A collaboration and concerted effort with all of the stakeholders would result in a consistent and strong message to be disseminated to all relevant end water users. This can be developed over time to ensure that all areas of the water resources network are targeted. In India there are many NGO's and social enterprises working in a piecemeal manner to provide a variety of different good practices in water use. Working with partners to help with the communication and dissemination of wise water use would be important to achieve behavioural change in both domestic and commercial environments.

Partnerships with multinational businesses already operating within India would be excellent to develop. In many instances foreign businesses will have policies under which they operate which may include obligations to perform their business in an environmentally responsible manner. This would then impact on their water consumption. Corporate Social Responsibility is a form of corporate self-regulation which is integrated into a business model[137]. The goal of CSR is to embrace responsibility for the company's actions and encourage a positive impact through its activities on the environment, consumers, employees, communities, stakeholders and all other members of the public sphere. Large companies which operate in India and have a CSR policy would have to adhere to wise water use. In addition, other policies and Environmental Management Systems in place my act as a vehicle by which the Indian Ministry may further encourage industry to use water wisely.

In addition to partnerships, the development of Best Practice Guidance should be undertaken to help businesses and industries know who to improve their water use. The guidance should be relevant and easy to implement in a lowest cost economic and environmentally acceptable way. With the introduction of best practice benchmarking could also offer valuable information to industry to help them optimise their water use. Benchmarking similar industries will enable comparative water use to be made. This will enable any outliers and/or good practice to be identified and disseminated.

5.1 Target setting - who are the biggest savers? Should specific industries be targeted?

Generally the industries that use large amounts of water include the paper & pulp, textile, leather (tanning), oil and gas, chemical, pharmaceutical, food, energy, metal and mining sub-sectors. The experience of Europe is instructive for India – as European countries have a declining manufacturing industrial base and India has a growing industrial base – the application of an industrial water saving strategy would benefit from the technological and policy perspective from Europe.

In Europe it is estimated that based on the application of technical measures (e.g. changes in processes leading to less water demand, higher recycling rates or the use of rainwater) can lead to estimated savings between 15 and 90% with a global estimate up to 43% of today's water abstraction[138]. A particular sub-sector of industry is electricity production. Electricity production uses large quantities of water for abstracting fuel and for cooling purposes in thermoelectric power plants. However, as usually a large proportion of the water abstracted in the energy sector flows back to the local environment, the benefits of water saving in this sector may be marginal.

The emphasis given to the industrial sector in the water saving debate in Europe has diminished over time, partly due to past decreasing trends of consumption figures and in many European countries, industrial water consumption decreased during the 1980s and 1990s. For instance in France, withdrawals fell from 5 107 Million m^3/year to 3 942 Million m^3/year between 1985 and 1995145. Various factors explain this decrease:

- Shifts and restructuring of economic sectors, e.g. major closures of the coal and steel industries that were high water consumers;

[137] Corporate Social Responsibility Europe: The European business network for CSR – http://www.csreurope.org/

[138] http://ec.europa.eu/environment/water/quantity/pdf/water_saving_1.pdf

- Stricter controls and charges on industrial pollution encourage industries to reduce volumes of effluents and water withdrawal;
- Water use legislation: since 1993 "closed circuits" for water use are compulsory for all new factories in the plastic transformation industry;
- Policies of individual industries aiming to reduce water costs and to present an environmentally friendly image. Industrial users appear to be more sensitive to price increase than domestic consumers are;
- Availability of new water saving technologies and their take -up by innovative and competitive industrial actors

At the same time, the European Environmental Agency observed that in some cases demand for better quality of products may induce higher water requirements. This has been particularly shown in the textile, paper and chemical industries. Denmark, Ireland and UK, for example, showed an increase in industrial water consumption during the 1980s and 1990s due to an accelerated industrial development.

Water remains of vital importance to many industrial sectors and is the most frequently used medium in industries. Industries that use large amounts of water include the paper & pulp, textile, leather (tanning), oil and gas, chemical, pharmaceutical, food, energy, metal and mining sub-sectors. To emphasise the importance of water for each of the major water using industrial sectors, the specific characteristics of the use of water are summarised below. Furthermore, important developments in the sector are given as far as they are relevant to water.

5.1.1 Paper & Pulp

In the paper and pulp industry, water is mainly used as a "carrying/transport/dilution" medium of the fibres. The major water related processes are washing, screening, bleaching and forming. Although much of the water is re-used in this industrial sector, the water related costs are still high. The total water consumption of the sector is 2,000 M m3 a year. Water related costs and the saving potentials are very high in the paper sector: water fees cover some 1– 2% of the entire production costs, energy 3-10%, additives 5-10%, fibres 4-8%. The product quality in relation to water is difficult to assess but is of course very important for the entire business.

5.1.2 Textiles

The textile and clothing industry consist of different parts. Water is mostly used in the textile finishing stage, which gives the products their final physical, visual and aesthetic properties. In the textile finishing industry, water is mainly used as reaction medium (dyeing, finishing) for washing/rinsing, heating and cooling. The development towards "smart textiles" requires high water quality in the future.

5.1.3 Food

In food processing, large quantities of water are used for different functions, namely washing/rinsing, reaction medium, cleaning of equipment and heat transfer. Also water is used as raw material (e.g. as part of the product). Due to very stringent hygienic standards, water quality is important to ensure product quality and safety. Much attention is given to a good quality of intake water. Until now, only drinking water quality is applied. However, the European legislation is changing, which offers possibilities to use other sources than drinking water, provided that 'the competent authority is satisfied that the quality of the water cannot effect the wholesomeness of the food stuff in its finished form' (Regulation EC 853/2004).

This makes closed loop systems feasible as well. The main point of attention is the microbiological constitution of the water. Other critical compounds in the water system are cleaning agents, pesticides, colouring and smelling compounds. In relation to water costs, in addition to water treatment, also cooling and heating losses are of importance.

5.1.4 Leather (tanning)

The manufacture of leather follows many steps. The major steps are: curing - lime soaking – dehairing – deliming/bating – pickling – tanning- retanning /dyeing/ colouring. In these steps large quantities of water are used, mainly for soaking, washing/ rinsing and dyeing. The tanning industry is a potentially pollution-intensive industry; environmental costs – mainly on water – are estimated at about 5% of the turnover.

5.1.5 Metal (surface treatment)

Metal surface treatment includes a variety of processes and metals. Some of the processes are not based on wet processes and are not relevant in the context of TWG3. The major wet processes are electroplating/anodising, phosphating, conversion coatings, surface preparation steps (e.g. degreasing), passivating or pickling. Both types of treatment use large quantities of water, mainly for cleaning/rinsing and as “solvent” for metals to be precipitated on the metal surface. The wastewater streams contain high concentrations of the metals mentioned. Other pollutants are oil, fats, dyes, pigments, corrosion inhibitors, complexing agents and cyanides. In the last decade, much attention has been paid to reduce the environmental impact of the wastewater effluents. The major developments in this field include the separation and advanced treatment of concentrated waste streams, the monitoring of bath quality and/or increase of bath lifetime, the reduction of drag out of bath liquids and drag out recovery, process-integrated measures, and the use of alternative raw materials with less toxic components.

5.1.6 Chemical/Pharmaceutical

The chemical industry is a very diverse business. The IPPC BREF distinguishes between different main branches, namely Large Volume Organic Chemicals, Large Volume Inorganic Chemicals, Polymers, Organic Fine Chemicals and Speciality Inorganic Chemicals. This indicates that there are plants that produce very large volumes of a few chemicals and others which produce small volumes of many different types of chemicals. Even though the total amount of different chemicals produced in the chemical industry is large, the ways to produce them are more limited. Water is essential in most chemical production. For a specific production, the choice of unit process(es) and unit operation(s), together with the choice of raw material and process equipment, define the need and use of water. Typically the majority of water will be used in the unit operations. Waste water is also generated in the unit process due to water in the raw material produced during the reaction or used as reaction media and/or to control the conditions for the process. The distribution of water use and emissions to water between the unit processes and the unit operations can vary widely depending on the chemical produced and the unit process chosen. Water is mainly used for reaction medium/solvent, product washing, cleaning of equipment and heat transfer (cooling, heating). As mentioned above, the contaminant concentration is not evenly distributed in the waste water streams. As a rule of thumb, 20% of the total waste water flow contains 80% of the contaminant load.

5.1.7 Oil/Gas

Water in oil/gas exploitation is used in drilling activities and water comes out as product water originating from the oil/gas resources. Critical compounds are drilling agents, salts from the oil/gas deposits, bio-toxic organics (PAH, BTEX), heavy metals, and sometimes high concentrations of biologically degradable organics. Since in future more complex oil/gas fields will be taken into production and legislation on water discharges will become more stringent, the need for water treatment technologies will increase. If the oil and gas section includes the energy sector (power stations) as well, the critical compounds should include components from the flue gas scrubber liquids (salts, nitrogen, biologically non-degradable (or slowly degradable) organics), nitrogen and heavy metals.

5.1.8 Mining industry

Mineral extraction, which is usually connected with the necessity of draining a working pit, is carried out using two methods: an underground method and surface (open pit) method. To some extent, the drainage water is irretrievably used for internal circle of the facility or pressed back into the orogen. Most of the water, however, is discharged to surface waters. Working pit drainage always disturbs the natural water balance - in the area of groundwater depression cones which may often be degraded. In surface watercourses, the flows are changed (usually raised, which in rivers containing municipal sewage can be an advantageous change). Unfavourable changes include increased salinity with chloride and European water saving potential sulphate salts, contamination with heavy metals and natural radioactive elements contained in groundwater. The techniques used so far are insufficient to remove salt from water effectively. Very often, in order to reduce the effects of salted water discharge, controlled dosage systems correlated with flow in rivers are built; their impact on water environment, however, is not well recognised. Methods for balancing costs of environmental changes and costs of constructing installations for mine drainage water management (or costs that must be incurred) are not worked out, either.

Obtaining good information on water use in industry is very difficult. Many company reports provide some water data, but they often fail to put these figures in their context, which makes their use and interpretation difficult. For many companies and industrial sectors, the availability of reliable and clean water is vital for operations. Recognising this issue, an increasing number of companies are expanding their annual or periodic reports to include information on water.

Overall, it is important to stress the different productivity of water in different industrial processes. Producing specific goods requires very different quantities of water. For example, the production of a computer chip requires 32 litres of water, while the production of a car (including all its components) requires as much as 400 000 litres of water. As a result, the industry sector is characterised by highly diverse production and valued added per unit of water. Average productivity of industrial water use for Europe (EU-15) has been estimated at 101 US$ per m3, ranging from a low 6 US$ per m3 for Luxembourg to a high 828 US$ per m3 Figure 22: Value added per cubic meter of water consumed and abstracted in Spain[139]

As mentioned earlier in most cases, water auditing of specific individual plants will be the starting point for identifying the areas where water can be saved and the most appropriate strategy/range of actions to be put in place for reducing water demand and increasing industrial value added per unit of water consumed. In many cases, and because of the very characteristics of industrial processes and the potential role of recycling and reuse plan, water

[139] Ministerio de Medio Ambiente (2007): El agua en la Economia Española: situacion y perspectivas. Documento
de Trabajo

auditing needs to consider both water quantity and water quality aspects – the need to reduce polluting discharges to the aquatic environment or to sewage systems is often the key driver to water saving.

Industrial grant programmes can also be incentives to the industrial sectors to invest in water saving measures. Such financial incentives can be administered at the level of water companies or cities. As an example, the city of Tempe in the USA offers financial support up to $20 000 (depending on the size of the project and expected water savings), a minimum of 15% reduction in overall water use being set as minimum target[140]

Also, eco-labelling and the application of ISO 14001 certification provides incentive to review water use and identify potential water savings. In wider Europe (44 countries), around 23, 316 companies had ISO 14001 certificates in 2002 – the largest group in the world far ahead of other regions. In the US, product certification is also applied and plays the role of incentive for industry to reduce water consumption[141].

The WaterSense product certification in the US[142]
WaterSense is a voluntary partnership programme sponsored by the U.S. Environmental Protection Agency. Its mission is to promote and enhance the market for water-efficient products and services. WaterSense helps consumers identify water-efficient products and programmes. It will indicate that these products and programs meet water-efficiency and performance criteria. The programme is partnering with irrigation professionals and irrigation certification programs to promote water-efficient landscape irrigation practices. It is also partnering with manufacturers, retailers and distributors, and utilities to bring WaterSense products to the marketplace and make it easy to purchase high performing, water-efficient products.

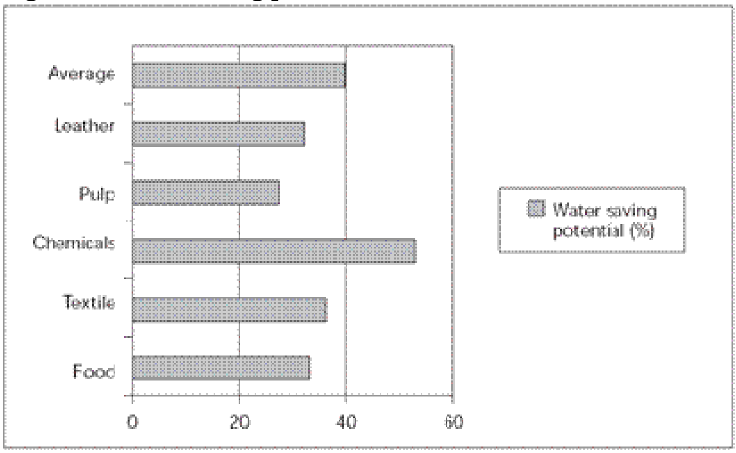
Similar findings were obtained in surveys in the United Kingdom for different industry subsectors:

- A survey in the soft drinks industry[143], a sector using around 25 Million m3 of water per year to produce 10 Million m3 (10 billion litres) of soft drinks, showed that good practices in terms of cleaning-in-place equipment, control flow rates to washing & cooling processes, immediate leak repair policy or steam, condensate management, water use monitoring or boiler management policy were already in place in 44%, 30%, 41%, 33%, 30% and 26% of the industrial sites, respectively. Interestingly, the same survey stressed that 38% of the companies responding to the survey did not know exactly how much water was supplied to their sites.
- A survey in the paper and board mills159 showed that many mills have introduced a range of measures to reduce water consumption. The percentage of interviewed mills who had already implemented water saving measures ranged from a high 81.5% and 78% for measures aimed at identifying water use and repairing leaks, to a low 19% and 22% for measures aimed at improving boiler management and washdown procedures. The average implementation rates of technical water saving measures amounted to around 30%.

[140] http:/www.tempe.gov/conservation/grants_industrial.htm
[141] United Nation Industrial Development Organization (2005): Water: a shared responsibility – Water and industry (Chapter 8).
[142] http://www.epa.gov/watersense/pubs/faq_cert-label.htm.
[143] Environmental Technology Best Practice Programme (1998): Water use in the soft drinks industry. EG126,

Water savings of between 40% to 90% can be expected on average (depending on industrial sub-sectors) if industry is given proper incentives. Few studies are available for the industrial sector concerning the impact of water saving measures in terms of volumes of water saved and cost implications. A study carried out by ICAEN for the Catalonia region in Spain between 1992 and1997155 shows potential water savings for different industrial sectors varying between 25 and 50% (see table)[144]. The same study stressed that around 35% of cost-saving measures were implemented in areas of management and control, 32% in the process and only 18% in the reuse of effluents.

Figure 1: Water saving potential



Possible water savings (average values) for different types of actions are presented in Table who stress that water savings between 40% to 90% can be expected on average (depending on industrial sub-sectors) if industry is given proper incentives.

Potential water saving from measures applied in the industry sector[145]

Efficiency measure	Percentage of water saved
Closed loop recycling	90%
Closed loop recycling with treatment	60%
Automatic shut-off	15%
Counter current rinsing	40%
Spray/jet upgrades	20%
Reuse of wash water	50%
Scrapers	30%
Cleaning in place (CiP)	60%
Pressure Reduction	Variable
Cooling tower heat load reduction	Variable

[144] Institut Català d'Energia. (1999): Gestió de l´aigua a la Indústria. Estalvi i Depuració.
[145] Envirowise (2005): Cost-effective water saving devices and practices – for industrial sites. Good practice guidance, Envirowise, United-Kingdom.

In summary, overall, there is significant water saving potential in the industry sector. It is interesting to note that sewage (compliance to effluent discharge requirements, sewage charges) is often the main driver explaining investments in water saving measures. Water savings documented in the literature stress the significant water saving potential in the industry sector. Reported water savings range from 15% to 90% of current water use, depending on the industrial sub-sector considered, the individual process investigated or the combination of water saving measures analysed with the most commonly found figures being within the 30-70% range.

6. Proposals for Reforms

Based upon the principal that all users of water need to take a responsible and caring approach to their water use, the growing requirements of industry for water need to be managed in a responsible manner by policy makers and industry alike. All have a duty to ensure that all other needs for water are respected.

There are many examples (some mentioned in this working paper, Australia, United States, United Kingdom and others in Germany and northern Europe) where work has gone on to promote and regulate water use in an industrial context, and these measures are undertaken in the context of a wider concerted action by Governments, NGOs and community groups to support wise water use by all society's water users. The measures recommended recognise that many industrial users of water do not pay or pay very little for their water use, and that the main motivation for conserving water used will be the lack of long term security in supply to meet their needs. Where the word "Government" has been used this means national and state levels of governance working together.

Specifically in the short term:

- Government Ministries need to commit themselves and their agencies to a programme of "leading by example", by undertaking their own audits of water use in their premises and setting targets for ensuring less water use waste and changes in behaviour that will reduce waste
- This should be accompanied by a statement at the highest level in national and state Government policy with a "vision" and commitment to the value of water which reflects the importance it places on all parts of society to demonstrate their commitments to wise water use. Industries and businesses are part of the wider society.
- The essence of a strategy for achieving a water conservation strategy in industry is a partnership between Government and industry; a partnership which will be formal and meaningful by setting targets and undertaking performance benchmarking with major industrial sectors.
- Working with the various industry associations and Confederation of Indian Industry, national and state Governments need to work with industry to develop a **forum** which will:
    - Provide information on industry specific good practice in wise water use
    - Undertake to develop expertise in water audits and water use advisory services
    - Provide details of "exemplar" case studies that are relevant to the different industrial sectors operating in India.
    - Provide a "gateway" for accessing information about water saving and water efficiency technologies in rain-water harvesting, recycling and reuse, water conserving devices and support to helping behaviour change.

- Many of the international examples have included programmes (UK's Envirowise for instance) in which Government provides funding for industry to conduct water use audits, in addition water utilities will provide "free" advice on water use to help industry reduce their water bills, but where industry is abstracting water a no or a nominal price the reduction of bills is of little incentive to reduce water use (see below).

The promotion of water conservation products and technologies has a useful role to play, but this goes wider that industrial use, and involves the use of water in all buildings especially in an urban context; WCs, washing machines, showers, taps etc. – many water utilities in the USA, Australia and the UK and Europe have introduced registers of products or "product labelling" that are considered to use less water than other similar category products.

In the long term industrial users of water, along with other large users of water including Government premises, need to be subject to the same regulatory requirements as other users, including those that relate to the introduction of abstraction licences, discharge permits and charging for water used if provided by a local water utility through a piped supply system. The charging and licencing system is an important measure that should assist Government meet its objectives to conserve water for all users and provide conditions for a sustainable economic outlook for industry to operate in the long term with the water it needs; and thereby provide employment and livelihood security for people.

National Water Resources Framework Study

Urban and Industrial Water

Working Paper No.10:

Water Utility Management:

Urban Water Supply Reform and Use of Private Public Partnerships

Simon Gordon-Walker and Anand K. Jalakam

Contents

Questions Raised

With regard to the reforms in the urban water supply sector the Planning Commission posed the following questions:

1) *What are the best examples of Private-Public Participation (PPP) that we may adopt practices from?*
2) *Can we specify the ways concession agreements need to be drawn up, outlining precisely what should never be done, what the positive non-negotiables are and what the desirables might be?*
3) *What are the main lessons from Indian experience with PPP in urban water supply?*
4) *Is it possible to spell out a roadmap for urban water supply reform in India?*

Managing a water utility at any time is one of the most important jobs and function of government – be it at a national, state or local authority level. Ensuring that high standards of water quality which are safe and reliably provided for citizens and other users of water is a critical function for a society to prosper in a healthy environment; and to be able to provide enhanced livelihoods and economic prosperity.

This paper includes a description of some of the main essential criteria that are likely to be required to ensure a successful policy of working with the private sector in water and sanitation. The paper describes the different types of public and private sector relationships that could exist and draws on examples from selected case studies. In terms of developing policy for the use of the private sector for water supply and wastewater projects it is crucial that lessons from past and existing PPP contracts should be incorporated. A number of good examples of poor and good practice exist. It is also important that the benefits of understanding how PPP have been taken up elsewhere are used to inform the political debate about PPP.

From "Charting our Water Future" (2009)[146]

"By demonstrating which measures have the greatest impact in delivering solutions, a robust fact base can also spur focused financial investments from the private sector as a key engine for reform. A number of approaches exist, from public/private water financing facilities, to public projects that create the space for private financiers to scale-up their investments, to innovative, microfinance solutions for end-users. Policymakers, financiers, conservationists, farmers, and the private sector need to cooperate to develop and promote innovative financial tools to ensure those willing to improve their water footprint are given the opportunity—and capital—to do so."

Some key elements for consideration in the development of policy are:

- Ensure that water and wastewater sector PPP arrangements are consistent with clear national objectives for PPP to support public sector infrastructure development. Also, as in Jordan, PPP and its different forms have been integrated with a clear set of objectives for policy in the whole sector.
- Ensure that the targets for the PPP are realistic, unambiguous and set in the context of verified data.
- Ensure the pro poor and community participation in the development of the PPP objectives because this will increase the chances of PPP success and achievements (see the examples of Johannesburg and Manila).

[146] Publication of The 2030 Water Resources Group which was formed in 2008 "to contribute new insights to the increasingly critical issue of water resource scarcity".

- Ensure that the PPP partner company possesses sufficient financial strength so it can sustain the investment over a 10 to 20 year period and endure.
- Any important tariff issues should be resolved early and a clear process of tariff setting be established. This process should be "free" from political interference and should be transparent for all parties – the PPP contractors, the regulator, but also including customers.

Without adequate management capacity within the governing institutions of the water sector, no reform processes can be entirely successful. The private sector cannot be contracted out without to some extent tackling failing management in the utility. Stakeholders over recent years have therefore spent more time and consideration in the development of policies and programmes that will deliver better management and improved capacity with water utilities. The emergence of new organisations from around the world which are willing to develop new forms of private public partnerships between water utilities are an important aspect to undertaking reform to meet the challenges of the future.

Estimated water sector investments requirements during 2012 - 2031 (2009-10 Prices)

Cost Indicator	Unit	Water Supply	Sewerage
Estimated Capital Cost	Rs. Crores	320908	242688
Per Capita Capital Cost	Rupees	5099	4704
Per Capita O&M Cost	Rupees	501	286

In order to generate, manage and sustain operations of this level of investment the 12th FYP aims to support States and municipalities develop well run water utilities and the features that often define a well-run water utility, whether fully public or one with some private sector involvement, include[147]:

(a) Operational Autonomy - being independent to operate professionally in the interests of all stakeholders, without arbitrary interference by others.

(b) Financial Autonomy and Clear Reliable Funding Sources - tariff policy that reflects economic cost of service provided, as well as clear and reliable subsidy mechanisms.

(c) Accountability - being answerable to another party for policy decisions, for the use of resources and for performance.

(d) Customer orientation - reporting and listening to clients.

(e) Market orientation - making greater use of markets and introduction of market-style incentives.

(f) Transparency - preparing accounts for independent audit to reflect true costs of operations.

The use of benchmarking and performance monitoring (audited) will be an important process to support this aspiration. This performance monitoring needs to include not just metrics but also indicators of management processes being used by water utilities.

[147] Characteristics of well performing public utilities; Aldo Baietti, William Kingdom, Meike van Ginneken; Water Supply and Sanitation Working Notes; Note No.9; May 2006

1 Introduction and background

The objective of reform in water supply utilities is to improve performance and water services to citizens. In doing so there is no “cut and paste” formula and the route to change for a given utility is unique, and there is no predetermined action plan of corrective measures that must necessarily be followed in sequence. However there is a broad process and some basic norms that are fundamental to success or, by contrast, similar actions that have helped to cause organizations to fail.

1.1 Why do many public water and sanitation utilities find it so difficult to be successful?

Water supply and sanitation services possess a number of characteristics that make the process of delivering good quality service and undertaking reform inherently political. Water has many social dimensions and is regarded as a public good.

Curiously, the other infrastructure sectors possess similar dimensions, yet tariffs are not politicised to the same degree as in water and sanitation. There is much more willingness to adhere to objectives of financial sustainability in the energy and telecommunications sectors, and in some transport services,than in water. So what makes water supply unique beyond these initial attributes?

First, unlike power and electricity distribution, water utilities can be gradually starved of resources without inducing a total collapse of service. Water services can decline over a long time frame before a total shut down would occur. In fact, many poorly performing water utilities are often relegated to a minimal standard of “life support,” where the enterprise is just barely recovering its operating charges and performing only essential maintenance. Therefore, service quality can drop considerably and still function, albeit poorly. However, withholding resources from the power sector will at some point bring about a complete and sudden stoppage of service, which may initially start with intermittent cuts when systems are overloaded. Such stoppages create havoc in any economy and its productive sectors, whether highly developed or developing.

Another main difference between water supply and the other service infrastructure lies in the characteristics of a typical consumer base, with power and telecommunications serving a higher percentage of business customers which are dependent on the service for their economic livelihood. Again, any stoppage in electricity service would have serious consequences on the productive sectors, particularly if the power grid spans the entire country. Water supply and distribution is normally confined to local geography and is typically owned by a municipal government. The other infrastructure services, however, are normally centralised “enterprises” overseen by central government regulatory agencies. Industry lobbying groups and business leaders are thus more motivated to apply pressure at the central level for improved services in the electricity and telecommunications sector than are consumer groups in water supply services. Generally, it is only in more developed economic environments (as it happening in India) that consumer groups begin to establish and strengthen as effective lobbying organizations at the local level.

Finally, although politics has much to do with the cost recovery problems of the sector, there is also a finance perspective to this. Many local politicians have used the excuse of affordability in resisting tariff increases, but countless studies have contradicted this because customers not only pay much more to informal water vendors, but also have voiced their willingness to pay if services were to improve.

The reality is that increases in customer tariffs to cost recovery levels would place added accountability with politicians to improve services as well as for them to come up the additional funding that would be required. Because the expansion or improvement of services will more often than not require a new injection of funds besides what can be generated from user tariffs, many political leaders foresee serious political risks in increasing tariffs if the counterpart funds are not there to fund the improvements—in a sense, holding up their part of the bargain with customers. It is interesting to note that in most of the cases, investment financing was provided through loans and grants from international financial and donor institutions. As such, in many of the poorer countries and communities where such financing is scarce or unpredictable, the safest political course is to hold tariffs down to keep customer expectations low.

For these reasons, local politicians, faced with financial constraints of short-term political objectives, tend to starve water utilities of funds to the extent they can, without being held accountable. They appease community with promises of holding down tariffs and effectively block the road to reform.

Political commitment to reforms is therefore viewed as the all important ingredient needed to initiate and sustain the process because it puts in check the behaviour of the "owner" when confronted with a policy trade-off that may be in conflict. Political consensus is essential to properly align both the social and financial objectives of the enterprise.

1.2 What are the characteristics of a successful water utility?

There are two aspects to this question; one is its performance in delivering levels of service to those it serves; and second is in the operating nature of the organisation that allows it to provide a good quality service and responsible management of water.

1.2.1 Performance in service delivery

Effective utility management can help water and wastewater utilities enhance the stewardship of their infrastructure, improve performance in many critical areas, and respond to current and future challenges. Addressing these challenges also requires on-going collaboration between government, industry, elected officials, and other stakeholders.

Quality of service: produces potable water, treated effluent in full compliance with regulatory and reliability requirements and consistent with customer, public health, and ecological needs.

Customer satisfaction: provides reliable, responsive, and affordable services in line with explicit, customer accepted service levels; receives timely customer feedback to maintain responsiveness to customer needs and emergencies.

Employee and leadership development: recruits and retains a workforce that is competent, motivated, adaptive, and safe-working. Establishes a participatory, collaborative organization dedicated to continual learning and improvement. Ensures employee institutional knowledge is retained and improved upon over time. Provides a focus on and emphasizes opportunities for professional and leadership development and strives to create an integrated and well-coordinated senior leadership team.

Operational optimisation: ensures ongoing, timely, cost-effective, reliable, and sustainable performance improvements in all facets of its operations. Minimises resource use, loss, and impacts from day-to-day operations; maintains awareness of information and operational technology developments to anticipate and support timely adoption of improvements.

Financial viability: understands the full life-cycle cost of the utility and establishes and maintains an effective balance between long-term debt, asset values, operations and maintenance expenditures, and operating revenues. Establishes predictable rates—consistent with community expectations and acceptability—adequate to recover costs, provide for reserves, maintain support from bond rating agencies, and plan and invest for future needs.

Infrastructure stability: understands the condition of and costs associated with critical infrastructure assets. Maintains and enhances the condition of all assets over the long-term at the lowest possible life-cycle cost and acceptable risk consistent with customer, community, and regulator-supported service levels, and consistent with anticipated growth and system reliability goals. Assures asset repair, rehabilitation, and replacement efforts are coordinated within the community to minimize disruptions and other negative consequences.

Community sustainability: is explicitly cognizant of and attentive to the impacts its decisions have on current and long-term future community and watershed health and welfare. Manages operations, infrastructure, and investments to protect, restore, and enhance the natural environment; efficiently uses water and energy resources; promotes economic vitality; and engenders overall community improvement. Explicitly considers a variety of pollution prevention, watershed, and source water protection approaches as part of an overall strategy to maintain and enhance ecological and community sustainability.

Water resource adequacy: ensures water availability consistent with current and future customer needs through long-term resource supply and demand analysis, conservation, and public education. Explicitly considers its role in water availability and manages operations to provide for long-term aquifer and surface water sustainability and replenishment.

Stakeholder understanding and support: engenders understanding and support from oversight bodies, community and watershed interests, and regulatory bodies for service levels, rate structures, operating budgets, capital improvement programs, and risk management decisions and actively involves stakeholders in the decisions that will affect them.

1.2.2 Organisation and governance

In general any successful organisation will adhere to using sound management practices, be they public or private. Most have been afforded a certain degree of external autonomy, although understandably, this autonomy in many areas is naturally limited, particularly in setting tariffs, procurement, and sourcing external financing. Moreover, the organisation managing the water utility will also have some authority to set pay scales or to downsize personnel. Nevertheless, the cases did reveal that most were capable of attracting and retaining qualified staff, implying that salaries may have been set along market references.

The legal authority bestowed upon a utility is often restricted in practice by the external environment. By their very nature, public utilities are part of a larger public finance formula that renders them dependent in many ways on the government’s overall fiscal situation and debt ceilings—and no utility is fully autonomous unless it is financially autonomous. At the heart of this dilemma is the paradox that resources may be denied to a utility not because of its own financial constraints but because of the government's overall fiscal situation. Working within this additional challenge is, in many ways, at the heart of the public sector reform process for water and sanitation. Beyond that, management is left to run operations as they deem fit, albeit with strong reporting requirements and prescribed performance objectives. In many cases, the government-owner has set specific performance targets that the utility must meet, along with a strong reporting framework including financial audits and annual and periodic performance status reports. It is not uncommon for utilities to put together business plans indicating their operational goals and performance improvement plans that are then monitored periodically during their implementation.

The organisational autonomy emanates from the utility's legal status and the governance system set up to represent owners and other constituents and stakeholders. Many of the utilities were organised as autonomous entities either by statutory law or by company law.

In many cases, particularly across Europe and North America, an "owner"-regulated framework has been adequate to ensure minimum service standards and an appropriate tariff adjustment process. Only Scottish Water, a public water utility is it overseen by an independent regulator.

All the utilities had a strong customer orientation, although few actually reported formally to consumer organization. PUB in Singapore established a Customer Advisory Committee from which it receives advice; in Scottish Water, consultation panels have been established by law to hold consultations with consumer groups. These bodies have no powers per se and act purely in an advisory capacity. The other utilities have demonstrated a strong customer orientation in a number of different ways, among others by carrying out service quality surveys, specifying consumer rights on contract documents that hold the utility accountable for certain service standards, or implementing more customer-friendly billing and collections systems.

However, it is not clear whether greater customer orientation is a determinant of well-performing utilities or one of its outcomes. It may simply be that well-performing utilities become more appreciative of consumer interests and needs, which in turn reinforces the objective for continued performance improvements. It should also be noted that most well performing utilities collect information on their customer base.

The analysis offers a better understanding of why public utilities can succeed like their private counterparts, and the case studies have demonstrated that many are functioning with sound management principles and practices. The case information has also provided much information on specific methods, processes, procedures, and approaches for improving performance in public sector utilities. Yet the case information also underscores the fact that utilities do not necessarily have to adhere to all that is prescribed in order to succeed. Each case is unique, with each utility possessing a mix of attributes that has worked for it in its own institutional and country setting. A good example is how PUB in Singapore has increased its efficiency through a combination of measures that include developing a culture of excellence within the organisation, a flexible personnel policy based on merits and qualification and extensive training.

How PUB in Singapore has improved performance through a Combination of Measures

PUB is a statutory body that has continuously improved its performance over the years. These improvements are being achieved through the development of a culture of excellence within the organization. Innovation is made possible by flexible and transparent hiring and promotion, a culture of learning, and transparent systems that put accountability and autonomy with departmental heads.

PUB recruits staff as and when necessary without specific constraints. Hiring and firing at all levels is based on merit and qualification. PUB determines its own salary scales using government salaries as guide. Staff salaries are competitive with those in the private sector. The chief executive officer is appointed by the board with the approval of the minister after consultation with the Public Service Commission. Other appointments are made by set hiring committees involving various management levels within PUB.

A systematic and objective approach is adopted for the career development of staff. The performance of employees is evaluated yearly through a staff appraisal exercise. Employees may be rewarded in the form of performance bonuses or promotions. Those who display high potential are groomed. Staff rotate within the organization to wider experience and perspectives. Poor performers are counseled and advised how to improve on their performance. If adverse performance persists, dismissal is an option. Absenteeism is low. Employee turnover is about 2.2% and this is mostly due to retirement.

An extensive training plan focuses on professional and competency development, as well as corporate culture and supervisory development. Emphasis is placed on the selection and training of frontline staff who come into direct contact with customers.

PUB is an organisation in which many operational decisions are made at lower levels. The PUB Financial Manual stipulates expenditure approval ceilings for various management levels. Internal communication is maintained through a set schedule of regular meetings. Business processes and systems – such as a performance measurement system and automated complaint tracking - are key to PUB’s success. All key business processes within PUB have attained ISO 9001:2000 certification. PUB outsources 25% of the operating budget following public procurement rules. Performance indicators are reported bimonthly to the Board of Directors and published annually in the annual report.

Source: WATER SUPPLY & SANITATION WORKING NOTE No.9 May 2066

Poland – public ownership and a variety of delivery solutions

Legislation on local government introduced in 1990 shifted ownership of, and responsibility for, municipal water and wastewater utilities to local governments, making them responsible for choosing appropriate forms of management, approving investment projects and finding funding sources for them as well as making decisions on prices and services. At first, municipal utilities were integrated into the administrative structure of local governments as so-called budgetary units, without any financial independence or their own budgets, allowing for municipal services to be subsidised out of the city budget.

Since individual municipalities decide by themselves how to manage the utilities, the organisational and legal forms of municipal water and wastewater companies vary considerably depending on the political and personal structure of their council. For example, some municipal governments regard the delivery of the cheapest possible services as their main obligation, without consideration for investment to, and upgrading of, the system. In these cases, prices of water and wastewater are set from a political perspective, disregarding market principles. It is common in these cities for budgetary units to be maintained, as they allow for the greatest degree of control by the municipality and enable services to be subsidised more readily.

On the other hand there are municipalities which corporatised their municipal utilities at an early stage with the objective to make them financially feasible, supporting the sector by creating a transparent and stable policy, allowing for sustainable growth and steady investment (OECD 2003). There are some 700 water and wastewater utilities in Poland, of which approximately 300 serve cities and towns in Poland. In most of the larger municipalities the water and wastewater utilities are organised as budgetary units or as companies in commercial law (OECD 2003, p.17). Most municipalities retain 100% ownership of the utilities operating on their territory, even those that have a legal status as companies in commercial law. There has been a trend towards greater cooperation and commercialisation of Polish water companies, creating new possibilities for utilities to become financially viable.

Source: OECD/DANCEE Programme (2003): Models of Water Utility Reform in the Central and Eastern European Countries. Simon Gordon-Walker, Swindon UK

1.3 Service Standards in India

India has about 1.21Bn (2011 provisional census) people out of which some 430m are living in some 4000 cities/towns. As against the overall decadal growth rate over 17% the rate of growth in urban areas is significantly higher due to the rapid urbanisation resulting from high economic potential generated from the cities and towns.

The urban water supplies in India are characterised by intermittent supplies often for some 2 - 4 hours of supply for few days in a week a service standard further deteriorating during the summer months. Even though Government of India estimates put the coverage of urban population at 91% (2003) but about half the urban households only have a tap inside the house and the balance population dependent upon public taps or local ground water sources. Even the population with access to house service connection need to cope with the limited low pressure water supplies with quality suspect forcing the households to supplement with indiscriminate exploitation of ground water resulting in rapid depletion of resources and avoidable investments by the affordable population in household level pumping, storage and treatment systems. About a quarter of the urban population either openly defecate or have limited access to un-hygienic sanitation facilities and about 45% of urban households have access to sewerage systems the remaining either resorting to onsite sanitation or toilets connected to storm water drains.

Large industries mainly electricity generation and chemical processing (fertilisers, refineries) requiring high volumes of water for the internal process, mostly depend upon resources allocated by the state from a surface water reserve and often supplement with local ground water. The medium and small industries depend upon the supplies from industrial development corporations or from local municipalities. The industrial demand met by the municipal utilities is very low at a maximum of about 3% of the total supplies in the city with the exception of industrial towns like Vizag, Tirupur, Dewas and Haldia. In times of water shortage periods specifically in summer months or drought years, the municipalities would first introduce water cuts to the industry that will generally turn to ground water or private vendors for water transported through tankers.

Table 1: Institutional structures in different states

Agency type	Jurisdiction	Responsibilities		Examples
		O&M	Capital Works	
State level Specialist Agency (SSA)	Entire state	SSA	SSA	Kerala
	Large cities	City level agency	SSA	Uttar Pradesh
	Small Cities	Local Government	SSA	Karnataka, Maharashtra, Tamilnadu
Public Health Engineering Organisation (PHEO)	Entire State	PHEO	PHEO	Orissa, Rajasthan
Metropolitan Water Board (MWB)	Metropolitan Cities	MWB	MWB	Bangalore, Hyderabad, Chennai, Delhi
Ring Fenced Municipal Department (RMD)	Large cities	RMD	RMD	Mumbai, Pune
Municipal Water Departments (MWD) with ULB Staff	Municipalities	MWD	MWD	Gujarath
Municipal Water Departments (MWD) with PHED Staff	Municipalities	MWD	PHED	Andhra Pradesh, Madhya Pradesh

Source: Anand Jalakam

All matters pertaining to urban water sector are mainly in the domain of State Governments and with the advent of the 74th Constitutional Amendment, the Urban Local Bodies (ULBs) have been obligated to ensure water and sanitation facilities to the residents. The current institutional structures in India are complex and vary between the different states. Table 1 below summarises the prevailing institutional structures in different states.

Table 2: Responsibilities for Service Provision in India

Function	GoI	SG	SPCB	UDA	SSA	PHED	ULB
Policy	√	√					
Planning	√	√			√	√	
Funding	√	√		√	√		
Asset Ownership							√
Resource Regulation		√					
Discharge Regulation			√				
Economic Regulation		√					√
Capital Expansion				√	√	√	
O&M					√	√	√
LEGEND							
GoI	Government of India						
SG	State Government						
SPCB	State Pollution Control Board						
UDA	Urban Development Authority						
SSA	State Level Specialist Agency						
PHED	Public Health Engineering Department						
ULB	Urban Local Body						

Source: Anand Jalakam

It can be seen from the two tables above, there exists overlaps of responsibilities among different stakeholders affecting the accountability of the service provider organisation.

The water works department currently embedded within the ULB (Urban Local Body) has very less autonomy and is affected by the day to day political governance contingencies. This situation is further affected by the lack of ring fencing of accounts and finances leading to poor internal financial governance of the utility operations.

Lastly and most importantly, the current staff working in the water works departments either belonging to ULB service or deputed from state PHED (Public Health Engineering Department) are governed by state civil service rules limiting the feasibility of incentivising or rewarding for their performance. This situation is further aggravated with the fact that most of states and ULBs have had no recruitment of staff for almost two decades and the utility either depends on un-qualified temporary workers or outsourced most of services on labour service contracts.

Since the mid 90's urban water sector in the country has been undergoing although slow and cautious but appreciable reform. The reform is both self-induced by the ULBs and promoted by Government of India under different reform linked programs like JNNURM and UIDSSMT. Simultaneously there had been many municipalities involving private sector through selective outsourcing and recently through delegated management contracts.

Many of the reform initiatives and programs are further detailed hereunder.

Reform under JNNURM Programme: with the recent implementation of Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT), Government of India's flagship reform linked funding programs; the ULBs have been incorporating the following mandatory and optional reform principles.

- Implementation of 74th CA
  (i)Transfer of responsibilities for water supply, public health, sanitation and Solid Waste Management to the ULB
  (ii)Transfer of responsibilities for city planning and service delivery functions to the ULB
- Instituting Public Disclosure Law
- E-Governance of all municipal services
- Incorporation of accrual based double entry accounting systems
- Levy of user charges for long term sustainability of services
- Encouraging water reuse
- Encouraging Public Private Partnerships
- Structural reform of decentralisation within ULB for effective service delivery

In addition to the above, reform recommends 100% metering of water supplies and volumetric pricing for financial sustainability of the services.

11th Five Year Plan: the eleventh five year plan while continuing the approach of the tenth five year plan set an ambitious target of achieving 100% coverage of population with urban water supply by end of the Plan period and recommended the following steps towards achieving this target:

- Introduction of State Ground Water Legislation based on the Model Ground Water Legislation
- Formulation of state water policy by respective state governments
- Special attention to cities and towns affected by water contamination under JNNURM
- Evolution of suitable strategies to meet O&M costs by State/ULBs, mandatory water metering along with levying of telescopic tariff
- Minimization of leakages and check on unaccounted water
- State governments/ULBs to take up reform measures under JNNURM
- Efforts to be made to step up the quantum of funds through alternative financing modes including institutional finance, pooled finance funds, FDIs, from multilaterals and PPP

National Urban Sanitation Policy: the Government has adopted the National Urban Sanitation Policy with a view to addressing the low coverage and improve the sanitation in the ULBs. The vision of the policy is that all cities and towns become totally sanitised, healthy and liveable and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women. Awareness Generation and Behavioural Change; Open Defecation Free Cities; Integrated City Wide Sanitation; Sanitary and Safe Disposal; and Proper Operation and Maintenance of all Sanitary Installations are the main goals of the policy.

Service Level Benchmarking: In 2010 the Government of India launched Service Level Benchmarking programme and rolled out to all the ULBs in the country.

Integrating the sector reform initiated under JNNURM, Government of India recognised Service Level Benchmarking (SLB) as an important mechanism for introducing accountability in service delivery and introduced 29 SLB indicators covering the water supply, sewerage, solid-waste management and storm water drainage sectors.

2 Types of PPP and options for PPP consideration

Many discussions of water sector reform focus on organisational issues – and a perennial favourite is Public Private Sector Participation and that these methods of organisational change can shape behaviour. But PPP or PPS is no "silver bullet" in the reform process and does not alter the need for current public sector monopoly service providers to improve their management processes or instruments of management - that is, the primary focus should be on instruments, rather than organisational forms. Organisations do matter, for example all well-functioning water systems separate the providers of services from the overall water resources management authority. But this is something that is much more about the instruments that govern the relationships between regulator and user than it is about new names and separation of cadres, the issues which too often occupy centre-stage in discussions of most water reform processes. The timing of a private sector relationship can present a paradox. Those countries most in need of an infusion of funds and increased efficiency in services, also typically require the greatest institutional improvements; while those countries less in need of PSP money typically possess an appropriate structure to successfully facilitate a PSP arrangement. Unfortunately, the lure of immediate money and the illusion of PSP as a cure-all can induce counties or states to seek contracts without first fixing institutional shortcomings, leading to failed contracts and exacerbating existing political and social problems. Countries need to recognise this reality and not put the PSP cart before the institutional horse.

Private investors have found the municipalities that retain service authority free from state companies the most attractive investments (no surprise there and probably an unrealistic prospect today).

The paper also considers the contribution of role of the private sector with in the Planning Commission's work on water sector reform. The paper covers the following contents:

- Providing a brief description of the types and forms of public private partnership.
- Understanding the requirement and motivations likely to be involved in any consideration to adopt a strategy that involves public private partnership
- Identification of any important criteria that would underlie a successful PPP implementation and delivery.
- Illustrations from case studies of the above; contained in the Annexes

A number of reasons can be identified for governments and municipalities developing water and sanitation management strategies decide to embrace the involvement of private sector companies. The motivation may not just be to raise investment. PPP can present opportunities to address issues such as limited technical and managerial capacities and inadequate commercial and cost recovery policies. Such deficiencies explain, in part, the poor performance and low productivity of many public water utility companies and the difficulties they sometimes experience in rapidly (a) expanding the service to non-served consumers; (b) improving the quality of service and the quality of drinking water provided; and (c) reducing the cost of service. Private companies are believed to be more efficient than public ones, because they react more to standard business incentives — i.e., the objective is to maximize profit, and they have professional and experienced management capacity to deliver efficiency. Their participation is often sought to address these issues and often used as a catalyst for raising the funding required to implement new investments in the sector.

PPP should not be considered as policy objective in itself and must be understood primarily as a means to achieve certain objectives within the wider water and sanitation strategy; seeking private funding for public water supply and or sanitation should be considered in this wider policy context. However it is true to say that a Government with a strategy to develop PPP relationships in the wider infrastructure context, is more likely to be able to provide the capacity resources in terms of contract and financial expertise and establish a regulatory environment that will deliver stable conditions for a successful PPP implementation.

The condition of the local state and national private sector capacity is an important factor in the Planning Commission's policies and strategy recommendation towards private sector involvement in water and wastewater serves. Private sector companies currently working as contractors to the Government in supplying infrastructure and engineering products and services will have a big role in underpinning wider PPP activities. The larger urban projects for example could become an important capacity building programme that allows local firms to play an increasingly important technical role in PPP in both rural and new urban areas.

Most water and wastewater utilities around the world are owned by public authorities but they generally have a long tradition of employing the private sector to design and construct public infrastructure. Countries that have a strong consulting engineering organisations and a large contracting industry are also well placed to use the private sector to support the delivery of their service improvements. Also those countries with strong economies have tended to fund these schemes, often using the private sector expertise, from their national budgets and from the charges they make to their customers. But in all situations, where investment and improvements in water and sanitation services are made there is no "free" money: PPP arrangements are made in order to manage the exposure and risks associated with the management and capacity improvement and in reducing economic and financial risk in delivering the investment. The types of PPP arrangements that exist can be described in the following way. For an overview see Table 4.

However before discussing the different PPP arrangements it is worth mentioning that in India, as elsewhere in the world, that water utilities already use the private to a significant extent and reach in their operations – and yet also retain public ownership and accountability.

Table 3: Selective Outsourcing in Water Utility Management already happens

Activity	Who	Sector
Planning	Consultants	Private
Design	Consultants	Private
Detail Engineering	Consultants	Private
Funding	Government/ Multilaterals	Public/ Private
Procurement	Consultants	Private
Construction	Contractors	Private
Supervision	Consultants	Private
Treatment Plant Operations	Contractors	Private
Annual Maintenance	Contractors	Private
Connections	Licenced Plumbers	Private
Leak repair	Contractors	Private
Valve Operations	Own Staff	Public
Meter reading	Own Staff/Contractors	Public/Private
Billing	IT Company	Private
Cash collection	Banks	Private
Contract Payments	Own Staff	Public

Source: Anand Jalakam

It can be seen above that most of the critical utility management functions are already outsourced to eligible service providers and many times the few senior engineers in the ULBs end up as contract managers. Under this background the utilities are now exploring to delegate the either the bulk supply or distribution management to eligible single service providers through performance based management contracts, a phenomenon which is transforming into public-private-partnerships with increasing capital risk to the developer-service providers. A brief review of the experience in public-private partnerships, in water services in India is presented in Appendix 2.

2.1 Service and Management Contracts

The most straightforward way to involve the private sector in the delivery of water supply takes the form of "service" contracts. Such contracts can be entered into for meter-reading, billing and collection, construction of connections or the operations and maintenance (O&M) of a treatment plant.

Service contracts, which require the contractor to provide short term assets only (vehicles, computers...) are typically of short duration (one to five years) and can easily be awarded after open competition among prequalified companies. Several utilities around the world already have service contracts, in particular for meter-reading and preparation of bills. In Santiago (Chile), the public water company, as part of its reorganization, has successfully encouraged its staff to leave and to create their own companies to provide services such as meter-reading and maintenance that were initially performed in house at a higher cost.

A "management" contract is basically a comprehensive service contract whereby a private company is contracted to provide a full service, including O&M of water production and distribution facilities, meter-reading, billing and collection. Management contracts typically are for five years and can also be subject to competition, among companies with relevant experience in the water sector. Under a service or a management contract (a) the customers remain under contract with the public water utility company, and the service or management contractor acts on its behalf, and (b) the service or management contractor is compensated by the public water utility company according to measurable quantities. While a service contractor is simply paid according to the quantity of work delivered (number of meters read or of bills issued), a management company is usually compensated or paid on the basis of a fixed fee and/or a performance related fee.

A four-year management contract for water supply and sewerage services was awarded after open competition by the Jordanian Government for the management of water supply and sewerage services in Amman. The Government of Ghana has also recently signed a management contract with an international consortium of Vitens (the Netherlands) and Rand Water (South Africa).

2.2 Concession and Lease Contracts

A concession transfers to the private operator (the concessionaire), typically for a 20 to 40-year period, the full responsibility for operation, maintenance and renewal of existing facilities, financing and construction of new facilities, billing and collection of charges from customers. The only revenue of the concessionaire is the charges collected from users, who are under contract with the concessionaire, and not with the public water utility company as is the case for service and management contracts.

Existing assets are put in the concession by the granting public authority, but remain its property throughout the concession. Usually, the public authority also becomes owner of the assets financed by the concessionaire as soon as they are commissioned, although, this sometimes happens only when the debt attached to these assets has been fully repaid. All assets, whether initially put in the concession, or financed by the concessionaire are operated, maintained and renewed by the concessionaire and returned to the granting authority, in good working order, at the end of the concession. The concession contract includes special provisions to compensate the concessionaire for those assets financed by the concessionaire that are not fully depreciated at the end of the concession. Typically, a concession contract is performance oriented and not construction-oriented; it is more appropriate to contractually require a concessionaire to meet service targets (number of connections, minimum pressure, water quality...) than physical objectives (a new treatment plant built by a given date). A concession contract should also spell out remedies the granting authority can have in case of non-compliance with agreed performance criteria.

Concessions have been granted for water supply and sewerage services for many years in Europe (France and Spain in particular), and were the preferred options for large cities in Latin America and East Asia and in Eastern Europe. Because the water sector is very capital intensive and long term and because financial viability of many water supply operations is not yet proven to commercial would-be lenders or equity investors, it can be difficult for a concessionaire to access private financing.

This is especially the case in countries where there is a perception that political risks are high. The "lease contract" (or "affermage") is a concession where the granting

public authority still is responsible for financing major extensions of the water production and distribution systems. In a lease contract, the private operator is often required to finance, in addition to the working capital, limited renewal of equipment, and sometimes extension of tertiary distribution networks. As in a concession contract, the customers are under contract with the lease contractor. The latter collects user payments and pays back to the public authority a rental fee set at a level sufficient to cover its operating costs, service the debt and contribute to the investment program. The performance of a lease contractor is directly linked to that of the public authority granting the lease. This may become an issue if, for example, delays occur in construction of a new system, or if the facilities built are inadequate.

Lease contracts are likely to be an option for operations that need to be improved but that are not sufficiently financially attractive for an operator to commit to a long term concession.

2.3 BOOT and BOT

When a concession contract is granted for a facility to be built (rather than for extension of an existing one) it is called variously a “build, own, operate and transfer” (BOOT) contract. BOOT has several variants such as BOT, where ownership of the facility is transferred as soon as it is built, or BOO, where the ownership of the facility remains with the private contractor indefinitely. BOOT contracts are suitable for new production and transmission facilities, such as treatment works and trunk main supplies, though not for existing distribution systems.

There are some significant differences between a concession for an existing facility and a BOOT contract for a new facility. The demand analysis is often provided by the public authority and the BOOT promoter often requires a guarantee against the commercial risk under the form of “take or pay” arrangements. This arrangement may cause problems if demand is significantly lower than expected or if increases of user tariffs are delayed. Also, all the BOOT financing has to be provided upfront, whereas a significant part of it can be generated from operations in the case of concessions. Thus, financing conditions of BOOTs are critical since commercial loans, in particular on the local market, are not always adapted to the financing of facilities of long duration, typically 20 years or more. While construction risks are usually borne by the contractor, foreign exchange and interest rate variation risks, on which it has no influence, have to be carefully assessed and properly reflected in the price revision formula.

BOOT forms of contract are well established in the water industry; Casablanca, the largest city of Morocco, has been supplied with water by a 2.0 m3/s/80 km transmission line (Oum R’Bia scheme) that was entirely developed and financed by a private company (Société Marocaine de Distribution or SMD) under a 50-year concession contract awarded in 1949. BOT contracts are also popular in Europe, for example the Brussels wastewater treatment plant, and a range of BOT projects that have taken place in Scotland

“Reverse BOOT” is an option where there are high economic or political risks, In the reverse BOT the government buys or builds the facility and then contracts a private firm to operate it. Over a period of time the private firm may decide to purchase the facility in instalments that cover the government’s debt service and management costs. By taking on much of the initial risk, governments can encourage more participation from private companies and lower the cost of that participation.

2.4 Other Types of PPP and private sector arrangements

Often public authorities are reluctant to transfer full responsibility of delivering essential public services to a private company, and seek possibilities of establishing "joint ventures" as an initial step of private involvement. For public water companies actively seeking financing for new facilities, the presence of a well-established private partner may provide the necessary creditworthiness. Joint ventures have sometimes been created for management or lease contracting companies, when the main objective is to improve management of the operations (Guinea). One of the main issues to be addressed is the potential conflict of interest of having the public authority as both the supervisor/regulator and the provider of service and the transparency of the decisions made.

A water supply company can also be sold or part sold on the stock market to private investors if the main objective is to generate revenues from the sale of public companies. The sale value of a water supply business depends not that much on the book value of assets, but much more on the discounted value of the stream of revenues, i.e., the level of rates the utility is allowed to charge and its track record in regularly adjusting them to reflect changes. In the case of outright sale, the role of the regulator is critical since a public monopoly is fully transferred to a private company.

Table 4: Simplified version of the different types of PPP contractual arrangements

PPP contract type	Asset ownership	O&M	Capital investment	Commercial risk	Tariff Collection	Typical duration
Service Contract	public	public/private	Public	public	public	1-2 years
Management Contract	public	private	Public	public	public	3-5 years
Lease	public	private	Public	opportunities for public/private risk sharing	private	8-15 years
Concession	public	private	Private	private	private	25-30 years
BOT/BOO	private/public	private	Private	private	private	20-30 years
Divestiture	private or private/public	private	Private	private	private	indefinite (maybe limited by license)

3 The policy motivations for Public Private Partnerships

The decision by a government to consider PPP in the water sector may be influenced by a number of factors. For example, a crisis such as a severe outbreak of water related disease, or a drought or flooding might prompt the government to consider reforms for the water sector, including the introduction of PPP. A financial crisis at the sector level, in which one or many water utilities were unable to service their debts might also prompt reform action from the government. A government may decide to engage in PPP as a result of a macroeconomic crisis, leading to reductions in government spending. In this context PPP in the water and wastewater sector is a part of a wider PPP policy that embraces other utilites and infrastructure services. Additionally, the level of indebtedness of a country is significant in determining PPP involvement.

This relationship generally exists in the following way: governments of more highly indebted countries find it more difficult to access credit, putting pressure on the government to engage in fiscal stabilization. Governments then reduce their investment expenditure on infrastructure as part of their stabilisation efforts as this is less politically costly than reducing current expenditures. In order to compensate for this reduction in infrastructure expenditure, the government often needs to turn to the private sector for project financing.

A second would be that countries with high levels of indebtedness are more likely to come under some pressure from the international financial institutions to whom they owe significant sums. This may be because countries which receive very large volumes of loans from multi-laterals are recognised as presenting a significant financial risk and are therefore less likely to be able to attract significant PPP involvement.

A third link between debt and PPP is caused by the effect of debt on macroeconomic risk faced by investors. More indebtedness raises macroeconomic and sovereign risks, discouraging investors from engaging in projects. It may well be that there is a balance between the effect of indebtedness on government demand for PPP AND the risk effect of indebtedness for the PPP investors.

The important “driver” for government demand for PPP, in the face of these economic pressures is the continuing need to increase urban coverage for water and wastewater services, and with this to meet the public health objective of increasing the quality of drinking water.

4 Criteria for a successful PPP arrangement

Although each country has its own set of specific issues to be addressed carefully, worldwide experience allows to draw some conclusions on what are the key points leading to a successful implementation of a PPP relationship. Increased PPP in water supply has better chances to succeed if (a) it is part of a comprehensive program of economic reforms; (b) political commitment at all levels of government is ensured; (c) consensus has been reached among the many stakeholders — various levels of governments, water utility management and staff, users and potential private partners; and (d) the public authority has defined clear objectives and put in place a clear decision making process. All options for private participation must be analysed; risks of all types (political, economic, commercial, technical and legal) must be assessed and appropriate mechanisms to mitigate them should be adopted.

In a study for the World Bank researchers say that the following important conditions need to exist for the private sector:

- Private investors will be more likely to engage in PPP where institutions support government commitment to upholding contracts or implementing established regulatory rules. The relevant institutions are: protection of property rights; enforcement of contracts; rule of law; ability of the bureaucracy to implement policies and rules; political stability; control of corruption.
- Developing country governments tend to engage in PPP when implementing measures that will improve financial discipline

- Governments will be more likely to engage in PPP where demands for increasing water supply or wastewater coverage or quality are strong
- Private water companies will be more likely to enter countries where household incomes are high enough to support 'willingness to pay' for water services.

The results are quite mixed for water sector PPP in many developing countries and over recent years there is an emerging trend of failures in the concession style of PPP. The list of contract cessations is growing, which includes some high profile PPP contracts such as Buenos Aires (Argentina), Atlanta (Georgia, USA), Manila (Philippines), Cochabamba (Bolivia), Jakarta (Indonesia), Nelspruit (South Africa), Kelantan (Malaysia), Mozambique, Nkokebde (South Africa), Conakry (Guinea), Gambia, Parana (Brazil), Trinidad & Tobago, Belize, La Paz (Bolivia), and Dar es Salam (Tanzania). In most cases, these projects were confronted with controversies relating to high price increases, significant political antagonism towards the private contractors and problems relating to non-payment from consumers.

Also this has led to the major water companies (like Suez, Veolia, and Thames Water) withdrawing from concession style contracts in developing countries as result of the economic and financial crises (Asian crisis, peso crisis in Argentina, natural disasters). Most of the long term privatisation partnerships were started during a stable periods and it was assumed that there would be long term macroeconomic stability and sustainability. In some cases the implicit assumptions of such stability and sustainability proved to be difficult to reconcile with changing political circumstances (Argentina, Philippines, Brazil). The cause of the problems seem to be that during times economic instability, it is very difficult to calculate a tariff that is appropriate for the private operator and at the same time affordable to the disadvantaged consumers and acceptable to local political opinion. This conflict between the expression of local political opinion, which often over rides the local regulator's independence and the commercial requirements of the private companies, has tended to be at the centre of the problems experienced by PPP contracts.

Some key areas that influence the success of PPP contracts are; the level and constancy of political support, the role of regulation, the setting and regulation of tariffs.

4.1 Regulation

There is general agreement that regulation of the water service utilities in developing countries is essential, but that regulation is too often limited and constrained. For effective and equitable regulation it is important that symmetry of information exists between the regulator and the regulated company. Regulators tend to be less well informed about the costs and quality of the water system operations than the water company management. This asymmetry of information is difficult to resolve within the context of a "commercial" contract which includes clauses on commercial confidentiality and where the regulator, usually in the public sector, often lacks expertise and resources to make rational decisions and to pursue detailed investigations.

A lack of transparency, accountability and good governance, can also foster inefficiencies and corruption in water service provision. It is argued that foreign providers of PPP can also exploit poorly regulated markets and that this can lead to corrupt practices between the foreign providers and government officials where there is scope for malpractice throughout the contracting process from bribes for contract awards to renegotiations to avoid contract penalties.

4.2 Financing

The main financial principle of water sector reforms and private service provision is cost recovery to enable financial sustainability. However, there is often concern that through PPP cost recovery will be achieved at the expense of the poor. The two issues often discussed in this context are the price of water services and financing strategies.

4.2.1 The price of water: Opponents of PPP argue that prices are higher than they need to be in PPP and customers who can't pay are frequently cut off. It is also claimed that purely public utilities can always be cheaper as they do not have to make profits to pay dividends to private shareholders. However, those in favour of PPP also point to the fact that through service extension to more poor people, the price of water can actually fall due to less reliance on the informal vendors who charge extortionate rates, meaning that the poor generally end up paying more for water when they are not connected. It is believed that there is a willingness to pay a reasonable economic price for water services providing it guarantees quality and availability.

4.2.2 Financing strategies: The financing strategies of foreign providers have been accused of being too risk adverse to address the complexities of poverty. This is crucial since any discussion on the role of foreign providers is all about increasing the availability of safe water to those who, through poverty, do not have this access. It is recognised that the capital cost contributions paid by communities can be effective and beneficial in terms of raising finance and creating a sense of ownership and responsibility for improving water services. Pro poor groups are wary of cost recovery through PPP because of the belief that there are insufficient payment methods available to provide a good service at an affordable price to the poor. Foreign providers have used cross subsidies with and without success. In Buenos Aires, the contract awarded to Aguas Argentinas resorted to cross subsidising, surcharging more affluent users for non-essential usage in order to extend services to households who could not afford to pay for services. This was met with opposition from the better off who did not want to pay the economic price for piped water supplied for non-essential items.

Financing improvements in water and wastewater services will not come "free" from costs; however PPP provides a mechanism for a private firm to take some of the risk in raising finance and in becoming a catalyst for finance that many governments might find it difficult to undertake. What is critical to the successful implementation of a PPP strategy is that the burden of financing new and improved infrastructure is allocated in a fair and transparent manner, and that this is supported by a regulatory framework that will ensure this balance is maintained throughout the duration of any contractual agreement.

4.2.3 Community or public participation and pro-poor strategies

Community participation is widely acknowledged, especially by the leading international financial institutions (IFIs), as a fundamental element in the development of a sustainable water service in developing countries. It is said to create a sense of "ownership" and willingness to pay amongst the community for the project at hand, which in theory improves the care and use of their new service, as well as providing a service tailored more closely to their needs. Certainly, in rural and small towns, this is the main approach of leading NGOs in the sector such as WaterAid.

Through the Water and Sanitation Program, the World Bank advocates the active participation of communities in the development of reform strategies and business plans for water utilities in developing countries to increase tariffs, without being called to account. The regulator may also be required to implement government policy in respect of subsidies.

In practice however, in many parts of the developed and developing world, community participation has never seemed to have been sufficient in the public or private sector. The urban poor in developing countries often live in informal areas without land tenure and are invisible to urban planning authorities. It is recognised that foreign providers face greater barriers to involving the community than the local and national authorities, mainly because of language, cultural and geographical reasons.

4.2.4 Setting and regulating tariffs

There are three principal reasons for regulation to affect tariffs: the first is the downward pressure on tariffs exerted by the regulator. This may give rise to lower prices for some customers and higher prices for others. The second is the upward pressure on tariffs due to the cost of levels of service improvements which effective quality regulation should achieve. It should be the regulator's objective to ensure that these costs are met by improvements in the service provider's efficiency, but this may not always be possible. The third is the cost of regulation itself. If the regulators are funded by levies on the service providers, this cost is likely to be passed directly to customers. Price increases can be minimised by providing low cost regulation and applying realistic levels of service. But the most significant effect on prices can be achieved through efficiency improvements by the service provider. This requires effective regulation to ensure, first, that efficiency benefits are achieved and, second, that they are passed to customers.

To assure financial viability, tariffs should be set at levels which reflect the full cost of providing water services including the cost of efficient operations, an allowance for depreciation of assets and a fair return on assets. The tariff structure should promote conservation of scarce resources (e.g., through a charge for extraction of water resources) and should also be reasonably easy to administer. In addition, because water is a basic need, water and sewerage tariffs are frequently used as a tool of social policy, and this complicates the matter considerably. With so many objectives to meet, there are inevitably conflicts, so regulators must make judgements about the trade-offs among efficiency, social goals, and administrative simplicity. For example, regional or national uniform tariffs, which may be adopted for social or political reasons, do not reflect the difference in the cost of providing service to different areas and therefore are not necessarily consistent with efficiency objectives.

4.2.5 Direct subsidies vs. cross subsidies: Subsidy programmes which are financed from general budgetary resources and which target individual households directly are probably preferable to cross-subsidies, because they can be limited to qualifying households and do not negatively affect other consumers. Cross subsidies (whereby higher income households and industrial and commercial consumers pay tariffs which are higher than the full cost of service so that low-income consumers may pay lower tariffs) appear to be more prevalent. Their disadvantages are that the higher tariffs which must be paid by some users may discourage water use for economically desirable activities and reduce overall demand for water, and therefore revenues. Cross subsidies should be designed so that social, economic and financial impacts are taken into account and a reasonable balance achieved – tariff policies consistent with the universal service objectives and that provide protection to the poor are key to this.

4.2.6 Maintenance and technical standards: There is a risk that a delegated operator which does not own the infrastructure, or otherwise bear the cost of its degradation, may try to maximise profits by neglecting maintenance and compromising technical standards when making repairs. On the other hand, an owner which leases its system to an operator may want to set maintenance standards unrealistically high in order to avoid the cost of replacements. Appropriate maintenance parameters are needed to balance the interests of the two parties.

4.2.7 Promoting efficiency: The tariff should reflect the cost of service which is operated efficiently, broadly accessible to urban inhabitants and of a quantity and quality which are appropriate to the local context, taking into account factors such as the availability of water and the income and preferences of consumers. The tariff should be adequate to cover operating costs, depreciation and return to capital. It should motivate consumers to use water services efficiently and to use them for purposes which produce the highest net benefits. The fees of service providers (operators and owners) should be adequate to cover reasonable costs and low enough to motivate them to look for ways to reduce costs.

4.2.8 Ensuring fairness in compensation of multiple operators: The tariff is what consumers pay for service. It may also be the revenue of the service provider, but this is not always the case. Under some arrangements, the tariff may be divided among one or more entities (e.g., a treatment plant operator – say under a BOT scheme and a distribution operator) with each receiving a fee to cover the cost of its operations. In addition, if the operators do not own the assets, the owner would be paid a fee for the use of the assets. Regulation is concerned with both the tariff as a whole and with the fees each operator and owner receives. All should be fair and motivate efficiency. If tariff revenues must be divided among two or more parties, then adjustments in the tariff as a whole could reflect justified changes in any of the cost categories, and procedures for allocating tariff revenues should be equitable so that none of the parties is unfairly disadvantaged by an adjustment in another's remuneration.

4.2.9 Performance incentives: To promote efficiency, a service provider's remuneration could be based in whole or at least in part on performance. The service provider must have some control over the parameters to which its remuneration is linked, and this varies from one arrangement to another. Examples:

- For support services: unit rates for work completed.
- For full operational contracts: the operator's share of collected tariff revenues and collected connection charges, minus total operating costs.
- For BOT operator (e.g. treatment plant): guaranteed minimum volume multiplied by operator's fee per volume.

Setting the initial fee: Awarding an operational contract on the basis of competitive bidding for the fee to be charged for services is an effective way to set the initial fee, but it does not eliminate the need to establish some regulatory or oversight capacity to monitor the operator's performance and negotiate fee changes during the life of the contract.

Establishment of clear rules concerning procedures to solicit and evaluate proposals, and to approve and enforce contracts is an essential element of the overall regulatory framework that helps private contractors to assess the risk that they would be taking and the corresponding premium they would charge. Although contracts provide self-contained regulations, it is clear that the set-up of a regulatory agency, independent and competent enough to negotiate and supervise sometimes highly qualified and powerful companies, is often a necessity. The current tariff levels and the track record in adjusting them are key factors in making a particular "project" or contract attractive to private lenders. Experience has shown that if the tariff has to be increased, this should happen before private proposals are invited.

Labour redundancy may in fact be the most sensitive issue to address from the very beginning of the analysis of options for PPP. Experience (as in Chile) has shown that aggressive promotion and attractive early retirement packages to be financed by the Government, the private contractor or both, help solve this problem; however, often surplus staff are again required with expansion plans, and need not be dismissed. The role of the public agency which has been partially or totally privatised must be clearly defined, to avoid misunderstandings and/or overlapping responsibilities. Transitional arrangements, such as the collection of bills sent out before the function had been privatised, have to be well defined also.

Table 5: Important criteria to ensure a successful PPP

	Management contracts	**Lease contracts**	**Concession contracts**	**BOT or BOOT contracts**
High levels of political commitment and consistency for the PPP strategy and its implementation	**3**	**3**	**3**	**3**
Establishment of an independent regulator with significant resource and capacity	**2**	**3**	**3**	**2**
Preparedness to undertake tariff reform during the early stages of a PPP contract	**1**	**2**	**3**	**2**
Community consultation and support during policy formulation and during implementation	**3**	**3**	**3**	**2**
A meaningful and priority approach towards ensuring affordable access to water and sanitation services – a "pro-poor" policy	**3**	**3**	**3**	**2**
Establishment of open and transparent processes for contract award and negotiation	**3**	**3**	**3**	**3**
Formulation of targets that are in the control of the PPP contractor and reflect strategic outcomes required by the PPP strategy – "simple, understandable, reasonable"	**3**	**3**	**3**	**3**

Key: 3: essential 2: important 1: desirable

At the same time effective and efficient institutions do take time to develop, even in developed economies. It is argued that developing countries have indeed established regulatory institutions on paper, but in reality they are sometimes ineffective. So there seems to be a need to allow sufficient time for the development of good performing institutions that would protect the consumers, operators and the government. Taking this concept further, the World Bank (2006) published a Toolkit on how to involve private sector in water services. It is argued that by involving the private sector in the provision of water services, governments will widen the reform benefits. More precisely, the private sector can create a focus on service and commercial performance, making it easier to access finance and to ensure long term sustainability. However the Toolkit also cautions that there is no free money, no unlimited risk-bearing, and that government regulation should continue.

5 Proposals for reforms

The following are the key elements of the proposals for reform with in the WSS sector:

- An acceptance by politicians and senior government personnel that the water supply sector in urban and rural areas needs to adopt the principles of sound business-like management and planning for its water utility entities
- To provide incentives through performance monitoring benchmarking for water utilities to develop “business planning” in order to ensure more effective water utility management for the planning of operations, investments and finance in a sustainable and affordable way, and
  - Providing a means to share information with employees, customers, political leaders and potential investors, so that there is agreement on the utility’s plans;
  - making sure that investment decisions take account of what consumers want and are prepared to pay for;
  - ensuring that revenues are sufficient and that the utility is financially sustainable;
  - helping the utility to monitor financial and technical performance;
  - supporting performance-based contracts with employees or a private operator, by helping to identify and agree on performance targets; and in
  - supporting activities needed for performance improvements, such as water quality monitoring, benchmarking, and external audits.

(For water supply utilities, business planning is the process of outlining how the utility will develop over time to provide the level of service required by its customers, owners and regulators)

- Municipalities and states need to embrace other approaches to improving water services. These approaches are characterised by decentralisation away from central state government and by greater autonomy. They include community water associations, town Water Boards, and possibly small-scale private water companies. Also, aggregated approaches are being tried, including existing, larger utilities absorbing smaller towns, and through creation new regional entities.

- Adopting a greater degree of end user consultation rather than standardised approaches that do not meet their needs. management to be state-focussed incorporating river basin management principles and practices;
- Utilities are now exploring to delegate either the bulk supply or distribution management to eligible single service providers through performance based management contracts, a phenomenon which is transforming into public-private-partnerships with increasing capital risk to the developer-service providers; the examples from pilot projects and initiatives described in Appendix A2 and the body of this report (such as in Scotland or Poland) need to be built on.
- The reforms under JNNURM, for ring fencing of water utilities needs to be strengthened to include “corporatisation” and has been underway in many states such as Orissa, Rajasthan, Gujarat and in some of the ULBs in Maharashtra state. Nagpur Municipal Corporation (NMC) has set up Nagpur Environmental Services Limited (NESL) a wholly owned subsidiary as an operating company to provide water, sewerage, solid waste management services to the citizens; and there needs to be greater replication in order to support the achievement of well-run water utilities that will provide India’s citizens with increasing service access and quality.

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Appendix A1: International Case Studies

The case studies discussed below have been used to highlight different types of PPP and different operating conditions. The case studies reviewed are:

- Jordan, the Amman management contract and associated national PPP projects
- South Africa, the Johannesburg management contract
- Philippines, the Manila concession contract
- Armenia, the Yerevan, management contract
- Mozambique water sector reform

The case studies are important in order to provide a reference to some of the lessons of PPP activity and as part of the evidence base for the criteria likely to underpin a successful PPP policy implementation. Despite this important goal, many of the facts that are available are not always from impartial or independent sources and are often obscured by commercial confidentially where those PPP contracts are still running, especially in the case of concession or lease style of contracts.

A1.1 Jordan – Amman management contract

The reform process in Jordan is interesting and useful because it illustrates the way in which a national strategy aimed at dealing with the potentially critical problem of water shortages, can be developed to create a "mix" of PPP solutions to tackle the investment and management capacity needs in an integrated manner. For Jordan, "water scarcity is the most important natural constraint to Jordan's economic growth and development…" (Ministry of Water and Irrigation); so the strategy for water management was of national importance and received a high level national political commitment. The approach reflects an integrated policy of water management from water resource development through to a profile water saving initiatives for the population.

The Government of Jordan embarked upon its privatisation programme with the goal to increase the efficiency of management and attracting private investment into the economy as a whole, much like Egypt is doing. The water and wastewater sector was included in this national private sector strategy. The Ministry of Water and Irrigation entered into management strengthening programmes for all water and wastewater related services and management contracts were the preferred option for Jordan's water supply sector. The control and development of the sector was vested in a new body called the Water Authority of Jordan (WAJ).

In 1999 the WAJ entered into a management contract with a consortium LEMA, led by Suez, for four years, for all water and wastewater related services in Amman Governorate. This contract was extended for a further two years in 2004. The stated achievements of this contract have been: higher revenue collection rates, reduced unaccounted for water; improved customer service, particularly relating to reduced response times and improved maintenance of the network; and much improved management capacity. No specific quantifiable details exist; however, one of the main achievements of the contract has been that it has become a catalyst for a massive injection of international finance from USAID, the World Bank, the EU and from GTZ and KfW.

Other PPP activities are also being undertaken and these include:

- The As-Samra Wastewater treatment works under a BOT, 25 year contract at an estimated cost of $155m
- DISI BOT project which is a 40 year contract for a water conveyance system at an estimated cost of $600m
- Zara Ma'en water desalination project on basis of a design, build and operate contract at an estimated cost of $120
- Aqaba water company established as a corporate state owned company
- A management contract for Northern Governorates

MWI has considered other options for the largest wastewater treatment plant in Jordan (Al-Samra) as a Build-Operate-Transfer (BOT) system with a consortium led by an international company, and awarded a management contract to a consortium led by international company for the four Northern Governorates of Jordan (Irbid, Ajloun, Jerash and Mafraq), who started the implementation in May 2006. MWI is studying the establishment of public companies for other water and wastewater services in other areas throughout the Kingdom.

Although it has been impossible to get details about the final performance of the contract, it is clear that the Government has been very satisfied with the results and is continuing to develop and expand the opportunities for further PPP involvement. The performance results after three years indicated the following key areas of improvement:

- Very significant improvements have been made to the financial performance of the utility since LEMA took over operations. Revenues increased and expenses decreased, thus improving net income.
- LEMA has replaced about 140,000 old or defective meters of different sizes over the last three years. This has substantially improved confidence in the accuracy of metering. The number of customers appealing bills is now in line with international standards.
- The maintenance of the water network has been improved. The response time for leakage complaints is reduced to about 6 hours, compared to about 72 hours at the start of LEMA's contract in 1999.
- LEMA has also set up an IT system with about 140 personal computers spread across the business; all interconnected by local area networks or wide area networks. Internal e-mail is now widely used by all managers, and the network is used to share data and run internal reporting.

Key points:

- PPP must be considered as one of a number of methods for generating improvement in the management and performance of the sector, in order to meet the long term goals of the Government

- The Government had developed before and in time clear policy objectives for the water and wastewater sector, that were both integrated and supported by effective institutional reform

- The use of expertise through the robustly established and supported PPP framework, provides a strong incentive for international donors and PPP partner companies to invest in the sector and in the specific PPP related projects

- Input related targets for a PPP are not sufficient, for example money spent on new IT systems must be able to demonstrate their value by contributing to improved management performance and this must be demonstrated

A1.2 Johannesburg, South Africa

As part of a major restructuring process in the late 1990s the city corporatised 14 public functions in 2001 in order to devolve operations to separate companies. The intention was to improve on the efficiencies of how these core services were run. The City remained the owner of Johannesburg Water, pty, (JW) and delegated its shareholder responsibilities to an appointed board of directors. The Contract Management Unit was set up as an in-council multi-sectoral monitor to oversee the service delivery standards of Johannesburg Water.

The early problems associated with this corporatisation model were rooted in the governance of this institutional arrangement. First, the autonomy of Johannesburg Water is limited by the shared services it has had with the city, such as billing, credit control and meter reading functions for the bulk of the city's residents. The inability of JW to take control over these functions seemed to undermine its ability to deal with critical areas related to improving the revenues of the company. The city has learnt an expensive lesson in retaining functions that it itself has been unable to improve and as such, is only after the completion of the management contract that it was able to transfer the revenue functions over to JW. Second, the authority of the Contract Management Unit, as a quasi-regulator was limited by remaining a department within the City Council. While the CMU might have benefited from the proximity to political councillors, it is nevertheless constrained in passing judgment on the behaviour of Johannesburg Water because it would have had to navigate through political and bureaucratic sensitivities.

The CMU capacity problems were rooted in a lack of human or financial resources to operate effectively. These difficulties were compounded by the lack of information at the CMU since the bulk of the expertise migrated to Johannesburg Water when it was created. The outcome of this situation left a vacuum of specialized knowledge within the city, a necessary feature for providing effective oversight.

The autonomy, authority and capacity issues of the regulator have created a difficult environment for the city to develop enforcement mechanisms for its contractor, Johannesburg Water. A second outcome of these regulatory difficulties was the proximity between the City and the Board of Directors it appointed to represent it as shareholder. The former outlined clear equity objectives that are driven by political will, while the latter interpreted these objectives narrowly as it has prioritised efficiency objectives with the intent of making Johannesburg Water more commercially viable. Johannesburg Water (JW) was formed as a utility company mandated to provide water and sanitation services to the residents of Johannesburg. JW took over the assets from council necessary to undertake this. Over 2500 employees of the city transferred to JW. JW purchases water in bulk from Rand Water, and then takes it to the residents and businesses of Johannesburg through a network of over 8000 km of distribution pipes and over 100 distribution reservoirs and water towers. Further, JW collected all waste-water through a network of sewers, and treats this at one of six treatment plants before discharging back into the river system. JW did undertake the commercial function of metering, billing and collection -this was done by the Finance Department (Revenue) of the city.

In 2001 JW entered into a management contract with an operating consortium - JOWAM (comprising Ondeo Services, France - part of the Suez group, and its subsidiaries Northumbrian Water Group, UK, and WSSA – of South Africa). Under this contract a team of twelve people initially - reducing to two over time, provided expertise in critical areas whilst the capacity of the utility was being developed. JOWAM assume some of the operational risk under this performance based contract and in practice fill various executive management functions within JW for periods ranging from 18 months to 5 years. An independent Board of Directors appointed by the city in its capacity as the sole shareholder governed JW.

The key strategies envisaged by the PPP relationship were:

- Capacity building within organisation through training, restructuring and focus, and targeted recruitment
- Targeted and increasing investment programme in rehabilitation and asset replacement and network expansion
- Metering all formal areas of the city, not the so called informal settlements
- Introduction of free essential water programme from 1July 2001
- Assume responsibility for full customer management
- Use procurement to promote empowerment and labour intensive construction

The single biggest technical challenge facing JW was the high UFW rate, which was estimated at 43 per cent when the company was created in 2001. This problem was linked to both commercial and technical losses. The reasons for the former were in large part due to the inability of the company to take control of its revenue functions related to high non-payment rates unmetered areas that happen to coincide with previously disadvantaged township areas. JW undertakes the commercial function of metering, billing and collection for its top 14,000 customers, which accounts for 30 per cent of JW's turnover. While JW has been reported to have made improvements in the quality of the data and billing for these customers, it was unable to do the same for the service users that were still being handled by the city's Revenue Management Unit. This put JW in a situation where it was powerless to improve the efficiency of revenue collection functions, an area where it certainly had the ability but not the authority to do so. In early 2004, the city agreed to transfer an additional portion of JW's customer base so that it could have control over 60 per cent of its revenues.. By the end of 2005, the final transfer of functions such as meter reading and credit control were supposed to have been completed and this open up a significant opportunity for the company to improve its revenue collections and, by consequence, its financial situation.

Outputs	**Targets**
Unaccounted for water	Reduction from 43% to 24% over five years
Operations	Reduction in environmental spillages on a per annum basis. Initially the measurement system has to be developed. Restructuring all operations to achieve focus Improved monitoring of water quality Plant utilization improvement - initially to set in place a measurement system, then to agree targets. Most important is the sludge handling facilities
Customer services	To establish an interim call centre for non account complaints by July 2001 To develop the capacity to take over the 10000 top customers by October 2001 To develop the plan to take over the remaining customers by December 2001 To take over and re-bid the meter reading contracts become accountable to JW by November 2001
Human Resources	To restructure the entire organisation by September 2001 To regrade the new structure by December 2001 To address the parity problems by December 2001 To develop a number of policy reports from July 2001 To comply with the requirements of the Equity Act, Skills Development Act
Capex and Development Planning	To provide an efficient service to developers and planners To deliver the capital programme efficiently and timely.
Social Programme	To commence the delivery of essential free water from July 2001 To utilise the farms to provide opportunities for eco-tourism and increased social mobility

Source: Ref: Dept of Water and Forestry (DWAF)

JW achieved a 100% collection rate due to the accrual of historical arrears from its largest customers such as schools and government departments. This collection rate compared favourably with the poor performance of the city's billing department for the remaining JW consumers, which is on average between 67% and 75%.

The company also had a major target to improve leakage levels and in doing so decided on a strategy to combine a one-off repair of indoor plumbing fixtures to reduce leaks with the installation of prepaid meters as a novel approach to address both commercial losses through non-payment as well as physical losses. JW claimed that unless these two issues were addressed, the company would have faced high financial risks. However this did create a controversy surrounding installing prepaid meters in an area with high levels of poverty and the policy of "free allocation of water" to the poor. The free allocation of water is cross-subsidized in several ways and when the policy was first implemented, Johannesburg incorporated a 5 per cent real increase on industry and high-income users for the 2001/2002 financial year. The next year, the utility targeted the second block of domestic consumers by raising the cost of water by 32.5 per cent for households consuming 10 kilolitres (see table below) as many low-income households have historically fallen into this category of consumption in terms of affordability, this is did raise political controversy about the PPP.

Key points:

- Targets to be set for the PPP partner must be those in which the contractor can have full control over.

- Pro poor and community participation in the development of the PPP objectives and contract will increase the chances of PPP success and achievements

- A regulator that is staffed with experienced people, knowledgeable about the water sector would provide a greater degree of confidence in the regulatory process and provide a better basis for resolving problem issues, such as those effecting the poor.

- The proximity and potential conflict of interest that existed between the regulator and the city council had the potential to increase "political uncertainty" in the PPP contract – anything that heightens political uncertainty must be avoided

A1.3 Metro-Manila, Philippines

The Philippine government enacted the National Water Crisis Act in 1995, in an attempt to address the burgeoning population's need for improved water services. Ayala, together with United Utilities, Mitsubishi Corporation, International Finance Corporation and BPI Capital, took over the operation of the East Zone of Metro Manila as agent and contractor of the government-owned Metropolitan Waterworks and Sewerage System under a 25-year concession agreement. The concession agreement also granted Manila Water exclusive rights to the use of land and facilities for the production, treatment and distribution of water, as well as the rights to operate the sewerage system. The East Zone is home to some five million people. Important parts of the concession contract were to undertake:

- A management decentralization policy where business areas were further subdivided into smaller and more manageable territorial boundaries with the objective to allow greater focus and faster response time to customer problems.

- Fiscal discipline was another key element. The first few years were the survival years for Manila Water. Limited loan funding was available at that time, and the company had to make sure that it maximized the use of its resources.

Over the last ten years the reported achievements of the concession contract have been:

- Reduction in water losses (non-revenue water) from 63 percent to 30.4 percent as of December 2006
- Increase in the number of customers served by two million, now at approximately more than five million
- Increase in the percentage of customers enjoying 24-hour water availability from 26 percent in 1997 to 98 percent as of end 2006
- Increase in the volume of water delivered to customers from 440 million litres per day (MLD) to 948 MLD by December 2006
- 100 percent compliance with water quality standards
- Water for the poor from 850,000 to 1 million people
- Capital investments from Euro 230 million

In addition, the company has also achieved significant inroads in terms of sewerage and sanitation services. It has also constructed 26 package sewage treatment plants all over Metro Manila and it continues to offer free de-sludging services to customers in its territory as part of its community service. Through the company’s "Water for the Poor" programme the company was able to reach out to more than 850,000 additional residents from poor communities who previously had no access to clean and affordable water.

All these were achieved through massive capital investments totalling P17.5 billion (Euro 175m) to 2006. Over the years, more than 1,300 kilometres of new pipelines have been laid out in various areas to improve service delivery and minimize water losses. Most of the existing pipelines in the system are slated to be replaced in various stages.

One of the company's most significant achievements has been its financial performance and this financial record allowed the company to secure favourable financing terms from international financial institutions such as the DEG (German Development Bank) and the International Finance Corporation.

Key points

- The contracting of a technically and financially strong consortium which in this case was led by Ayala, together with United Utilities, Mitsubishi Corporation, International Finance Corporation and BPI Capital., has been important to ensure that the contractor was able to sustain its long term involvement.

- A focus in the early stages on organizational capability and flexibility which included the establishment of excellent relationship with key parts of the public sector and the unions was very important.

- Delivery in the early stages of the contract of some key performance indicators has improved the political and customer support for the PPP arrangements - non-revenue water and increases in billed volume while maintaining fiscal prudence, managing an efficient bill collection system and achieving lower costs per connection.

- An apparently active, serious and well publicised "pro-poor" series of programmes and targeted investments helped to maintain the backing of local and national politicians and local communities leaders – this was very important to the maintenance of a stable contract environment.

- A stable and professional working relationship with regulators and critically the with the Government to ensure that the political establishment is not antagonistic toward the PPP contractors

- Financial strength of the concession company is important to ensure that it can sustain the investment improvements through an ability to raise financing at competitive costs.

- The customer base was an important consideration to providing some basis for financial sustainability in that it also included the main commercial and business centres in Metro Manila

A1.4 YerevanVodokanal, Armenia

The first attempt to introduce private management of a state-owned water service company occurred in 1999 when YerevanVodokanal was transferred to a private operator for four years. The Italian ACEA & Company Armenian Utility S.C.A.R.L. won the international tender, offering the lowest "Fixed Management Fee" (USD 2,925,000.) On February 14, 2000, the Yerevan City Administration and ACEA signed a four-year contract under which CJSC "YerevanVodokanal" was transferred into private management, operation and maintenance until May 1, 2004 (this contract was extended for one year until May 1, 2005). The purpose of bringing in a private manager was to improve water service efficiency, increase payment collection, improve customer services and public relations, maintain the integrity of surface water sources, enhance management and administration control over water and wastewater systems, as well as apply international experience of private management. This management contract has now finished and been superseded by a Lease contract with a group led by Veolia.

The management contract specified activity indicators for the private operator to meet (improved collection rate, reduced losses, extended water supply, etc.). Under the contract, the operator had to improve 97 types of services over four years encompassing all aspects of the company's activities: 11 indicators were benchmarks for calculating bonuses. Overall the contractor had to deal with 128 individual targets; for a system that was in a near state of dereliction this was a ludicrously large number to keep up with.

According to experts with the State Water Sector Committee, the existing contract made it possible to achieve significant improvements in the legal framework, regulations of water services to customers living in apartment buildings, and in payment collection. In the second year of the contract, the company achieved significant improvement of its operation indicators, particularly, in those related to financial conditions and quality of services. Progress continued in the third year of the contract, particularly, with regard to payment collection from residential customers. This indicates that bringing a private operator into the water system started to yield significant positive results, once the early uncertainties concerning the relationship between the municipality and private operator were overcome. The government of Armenia has expanded implementation of PPP in the water sector and in other public services sectors.

On June 1, 2002, the Mashtots branch of Yerevan Vodokanal was transferred into private management by a local company for five years (CJSC "Zapadny Vodokanal"). The joint stock company Nor-Akunk was set up in 2002 under the program to improve water and wastewater services in the Armavir marz region under the credit agreement between the governments of Armenia and Germany. The government owns a 34-percent stake in the newly created company while 11 communities of the Armavir marz, including the city of Armavir, own the remaining 66-percent stake with an option to sell a portion of stock to private bidders to raise additional investment funds. The emphasis of the tender was to recruit an experienced management team. This emphasis on getting an able management team in place was considered very important precondition in ensuring the success of the PPP. Currently, the entity is repairing networks, improving the water supply system and enhancing financial indicators. Currently, Armavir has the highest water and wastewater tariff in Armenia, AMD 100 per 1 m3 (1.1 Euro) and a high payment collection rate, while the percentage of water meter installation is reported to significantly exceed the Armenian average.

Similarly, a Vodokanal restructuring scheme is planned in Lori (city of Vanadzor) and Shirak. Here too, local Vodokanals became joint stock companies under the KfW credit program, with the government stake of 51 percent and the remaining shares allocated among the city and adjacent villages. In October 2003 a tender was announced for a management contract to be signed with a private operator at ArmVodokanal within the World Bank operated Community Water and Wastewater Programme and this was awarded to a Veolia company.

Reported highlights of the Yerevan management contract are:

- In Yerevan, water supply has increased from about 7 hours to about 18.5 hours a day. More than 70 percent of Yerevan now has 24-hour service.
- Outside Yerevan, 16.5 percent of the population in the service area of the second urban water utility now have access to 24-hour water.
- Payment collections have increased from 20 percent to 79 percent over the past 10 years

- Water quality is better monitored, with modern chlorination equipment and improved security at all water sources
- Energy consumption decreased by about 48 percent as a result of using gravity powered water sources, increased efficiency and reduction in the number of booster pumps for high rise apartments.
- A project component supported by Japan Social Development Fund (JSDF) renovated internal plumbing in 1,808 residences in Yerevan, resulting in a reduction in water losses of some 35 percent.
- Metering is now near universal in Yerevan, resulting in a significant reduction in water wastage and savings on monthly bills for households – see below
- Financed most of the three projects' total cost of US$83.6 million. (Counterpart contributions amounted to US$10.5 million).
- International funding agency financial and advisory support helped attract private operators by reducing perceived investment risks.
- Used lessons from strengthening the Yerevan water service to replicate and scale up operations for a larger population outside of Yerevan.
- Attracted other donor interest in the water sector: KfW, the German development bank, is financing water supply investments in the municipal water utility in northern Armenia.
- Improved the regulation of water supply through its policy loans. Armenia's regulatory commission now covers both energy and water regulation.

However this apparent "good news" story does hide some important issues that created major problems in the early years of the contract. First was an apparent "cut and paste" advisory job on the establishment of the contract terms and the unrealistically high number of targets set for the early part of the contract – a large number of reports in the first year, that would in any case have to be re-written following proper study about the condition and performance of the network. In addition the targets were set on the basis of unverified client data and too much store was placed on its accuracy and the targets were sometime poorly defined..

The early months of the management contract were adversely affected by a difficult relationship with local politicians this created a negative political environment, and made it very difficult for the company to sort out the tariff structure and increase the level of revenue needed. After 18 months the water sector was reorganised and a new head of water in government transformed the relationship between the government, the city administration and the water company. The companies' assets came under the ownership of a new State Commission, similar to Egypt's State Holding Company, and this sidelined the negative political atmosphere that had blighted the first 18 months of the contract. With this political support and the transformation in political will to support actions that were required to achieve the PPP objectives. For instance; although the tariff structure remained in a precarious state that required the company to be subsidised throughout the management contract period of 5 years, the company did manage to implement a metering programme that increased those on meters from 0 to 90% in 12 months. The effect of this was to increase the level of payments to the company, and hence revenues, thereby increasing the revenue available to cover O&M costs by the end of the contract. The increase in the collection rate also meant that actual bills for those that were on a meter actually reduced in comparison with the "state norm" price for water paid by those not on a meter.

Key points:

- Targets for the PPP contractor must be realistic, unambiguous and set in the context of verified data. They must reflect the core objectives of the PPP strategy, such as increases in collection rates, reduction in energy use – no "nice to haves". Maxim for setting targets – be "simple, understandable and entirely reasonable"

- Political leaders that are supportive of the water company and have a commitment to supporting fairly the objectives of the PPP strategy are critical for achieving all aspects of the PPP strategy

- PPP does not automatically result in increases in prices for customers

- Tariff issues do need to be resolved early and the political and regulatory institutions need to take the responsibility for ensuring that powers exist to implement changes

A1.5 Water sector reform in Mozambique

The Government of Mozambique (GOM) has adopted a Poverty Reduction Strategy Paper, through a consultative process, which has resulted in the 'Plano de Acção para a Reducção de Pobresa Absoluta 2002 - 2005 [PARPA]' (Action Plan for the Reduction of Absolute Poverty). The specific objective of this action plan has been to reduce the incidence of absolute poverty from 70% in 1997 to less than 60% by 2005, and to less than 50% by 2010.

The PARPA identifies six priority areas: education, health, basic infrastructure, agriculture and rural development, good governance, and macro-economic and financial management. Two areas identified in the PARPA, health and basic infrastructure, have a direct link to increasing the provision of safe water supply, while elements of three other areas are integral to the water sector, to various degrees, such as education (vocational and on-the-job training), good governance (institutional and corporate structuring of the water companies) and macro-economic management (creating conditions for gradual implementation of full cost recovery).

Water supply and sanitation services in Mozambique were characterised by low coverage, poor service quality and weak sustainability. Only 28% of the population had convenient access to safe water supply, a significant cause of Mozambique's health statistics being among the worst in the world. The sector's poor performance was due to: (i) nearly twenty years of war, which resulted in the neglect or damage and destruction of most of the country's infrastructure; (ii) until 1995, poor policies, such as low tariffs, inadequate financial and human resources management and excessive centralisation, which made it impossible for the Government-owned urban water companies and the provincial and district administrations to operate and maintain facilities effectively; and (iii) the influx of several hundred thousand refugees.

In the mid-1990's, the Government of Mozambique started their programme of restructuring and transformation of the water sector in Mozambique. A result of this overarching policy to tackle poverty has been the development of a national water policy. Important in this discussion were the themes of decentralisation of service responsibility, the importance of water services as having both of economic and social value, and the involvement of the private sector as a mean to achieve the investment needed to expand services. and not as an objective in itself.

The reasons for considering private sector involvement were to create:

- an improved institutional capacity (human resources) by transfer of technical and organisation knowledge of an experienced drinking water company;
- a commercial orientation which would lead to improved efficiency and an improvement in levels of customer service;
- an injection of capital resources for investments in the drinking water operating company and the infrastructure.

With the adoption of the 'National Water Policy' in 1995, the Government of Mozambique committed itself to increased participation of the beneficiaries (such as the town community leaders and population), a recognition of water as an economic as well as a social good, decentralised autonomous and financially self-sustaining provision of water supply services, a direction role for the Government with a withdrawal from direct service provision, and greater focus on capacity building and an increased role for the private sector. The prime objective of the policy was to increase the coverage of the provision of basic water supply especially for low-income groups in peri-urban areas.

As a result of this new policy, two principle objective statements were developed - the 'Water Supply Delegated Framework' and the 'Water Tariff Policy'. These were adopted in 1998. In the context of the 'Delegated Framework' proposal, two new institutions were created:

- the 'Water Supply Investment and Asset Fund' (FIPAG Fundo de Investimento and Património do Abstecimento de Água -) would act as an investment and asset holding company and be responsible for monitoring and enforcing the contractual obligations of utility operators, and,
- the 'Water Supply Regulatory Board' (CRA - Conselho de Regulação do Abstecimento de Água) which would regulate the drinking water sector and in doing so would reconcile conflicts of interests between the asset holder and the operator, by authorising tariff level and providing a mechanism to safeguard consumer interests.

In 1999, asset ownership of urban water supply infrastructure for Maputo, Beira, Pemba, Nampula and Quelimane was transferred to FIPAG. Private Sector Participation (PSP) contracts were introduced, first, through a 15-years' lease contract between FIPAG and Águas de Mozambique for the city of Maputo, and secondly, the same private operator entered into management contracts for the towns of Beira, Pemba, Nampula and Quelimane.

In 1998, the Government had made a request to the African Development Bank (AfDB) to consider financing the rehabilitation and extension of the water supply, sanitation and solid waste disposal facilities in the towns of Chókwè, Maxixe, Inhambane and Xai-Xai. This eventually resulted in the US$32 million 'Urban Water Supply, Sanitation and Institutional Support Project' financed by AfDB through the

African Development Fund (ADF). The asset ownership of these towns was then transferred to FIPAG in 2002. These four district centres constituted the second tranche of cities that were transferred to FIPAG ownership and, subsequently, would be operated under the delegated management framework.

As a result of extensive system rehabilitation and extension to low-income areas, it was envisaged that coverage would increase from 37 to 65%, and that Unaccounted-for Water would drop from 55 to 30%, and full cost recovery would be achieved and this would be done with the support of a Private Sector Participation involvement.

The implementation of the AfDB investment project executed by FIPAG will have a substantial impact on the normal functioning of the water companies during the first years of cooperation. Although the investment program includes a Technical Assistance and training component, these are directly related to the investment program. Vitens offers additional technical and management support for a prolonged period of time to enable the water companies to evolve into autonomous sustainable water companies.

The performance of water utilities is determined by the following main issues: (i) physical infrastructure (comprising treatment works, distribution networks, etc.); (ii) operational management procedures (comprising financial/commercial management, operation and maintenance procedures, customer relations, etc.) and human resources (comprising recruitment and selection, job description, evaluation and appraisal, training, etc.).

It is generally recognised that these three issues are inter-linked: targeted performance improvement through investments in physical infrastructure needs to go hand in hand with improved operational management procedures and improved human resources. Or said otherwise, as an example: the rehabilitation of treatment works will not bring about the envisaged performance improvement unless accompanied by the introduction of relevant, improved operation and maintenance procedures executed by adequately qualified staff.

The concerted action of the public-private partnership in this respect consists of the following: FIPAG will be responsible for the investments that are financed by the African Development Bank. Vitens will contribute to the necessary activities on the level of operational management and capacity building in terms of expertise and experience through Technical Assistance in the project period. The overall goal is to ensure the optimal and sustainable operation of the rehabilitated and extended infrastructure. In the next chapters the roles and activities of both partners will be elaborated in further detail. There will be a coordinated effort to streamline Vitens input and the technical assistance component of the AfdB investments executed by FIPAG.

The Government of Mozambique recognizes the strong links between integrated water resources management, water supply, sanitation (incl. solid waste) and hygiene education (awareness creation, environmental education).

- Five Regional Water Administrations ('Administração Regional de Água' - ARA) play a key role in integrated water resources management.
- The municipal councils are responsible for sanitation (incl. solid waste) and are assisted by the Sanitation Department within the National Directorate of Water (DES/DNA).

- The councils and DES/DNA in close collaboration with the Provincial Directorates of the Ministry of Health are responsible for the delivery of health education activities.

A1.6 Brazil

History of water and sanitation

Legislation defining the institutional framework of the water sector in Brazil has developed significantly during the past four decades, with innovative legislative efforts frustrated by legal and political wrangling among three sectors of government—national, state, and municipal. In response to scarcity and pollution concerns created by rapid urbanization in the late 1960s, Brazil began structuring the water and sanitation sector at a

The National Water and Sanitation Supply Plan (Planasa), created in 1968 under the management of the National Housing Bank (BNH), encouraged the creation of State Water and Sanitation Companies (CESBs) by offering favorable loans to the states from the Employment Guarantee Fund (FGTS). To qualify for FGTS loans, states were required to obtain long-term concession contracts with municipalities and to acquire water and sanitation service rights originally granted by the Brazilian

Constitution to municipalities.63 Planasa was based on the following noteworthy guidelines:64 (i) extending service to all urban centers and income groups while maintaining the balance between supply and demand through continuous planning and management; (ii) self-financing Individual State Water and Sewerage Funds (FAEs) through transfers from the FGTS and federal and state budgets; (iii) setting tariffs that allow balance of revenues and expenditures while permitting cross-subsidies between high- and low-income users; (iv) managing CESBs with a business-oriented philosophy; (v) establishing the federal government as manager of National Water and Sanitation Policy; and (vi) devising global feasibility studies at the state level. Planasa proved highly successful over its twenty years of operation, from roughly 1970 to 1990.65 In that span, the percentage of water service coverage for urban residents increased from 45 to 85 percent. Correspondingly, sanitary sewage coverage increased from 24 to 42 percent in urban centers. In 1988, however, financial difficulties prompted the dissolution of BNH whose functions were absorbed by the Caixa Econômica Federal (CEF), thus ending the successful implementation of Planasa.

Several factors ultimately led to the failure of Planasa, yet the most serious were within the CESBs themselves as accentuated by a weak regulatory scheme unable to support the bold intentions of Planasa. Soaring debts, unrealistic tariffs, an inability to develop and sustain high standards of performance, low productivity, and the high costs associated with political interference as well as the lack of transparency doomed the majority of CESBs.

The demise of Planasa led to a fragmentation among service providers and a diffusion of the national water policy. This further aggravated the inherent legal and institutional conflicts that were only temporarily resolved by the FGTS loan arrangements. During Planasa, each state and the Federal District created a CESB and signed concession contracts with nearly 80 percent of the municipalities.71 After Planasa, and without any strong guidance from a national water policy, states took many different approaches to financing the operations of the CESBs. The state of Rio

Grande do Sul shored up the operations of its CESB through the state treasury and created a participatory budget system in which all stakeholders vote on the expenditures of the CESB. Similarly, São Paulo elected to continue providing service through its CESB, SABESP, and reinvesting to improve the system—leading to a successful flotation of SABESP stock on the New York Stock Exchange. In Mato Grosso, the state government elected to return the service operations to the municipalities through a series of three contracts, with the intention of eliminating the CESB entirely. Still other states, such as Paraná and Toncantins, turned to PSP and private investments to continue operation through the sale of assets held by the CESB. Further, states such as Rio Grande do Norte, Bahia, and Rio de Janeiro sought PSP through concession contracts.

The smaller and less prominent states continue operations today with funding assistance from the federal government, federal banks such as CEF and BNDES, along with grants and on-lending of national debt made available from international agencies such as the World Bank.

Additionally, municipalities that did not assign their rights under Planasa chose among four different courses. Some continued operating their facilities autonomously while others received service from microregional water agencies. Poorer municipalities, particularly in the Northeast, retained partial autonomy with federal assistance through the Health Ministry. Finally, some municipalities, particularly in São Paulo and Rio de Janeiro, signed concession contracts and continue to seek the benefits of PSP, although with dramatically different levels of success.

Despite the lack of clear legal authority and often in spite of existing laws, several of Brazil's states and municipalities have pursued various forms of PSP for water and sanitation services. The states of Rio de Janeiro and Espirito Santo have both failed in their attempt to sell the assets and sub-grant the operational rights of their water and sanitation services to private operators. On a smaller scale, municipalities such as Manaus have entered into seemingly successful PPPs, while other municipalities such as Petrolina have had PSP attempts fail. Overall, private investment in Brazil's water and sanitation services has not nearly achieved the goals of the national government and existing arrangements continue to suffer from the uncertainty created by the prospect of future litigation. The following section analyzes PSP attempts, successes, and failures throughout Brazil, highlighting areas of weakness in Brazil's institutional framework.

Unlike the Chilean system of private water rights, the 1988 Federal Constitution shifted the ownership of Brazil's surface and ground water from the private to the public domain. Generally, surface water running between two states, creating a border with another country or entering from or departing into another country is considered federal water. The remaining surface water is property of the state in which the water resides. Finally, according to the Constitution, all groundwater is the property of the state in which the groundwater resides.

The Federal Constitution also defined legislative power for the three levels of government—Federal, State and Municipalities—leaving some power and responsibility shared among the three. Generally, the federal government has the sole power to legislate on waters, unless a supplementary law is created authorizing the states to legislate on specific questions.

The government has not inhibited the use of its water resources. The permitting program would remain highly relevant for any PSP looking to operate a water facility withdrawing surface or groundwater, or releasing treated or untreated waste effluent into such waters. Theoretically, a PSP would need to acquire a permit for the length of time of the contract or receive adequate assurances that permitting in the future would not be a problem. This feature of Brazilian law increases transaction costs in PSP or PPP arrangements, particularly when the permitting authority exercises its authority inconsistently.

Water and Sanitation Services

The right to provide water and sanitation services, and thus the power to sign concession contracts with PSP, remains a hotbed of debate between states and municipalities. Article 30 of the Federal Constitution allows municipalities to legislate on matters of "local interest," and to "organize and provide, directly or by concession or permit, the public services of local interest."84 Throughout the Planasa era, states were technically required to sign concession contracts with those municipalities that would receive service from the state company. While states and municipalities often did sign such agreements, some states provided service to the municipalities without explicitly receiving the authority. Additionally, during Planasa, states provided fifty percent of the capital outlay for the creation of the water and sanitation infrastructure. States believe the service rights belong to the state company because the law is ambiguous and the state companies either explicitly or implicitly were assigned the rights to control the service during Planasa.

The experiences of the states of Bahia and Rio de Janeiro demonstrate the effects unclear property rights have over water and sanitation services in PSP.

Bahia In Bahia, the state government attempted to define legal authority over water and sanitation services at the state level to encourage a PPP for the state water company EMBASA. In 1999, the government altered one third of the articles of the state constitution without discussion in the state legislative assembly. Among the modifications was the transfer of the ownership of services from the municipality to the state. The Workers' Union filed suit in the Federal Supreme Court claiming the Federal Constitution granted the rights to municipalities. The federal government pressured the municipalities through EMBASA to accept the changes. Meanwhile, Suez expressed interest in purchasing EMBASA, yet the PPP cannot move forward until the constitutional issue is decided.

Rio de Janeiro Rio de Janeiro has faced similar problems as Bahia in attempting to define the legal authority over water services within the state. In 1995, Rio de Janeiro became the first state to create a privatization programme in an effort to privatize twenty-six of its state owned companies, including the state water company, CEDAE.87 The state assembly passed legislation88 to create a regulatory authority (ASEP-RJ) for public services. PSP, however, has been slow in coming. In the second half of 1996, the state put out to tender water and sewage concessions for the municipalities of Barra da Tijuca, Recreio, and Jacarepaguá. The tendering process was halted due to modifications in the tendering documents made by the state. Subsequently, the state decided to tender CEDAE in its entirety. Meanwhile, the local authority in the municipality of Campos declared that its concession with the state had expired and successfully launched a tender for the concession of its services to a consortium including Águas do Paraíba. CEDAE successfully sued to prevent the municipality from entering into a PSP. On December 16, 1997, the state assembly approved Complementary State Law No. 87, creating the Metropolitan Region of Rio de Janeiro and micro-region of Lagos, and defining services of public interest in these areas, including basic sanitation, water production and distribution. The law further gave the state government authority over these services. The Democratic Workers' Party appealed to the Federal Supreme Court to suspend Complementary State Law No. 87 and Ordinary Law No. 2,869, which regulated No. 87, on constitutional grounds. On February 3, 1998, the public hearing for structuring the sale of CEDAE took place. The parties agreed to sell a single lot of 89.9 percent of the company's share capital to a new owner, with 10 percent offered to employees at a 30 percent discount from the determined sale price. In response, the local authority of the municipality of Rio de Janeiro advertised that it would take judicial action if the sale of CEDAE went through without its participation in the process. The local authority asserted that Law No. 87 was unconstitutional. Further, the local authority of Niterói published an advertisement indicating CEDAE did not own the relevant operating assets within Niterói's concession area and that the local sanitation company,

EMUSA, had already tendered a concession for the area's sanitation service to a consortium, Águas de Niterói. At that time, the concession granting CEDAE's authority over Niterói's sanitation services had expired. The litigation between the state and the municipalities currently sits in the Supreme Court. As a civil law nation, though, stare decis does not exist and the results of the cases will not create precedent.

The Brazilian government needs to determine and legally define which level of government should have the property rights to water and sanitation services. This question is crucial in determining which level has the power to grant concessions and receive the proceeds of initial outlays by private investors in water and sanitation services. While lawsuits have prevented PPP attempts by both municipalities and states, the states stand to lose the most as their contracts with municipalities continue to expire and wealthier municipalities have engaged in successful PPP contracts. The federal government needs to weigh the competing interests to decide which level of authority would best ensure universal access to services.

Paraná In 1998, the governor of Paraná, Jaime Lerner, signed a contract with the Dominó Consortium—made up of France's Vivendi, the Brazilian construction company Andrade Gutierrez Concessoes, Brazilian investment fund Opportunity Dalleth, and state power company COPEL—transferring nearly 40 percent of the shares in the state water company, SANEPAR. The private group was granted the power to appoint government representatives and have a majority vote on the board. In March 2003, newly elected state governor Roberto Requiao, stripped the private consortium of half its shares and its decision-making power. Further, Dominó was required to return all individual profits received from the water utility. Requiao alleged that Lerner lacked the authority to sign such a contract and that Dominó did not meet its financial obligations. In February 2004, a Paraná state court upheld the takeover. In July 2004, a federal court overturned the decision and returned the expropriated assets to Dominó.

Paraná illustrates a major concern for PSPs. PSPs require a fair and transparent body for deciding disputes. If state judiciaries evince anti-PSP sentiment, investors will shy away. Although the Dominó consortium was vindicated by the federal court decision, the expropriation should probably never have occurred in the manner in which it was done. Since the granting authority, in this case the state of Paraná, maintains the authority to expropriate assets under specific circumstances based on Federal Law

8,987, concessionaires will have no security. The law does not indicate what special circumstances may qualify or what body determines when special circumstances occur. Further, expropriation of this sort indicates larger issues regarding the stability of the economy as a whole. The decision of the state court to enforce the expropriation further highlights the inefficacy of the existing framework. Without an accessible, transparent, and fair forum for adjudication, concessionaires face the possibility of expropriation supported by a legal system.

Tocantins Tocantins' state water company, SANEATINS, sold 51 percent of its shares to EMSA, a Brazilian construction company, in 1999. The thirtyyear agreement called for EMSA to invest 400 million reais ($219.3 million) to expand and improve service coverage. In its first year of operation, EMSA increased water connections by 30 percent and decreased leakage to 30 percent (well below the national average of 50 percent). In June 2001, the state took back majority control by transferring two percent of the shares from EMSA. The move was made in order for the state to qualify for funding from the federal government's social development plan, Projeto Alvorada. The state government returned the two percent share in June 2002 after the funds from the federal government were disbursed. There is no indication of EMSA's willingness to allow the state to take the two percent, the effects of the taking on profits, or any possible remuneration for the taking. As with Paraná, Tocantins' government's actions represent an unjustified expropriation. EMSA's Director of

Pertrolina The municipality of Pertrolina broke its concession contracts with the state-owned water company, COMPESA. In 2003, Petrolina twice tendered bids for a twenty-five-year concession contract to operate the municipality's water and sanitation service. Both times, the tender attracted no bidders. Potential PSPs indicated that their reluctance to invest stemmed from a high minimum bid price, unfavorable payment scheme, and regulatory uncertainty

Despite the lack of a clear legal or regulatory framework, municipalities and private investors continue to enter into PSP arrangements. So far, some of the contracts appear to function smoothly. However, experience in other countries shows the tenuous nature of PSP in such a framework. A more pressing problem for Brazil is the scope of PSP. Without a clear delineation of service rights and regulatory structure to support PSP, investors have sought wealthier municipalities for PSP contracts. With each wealthy municipality that locks itself into a long-term concession contract, the states as a whole lose the ability to provide service for the entire region and use lucrative municipalities to cross-subsidize poorer regions. This same problem of private investors seeking the "low-hanging fruit" has occurred in other nations. Chile's system of regionally-based companies accounts for all users, as illustrated by the universal coverage. Brazil should consider whether allowing municipal concessions in only the wealthiest parts of the country will achieve the goal of universal coverage.

Appendix A2: Review of National Experience in Delegated Management in Water

Under delegated management, an owner of water supply and/or wastewater infrastructure contracts out various aspects of water utility management to another entity, which may be either privately or publicly owned. To some degree, all utilities delegate: they may outsource various tasks to consultants or manufacturers of physical plants, for example. In the water sector, "delegated private utility" is understood to refer to outsourcing of core activities such as construction, operations and maintenance, and customer services. This model is also referred to as private sector participation" or as "public private partnerships," PPPs.

Features of delegated management contracts include:

- The participation of the private company does not extend to ownership of assets
- Contracts are time-limited (between 1 and 30 years, typically)
- There are a wide variety of risk and responsibility-sharing options such as:
    - Selective outsourcing (service contracts)
    - Management contracts
    - Lease/concession contracts

Advantages

- Outsourcing of required expertise takes place.
- Potential access to finance is available.
- There is increased flexibility.
- Potential cost reductions arise from efficiency gains and increased innovation.

Disadvantages

- This requires skilful contract administration.
- Cost of capital may be higher.

The responsibilities and risks are shared between public and private as shown below.

Table A2.1: Responsibility and Risk Matrix for Delegated Management Contracts

Responsibility	Service Contract	Management Contract	Lease Contract	Concession	BOT/BOOT
Duration	2 – 3 years	3 – 7 years	8 – 15 years	15 – 30 years	15 – 30 years
Ownership	Public	Public	Public	Public	Private and Public
Capital	Public	Public	Public	Private	Private
O&M	Private	Private	Private	Private	Private
Commercial Risk	Public	Public	Shared	Private	Private
Overall Risk					

The key requirements for success of delegation are summarised in the following table.

Table A2.2: Key Requirements for Success of Delegated Management Contracts

Criteria	Management contracts	Lease contracts	Concession contracts	BOT/BOOT contracts
High levels of political commitment	Essential	Essential	Essential	Essential
Consistency in PPP Strategy	Essential	Essential	Essential	Essential
Establishment of an independent regulator	Important	Essential	Essential	Important
Preparedness to undertake tariff reform	Desirable	Important	Essential	Important
Community consultation	Essential	Essential	Essential	Important
A “pro-poor” policy	Essential	Essential	Essential	Important
Transparent processes for contract award	Essential	Essential	Essential	Essential
Simple, measurable and reasonable targets	Essential	Essential	Essential	Essential

A2.1 Selective Outsourcing Phenomenon

During the past decade, selective outsourcing has been fast growing and is increasingly preferred by many utilities in the country originating from the need of skilled staff and the limitation of utility/ULB in undertaking timely recruitment to match with the operational needs. A review of the trend of selective outsourcing is presented in the following table.

It can be seen above that most of the critical utility management functions are already outsourced to eligible service providers and many times the few senior engineers in the ULBs end up as contract managers. Due to multiple contracts compromising the overall accountability, the selective outsourcing often derails the final outcome.

Under this background the utilities are now exploring to delegate the either the bulk supply or distribution management to eligible single service providers through performance based management contracts, a phenomenon which is transforming into public-private-partnerships with increasing capital risk to the developer-service providers. A brief review of the experience in public-private partnerships, in water services is presented below.

Table A2.3: Selective Outsourcing in Water Utility Management

Planning	Consultants	Private
Design	Consultants	Private
Detail Engineering	Consultants	Private
Funding	Government/ Multilaterals	Public/ Private
Procurement	Consultants	Private
Construction	Contractors	Private
Supervision	Consultants	Private
Treatment Plant Operations	Contractors	Private
Annual Maintenance	Contractors	Private
Connections	Licentiate Plumbers	Private
Leak repair	Contractors	Private
Valve Operations	Own Staff	Public
Meter reading	Own Staff	Public
Billing	IT Company	Private
Cash collection	Banks	Private
Contract Payments	Own Staff	Public

A2.2 Initial Market Development

With the mixed success of privately financed power generation plants, water utilities in India have attempted public-private-partnerships since the year 1995. Without initial preparation and with total lack of understanding of risks with private finances several Built-Own-Operate projects primarily to augment the source capacity were initiated (Hyderabad, Goa, Tirupur and Bangalore). Other than Tirupur, most of the projects could not be concluded or abandoned in development phase.

A2.3 The Operator Sponsored Initiatives

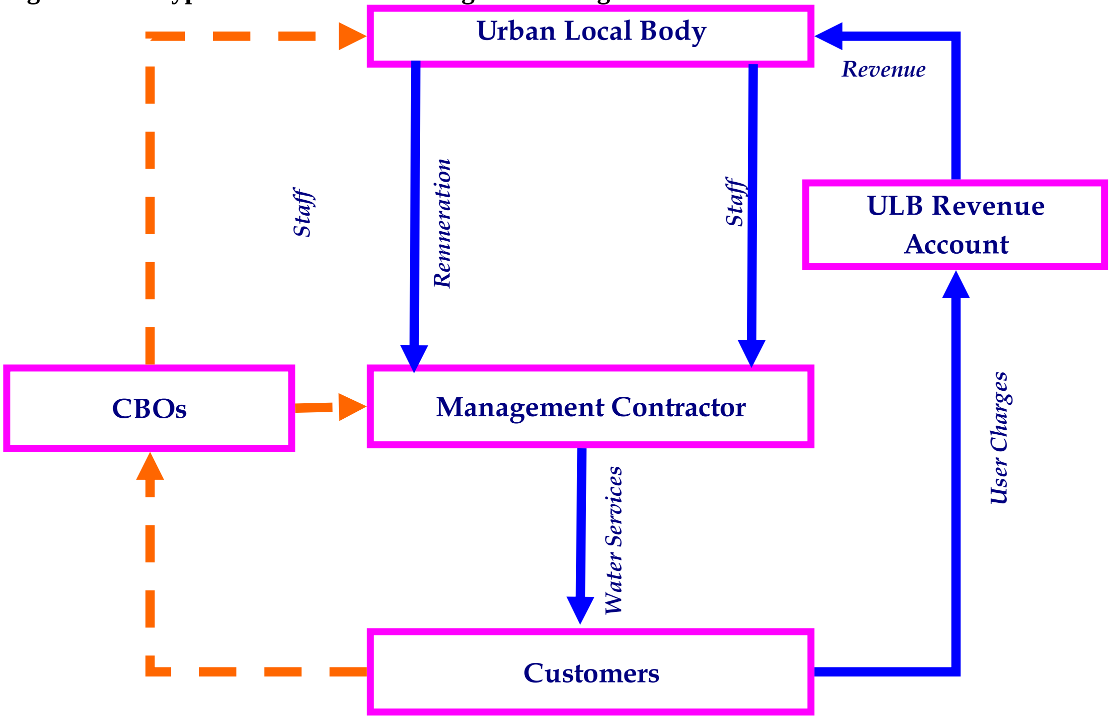
In parallel, the European water companies have set shop in the country and the Operators have tried to develop the market with un-solicited bids primarily to improve the distribution efficiencies with public funding (Goa, Bangalore and secondary cities in Karnataka State). Interestingly the choice of Operators were cities with more autonomous and metered water utilities with tariff levels relatively higher than most of the ULBs in the country. These Operator sponsored initiatives could not be concluded due to the fact that there was no competition and transparency in selection of Operator.

In the following period, there were several attempts by utilities to involve private sector but it was all limited to service contracting of water/sewage treatment plants, pumping stations and leak repair and in some cases valve operations.

A2.4 Success in Karnataka Project

As part of the World Bank funded Karnataka Urban Water Supply Improvement Project (KUWASIP), a pilot demonstration project was initiated to improve water distribution services in some 22000 connections in demonstration zones in the three cities of Belgaum, Hubli-Dharwad and Gulbarga in northern Karnataka. This was mainly a four year performance based management contract with public funding and the Operator shall study the existing water distribution system and prepare a capital investment plan within a pre-fixed capital investment threshold and implement the plan with public funding to achieve set of performance targets and operate and maintain the services for two years and hand back the facilities.

Figure A2.1: Typical Structure of a Delegated Management Contract



This project implemented by an international Operator selected through transparent bidding process has successfully demonstrated, how continuous (24x7) pressurised water supply services can be provided to customers and demonstrated the best practices in terms of distribution management, hydraulic modelling, demand and pressure management, metering and customer services including subsidized services to urban poor.

Key benefits from the project

The water supply situation before the implementation of the project and during a study in the year 2010 is summarised in the following table.

Table A2.1: KUWASIP – Comparison of Situation before and after the 24x7 Service

Karnataka Urban Water and Sanitation Improvement Programme

Comparison of situation before and subsequent to 24/7 water service

Parameter (all referring to Demonstration Zones unless specified)	Unit	Belgaum Before	Belgaum 2010	Hubli Before	Hubli 2010	Dharwad Before	Dharwad 2010	Gulbarga Before	Gulbarga 2010	Average/Total Before	Average/Total 2010
Total population of town		500,000		650,000		350,000		430,000		1,930,000	
Population served in Demo Zones			72,124		46,270		35,140		29,134		182,668
Public Standposts	Number	*118*	0	*41*	0	*74*	0	*0*	0	*233*	0
Handpumps	Number	*48*	0	*41*	0	*43*	0	*26*	0	*158*	0
Cisterns	Number	*11*		*32*		*60*		*0*	0	*103*	
Borewells with motors	Number	*16*		*55*		*55*		*42*		*168*	
Tanker water supply		*yes*	0	*yes*	0	*yes*	0	*yes*	0	*yes*	0
Number of connections in Demo Zones	Number	4,918	8,509	5,346	7,577	4,139	5,779	1,996	3,307	16,399	25,172
Supply frequency	**Hours/week**	12/168	**'24/7'**	9/168	**'24/7'**	9/168	**'24/7'**	10/168	**'24/7'**	10/168	**'24/7'**
Total length of distribution lines rehabilitated	km		94		69.8		34.6		48.3		247
Length of original pipes retained	km		3		0.2		0		0		
Volume of water supplied (average)	Cum/month	203,400	229,814	178,800	176,552	203,400	108,461	203,400	73,778	664,350	588,605.0
Two years average	Mld		7.13	5.80	5.70		3.7		2		18.7
Actual losses in distribution system	l/connect/day/m head		7.93	35	5.43		3.15		0.50		4.3
Percentage losses in distribution system	%		3.3%								
Volume of water consumed	Cum/month	NA	204,290	NA	150,460	NA	92761	NA	60624	NA	508,135.0
Water consumed	Litres/person/day		93		107		87		68		91
Meters read	Number/month		8,470		7,586		5786		3274		25,116.0
Bills generated and distributed	Number/month		8,470		7,586		5786		3274		25,116.0
Revenue billed	Rs/month	409,833	3,395,882	481,140	1,959,463	372,510	958,223	119,760	789,512	1,383,243	7,103,080.0
Revenue collected (incl arrears)	Rs/month		2,030,192	250,000	1,929,047		978946		771451		5,709,636.0
Maintenance cost	Rs/month	NA	32,660	NA	62788	NA	62118	NA	49362	NA	206,928.0
Complaints recorded and resolved	Number/month		45		53		89		61		248
Average water pressure	metres		15	0-5	25-40		22		12-15		12-40

Information courtesy of Veolia Water (Compagnie Generale des Eaux), Karnataka

Legend: NA - Not Available

Source: WSP Field Note

A2.4.1 Improvement in Service Levels

The results of the ‘demonstration’ are clearly shown in the above Table. The average 10 hours of supply per week (two hours every 15 days in one zone) has become continuous water ‘24/7’. From a level of authorised connections estimated to be serving less than 50% of the population there is now 100% household connection coverage. There has been a fivefold increase in revenue billed and approximately a sevenfold increase in revenue collected. The ongoing bill collection efficiency is 80% across all five zones (in fact it is as high as 99% in Hubli-Dharwad and Gulbarga, but the overall average is reduced by the limited 60% ratio from Belgaum where arguments over paying arrears from before the start of the project continue). There are functioning meters on all connections which are all read and billed by the operator monthly.

A2.4.2 Reduction in water consumption

There has been a reduction, around 10%, in the overall amount of water being used (noting that the original volume of water supplied was necessarily an estimate). The fear that continuous water supply would lead to an unsupportable demand on water resources has proved to be unfounded in practice. In fact the losses in the distribution system, a factor of the complete replacement of the network, have come to as low as 0.5 litres per connection per day per metre head of pressure (l/c/d/m) in Gulbarga, dramatically lower than the allowed 20 l/c/d/m.

Households are now consuming an average of 91 litres per person per day which is at a sufficient level to enable the maintenance of hygiene standards as well as meeting most convenience needs.

A2.4.3 Reduction in Energy Consumption

As the water consumption at the customer end has significantly reduced and the physical losses in network are being maintained low, the requirement of bulk water to the service area has reduced substantially resulting in good savings in energy costs of bringing bulk water. Additionally, as the service is now continuous and pressurised, many customers who were earlier dependent upon local own tube wells and also pumping from own sumps have now discontinued the usage of tube wells as well as pumping from sumps saving reasonably good amount of energy at customer end.

A2.4.4 Reduction in Maintenance Cost

Other than the key benefits of improvement in public health and reduction in coping costs specifically for urban poor, the resultant effect of improving the networks was significant reduction in maintenance costs in the service area. It can be seen from the above table that the maintenance cost was ranging between Rs.32000 to Rs.63000 in each city it was far less than the earlier spent which was said to be in the order of at least Rs.250000 per month in the same areas for very low service levels.

The success of KUWASIP has increased the confidence in the choice of delegated management as an option in improving services and several ULBs have proposed either pilot zones or the entire city distribution for management by private sector and public funding.

In the recent times with the reforms initiated under JNNURM, the ULBs have been in the progressive path of rationalising water tariffs and moving towards O&M cost recovery, the private sector also is gaining confidence in the sector and there had been attempts to take the risk of partial funding (about 30%) of the rehabilitation costs by the private sector.

A2.5 Cost of Improving Services

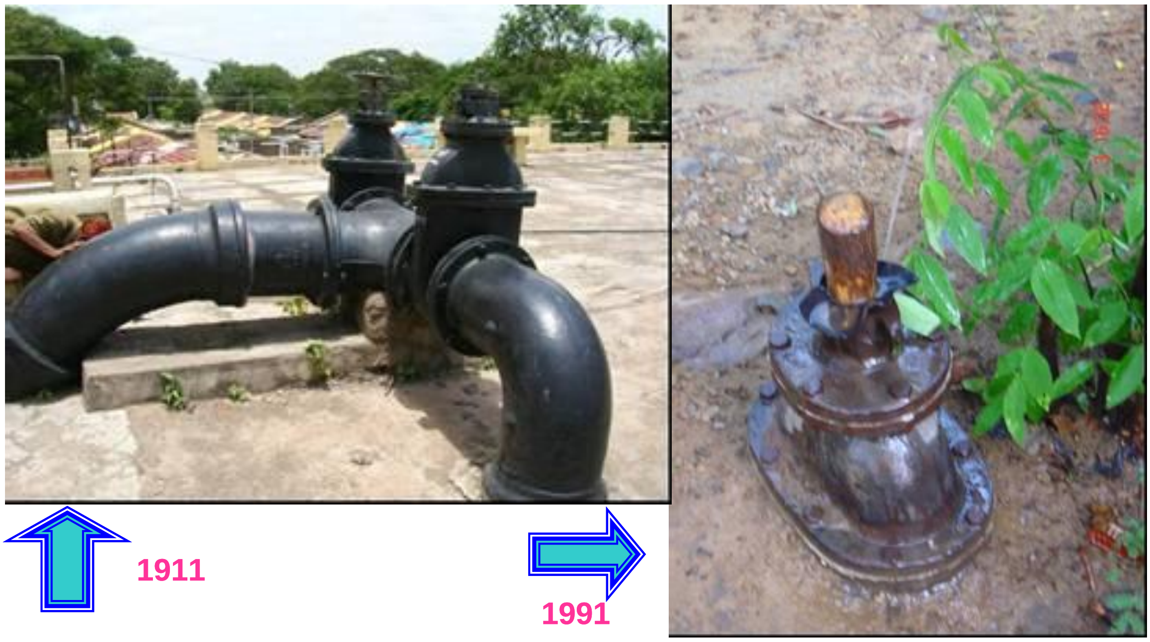
The capital cost under KUWASIP for delivering an entirely renewed distribution network and the initial 22,450 new connections with functioning meters complete with flow and pressure management was Rs.11,635 (USD$260) per connection, that is about Rs.1,430 per person served (USD$25) at 2006 prices.

The KUWASIP project provided an indication of likely capital costs of improving services although at a pilot level. The experience has generated lot of interest among several other municipalities who have either taken up pilot projects within their cities or some cities have gone head with city wide management contracts like in the case of Mysore, Latur and Aurangabad. Currently projects are under various stages of development in the cities of Delhi, Bhopal, Gwalior, Jaipur, Kota, Ahmadabad and many other cities.

The Mysore contract awarded during the year 2009 and is under implementation indicated the capital cost of improving services is in the order of about Rs.16000 per connection.

The key factors influencing the level of rehabilitation costs are:

- Current service levels in the city – if the service levels are relatively good meaning at least daily 4 hour water supply then the rehabilitation costs tend to be significantly lower where in it is observed that about 30% of the assets would only require replacement and the strength of balance networks is improved through rehabilitation techniques
- Condition of existing assets – The condition of existing assets is a very tricky phenomenon in India where in the adage “old is gold” holds lot of relevance in the sector. In many cities observed by the author, the relatively new assets constructed during the period 1970 – 90, the workmanship was such that the network efficiency is comparatively lower than the old time assets. In the recent times due to lack of good construction supervision and quality control, the pipes are laid at shallow depths of less than 0.5m resulting in joints getting weaker due to traffic loads. Also many times the hydraulic test of the pipelines is seldom done and hence the network efficiency is found to be relatively low when compared to the pipelines laid prior to 70s *(Pl see picture below)*.



Connection/Repair practices – although many pipe line assets may be relatively new but due to the prevailing practices of connections or repair, the strength of the network was compromised and one may find good number of connections very weak as well as pipe joints leaking. A network which laid at shallow depths and also provided with connections by local plumbers with neither supervision nor quality control, the network strength is observed to be very low and in some of the cases the cost of total replacement of network is almost similar to repairing the existing network when considering cost of road cutting and road restoration between the two options.

A2.6 Investment Requirements for the Sector[148]

The Report on Indian Urban Infrastructure and Services published in March 2011 by the High Powered Expert Committee (HPEC) indicates the following investments for water and sewerage improvements in the urban areas for the period between 2012 – 2031.

In preparing detailed estimates for infrastructure investments, the HPEC has used service norms prepared by the Ministry of Urban Development, Government of India. The estimates not only include additional demand over the next 20 years but also the unmet demand for the current population as well as the cost of asset replacement.

Per capita investment cost (PCIC) is estimated by city size class and by sector using data from a sample of projects under the two components of the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), i.e. the Urban Infrastructure and Governance (UIG) Scheme and the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT), and projects funded by the World Bank.

The assessment of investment requirements by the HPEC is based on the service standard benchmarks prepared by the Ministry of Urban Development as presented in Section 3.4. For the services of water supply and sewerage, service standards (24x7 water supply, underground sewerage systems with complete coverage, 100 per cent collection, treatment, and disposal for all cities) as specified by the Ministry are the same for all city size classes.

The approved projects under the UIG and UIDSSMT Schemes of the JNNURM during the period 2006 to 2009, were studied together with projects funded by the World Bank to estimate PCIC for water supply and sewerage. For water supply, a combination of engineering and statistical criteria was used to screen the data for outliers; for 24x7 upgradation and extension for distribution, given the limited availability of data, distribution network data from City Development Plans (CDP) and cost estimates provided by sector experts were used.

Estimated Investments Required during 2012 - 2031 (2009-10 Prices)

Cost Indicator	Unit	Water Supply	Sewerage
Estimated Capital Cost	Rs. Crores	320908	242688
Per Capita Capital Cost	Rupees	5099	4704
Per Capita O&M Cost	Rupees	501	286

A2.7 Emerging Trends in Delegated Management[149]

The emerging trends in Delegated Management in the sector are summarised as follows.

(a) Increase in number of contracts concluding to award – until the year 2003 there were just two projects (Tirupur and Alandur) reached award stage out of some 42 attempts

[148] Report on Indian Urban Infrastructure and Services; March 2011; by High Powered Expert Committee on estimating investments required in urban infrastructure

[149] Trends in Private Sector Participation – A critical review; WSP-SA; November 2010

whereas there had been11 projects concluded out of some15 attempts during the period between 2003 and 2010.

(b) Spreading of geographic concentration from southern states to all over the country – most of the initial attempts were concentrated in the states of Andhra Pradesh, Karnataka and Tamilnadu but in the recent times there had been projects all over country other than eastern states.
(c) Realisation of benefits of combination of public funding and private management
(d) Attempts to structure the contracts within the prevailing institutional and legal framework instead of elaborate legal amendments often derailed due to long preparatory times or changes in civil service decision makers
(e) ULBs choosing private operators as a preferred choice for operation of all expansion and new assets instead of increasing ULB own operational staff to minimise risks from strong unions as well as gaining significant financial savings from private sector in spite of additional service tax obligations
(f) Development of local skills in transaction advise and project development

Increasing interest among Indian private companies and growth of domestic private operators

A2.8 Key Issues Emerging from the Review of Contracts

A2.8.1 General Issues

(a) The initial focus of utilities on increasing source capacity ie bulk supply augmentation through private sector investments proved to be a non-starter as the utilities were operationally in-efficient with high volume of water losses and were not even recovering the operating costs
(b) Lack of preparation and treating the PPP contracts similar to conventional piecemeal contracts based on ‘Length-Breadth-Depth’ (LBD) measurement framework resulted in abandonment of projects.
(c) There is a serious lack of capacity among the ULBs and state agencies in understanding the complexity of the contracts as well in managing the same and in particular while dealing with international operators whose contract management teams include highly competent contract lawyers
(d) Most often, the utilities insist upon rapid, high and un-achievable targets within short time frames resulting in avoidable contract deviations and problems in interpretation of payment obligations
(e) There is a serious dearth of local capacity of private enterprise and in many tenders there had been about half a dozen bidding groups with local EPC contractors partnering with international operators from Europe of South East Asia.
(f) A structured capacity building program is very much necessary for both the ULB managements as well as for developing local private enterprise for ensuring sufficient market competition
(g) There is also felt need for good transaction advice and in many times the transaction advisors resort to ‘copy cut and paste’ methods of emulating from other contracts even though each local situation and condition is different from others.

(h) Mechanisms to address the contract rebasing to reflect the truing up of costs which are unpredictable in case of networks which are buried and are difficult to assess interms of rehabilitation requirements.

A2.8.2 Management Contract in Karnataka 2nd Cities (KUWASIP)[150]

(a) A simple performance based management contract of 5 year duration split into three phases of starting form a (i) preparatory phase during which operator studies and proposes a Capital Investment Plan for achieving the performance targets within a prefixed Capital Investment Threshold for approval by client (ii) implementation phase during which the operator implements the rehabilitation works through competitive bidding and the contractors supervised and project managed by the operator but paid directly by the client based on operator certification and (iii) O&M Phase during which the operator provides and maintains the service levels.
(b) The operator is selected through a competitive bid (four substantially responsive bids were received) based on lowest quoted management fee out of which 60% is fixed and 40% is linked to achievement of performance with add on bonus for over performance and a capital efficiency bonus on savings achieved in capital costs compared to the Capital Investment Threshold.
(c) The success of this contract shifted focus from bulk supply augmentation to distribution improvements
(d) Performance based management contracting framework minimised risk of investment on the private sector while transferring the operating performance risk from public to private sector
(e) Elaborate preparation (over six years) required being the first pilot initiative in the sector but proved the benefit of good preparation
(f) Despite several initial studies by reputed consultants, the information on existing assets was very sketchy and found to be very different from the findings of operator.
(g) Stringent performance targets and time lines in the contract coupled with poor quality of material and workmanship in the existing assets forced the operator to replace all the assets. Progressive targets would sure lessen the front end capital costs for rehabilitation.
(h) The concept of Capital Efficiency Bonus proved a success where in the Operator gained a good capital efficiency bonus by saving capital costs to the client by way of optimising designs and achieving market economy through transparent tenders in spite of replacing all assets.
(i) As the operator carried entire performance risk, it insisted upon specific equipment and work practices significantly different from conventional methods adapted by local water board and it led to several initial controversies generally expected during transition of public sector change management. Even the third party auditor (a local consulting company) had to face difficulty in adjusting to the new work methods and materials and technology.
(j) Outcome based performance contract posed a difficulty in assimilating by the water board as the mind-set was tuned traditionally to LBD contracting framework.
(k) Public procurement rules to be followed by the Operator resulted in some delays and anxious moments when the client was required to approve a bid for equipment where

[150] KUWASIP – Demonstration Project – Contract Documents

in the Operator recommended the bid other than the lowest based on quality and higher performance of the equipment.

(l) In spite of good communication with the stake holders undertaken by the sponsors, there was delay in one zone due to local NGOs protesting against 'water privatisation'.

A2.8.3 City Wide Water Distribution Management Contract in Mysore[151]

(a) The contract is six year tenure management contract almost similar to the KUWASIP contract detailed in the previous section but includes the rehabilitation works as part of the bid in Bill of Quantities so that the operator assumes the role of construction contractor also.

(b) The operator is selected through competitive bidding (three substantially responsive bids were received) based on lowest total costs quoted for management fee, operating cost and rehabilitation costs and is paid a bonus for over performance with penalties for under performance.

(c) The contract is progressing although the operator is not comfortable due to very low rates quoted by the operator to desperately win the contract and also due to the mixing up of outcome based contract with that of conventional LBD contracting framework by the client.

(d) Rehabilitation costs estimated as part of Detailed Project Report (DPR) proved to be significantly less when operator collected true information from ground; Ex: the existing network length found to be about 1800km as against 1280km provided in the DPR.

(e) Items of work specified by the water board was not commensurate with right way of improving services for ensuring 24 hour water supply and there was no flexibility to the operator to either improve or depart from the included works.

(f) Operator was bound by traditional engineering specifications with no room for either changing or improving the same while the client prevailed upon usage of certain equipment only from the approved vendors affecting the market economy.

(g) No baseline exercise was undertaken for existing services prior to bidding of project. The target service levels therefore had no linkage to the existing level of service in terms of timelines, costs, quality and availability of information on the existing system.

(h) Service level targets were too difficult to achieve in the given timelines; ex: achieving 15% NRW targets in 3 years period.

(i) Some service level definitions were very global and not specific. Ex., 100% coverage, 100% metering etc. Needed more specific definitions to easily measure and evaluate results achieved.

(j) Inclusions and exclusions under services and scope of work of operator were not well defined in the contract. Ex: Operation and maintenance of borewells and tanker water provision was not well defined in the agreement.

(k) Timelines for construction works were very short and not appropriate with the scale of works estimated in the Bill of Quantities (BoQ)

(l) No room provided for truing up of information and subsequent contract adjustment and review or revision of service levels and any other parameters, which could be

[151] Mysore Delegated Management Contract Documents

based on actual information and learning from the ground work by operator in the initial period of the contract.

(m) Client had not interacted with the employees working on water supply works and no agreement reached on their deputation.
(n) Neither the employees nor the Operator had any choice with respect to the employees' deputation to the project resulting in friction between un-willing employees and the operator.
(o) No consultations were carried out with the political representatives prior to bidding of project. Confusions prevailed among the elected representatives on role of the operator, contract structure and service delivery.

A2.8.4 Citywide Lease Contract from Source to Customer in Nagpur[152]

(a) The contract is a 25 year concession where in operator provides all water services from source to customer and provides partial investment to a tune of 30%.
(b) The operator is selected through competitive bidding (single substantially responsive bid received) based on a single uniform water tariff per unit volume billed to customers and linked to natural inflation which shall cover all operating costs, return on investment but excludes the electricity and raw water costs which shall be borne by the client.
(c) Elaborate preparation (over three years) helped the successful concluding of the contract
(d) Initial pilot contract provided good baseline data and comfort to the operator for assessing the operating risks and encouraged in providing partial investment
(e) Delinking average tariff proposed by Operator to that what need to be charged by ULB to the customers avoided resistance from political and civil society activists.
(f) Nagpur Municipal Corporation (NMC) providing 70% of initial investment and 100% future investment for any expansion of service minimised the investment and demand risk to the operator and at the same time any additional funding required over and above the initial investment 30% is the responsibility of the Operator.
(g) Low numbers of existing staff due to no recruitment in the ULB resulted in outsourcing of many activities and hence there was less resistance among the staff in progressing with the bid
(h) Embedding the contract within the prevailing legal framework ensured timely conclusion avoiding elaborate legal and legislative amendments
(i) Progressive gentle performance targets ensured balanced risk among parties
(j) Fixed assured return during the first five years followed by contract rebasing arising from truing-up of asset condition minimised risk to the operator and ensured return on investment.
(k) Presence of the same company in ongoing contracts proved to be a factor making the bid un-attractive to other companies and has reduced competition
(l) Setting up of Corporate entity, Nagpur Environmental Services Limited (*please see the box at the end of this section)* by the NMC under Indian Companies Act provided ring fencing of services and also facility of smooth financial flows among contract parties.
(m) Corporatisation would also insulate the operator from day to day political governance contingencies experienced in ULBs.

[152] Draft RFP Documents available on Nagpur24x7water.com

(n) The Corporate entity has facility to hire skilled and experienced professionals from the market to assist in Contract Management resolving the interpretation problems faced in Karnataka Contract

A2.8.5 Citywide Source to Customer Concession Contract for Aurangabad[153]

(a) The project structure is an annuity model wherein the client has fixed the scope of works and would provide some 50% investment and the operator need to implement the works and recovers the costs and return on investment through revenues based on pre-fixed tariffs supported by an Annual Operating Subsidy Grant (AOSG).
(b) The Operator is selected through competitive bidding (two substantially responsive bids received) based on lowest quoted AOSG. The project received two bids and is in bid evaluation stage.
(c) The high investment risk coupled with risk on future growth of demand proved a difficult proposition and hence did not attract market competition
(d) The tariff committed by city through the contract was very high, especially the third and fourth slabs and the cumulative effect of the revised tariff may result in three times higher bills casting a shadow on the overall sustainability of the project and cost recovery.
(e) The volumetric tariff was to be introduced after three years of construction period which meant all investment from the concessionaire would have taken place and if there is public outcry and client rolls back the tariff thereafter, the remedy proposed was to compensate the concessionaire from other municipal funds which was not sustainable.
(f) The operator had no flexibility in either phasing of investments or in choice of materials or to introduce market economies making the project cost prohibitively expensive.
(g) The client was noncommittal on the release of total construction grant and the Concessionaire was required to bridge finance the grants in case of delays in grant disbursement or non-grants.
(h) Even though the information on existing assets was poor, there is no provision for contract rebasing and the concessionaire was required to commit the entire investments required during the concession period which is a difficult proposition in case of water sector with buried assets..
(i) The implementation timelines were very stringent with high penalties making the project un-attractive to the market
(j) No base lining exercise was undertaken for existing services prior to bidding of project. The target service levels therefore had no linkage to the existing level of service in terms of timelines, costs, quality and availability of information on the existing system.
(k) Service level targets were too high, Ex: achieving 15% NRW targets in 3 years period.
(l) Methodology for measurement and evaluation for the various service level targets was not provided in the agreement.
(m) Increase in cost of raw water, power cost and cost escalations due to change in law etc were clubbed as business risk in the project and to be borne by the concessionaire.

[153] Draft Concession Contract; Aurangabad Water Supply Improvement Project

(n) Many grey areas in the project were left unaddressed till end including change in raw water quality. In case of deterioration of raw water quality which is beyond the control of the concessionaire, any added cost related to treating the raw water to potable standard was a risk to be borne by concessionaire.

(o) Client had not interacted with the employees working on water supply works. Employees were not clearly communicated and/or any agreement reached on their deputation.

(p) There were payment related issues for corporation employees including payments not in time, non-payment of arrears and benefits. These were neither addressed prior to bidding and no incentive mechanism to the existing staff was provided in the contract.

(q) No flexibility to the operator in choice of deputed staff and no choice for the employees to work or not to work with the operator

Appendix A3: Business planning and management change for decentralised water and wastewater service providers

A3.1 Introduction

As the urban population in developing countries increases, improved services are required to meet the demand, but often poor utility management structures and a lack of skilled workers hinder expansion and improvement in smaller urban areas. The development of a business planning management approach is key to assist the development of successful urban water supply provision, and improving operational efficiency in towns.

It may seem an obvious thing to say, but successful organisations are those that know what they are doing and do it well. 'Business planning' is precisely about the first part of the statement, and for water utilities it provides a basis for professional management of one of the most important life enhancing services. Many water services organisations have long been managed by professional managers in circumstances of stable political environments imbued with a culture that promotes and supports public service, and an altruistic commitment from government bodies that allows the poorest and needy to benefit from access to essential community services. However many are not.

A3.2 Government role in providing water services

Governments all over the world have rightly placed themselves under a lot of pressure to achieve better water and sanitation coverage for developing countries. The Millennium Development Goals (MDGs) aim to halve the proportion of people without access to water and sanitation services by 2015. Most governments in developing countries have consistently failed to deliver affordable and sustainable water and sanitation to the poor. It is difficult to summarise the causes for this failure as each situation is different and complex. However, some broad problems cut across many public utilities and municipal services, such as bad financial management, low funding priority, lack of staff experience and qualifications, absent or weak customer service orientation, political interference, and little or no independent regulation or oversight.

Many of these problems have been attributable to weak governmental and utility management capacity. Since the mid 1990s the introduction of policies to encourage the involvement of private sector participation (PSP) has been seen as an important measure to tackle many of these underlying causes of the failure of water utilities in developing countries to deliver improved access to water and sanitation to their communities and in their service to the poor in particular. Some progress was no doubt made by some international companies investing to improve water services in these countries. Nevertheless in some important areas such as capacity building, community participation, finance and institutional reform, major problems persist and international water utilities as private sector investors and their sponsors have been re-assessing their roles in a way that will make a significant impact towards achieving the MDGs. Without adequate management capacity within the governing institutions of the water sector, no reform processes can be entirely successful.

Urban centres in South Asia are growing rapidly. It is expected that the current 60% rural/40% urban split in these regions will soon shift to the current 25:75 split found in Europe and the Americas. Much of this growth is taking place in smaller urban centres or 'towns'. At present between 20% and 40% of the population live in towns, but as villages grow and develop to become towns, and towns get bigger, the number of people living in towns in South Asia is expected to double within 15 years, and double again within 30.

A3.3 Increase in urbanization

In terms of water supply, the standard of service in towns is typically the worst in the urban sector, and is deteriorating as more and more people either live in towns or depend on them for their livelihoods. In confronting this challenge, new approaches are emerging that address the need for improved, sustainable services and expansion to keep up with growth in demand.

From the point of view of water supply, towns must be understood to have a mix of urban and rural characteristics. Within their boundaries there is wide variation not only in the physical density of settlement, but also in the range of different types of consumers, socio-economic groups and classes of housing. This is true of most urban settings, but for towns, with their smaller revenue base, it is even more important not to overlook any potential customer group.

Performance of national utilities in towns has been poor where the classic public sector national utility model has had a broad range of responsibilities including planning, investment, service provision, quality and performance monitoring, and sometimes policy and standard setting. In most countries, performance of these organizations has fallen well short of promise. Fundamental to this has been the expectation of providing universal services at very low or no direct cost to consumers, and a failure to understand or provide the means to do so. High failure rates in towns can be attributed to overly centralised management and related bureaucratic complexities that leave no person directly responsible for the quality of services and reward no one for good performance. Decisions made at the head office are based on standard practices for all towns. They do not take local conditions, consumer preferences and willingness to pay into consideration, and lack customer relations and operation and maintenance capacity at town level. The tendency is to minimize financial losses by minimizing services in towns.

Municipal water departments often lack autonomy and professional capacity – where management has been decentralised to local government, decisions are moved to a local level but often resources are not, and the results have not been good. Operation and maintenance is carried out through creation of a municipal water department, or less formally by assigning tasks to the existing works department. In most cases, performance has been poor due in large part to a lack of management and financial autonomy, and to weak managerial and technical skills. Officials often do not appreciate what is involved in improving operational efficiency and in expanding the system and services. Often, decisions about water supply are influenced by political considerations and water revenues are used to finance other pressing municipal activities (sometimes understandably and this is certainly not unknown in so called developed countries). Accountability is usually imprecise and not based on business plans with agreed performance targets, and technical staff, have other municipal duties and few performance incentives. As a result, the strategy is generally one of keeping the operation afloat rather than improving and expanding services.

In recent years, good success has been achieved in rural villages with a ‘bottom up’ approach based on ‘community management’ and development of local supply chains for goods and services. Urban utilities have also benefited from this decentralization process by being able to consolidate their operations in larger, more profitable urban centres.

Municipal water departments are most common in towns, but other approaches are emerging. These approaches are characterised by decentralisation away from central government and greater autonomy. They include community water associations, town Water Boards, and possibly small-scale private water companies. Also, aggregated approaches are being tried, including existing, larger utilities absorbing smaller towns, and through creation new regional entities. A lack of maintenance, poor operational efficiency and inability to expand to meet growth in demand, have been familiar failings of many water service organisations for many years.

Systems are often designed and built without consulting end-users, using standardised approaches that do not meet their needs. Furthermore, tariffs are often set at a higher administrative level and do not reflect system operational and investment needs. Even contracting of operators, where this has taken place, has tended to be centrally managed. These issues reflect a centralised planning process with little attention to building local management capacity. As a result, autonomy is limited to nominal control of operations and bank accounts.

Above all else, it is apparent that town water supply has been managed as a 'business without a plan'. Investments and designs have not been cross-checked against water sales and projected revenues or customers' expressed willingness to pay. No plans have been made to improve operational efficiency or for expansion – or to secure the professional support needed to develop these. Financial management, reporting and auditing have been inadequate, and transparency and accountability have deteriorated. At best, towns have been provided with the 'business case' document required for 'one-time' investment financing – but not with the capacity to understand, develop and update their business plans as an ongoing process.

A3.4 Poor sustainability of water services

Various technical and financial issues affect sustainability of town water supplies as outlined above (perhaps exaggeratedly so). Since the technical issues are financial in nature, the two are combined here. Taken together, the fundamental issue is the introduction of management reforms and planning processes that make for a viable "business".

Government and donor financing of town water supply projects have often failed to result in sustainability. Towns have been selected for investment without regard for their capacity to manage and maintain the systems, nor with any attention given to the willingness and ability of the local population to pay the on-going running costs of the system. Where tariff and management reforms have not been addressed in conjunction with water supply and sanitation improvements, facilities have quickly fallen into disrepair and the utilities have remained financially weak, unable to secure financing for required rehabilitation or expansion from any source but the government.

Strict design standards have led to poorer service in towns. Many town water supplies have been designed and constructed based on standards appropriate for larger urban centres, but unaffordable to small community customers. Excess capacity means unnecessary production and maintenance costs. The result has been rapid deterioration of the systems as revenues have been insufficient to provide for on-going operation and maintenance. It is not unusual to find a town water supply system that serves only the core of the town, often with daily interruptions in service, and with no attention paid to fringe areas. New customers cannot be connected to the system and many residents must purchase water from vendors at high prices or resort to unsafe sources.

Growth in individual towns is uncertain in terms of demand and location, and so it makes sense to expand the system only when actual demand and settlement patterns are known. Responding as quickly as possible to demand for private connections is then critical to bring revenues up to cover costs. This calls for a dynamic planning/expansion process.

The revenue base in towns is small, often insufficient even to cover the fixed costs of a local operator, not including the cost of specialist services to advice on business planning, efficiency improvement, and expansion. Provision of public standpipes alone does not take advantage of the more affluent households in a community who would be willing to pay considerably more for house connections.

Subsidies too often finance poorly performing utilities and wealthier customers connected to the system instead of those truly in need. Low tariffs and high connection fees can be common. This combination only benefits the relatively wealthy people who can afford to connect to the system. The poor often cannot afford connection fees and are left to pay more for water obtained from vendors or neighbours – or pay indirectly by spending increased time fetching water from alternative sources and in terms of poorer health. Subsidies to utility operations that are not appropriately targeted at the poor and performance-based have created disincentives for efficient operations and have wasted public funds.

Decentralisation in many countries has shifted responsibility for water supply and sanitation to the local level. However, local governments do not have sufficient resources to fully fund needed improvements to water supply and sanitation, and do not appreciate what is involved in managing a water supply system. As a result, town water supply facilities fall into disrepair while local officials wait for financial support from central government. Even when financing is provided to rehabilitate their facilities, towns tend to 'go it alone' without securing the technical support needed to plan expansion and operate their system effectively. To make matters worse, revenue from water sales is often used to finance other pressing government functions, and decisions about the water system are often influenced by other political considerations.

A3.5 The importance of business planning

Business planning helps town water utilities to plan operations, investments and finance in a sustainable and affordable way.

- It provides a means to share information with employees, customers, political leaders and potential investors, so that there is agreement on the utility's plans.
- It makes sure that investment decisions take account of what consumers want and are prepared to pay for;
- It ensures that revenues are sufficient and that the utility is financially sustainable;
- It helps the utility to monitor financial and technical performance;
- It supports performance-based contracts with employees or a private operator, by helping to identify and agree on performance targets;
- It helps to support activities needed for performance improvements, such as water quality monitoring, benchmarking, and external audits.

For town water supply, business planning is the process of outlining how the utility will develop over time to provide the level of service required by its customers, owners and regulators.

In traditional project-based approaches to town water supply, where systems have been designed and built by the Government and handed over to the town on completion, the business planning process has often been overlooked. Often, design has been restricted to technical, economic and financial feasibility studies prepared by consultants without adequate stakeholder consultation. If those who inherit management of a water supply system have not been involved in its design and do not understand the choices made or what is required for sustainability, they may be reluctant or unable to maintain tariffs at a level required to cover costs and to pay for adequate maintenance of facilities or to retain qualified staff and contract for professional support.

The business plan is not a static document. It will need to be adjusted over time to take into account actual performance and changed circumstances. Generally, the business plan should be revised every three to five years and updated on a rolling basis each year between these revisions. Annual budgets and requests for tariff adjustments should be prepared and reviewed in the context of the business plan to ensure consistency with the longer term plans of the utility.

Business planning is best understood as an iterative process. Initially an assessment of regulatory requirements, current service levels and operations and demand assessment are carried out, which serve as the basis for identification of an initial technical design and a management and operations plan. The design is then cross-checked to customer willingness and ability to pay and a financial projection is prepared. If the design cost is not affordable, if customers would not be willing to pay the cost of the system or if the utility could not be financially viable, the design and/or management and operations plan must be revised.

A3.6 Operations & maintenance

This is a bigger factor than is often appreciated by local government bodies. The country (and many others) are littered with examples of small scale water supply and treatment systems that lie dormant as a result of a lack of parts, willingness to solve technical breakdowns and a lack of local self sufficient expertise. The restless question is how to maintain the momentum of enthusiasm for the creation of new facilities for the future; where there is no end point to that future - “having a water supply is not the same as having a reliable and safe water supply”; and “having a reliable and safe water supply now is not the same as having a reliable and safe water supply tomorrow”. Hence the question of developing a locally based and robust technical resource for O&M is crucial. Otherwise a declining cycle of non-sustainability might be the consequence; lack of a service or poor service resulting in people no longer willing to pay; thereby creating financial decline that further inhibits the financial resources to provide O&M.

The development of a vibrant entrepreneurial approach by some would support the sustaining of facilities and of behaviours. How? In order to sustain the delivery of WASH education and knowledge, and public awareness the responsibilities for maintaining behaviour change messages and information needs to be broadened. Those who might have a financial and business advantage in selling more WASH related products (soaps, sanitary ware, tissue etc) or offer WASH services (latrine maintenance, cleaning or latrine improvements) provide a conduit for entrenching and selling good WASH practice.

These are not the limits as options for building local entrepreneurial activities and others should be discussed and developed; particularly as the volumes of potential “business” start to emerge such as in the emptying of latrine pits and disposal of faecal sludge; development of fertiliser use (with branding?); management (or caretaking) of communal latrine facilities for a number of village communities. These options exist as potential ones for BRAC WASH to develop a support and investment programme through its micro-financing operations and it is recommended that the feasibility of these opportunities is considered within Phase 2 and within the existing BRAC programme of support for WASH sustainability. BRAC could provide information about “business opportunities”; market and sell the concepts through discussions in the communities.

Appendix 4: A global perspective and debate about PPP

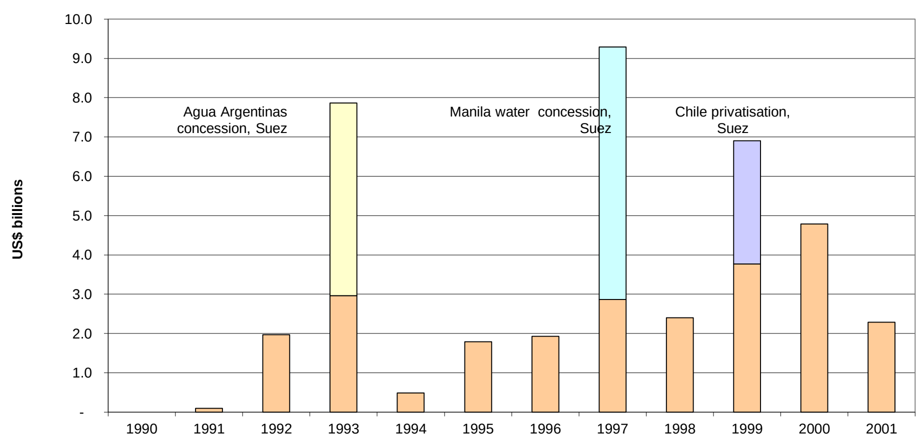
A4.1 General

It is difficult to obtain up-to-date and unbiased data in order to provide a definitive assessment of the impact of foreign operators in developing countries. The World Bank website provides access to relevant data but this does not report in a comprehensive manner. The two opposing views of the PPP debate (mentioned above) provide a wealth of empirical evidence to support their respective arguments, however, it sometimes proves difficult to reconcile their somewhat stylised data that each prepares. The availability of data from foreign providers is also often limited to promotional material due to corporate confidentiality clauses and no obligation to report such data. Whilst research papers have tended to focus more on finding solutions to current problems and preparation for PPP, than detailing the actual impact of PPP related service provision.

A4.2 Investment in the sector

Foreign water service provision in developing countries has been a key element of water reform policies from the mid-1980's to the present day. According to World Bank data, from 1990 to 2001 the sector saw 43 developing countries award 203 PPP contracts committing a total of almost US$ 40 billion of investment. Figure 1 shows that annual investment rose gradually to a peak in 2000 then more than halved in 2001. The slump in investment could be a result of the international private sectors attempts to restructure, shed global portfolios, and reduce project debt, in response to the growing risk aversion of their shareholders following 9/11, the Argentina crises, and corporate bankruptcies. Furthermore, it could be argued that the easier investment opportunities have already been supported, and that markets with a commercially tolerable level of risk are becoming scarce. Presently it is hard to tell whether the slump will continue due to the reasons offered above or whether it simply represents a glitch in the rising trend. The peaks in investment identified in the diagram are the result of three significant PPP contracts awarded to Suez.

Annual investment in water and sewerage projects with private participation in developing countries (the trend over the last decade has remained broadly similar)



As stated earlier, generally more investment has been made in developing clean water as opposed to wastewater services and this has concentrated in the more commercially attractive regions of Latin America, East Asia and to a lesser extent Central Eastern Europe. That said the financial institutions are attempting to reverse this trend. From 1999 to 2003, the World

Bank committed US$ 5.14 billion to Water and Sanitation Services (WSS) and was spread as follows: East Asia & Pacific 32%, Africa 20%, Latin America 20%, East Europe & Central Asia 11%, Middle East & North Africa 10%, South Asia 7%.

A4.3 Capacity of local providers

The report 'Bridging the Water Divide' (2002) by Suez describes how in La Paz, Bolivia they have engaged local communities to manage and operate the system. When the field teams departed, the local community were then able to continue running the service. A study into PPP identified some of its successful outcomes, including increased managerial efficiency, personnel training and technology transfer.

On the one hand there is evidence to suggest that foreign providers are aware of the importance of capacity building and that similar approaches to that published by Suez are being implemented elsewhere. Such approaches are a relatively recent occurrence as providers continue to learn from experience and find themselves under more pressure to practice corporate social responsibility.

A4.4 Costs and Price of water

In the past, the price of providing water and sewerage services in developing countries has had little relationship to the cost, with the government usually making up the financial shortfall. The main financial principle of water sector reforms and private service provision is cost recovery to enable financial sustainability.

There are numerous examples of where foreign providers have made significant cost efficiencies through more effective operational management procedures. Since 1997, United Utilities (UU) in Eastern Manila, Philippines has repaired 140,000 leaks saving 250 Mld of water and increased the billed water volume by 84%. Nuon in Karasai, Kazakhstan has improved the billing collection rate from 25% to 90% over the first few years of the contract. In theory these cost efficiencies help to set affordable prices as, arguably, shown by the UU's contract in Manila, which was able to cut prices by 65% in 1997.

The problems of high staff to connection ratios, bill collection and illegal abstraction are a few examples of the problems that remain in developing countries. Suez in Manaus, Brazil has managed to cut distribution and illegal abstraction losses from 77% in 2001 to 70% in 2003 however the figures are still alarmingly high. Since private sector participation in the provision of water services in developing countries began, the price of water has tended to increase. The impact that this has had on water service provision has been viewed two fold. On the one hand donors are encouraged by attempts to install financial sustainable water services that place less reliance on government subsidies. Yet on the other hand, the impact is said to have unfairly limited access by the poor who cannot afford to pay.

A4.5 Access to water services, in particular for the poorer group in society

Service extension is reportedly a common goal between foreign providers. Inroads have been made since international service provision began in the sector, for example Suez have extended services to nine million customers living below the poverty line. This is quite an achievement but represents a small proportion of the poor yet to be served. Allowing for the expected growth in population, attaining the Millennium Development Goals (MDGs) will mean new global connections of more than 250,000 people a day for water supply, and more than 300,000 a day for basic sanitation, every day for the next 11 years. It is acknowledged that the current rate of service extension needs to notably increase.

A major problem faced by foreign providers and investors is that the poorest often remain “invisible” from their operations and area for responsibility. Even well intentioned legal systems can restrict access to the poor. For example, in Buenos Aires settlements are not allowed to be built in low-lying areas prone to flooding however the poor, who seem to have no choice but to settle in such areas, are subsequently prevented from access to water and sanitation. Similarly the poor have not had access in rural areas where the private contractors have constructed water-points in cheaper and easier locations, rather than marginal, inclined or rocky areas where many of the poor reside.

A4.6 Coverage of rural areas and small towns

Over the past decade, the market has focused on large and expanding urban areas. Private investors and service providers have considered small towns and rural areas less attractive for investment due to high levels of financial and political risk and limited scope to recover costs. Furthermore, their skills are better suited to large scale urban projects as opposed to small scale rural projects scattered over a large geographical area. The complexities of poverty are amplified in rural areas where the local culture, language and economy are inherent factors of water service provision. The current donor strategy to encourage a more devolved structure for water and sanitation service provision will, without moves toward aggregating certain functions of the local utilities, make it more difficult to attract any international water service providers. The benefit of this strategy might be to provide encouragement to new and locally based private sector partners and examples exist in Asia and in Central Europe where local water utility managers have

Although more prevalent in urban areas, there are cases of international providers operating in rural areas. Suez Ondeo, for example, manages a water supply project for rural and peri-urban communities in the Eastern Cape and Northern province of South Africa. From the outset of the project in 1997 to 2001, the population with access to water services increased from 500,000 to 2.2 million. It appears that a significant contribution has clearly been made to these rural communities.

A4.7 Community participation in decision-making

A great deal information relates to the importance of involving the community in water service provision but in practice it does not appear to be common or successful. When it does occur, it is most common in projects that also involve local NGOs who are in a better position to engage with the community. The World Bank, other funding agencies and NGOs are running a number of projects on community and public participation. Certainly all PPP projects supported by these agencies now require a significant element of work in the area of public participation and community support.

Lack of consultation with the people can contribute to problems in PPP contracts and this was a part of the International Water’s (IWL) experience in Cochabamba, Bolivia. Five months after a 40 year concession was awarded to IWL for water and sewerage services, there was a week of rioting - the protests were apparently mobilised to oppose the privatisation and rises in water rates. The contract was subsequently nullified. Less politically charges, although equally relevant, community participation in Mozambique was proved essential. Those villages given a choice of water service opted for basic wells with rope and bucket. Villages not given a choice were constructed hand-pumps but left without water when these broke down because they did not have the training or equipment to repair them.

A4.8 The debate about PPP

A distinct divide exists between those in favour and those against PPP in the provision of water service in developing countries (in fact this divide exists also for developed countries). The former group consists of the so-called Bretton Woods institutions, the World Trade Organisation, some governments and some international water companies and the latter group, trade unions, international Non Governmental Organisations (NGOs) and other generally politically left of centre networks. Foreign involvement in the provision of water services arouses anti-privatisation and PPP sentiment and is concerned that through the market mechanism, water will be disregarded as a human right and priced above an affordable level to the poor. Those who support the inclusion of PPP contracts in developing countries point to the major funding gap that exists in the public sector to achieve the Millennium Goal Targets. They also argue that water in many parts of the world is a scarce resource and needs to be regarded as an “economic good”. The main thrust of the argument is in favour of increasing foreign participation as a service provider They argued that the private sector is vital for mobilising the much needed finance, which the public sector alone cannot provide – and this is particularly the case for developing countries..

The debate is particularly relevant in the context of improving service coverage to the poor; currently it is estimated that over one billion of the world’s population do not have access to safe drinking water (World Health Organisation). Advocates of PPP, such as the World Bank and OECD have in the last decade been active promoters of PPP and now continue to be so. But in an environment, in which the international operating companies are significantly risk adverse and have been reducing their exposure to project debt and shedding their international portfolios, the role of PPP as a pro-poor strategy is being re-evaluated and more local PPP solutions are being developed than ones which target foreign participation.

A4.9 The international suppliers of PPP expertise

In 2002 there were approximately 24 foreign water service providers served the water industry in developing countries. The number is in a constant state of flux as the industry undergoes mergers and acquisitions, strategic alliances and contract gains and losses. Suez-Ondeo and Veolia Environment (formerly Vivendi) of France dominate the market in terms of numbers served and geographical coverage and with over 70% of the contracts involving foreign provider participation. The other major players are also European and comprise of: RWE/Thames (Germany/UK), SAUR Bouygues (France), Agbar (Spain, although under indirect control of Suez), AWG (UK), United Utilities (UK) and ACEA (Italy). Having said this private sector suppliers of water services remain at a low and currently decreasing level – in 2003 over 90% of the world’s water service was still delivered by publicly owned organisations and only approximately 200 million people in the world were served by a privately operated company, most of these are in Europe, with half of them in France and the U.K..

Foreign providers have typically operated in more commercially viable markets and Latin America, East Asia and Central Eastern Europe, for instance Argentina, Chile, China, the Czech Republic and Turkey have over recent years attracted significant levels of PPP interest; and China in particular continues to be strong market for PPP contracts. There have been fewer contracts and less investment in the regions of the Middle East, Africa, Central Asia and South Asia. Attempts, primarily through the international funding institutions such as the World Bank and OECD, are being made to develop opportunities that support and encourage the involvement of foreign providers.

Approximately two-thirds of PPP contracts serve less than 1 million people each. The majority of the limited number of contracts in the Middle East, Africa and South Asia serve a population under 1 million. Contracts in Central and Eastern Europe are similarly small in terms of numbers served, with a maximum of 2 million people served by any one contract. The majority of the final third of contracts serve between 1 and 5 million people and these are in Latin America, East Asia and a few in South Asia. Fewer than 10 contracts serve between 5 and 8 million people and are located in Latin America with the exception of Bouygues' operations and maintenance contract in the Côte d'Ivoire, which serves a population of 6.9 million.

From 1990 to 2001, concession agreements proved to be the most popular form of PPP contract, though this hides a recent shift over the last three years from investment based concessions to BOT contracts, and more recently to management style contracts. In fact, following the financial crises in Argentina and Russia, management contracts are now considered the "safest" risk free way of being a PPP service provider

Recent failures in large well known PPP contracts have highlighted potential pitfalls and created nervousness amongst foreign companies in their ability to provide an effective service. Over the past 15 years, the role of PPP in service delivery has gradually increased, but still served only 8% of 6,211 million people in 2002. The Masons Yearbook 2003 - 2004, forecasts this to increase to 17% of 6,800 million people by 2015, mostly due to extended coverage in developing regions: Middle East; South Asia, and South East Asia, but not Africa. However, there has appeared to be a rapid downturn of interest in investing in water (and sanitation) projects by the leading international service providers, as they have shifted their business strategies towards less risky countries and projects – these tend not to be in the developing world. This increase is based on a continuing advocating interest in PPP by the International Finance Institutions (IFIs), continuing interest in developed countries and continuing growth in China.

The main issues that have over the last few years dissuaded many of the main international service providers from further involvement in concession or lease type contracts were the sorts of issues highlighted in the Camdessus report (World Forum on Financing Water Infrastructure –Kyoto 2003); and remaining, as being unpredictable behaviour by the public partner; exchange risk – a fear heightened by events in Argentina during 2001; lack of potential funds (say available from IFIs); and high fixed costs of preparing tenders and contracts.

National Water Resources Framework Study

Urban and Industrial Water; Regulatory Framework

Working Paper No.11:

Regulation of Water Supply and Wastewater

Simon Gordon-Walker and Anand K. Jalakam

Contents

Questions raised

The following questions were raised by the Planning Commission with regard to the regulation in water sector:

- *What should be the functions of a regulator?*
- *What should be the degree of independence of the regulator from government?*
- *What should be the precise nature of the relationship between regulator and government?*

Understanding the role of a regulator in the Water Supply sector

In discussions over the role of regulators in the water sector a number of potential roles and activities for a regulator have been identified. The regulatory "regime" within a federal government structure will require regulatory functions being assigned to a constitutionally appropriate level of governance. This note aims to provide a succinct description of the sorts of activities that a regulator might undertake and in the context for this activity.

In India the access of water for all people and to meet all their needs for their healthy and good livelihoods is the overriding policy objective. There are many society needs for water and India is faces special challenges as the water needs of people in cities and towns starts to grow, and for those whose livelihoods depend on industrial or business employment and prosperity then the water needs of these industries are important. In addition farmers whose livelihoods depend on selling food to people living in the urban environment will depend on the prosperity of this urban and industrial sector in order to have a sustainable market for their produce. Everyone in society has a water need, and these needs are all interconnected. All people expect Government to set the conditions and policy actions that will ensure everyone's needs are met. This is the context for "regulation"; for regulation is part of the framework for providing a fair allocation of water to meet everyone's needs; it is about ensuring that if payments are to be made for water used by people that this is fair and equitable. Regulation is also about safeguarding the long term sustainability of water for ALL those that need water, and this includes the long term financial viability of organisations such as water utilities which provide infrastructure and services in cities, towns and villages.

The regulation of water and wastewater service refers to public sector control over utility service providers so that their conduct is channelled to achieve public sector objectives. Regulation can be seen, therefore, as the means of converting broad policy into effective service delivery. Without good regulation of service providers, the best of policies will fail to be implemented.

There are in the water supply area three types of regulator; one that regulates a specific contract between a municipality and a private supplier (such as in a concession contract or even a management contract) and this regulator operates to supervise the contract and applies certain rules and standards when assessing prices for water supply and cost incurred by the operator; second is a regulator, such as OFWAT in England or SISS in Chile that operates as a national organisation to determine prices for water customers operating in a monopoly situation; and third is a "softer" regulator which has no overt statutory powers but applies a regulatory pressure through various activities such as performance comparison, the provision of best practice advice and guidance and can work with water utilities to support their improvement in performance needed to meet the public policy goals in the sector; such is the example in Australia with the National Water Commission and the Water Services Association of Australia.

Type of regulatory activity	**Level of governance**	**International example/reference**
Contract regulation between a private investor and supplier of water services – which covers both price setting, targets for service delivery and investment costs.[154]	Municipal, but requires a high level of regulatory and sector expertise.	There are many examples of contracts between municipalities and private sector service providers and these contracts cover a range of different type of PPP relationships: e.g. provision of management services, concessions, infrastructure building, Examples: Manila Water, Philippines Sofia Water, Bulgaria Many of the concession based contracts from the 1990s have ceased to exist because of disagreements between companies and governments over price determinations
Provision of benchmarking and performance comparisons – performance reporting[155]	National and can operate as "voluntary" scheme or an "obligatory" scheme. Essentially the system provides a peer review of performance aiming	Many European countries operate a benchmarking system at national level with detailed regulation taking place at municipality level (where municipalities are the main owners of utilities). The schemes can be operated by water utility associations or by a national

[154] It is now generally agreed that it is infeasible for most, if not all, long-term concession arrangements covering an entire water service system to function well for many years just on the basis of adjustment clauses that deal with specific events, such as changes in law. It would be very difficult – if not impossible – to devise mechanical adjustment formula (one incorporating price indexation and perhaps a price-cap-type 'X' factor) that could closely track changes in efficient costs for an entire water and wastewater system over ten or more years Even in the U.K. water sector, where the process of setting price caps has been in operation for over 15 years and the data is of a comparatively very high quality, this is arguably not feasible. It is therefore hard to avoid the conclusion that, for most water systems, a comprehensive price review of some kind will be needed to reset prices every few years, based on some notion (suitably defined) of what the company's costs 'should' be. There is often great uncertainty about the condition of underground assets in the system of a water utility operator. It is extremely difficult to estimate needed improvements and their timing and to fix a realistic long-term base tariff level. The method for resetting a base tariff after better information is obtained will almost certainly involve principles relating to 'acceptable' or 'efficient' costs, or something similar, and these will often lead to thorny issues of definition and verification. Other types of initial uncertainty exacerbate these difficulties: for example, in some systems, the lack of metering (bulk meters and customer meters) can create uncertainty over the potential revenue base; and usually the lack of a good understanding of the breakdown of non-revenue water into technical losses and commercial losses presents a severe challenge to the planning of remedial actions. Uncertainty in relation to these aspects means that estimating future cost-recovery and revenue levels and the concomitant impact on tariffs cannot be carried out using precise rules alone. They will need to be supplemented by other mechanisms. But all of these problems involve largely (but not wholly) technical, as opposed to policy, questions,

[155] In the late 1990s Bangalore's nongovernmental Public Affairs Centre, for example, produced a scorecard for performance of the city's public services. The group's presentations are discussed in well-attended town hall meetings and followed up by the local media to pressure providers to improve services. The Public Affairs Centre took the initiative to extend its activities and benchmark the quality of basic services across 22 major states in India.

Consumer advocates and pressure groups can play a powerful role in mobilizing public opinion in response to published information. Independent analysis lends punch to the data By exposing poor performance public reporting makes service providers more accountable to the public and thus increases their motivation for improvement—to the benefit of the end user. Government and donor agencies can do more to encourage public performance reporting and to help guide the effective use of scarce resources. "Worst in the class" performance must not be seen as a route to additional resources but rather as a clear challenge to do better.

	to provide peer pressure for improvement.	government commission. Examples[156]: Denmark, The Netherlands, Australia, Germany, United States The main issue concerning these schemes relates to ensuring the quality and reliability of information
Centralised performance comparisons used in order to establish consumer price determinations at a national level	National level within a centralised state; involving a high degree of regulatory expertise, large volumes of data.	Takes place in very few countries where water utilities are not owned by municipalities, either singularly (France, Denmark, USA) or in aggregate form (Netherlands, Italy). Good examples of this highly centralised national regulation of private water and wastewater services are England and Wales, Chile, And of a public supplier, Scotland.
Provision of advisory services to support best practices that support water sector improvement	National level	Delivered by a national water commission such as the National Water Commission of Australia, but also by Associations of municipal water utilities – Netherlands, Denmark and Germany

Recommendations

In a decentralised country such as India there is a complexity in the institutional framework in urban water supply; and hence it is inappropriate to stipulate or recommend a 'one size fits all' regulatory solution. It is also clear that the information vacuum in the sector would make it even more difficult for a "hard" contract based regulator to function in the current level of functioning of the local municipality water utilities or state owned water utilities.

Hence a combination of approach/actions is suggested to achieve progressive regulatory regime in the sector.

- Accelerate and consolidate the water utility performance monitoring scheme roll out so that each State achieves benchmarking all cities and towns say by the year 2015; this would provide the baseline information and enable the future regulator to set

[156] **National Benchmarking Initiatives**

•Association of Dutch Water Companies (VEWIN) represents the Dutch drinking water sector. VEWIN, the Water Association of the Netherlands regularly undertakes benchmarking on behalf of its members utilities.

•Brazil National Information System for the Water and Sewerage Sector (SNIS) is the water utility performance system that includes most of water and sewerage utilities in Brazil managed by the Ministry of Cities.

•Canada National Water and Wastewater Benchmarking Initiative is a national benchmarking scheme and this website contains links to other contacts and information about benchmarking and best practice for water and wastewater utilities, representing approximately 50 percent of Canadian utilities with service population larger than 50,000 that serve 60 percent of the country's population.

•South African Association of Water Utilities (SAAWU) is a member based organization that launched a benchmarking project in April 2001. The main focus of the project was to develop a process that would enable participating organisations to learn, share and compare information on their technical and functional operations, to improve their business performance and enhance the services they provide to municipalities.

periodical progressive performance targets for each utility for achieving the national benchmarks.

- Review the current performance indicators of the benchmarking network to include "process benchmarking" activities and to promote the business-like planning approach to be adopted by water utilities
- Strengthen the State SLB Coordination Cells into full-fledged Performance Monitoring Units to function within the respective Urban Development Departments or Directorates for monitoring the service standards and developing information data-base on all aspects of service and economic regulation.
- Introduce periodical rating of cities and institute awards for best performing cities in the league especially in the area of sanitation as the moving towards regulation would require long time to establish base lines and even longer time in achieving the benchmarks considering the backlog in the sector.
- Increase the delegated management through appropriate form of PPPs so that contractual regulation is ensured by way of ULBs committing to some fixed tariff adjustments linked to natural inflation. This can be achieved at very short time frame without the elaborate legal and legislative changes required for establishing independent regulators.
- Assign the responsibility of economic regulation ie recommending the tariffs to the existing electricity or water resources regulators by attaching a water sector unit either through internal increase of resources or by way of outsourcing the skills to eligible experts. This would help in achieving the most crucial regulatory objective of setting and monitoring tariffs at a very short time frame and also is in line with the recommendation of Planning Commission encouraging multi-sectoral regulators.
- Ring-fencing ULB or state owned utilities by way of separation of role of policy maker, owner and service provider and to this effect; introduction of "corporatisation" of large city or regional utilities may be explored which would improve internal governance, commercial nature and can induct professional management so that the service provider entity would transform into a professional managed utility.
- The experience from electricity regulation is that enforcing penalties for utility's non-performance is difficult and it is further complicated in case of UWSS when the utility is either embedded within the ULB or State. As such it would be prudent to explore 'carrot'-based regulation by way of instituting performance linked financing mechanisms while releasing capital or revenue subsidies to the cities. This has already been enshrined in the 13th Finance Commission where in some part of future budget allocations are linked to achieving targeted performance by the utility. (The State of Karnataka has been contemplating establishing a Water and Sanitation Council within the UDD to undertake this role of service and financial monitoring and advising the State while sanctioning any future capital or revenue subsidies to the cities).

Independent regulation in a public water utility

As a precursor to the discussion on regulation it is important to place the concept of independent regulation as one that takes place for public as well as private-owned organisations. The publically owned water utility in Scotland – Scottish Water, is independently regulated by the Water Industry Commission (WIC). The WIC is a non-departmental public body with statutory responsibilities and its job is to manage an effective regulatory framework which encourages the Scottish water industry to provide a high-quality service and value for money to customers, acting independently of Ministers. They have a statutory duty to promote the interests of customers and do this by setting prices for water and sewerage services that deliver Ministers' objectives for the water industry at the lowest reasonable overall cost. The price setting process takes place every five years. If Scottish Ministers refuse to accept the WIC's recommendations then they must publish an "open" notice explaining the reasons – this ensures that politicians do not make arbitrary and short term political decisions on tariffs.

Scottish Water was created against the trend of nationally regulated, locally provided services. The route was adopted against a backdrop of public and political opinion that rejected the full privatisation (divestiture) option adopted earlier in neighbouring England and Wales.

Scottish Water is a publicly owned body corporate serving some 5.5 million domestic and non-domestic customers with water supply and sewerage services throughout the country of Scotland. The Commission monitors compliance with the code and the code may be varied if appropriate. Scottish Water is also required to work to a consultation code approved by Ministers, with the purpose of involving customers, rather than only those who would claim to speak for them.

Scottish Water owns general water supply and sewerage surface and infrastructure assets and attendant liabilities. Management oversight cascades down from Ministers to a Board of Members with a majority of non-executives over executives. The former are Ministerial appointees and the latter are appointed from Scottish Water employees subject to Ministers' approval. With the purpose of issuing challenging efficiency targets, the Commission (Regulator) carries out benchmarking against the English and Welsh and other utilities. As illustrated by the following quotations from its enabling legislation, the utility has assumed a mandate to manage its operations as a modern customer-focussed business:

".....Scottish Water, when exercising its functions, must have regard to the interests of every person who is a customer or potential customer of Scottish Water....."

".....Scottish Water must, in exercising its functions, seek to ensure that its resources are used economically, efficiently and effectively....."

Scottish Water is both an asset owning and operational organisation. In a traditional way it uses internal staff, outside advisors, consultants and contractors to develop and execute capital works, in addition to exploiting BOT opportunities and is enabled to out-source functions, such as billing

Scottish Water has normal sector powers to set salaries, provide benefits and engage and dismiss staff. It is to recognise staff and labour representation through liaison committees and has a Board Member responsible for staff matters.

Scottish Water must report to Ministers, the Commissioner, the Scottish Environmental Protection Agency and the Drinking Water Quality Regulator for Scotland. It is required to keep records of its activities and accounts, making them available for inspection and explaining them to persons appointed by Ministers. Reports must be submitted as soon as practicable and annual reports are submitted to a Convenor of the Water Customer Consultation Panels in addition to other noted bodies.

Scottish Water must keep proper accounts and records and prepare statements giving true and fair views. In accordance with timing directed by Ministers, statements must be sent to the Auditor General for Scotland for auditing.

1. Introduction

This working paper covers the following areas: regulation in the urban municipal water and wastewater services context; the relevance of regulatory practice and what it means for service providers in a decentralised context; and with this the opportunities that arise for providing services through entrepreneurial activity.

The aim of the paper is to provide suggestions on "what could be done"; the sort of guidance that would be particularly required during a decentralisation process; and how that might open up new opportunities for a variety of locally evolved arrangement and how that might be managed

In countries where decentralisation reforms are underway, one of the choices that towns have to make is about the type of utility that will provide their water and sanitation services. Currently water and wastewater services (often known in a rural or peri-urban context as WASH – Water, Sanitation and Hygiene) are mainly a municipal responsibility with a consequence that any reform process would have impacts not only for the water and wastewater service providers themselves, but also for the political and governance structures of many of the municipalities within federated states.

Water and sanitation provision is a public (health) service responsibilities and these are variously allocated between national and one or more other tiers of government, state and municipality or village. For example in all countries the ultimate responsibilities for water and wastewater services exist with municipalities and outside environmental regulation, the main regulatory influence also takes place at this municipality level (in some countries such as Brazil and in Italy municipalities frequently agree to combine in larger entities or a state level to achieve benefits associated with aggregation) . National legislation can provide a framework for municipalities to decide the manner in which water and wastewater services are provided, and so this same framework can allow significant discretion for the manner in which regulation is conducted. For example in Germany, some municipalities require higher standards of drinking water or effluent discharge than that recommended in national law. This devolution of responsibility both for the service and regulation means that it has been consistently difficult for national authorities proscribe precise and uniform approaches to the way in which water and wastewater services are provided; and ambiguities in the legal position of the role of municipal governments and political ambitions/programmes have created sources of conflict during periods of reform that may involve the private sector and different approaches even within the public sector.

The thesis here is that the "form" of reform is perhaps less important than the essential "principles" that a reform process needs to deliver; and that too much concentrated effort on the form of reform, especially when dictated top down from national level (more so when that country is a federal one), that political and governance issues detract from the reform objectives. If the form of reform can become neutral; and the objectives of reform become the essence of the national reform objectives such as "increasing coverage", "increasing quality", "efficiency"; "public health reductions in water borne disease and infection", with "economic/socially fair" allocations of water. Where needed the national government should provide a facilitating role; capacity support, advice, information and comparative performance data, as a supporting function to the devolved entities responsible for service provision.

2. Water and wastewater sector regulation

The optimal balance of responsibility between the different tiers of government depends on the characteristics of the utility sector, jurisdiction units and the regulatory issues in question. In the water and wastewater sector utilities generally operate solely through local distribution networks. However they will often abstract water from resources that are shared with other local networks. Here the regulators and indeed the provider are likely to be at a higher, regional tier of government. A similar split exists between the local wastewater collection network and its regulator at the municipal level, and the regulator of discharges to the environment, which is more likely to function at a regional, national or river basin level.

The regulatory issues that seem to be relevant are:

- the water sector is a regulated public health function and needs to be regulated, be that as a public or private endeavour;
- regulation and competition are not contradictory and may complement/supplement each other;
- as a public function it needs to be relevant and sensitive to the behaviour of public authorities and the legislative measures;
- good regulation can have a positive impact by playing a greater role in advocating for customer interests and for greater efficiency.

All industries are regulated to different degrees, depending on conditions of market competition and community interest. The water and wastewater industry needs to be highly regulated given the impact that its operations can have on public health and the environment. In addition, being in the main undertakers of a natural monopoly, there is a need to protect the customer's interests.

The challenges for regulatory authorities to become such “advocators” of and for the customer in water and wastewater sector are significant. This is because in many states (maybe most) the political interest in water services and the notions of private sector involvement can appear to conflict with ethos of public service (this is certainly the case in Europe for example where the language of “competition” has been inherently confused and entwined with the language of “privatisation” and “liberalisation”.

The issues and the language of private sector involvement, entrepreneurial interest is distinct and is about processes and structures, and regulation that support efficiency, high quality of services and competitive prices.

Regulatory solutions in this context not only covers formal processes of regulatory that involve rules and acts of enforcement, but also processes of providing information to customers. The paper describes the main elements of regulation pertinent in the water and wastewater sector.

3. Water sector regulation

Key objectives of regulation in the water and wastewater sector are to:

- protect the environment from over-exploitation and in particular to establish fair allocation of water resources between competing users;
- ensure public access to good quality drinking water to protect public health
- protect customer interests by establishing acceptable levels of service and price and efficient operations, for which they would need to provide incentives for competition (for example in ensuring competitive tenders are conducted properly).

In the areas of environmental protection and drinking water quality, the regulation of a water utility with private sector involvement will be the same as for a public sector water utility. Although, where private capital is involved in water service provision, special care must be taken to avoid private economic interests achieving dominating influence over decisions.

In the areas of customer service and service pricing some additional regulation may be necessary to ensure "fair" pricing and an acceptable level of service to customers are provided by the operator. Customers should expect an acceptable level of service from their water and wastewater utilities. This level of service should be clearly stated, and the actual service provided should be monitored. Apart from monitoring drinking water and effluent qualities, there is often little attention paid to the service standards provided to customers. If there has been, the information has and is generally not within the public domain, and certainly not analysed on a comparative basis.

If a competing operator is to provide services to customers it is important, as part of the relationship, that the level of service to be provided is established at the outset. Otherwise there is little recourse for poor performance. Pricing of service is a complex issue. However some form of regulation is necessary to assess that the level of prices to customers are "fair" - the key is balancing the 'cost and quality'. Regulation in the water sector generally covers the following areas, which will be looked at:

Prices Regulation of prices is necessary to ensure that the service provider does not abuse a monopoly position.

Levels of service and operating costs In order to assess appropriate price levels, the regulator needs to know what levels of service the utility is providing. The regulator therefore monitors levels of service and estimates the corresponding costs.

Investment Many of the assets utilised in the water industry have very long lives (pipes may last 100 years or more), so it is essential that adequate maintenance is carried out to preserve them for future generations of consumers. As well as providing new assets to extend or improve services, the utility invests in the maintenance of existing assets. The regulator ensures that prices provide sufficient revenue to finance this investment but, equally, the regulator ensures that customers do not pay too much for this.

Customer protection In a monopoly industry dissatisfied customers cannot choose an alternative supplier, so they have very little power to force the utility to act on any dispute. There is thus a need for a body that can act in support of customers. This body must have sufficient authority to enable it to influence the utility. Such authority could be provided by making it a government body, responsible for all consumer industry relations. This is often the case where states have Consumer Protection legislation.

Drinking water quality Since good quality water is critical to the health of consumers, water quality standards must be established and utility performance should be monitored. Drinking water standards are universal and should be set by a national organisation in accordance with international best practice. Legal standards for drinking water quality may be established at National or Federal level or municipal level.

Where compliance with the standards affects prices, monitoring is also the responsibility of a regulator but, since public health issues are involved, this responsibility is normally given to a separate body which would work closely with the regulator for customer services.

Environmental protection Since water utilities take their raw water from rivers and underground aquifers, and also use the rivers for the final disposal of treated wastewater, it is essential that the utilities' activities do not damage this environment. Standards for abstraction and discharge must be established and performance monitored.

As with drinking water quality, where compliance affects prices, monitoring should be the responsibility of the regulator. However, the water service provider is not the only body with water abstraction needs, nor the only body with the potential for causing harm to the aquatic environment. Industrial organisations may need to abstract water and may discharge their effluent to the rivers, and other discharges can be due to highway drainage and run off (land drainage) from farms, etc. Environmental regulation is normally given to an independent national or state entity. This body would be responsible for establishing allocations of water for use, granting abstraction and discharge permits, setting environmental quality standards and monitoring compliance.

4. Role of economic regulators

Every regulator in a utility sector; that is a public service; that is regarded by political entities as a service of general interest; and that is required to be provided on a universal basis, will operate in difficult circumstance. These include:

- An environment characterised by severe information problems for customers. Probably the most significant of which relates to the ability to obtain reliable information from the regulated entities. But well informed decisions also require inputs from a broad range of consumers, who individually may have limited incentives to provide full or accurate information.
- An environment characterised by significant political involvement or interference, which will often have an interest which is short term. Counter to this is the importance of the political process to influence the delivery of essential public services; hence the ambiguity that remains in the debates that exist in the water sector as to whether the provision of the service is or is not and economic activity.
- Pressures or undue influences from regulated firms (often owned by public authorities) which will have incentives to "capture" the regulator or influence its independence, and thus ensure the balance between consumer and supplier interests are struck in their favour.
- Pressures from other regulators, maybe with conflicting interests to safeguard.

In the water sector this is often characterised between environmental or health regulators seeking to increase standards as against "economic" regulators pressuring to keep prices low.

The activities of economic and customer service regulation are conducted in one form or another by most countries, be this independent bodies such as the Water Services regulator in

England and Wales, the Water Industry Commissioner in Scotland, regional regulatory bodies such as that appointed in Lazio, Italy, or by the municipalities themselves through regulation and or through contracts with the operating utilities, as in Germany, France and many other countries around the world, nit just Europe. Many of the functions of price regulation are stipulated in law, such as the requirement in Sweden for utilities not to make profits. In Germany the basis for calculating tariffs is prescribed by law and in France by contract with the operating companies.

The pertinent issue remains as to what extent regulators that undertake general customer protection or price regulation undertake their tasks with a view to ensuring that the utilities are operating at optimal efficiency as they would need to be doing in a "competitive" market.

Regulation of the water and wastewater utilities, as with telecommunications, electricity and gas, aims to achieve a couple of objectives;

- To deal with market failures associated with the service provision – such as monopoly position and imperfect information.
- Create an operations and investment environment that focuses on customers and operates in a transparent and proportionate manner.

Understanding regulatory risks – from procurement to tariff setting

Establishment of clear rules concerning procedures to solicit and evaluate proposals, and to approve and enforce contracts is an essential element of the overall regulatory framework that helps private contractors to assess the risk that they would be taking and the corresponding premium they would charge. Although contracts provide self-contained regulations, it is clear that the set-up of a regulatory agency, independent and competent enough to negotiate and supervise sometimes highly qualified and powerful companies, is often a necessity.

The current tariff levels and the track record in adjusting them are key factors in making a particular "project" or contract attractive to private lenders. Experience has shown that if the tariff has to be increased, this should happen before private proposals are invited. At the same time effective and efficient institutions do take time to develop, even in developed economies. It is argued that developing countries have indeed established regulatory institutions on paper, but in reality they are sometimes ineffective. So there seems to be a need to allow sufficient time for the development of good performing institutions that would protect the consumers, operators and the government.

Effective regulation in these areas requires them to;

Control prices: The control of prices is a central regulatory function, generally undertaken by municipal authorities across member states with certain legal parameters set at national level. There nevertheless remains a significant degree of municipal discretion in setting prices and in interpreting costs

Broadly, regulators need to understand the company's cost structure in order to decide on the level of prices necessary to cover all the costs. In general terms, the costs can be divided between operational costs, capital costs and the cost of financing capital investment (equity/bond finance). Regulators collect, or are provided with, details of the company's operating costs, any capital investments made and the value of the assets utilised by the business. After analysing this information, regulators will be in a position to determine the tariff level to be allowed. This process is undertaken at defined times – annually or at longer intervals with most concession type contracts.

There are two principal methods by which tariffs can be set: "Rate of return" and "price cap". Rate of return regulation allows the service provider to set prices at levels which provide a specified return on investment, whilst price cap regulation allows the service provider to raise prices up to a specified limit.

Rate of return regulation ensures that service providers do not make excessive profits but it provides few incentives to control costs. The regulator reviews the company's cost structure and decides whether it is providing the services cost effectively. If the company is efficient, customers will benefit from low prices. If the regulator's view is that the company is not efficient, it can impose penalties.

Price cap regulation sets an upper limit on prices and allows the service provider to increase his profits by reducing costs. The regulator reviews the company's cost structure and decides on appropriate price levels. To encourage investment in efficiency improvements, the company can be allowed to retain the higher profit margin for a significant period of time before a lower price cap is imposed. There is thus a time lag between efficiency improvements and when customers benefit from lower prices. The rate of return regulation has certain advantages and disadvantages

- Rate of return on investments is guaranteed, but also limited, at a pre specified level.
- Tariff changes are unpredictable.
- Encourages excessive investments.
- The operator has little incentive to reduce operating costs.
- Reviews are complex and impose high costs on all sides.

Likewise price cap regulation has advantages and disadvantages

- Profits (rate of return) are not restricted. Operator may keep any profits it makes for a specified period, after which fees are renegotiated.
- The operator is motivated to improve its operational efficiency because it can retain the benefits of efficiency improvements, at least until tariffs are renegotiated.
- During renegotiations, the regulator must try to capture some of the operator's efficiency gains for the consumer, through reduced operator fees or improved services.
- Fee and tariff changes are regular and predictable.
- The concept is simple: fee and tariff adjustments are linked to an inflation index which is understood by consumers.
- Discourages investments: In an effort to cut costs and increase its profits, a concessionaire or private owner may cut corners on investments. A lease contractor or concessionaire may try to cut corners on maintenance. Maintenance and investment programs must be agreed in advance and monitored.

However, if, at any time, profits seem excessive and there is public pressure to reduce them, the regulator is likely to call for re-negotiation of the tariff. In this sense, the price-cap approach tends toward rate-of return regulation.

Understanding the prisoners' dilemma

The relationship between the operator and the asset-holding company to the "prisoner's dilemma", a well-known problem in game theory, is relevant in PSP or PPP contracts. In the prisoner's dilemma, each of two prisoners suspected of a crime, who are not allowed to communicate with each other, are offered freedom if one implicates the other; in this case the other will be sentenced to three years. If neither implicates the other, both will receive a 1-year sentence. However, if the prisoners implicate each other, then both are sentenced to 2 years. The dilemma arises as neither knows whether the other will choose opportunism or cooperation.

In analysing the relationship between the two parties to the contract, a regulator and the private firm, as also being a choice between opportunism and cooperation. (The analogy differs in that the regulator and the firm have the opportunity to communicate and therefore cooperate – the true prisoner's dilemma has no optimized solution.) If the private operator behaves opportunistically and the regulator decides to be cooperative, the firm will maximize profit at the expense of the public. If the firm is cooperative and the regulator opportunistic, the firm will lose money, possibly introducing instability. If both parties behave opportunistically, there is potential for endless haggling, disputes, and litigation, making excessive regulation of the sector necessary, and leading to higher costs and lower efficiency. However, if both partners cooperate, the outcome will be optimized. Given this, the dilemma is that each "party" has the potential for highest gain if he is opportunistic and the other is cooperative.

(Ref: Aquanet, *Institutional Reform of the Urban Water Sector, Volume 1 Main Report: Functional Relations*, August 1994) – slightly amended to be made relevant to this report.

Monitoring levels of service and operating costs: the service provider's performance is monitored against appropriate standards. These "Levels of Service" standards may be specified in a concession contract between the service provider and the body granting the concession, or in a statement of requirements produced by a regulator or the municipality. Some standards will be mandatory (eg. water quality and environmental protection) while others may vary according to customer preferences. If performance falls below the required levels of service, the regulator may impose financial penalties in the form of refunds of water charges to customers.

Most of the data will be submitted by the utility, but the regulator may collect some (such as complaints from customers) and some may be supplied by other regulators (such as compliance with the water quality and environmental discharge standards). Technical and financial audits can be carried out on the data collected to confirm its accuracy.

The specification of data requirements and the quality of the audit are critical to effective regulation because of informational asymmetry - the utility will always have more information than the regulator. Therefore the company always has a better understanding of its business and is better able to control negotiations with the regulator.

Monitor capital investment and activity: Regulators determine whether the service provider is making adequate investments in asset renewal in order to maintain the overall condition of the assets. Some concession contracts may specify an amount of capital investment the service provider must make during the course of the contract. Regulators therefore collect details of investments in new assets and in the maintenance of the existing assets. This information is accompanied by an assessment of the overall condition of the assets and their serviceability (their overall ability to perform the functions required). Regulators may also wish to obtain details of the percentage of assets renewed or replaced in order to determine whether this investment is being carried out efficiently.

Protecting consumers: The task of consumer protection may be included within the sector regulator's responsibilities. If so, the regulator establishes channels of communication whereby consumers can be advised of their rights and can complain if they have a problem. The regulator would then pursue the matter on the customer's behalf. Regulators often have the power to ensure that the utility compensates customers if appropriate.

5. Implementing effective regulation

This section takes some of the generic regulatory issues already discussed and proposes a framework or model for further discussion and as a way of describing the sort of roles a national regulator might have. The framework is one that recognises the regulatory authority of municipalities in the provision of water and wastewater services. This is a discussion that needs to take place within the context of balancing national and local regulatory responsibilities, and which could be at the core of any application of competition policies in the water sector of each member state. It is understood that there can be difficulties in the implementation of competition rules when applied to public authorities and their activities. Consequently a regulatory solution could be implemented that would go a long way towards the achievement of competition policy objectives. The regulatory "solution" should also be seen in the context of public reporting proposals described in section 6.6 of this chapter.

When a national regulatory office ("regulator") for water and wastewater services is established, it generally has all the powers of a conventional "best-practice" sectoral economic regulator. Especially important are its activities in the area of information gathering, analysis and dissemination (e.g. metric benchmarking).

In general there are three modes or types of national regulation. The first type ("Type A") applies to water companies if neither of the other two types were to apply. For this mode, the regulator sets performance standards, other regulatory requirements and tariffs. Implementing regulations would elaborate on the methodology to be used for setting tariffs and there is ample precedent for drafting laws dealing with this type. It should be noted, however, that the regulator will be allowed to take a different approach to tariff regulation for privately controlled and publicly controlled water companies.

The other two types apply if the municipality has entered into a contract with the water company that fixes performance standards and tariffs (or tariff formulas) in a non-discretionary way. Type B applies if the water company is privately controlled; whilst Type C applies if the water company is controlled by the municipality.

In both Type B and C, if the contract meets certain criteria (see below) the contract regulator will allow the regulation of the water company to proceed under the terms of the contract (except in certain circumstances, to be discussed below). This means that performance standards and other requirements and the tariffs would be set and adjusted by the terms of the contract – not by the regulator.

The main differences between Type B and C are the following:

For Type B (private company):

- The "contract" in question must be a legally binding contract.

- The dispute resolution procedure in the contract must be consistent with broad rules set out in the law or developed by the regulator – with a view to assuring a speedy, unbiased, competent decision.

For Type C (public company):

- In the nature of the agreement between the municipality and the operating company, the possibilities range from a memorandum of understanding or an agreement that is not legally binding – all the way to a contract binding under law. A high degree of specificity for all provisions may not be needed in this agreement between the company and the owner of the company. What should be precisely set out are (at least) the performance requirements and the tariff adjustment mechanism, all within a process that is transparent between the operator and municipality owner.
- In the same vein, some thought needs to be given to what the dispute resolution procedures for the agreement should be. It may not be appropriate that they are the same as those for Mode B. One possibility is that a panel of experts would decide disputes, with limited appeal to the regulator (e.g. decision of the panel accepted so long as there is "substantial evidence" to support it), or perhaps publicity to city residents would be sufficient.
- The idea of a service agreement between the municipality and its own water company requires one more element to be feasible. Certain key features of the supervisory board of the water company need to be specified in the law (or the regulations) to ensure that the company has sufficient independence from the municipality – especially concerning the method of appointment and dismissal of board members. The board must be able to see itself as acting on behalf of all stakeholders, not just the municipal administration or council. The idea of a service agreement is meaningless if the water company manager fears that if he disregards ad hoc orders of the municipality too often he will be removed from his job.

It needs to be thought through what kind of ex ante approval power or role a national regulator should have over the contract. It might not make sense to allow the municipality and the water company to enter into a contract with any kind of provisions they wished. On the other hand, instead of a prescriptive approach, it might be better to take an advisory approach. The municipality would be obliged only to take the comments into consideration. In addition, the regulator might be given the authority to develop certain contract provisions and guidelines; ensuring mandatory contract clauses – e.g.

(i) indemnity and force majeure – is there really a need to negotiate these for each contract?
(ii) standard direct agreements?
(iii) a set of standard provisions to deal with what the company must do in cases of severe water shortage?

And in advising on non-mandatory guidelines for certain contract provisions – e.g.

(iv) methods of adjusting tariffs in response to "specified events"
(v) ways of formulating performance standards and penalties;
(vi) tariff structures.

Whatever approach is taken to the issue of how to ensure sound contracts, the same approach should be taken to any contract amendments agreed by the parties. Direct intervention by the regulator in Types B and C is limited to Comprehensive Tariff Reviews (i.e. rebasing). The underlying idea is that, in the water sector, **this is the critical regulatory activity** that may not always be able to be handled adequately by "regulation-by-contract" and the normal dispute resolution mechanisms – because of the extremely high level of expertise and information required and the need for regulatory consistency across companies and over time.

Tariff Reviews involve estimating all the future operating and capital costs that would be incurred by a reasonably efficient operator in order to meet the specified performance standards and other requirements, and then determining the average tariffs over time that would be needed to generate the required revenue. Past gains or losses (relative to past expectations) are not taken into consideration. The outcome of the tariff review is the resetting of the base tariffs.

Although the basic idea can be straightforward to convey, a set of more detailed rules has to be developed to make sure that the desired objectives are achieved without creating perverse incentives. These would be set out in implementing regulations issued by the regulator. Also, special rules would have to be developed to deal with capital costs in the case of a private operator – involving a methodology for estimating the cost of capital and an approach for estimating the future rate of return.

A special unit within the regulator's office would be responsible for preparing implementing regulations for the tariff review process. Thought should be given to whether even greater safeguards should be included to reinforce the independence and high level of expertise of any tariff review unit within the regulator's office. This is essential to the credibility of the whole regulatory system.

It would be mandatory for a tariff review to take place whenever requested by either party under conditions such as the following (regardless of what the contract says):

- if the contract calls for it (which it would of course) ;
- if at least five (say) years have passed since the last tariff review;
- if un-indexed tariffs have changed by more than X% in response to specified events since the last tariff review
- if nominal tariffs have changed by more than Y% in Z months in response to a specified event or to the operation of the indexation formula; or
- if requested by Government.

If a tariff review is required, then the parties can choose between:

- carrying it out themselves (preferably in accordance with the regulator's guidelines, perhaps while receiving advice from a staff member from the national regulator) – and if they cannot reach agreement on the new base tariffs, then the review is carried out by the national regulator and the outcome is binding on the parties; or
- requesting the national regulator to carry out the tariff review

The interaction between the tariff review process and the specified dispute resolution procedures under the contract will need to be carefully worked out. Any dispute proceeding subsequent to a tariff review must take into consideration factors that were explicitly or implicitly taken into account in the review. (E.g. if the tariff review took into consideration a particular change in circumstances in its cost forecasts, then the parties cannot dispute that particular specified event afterwards through the normal dispute resolution procedures.)

6. Application of regulatory solutions

Much of the technical and financial information that is needed for regulatory purposes is frequently considered to be confidential, between the municipality and the utility. The key to unlocking the ability of regulators to advocate and increase pressure for greater efficiency will be to ensure greater transparency of financial and service performance information of the utilities. Good information for consumers is one of the most important elements in facilitating an efficient delivery of products and services. Good information in highly regulated sectors, and ones like water and wastewater which tend to be structured as monopolies, become the principle way in which those groups representing customers can keep a check on companies' abusing their dominant, monopolist, position.

By recognising the importance of information to the regulatory process, it seems likely that any regulatory solution will concentrate on increasing the transparency and dissemination of information on water industry performance. Currently performance comparisons are difficult because of the lack of information and/or comparable information. This supports the idea, suggested above that there should be a regulatory body (at a central level) which ensures that these kinds of comparisons are possible. And given the importance of local autonomy this body is likely to be **non-compulsory**, **acting as an advisory body rather than a regulatory body, ensuring that best practices are spread.** All other regulatory mechanisms will rely on the need for a more transparent and consistent method for the collecting and reporting of performance and financial information of water and wastewater service providers.

The approach may seem to be a modest one, but in a sector fraught with a lack of detailed performance information, it presents an opportunity for all stakeholders to consider issues of efficiency and customer interests on the basis of a common understanding of the sector's performance and cost.

6.1 How performance indicators are used

A service performance indicator says little by itself unless it is compared against some benchmark. There are several different kinds of benchmarks, as follows:

- Results from previous years for same company. This is one of the most useful comparisons that can be made. The validity of the measure is high since there is no problem of comparing different service systems. Regulators – or companies themselves – may want to set targets that are specified in terms of percentage improvement from one year to the next.
- Targets set out in the company's own business plan. This is similar to the previous benchmark, in the sense that the comparison is for the same company, but here the benchmark is a target set by the company itself. One appealing feature of this is that it is the company that estimates the degree to which the particular performance indicator is within their control and the speed with which they can make improvements. Regulators have a greater justification for imposing strict standards when the standards are set by the companies themselves.
- Targets contained in licenses or contracts. This benchmark is obviously important for purposes of imposing positive or negative sanctions. The main point to stress in this context is that this benchmark should be based in turn on other kinds of benchmarks – from the same company, other companies, or accepted industry standards, and preferably from an examination of all of these. But all too often, public authorities and regulators begin to regard the SQI targets set out in a license or contract as being justified simply because they are contained in the license or contract.

- Results from other companies that are subject to the same regulatory regime. These results can be very useful to indicate how one company is performing in relation to others. Their best use is probably to highlight potential problems, triggering a detailed examination within the company itself of the reasons why it appears to be underperforming on a particular SQI in relation to comparators. Reaching a definitive conclusion based on a comparison between companies can be difficult when conditions affecting performance along various dimensions are different for different companies – e.g. for water systems of different sizes or with different densities of connections – but this problem affects efficiency indicators more than SQIs.

Regulators can and do use various econometric techniques to try to control for these different conditions – especially when looking at PIs related to efficiency. This is often what regulators mean when they refer to "benchmarking". But, despite initial high hopes of some economists, it has become apparent over the past decade that these benchmarking techniques should not be used mechanically – at least, certainly not in the water sector. There are simply too many explanatory factors (cost drivers) beyond the control of management in the short and medium term (e.g. topography and terrain, nature and distance of water resources, asset condition, connection density) and that are not picked up well by existing econometric models. But the analytic models can be useful to identify company features that justify more detailed scrutiny.

A severe obstacle to using econometric benchmarking methods for the water sector in some countries is that one needs to have a sufficient number of comparator companies (certainly at least ten and probably more) for the methods to even begin to control adequately for extraneous variables.

Publicly available reference values – e.g. international benchmarking indicators. Regulators with jurisdiction over a small number of companies will often use international comparisons in their benchmarking exercises. This is sometimes difficult because of different accounting and reporting practices, especially for capital expenditures. Nevertheless, it is likely that relevant information about companies will become more standardized in the years to come. In any case, international indicators are useful as a start of the discussion process with a company.

Use of performance indicators within the company to improve performance

This working paper is mainly concerned with regulation and therefore the use of performance indicators by government entities (e.g. a regulator). But it is important to note that the most important use should be by the companies themselves. Poor performance along a particular dimension should trigger a review process within the company to uncover the causes of the poor performance, or in some cases to conclude that it is mainly due to factors beyond the control of management.

Once certain activities or groups of activities within the company have been identified as being involved in the poor performance, the company can begin to plan remedial action. Techniques of so-called "process benchmarking" can be used in this context. This involves carefully analysing in detail what goes on in the identified process within the company. Then comparisons are made – through site visits, detailed discussions, etc. – with similar processes in other companies, which may not even be in the same industry.

The key lesson is that the most important use of PIs by a regulator is to make the company take notice and make a serious effort to understand the causes of poor performance and the steps needed to improve performance.

6.2 Improving performance through public reporting

In a normal competitive market, system performance by individuals and organisations is evaluated by the end user and the supplier is rewarded or penalised. When the ideal market is replaced by bureaucracies and monopolistic market structures, the link between performance and reward becomes more complex. Typically the alignment between what the end user wants, and what the supplier provides is lost. This is because the supplier will take on divergent views on what constitutes performance, and this may have nothing to do with meeting the needs of the end user of the service. A public enterprise manager working within a government ministry, for example, would consider maximising his budget appropriation as the benchmark of good performance. In other words, incentives facing the employees generate performance standards that are often at variance with the overall organisational or welfare goals of society. These "agency" problems dictate the actual performance attributes in organisations.

One alternative approach, however, is to complement the regulatory discussion on incentives and penalties to concentrate on mobilising "end users", or civil society, to demand improved performance from the supplier. Such demand would act as the catalyst for adoption of reforms appropriate to the situation. The "agency" would have to work out what it needed to do to meet those demands. The question becomes – how can the "end user" be mobilised in this way? One possible solution is through public reporting of performance.

The key features of such an approach are:

- The selection of appropriate indicators of performance. These should be measures which are both measurable, and are meaningful to the end user. Review of the indicators will give the lay person and adequate understanding of the performance of the provider.
- The presentation of results in a way that the end user can understand. This will allow an informed assessment of how good or bad the service is, and hence the extent to which improvements should be expected.
- Having an end user, or representatives of end users such as an independent regulator, who are able to articulate the need for improvement in such a way that suppliers feel a need to improve.

Publication of meaningful indicator based information on performance, in a way that is readily understood by the end user, will have two important results:

1. It will increase transparency by reporting the actual level of performance being achieved by the supplier. While civil society might grumble about poor performance, it is often hard to find data that will support their case. The public reporting system will provide them with that data.
2. It will increase accountability. Publicly identified poor performance will be, or will quickly become, someone's responsibility.

With increased transparency and accountability, and with adequate pressure from civil society, improvements in efficiency and services might reasonably be expected.

Public reporting of performance can be applied equally to public or private suppliers. In the Scotland and the Netherlands, performance information supported by customer surveys for the public water distribution companies on an annual basis is collected and published. **There is nothing to stop performance reporting on a mix of both public and private entities.**

Regulators and industry associations maintain and regularly update key performance indicators of their constituents. Many regulators (Ofwat and the WIC in the UK) and industry bodies (VEWIN in the Netherlands publish performance data from water companies utilising a relative comparison approach in many indicators (below average, average etc). From these data a reader can easily figure out the utility which is doing well, and another not doing so well. These results have spurred the whole group of utilities to perform better, where a ‘below average’ today is actually better than an ‘above average’ 10 years ago.

Pressure comes on in a wider arena than that. For example, a public water utility is usually overseen by a Board, or by locally elected politicians. Poor performance of a water utility is therefore also a reflection of poor performance of the Board and the local politicians.

It is not only the providers that will come under the spotlight. There will be some exposure of the body that compiled, and provided analytical commentary on, the public performance report. They will have to ensure they have compiled and analysed the data correctly, and their commentary is fair and objective.

Public performance reporting could be a valuable tool in the battle to improve service performance. As it is not a widespread activity, the question must be asked as to why it does not receive greater attention. Most of the reasons relate to the legacy arising from decades of public sector provisioning.

In India it is likely that data availability in the appropriate reporting formats are often not available. Reports of utility performance typically are not closely monitored by national policy makers and donor agencies in a format that helps identify the best in the class or the underachievers. Instead, data collected are either on broad policy-oriented themes such as coverage (focusing on service deficits), or specific information useful for public investment purposes (eg project-related information, disbursements and financing requirements etc).

In the latter instances, the underlying premise is that service providers need a lot of resources to meet service deficits, and that if resources are provided they would have the right set of incentives to service consumers according to what the latter want and are willing to pay for. When agency problems exist, this premise is obviously questionable, and the fallout is that data availability gets tailored to the specific agency interests rather than for enhancing consumer welfare. Not only are data not available, but more often sectoral agencies are unwilling to report/receive information on the extent of any under-achievement.

So who benefits from a public performance reporting system? The customer, if the reporting results are utilised by civil society, policy makers and funding institutions. No-one, if the “worst in the class” are able to use specious arguments such as distributional equity to secure more resources.

- Public reporting of performance is a high impact activity, the effectiveness of which has been demonstrated in a number of examples presented in this report. While its benefit/cost ratio has not been quantified anywhere, it would be reasonable to assume it is very much greater than 1.
- Public reporting introduces a transparency to the relationship between the supplier and the end user which cuts out the various players that would otherwise interfere with, or cloud, the discussion on service provision.

- Public reporting allows the end user to better understand whether they are receiving a reasonable service, whether that service is improving or deteriorating over time, and hence to what extent they might feel justified to push for change.
- Public reporting, by exposing poor performance, will increase accountability within the supply agency and hence their motivation for improvement – to the benefit of the end user.

7. Entrepreneurial opportunities through decentralisation and "inside out" regulation

The formal decentralisation of the responsibility for service provision provides the opportunity for municipalities and local communities to develop solutions and forms of service that suit local circumstances. Much is talked about in terms of reform being 'bottom-up' or 'top down' but perhaps the best approach to understanding community need and opportunity as being neither top-down nor bottom-up, but rather 'inside-out'; this means a community (government, people, business, NGOs and other stakeholders) doing things together and gradually coming to know itself through its own actions- this is closer to the idea of a sense of community and its development as a process of both discovering and harnessing existing community networks perhaps through a specific event or happening.

In Appendix One, an approach to business planning is described; this could then become a basis for local conversations about the "what" type of services must be provided and the "who" should be doing this and "how" they should be regulated. A diversity of approaches in countries as diverse as India should not be regarded as a "bad thing"; as long as some essential tenets of process and performance are adhered to; and many of these have been described in this paper and the WP1.

The diversity of approaches might be felt across the supply chain, and one high profile social enterprise, the Naandi Community Water Services is a good example of a model bringing entrepreneurship and business thinking to water supply; particularly in the area of operations and maintenance which is so often the failing of a sustainable long lasting water supply system for small and medium sized communities. Recent work from the International Water and Sanitation Centre's TRIPLE "S" programme indicate that there are ten important factors were required and should be encouraged:

- Need for professional community management with appropriate legal status
- Increased recognition and promotion of alternative service provider options, including small scale private operators
- Sustainability indicators and target for service delivered and performance assessment
- Common national approaches or "rules of the game" not prescriptions
- Post construction support and management for community entities
- Capacity support to decentralised government authorities covering the life-cycling of systems (a continuous process of business planning)
- Learning and sharing across national and decentralised entities – something a national regulatory authority might be able to develop and organized.

- Planning for asset management with systematic financial forecasting
- Adequate frameworks for financial planning to cover all life cycle costs
- Regulation of service providers through "agents" at a local level

Decentralisation has the potential to build stronger links between citizens and their services; provides the opportunity for new “players” to get involved such as entrepreneurs, and it provides an opportunity to structure and ensure locally based means of accountability and regulation.

8. Proposals for reforms

In a decentralised country such as India there is a complexity in the institutional framework in urban water supply; and hence it is inappropriate to stipulate or recommend a ‘one size fits all’ regulatory solution. It is also clear that the information vacuum in the sector would make it even more difficult for a “hard” contract based regulator to function in the current level of functioning of the local municipality water utilities or state owned water utilities.

Hence a combination of approach/actions is suggested to achieve progressive regulatory regime in the sector.

- Accelerate and consolidate the water utility performance monitoring scheme roll out so that each State achieves benchmarking all cities and towns say by the year 2015; this would provide the baseline information and enable the future regulator to set periodical progressive performance targets for each utility for achieving the national benchmarks.
- Review the current performance indicators of the benchmarking network to include “process benchmarking” activities and to promote the business-like planning approach to be adopted by water utilities
- Strengthen the State SLB Coordination Cells into full-fledged Performance Monitoring Units to function within the respective Urban Development Departments or Directorates for monitoring the service standards and developing information data-base on all aspects of service and economic regulation.
- Introduce periodical rating of cities and institute awards for best performing cities in the league especially in the area of sanitation as the moving towards regulation would require long time to establish base lines and even longer time in achieving the benchmarks considering the backlog in the sector.
- Increase the delegated management through appropriate form of PPPs so that contractual regulation is ensured by way of ULBs committing to some fixed tariff adjustments linked to natural inflation. This can be achieved at very short time frame without the elaborate legal and legislative changes required for establishing independent regulators.
- Assign the responsibility of economic regulation i.e. recommending the tariffs to the by attaching a water sector unit either through internal increase of resources or by way of outsourcing the skills to eligible experts. This would help in achieving the most crucial regulatory objective of setting and monitoring tariffs at a very short time frame and also is in line with the recommendation of Planning Commission encouraging multi-sectoral regulators.

  INDEPENDENCE FROM POLITICAL INTERFERENCE IS CRITICAL
- Ring-fencing ULB or state owned utilities by way of separation of role of policy maker, owner and service provider and to this effect; introduction of “corporatisation” of large city or regional utilities may be explored which would improve internal governance, commercial nature and can induct professional management so that the service provider entity would transform into a professional managed utility.

The experience from electricity regulation is that enforcing penalties for utility's non-performance is difficult and it is further complicated in case of UWSS when the utility is either embedded within the ULB or State. As such it would be prudent to explore 'carrot'-based regulation by way of instituting performance linked financing mechanisms while releasing capital or revenue subsidies to the cities. This has already been enshrined in the 13th Finance Commission where in some part of future budget allocations are linked to achieving targeted performance by the utility. *(The State of Karnataka has been contemplating establishing a Water and Sanitation Council within the UDD to undertake this role of service and financial monitoring and advising the State while sanctioning any future capital or revenue subsidies to the cities).*

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Appendix A1: Tariff Setting and Control

There are three principal reasons for regulation to affect tariffs:

- The first is the downward pressure on tariffs exerted by the regulator, without whom the utility service provider would be in a better position to increase tariffs without being called to account. The regulator may also be required to implement government policy in respect of subsidies for disadvantaged customers. This may give rise to lower prices for some customers and higher prices for others.
- The second is the upward pressure on tariffs due to the cost of levels of service improvements which effective quality regulation should achieve. It should be the regulator's objective to ensure that these costs are met by improvements in the service provider's efficiency, but this may not always be possible.
- The third is the cost of regulation itself. If the regulators are funded by levies on the service providers, this cost is likely to be passed directly to customers.

Price increases can be minimised by providing low cost regulation and applying realistic levels of service. But the most significant effect on prices can be achieved through efficiency improvements by the service provider. This requires effective regulation to ensure, first, that efficiency benefits are achieved and, second, that they are passed to customers.

To assure financial viability, tariffs should be set at levels which reflect the full cost of providing water services including the cost of efficient operations, an allowance for depreciation of assets and a fair return on assets. The tariff structure should promote conservation of scarce resources (e.g., through a charge for extraction of water resources) and should also be reasonably easy to administer. In addition, because water is a basic need, water and sewerage tariffs are frequently used as a tool of social policy, and this complicates the matter considerably. With so many objectives to meet, there are inevitably conflicts, so regulators must make judgements about the tradeoffs among efficiency, social goals, and administrative simplicity. For example, regional or national uniform tariffs, which may be adopted for social or political reasons, do not reflect the difference in the cost of providing service to different areas and therefore are not necessarily consistent with efficiency objectives.

Direct subsidies v cross subsidies: Subsidy programmes which are financed from general budgetary resources and which target individual households directly are probably preferable to cross-subsidies, because they can be limited to qualifying households and do not negatively affect other consumers.

Cross subsidies (whereby higher income households and industrial and commercial consumers pay tariffs which are higher than the full cost of service so that low-income consumers may pay lower tariffs) appear to be more prevalent. Their disadvantages are that the higher tariffs which must be paid by some users may discourage water use for economically desirable activities and reduce overall demand for water, and therefore revenues. Cross subsidies should be designed so that social, economic and financial impacts are taken into account and a reasonable balance achieved – tariff policies consistent with the universal service objectives are key to this.

Maintenance and technical standards: There is a risk that a delegated operator which does not own the infrastructure, or otherwise bear the cost of its degradation, may try to maximise profits by neglecting maintenance and compromising technical standards when making repairs. On the other hand, an owner which leases its system to an operator may want to set maintenance standards unrealistically high in order to avoid the cost of replacements. Appropriate maintenance parameters. are needed to balance the interests of the two parties.

Promoting efficiency: The tariff should reflect the cost of service which is operated efficiently, broadly accessible to urban inhabitants and of a quantity and quality which are appropriate to the local context, taking into account factors such as the availability of water and the income and preferences of consumers. The tariff should be adequate to cover operating costs, depreciation and return to capital. It should motivate consumers to use water services efficiently and to use them for purposes which produce the highest net benefits. The fees of service providers (operators and owners) should be adequate to cover reasonable costs and low enough to motivate them to look for ways to reduce costs.

Ensuring fairness in compensation of multiple operators: The tariff is what consumers pay for service. It may also be the revenue of the service provider, but this is not always the case. Under some arrangements, the tariff may be divided among one or more entities (e.g., a treatment plant operator – say under a BOT scheme and a distribution operator) with each receiving a fee to cover the cost of its operations. In addition, if the operators do not own the assets, the owner would be paid a fee for the use of the assets. Regulation is concerned with both the tariff as a whole and with the fees each operator and owner receives. All should be fair and motivate efficiency. If tariff revenues must be divided among two or more parties, then adjustments in the tariff as a whole could reflect justified changes in any of the cost categories, and procedures for allocating tariff revenues should be equitable so that none of the parties is unfairly disadvantaged by an adjustment in another's remuneration.

Performance incentives: To promote efficiency, a service provider's remuneration could be based in whole or at least in part on performance. The service provider must have some control over the parameters to which its remuneration is linked, and this varies from one arrangement to another. Examples:

- For support services: unit rates for work completed.
- For full operational contracts: the operator's share of collected tariff revenues and collected connection charges, minus total operating costs.
- For BOT operator (e.g. treatment plant): guaranteed minimum volume times operator's fee per volume.

Setting the initial fee: Awarding an operational contract on the basis of competitive bidding for the fee to be charged for services is an effective way to set the initial fee, but it does not eliminate the need to establish some regulatory or oversight capacity to monitor the operator's performance and negotiate fee changes during the life of the contract.

Appendix A2: International examples of regulation

A2.1 Argentina (Buenos Aires)

In Buenos Aires and surrounding districts, the water and wastewater services have been privatised using a concession contract. A tripartite regulator provides economic regulation of the contract. This tripartite regulator is established under a formal agreement between the City of Buenos Aires, the Municipalities and central government. There was extensive debate as to whether the regulator should be set up under a National Congress Law or whether it could be established by a Government decree. In the event, a document was approved by a decree. This document satisfied the complicated technical, legal, economic and political requirements of the various groups involved in implementing the proposed reforms in the water sector. The government decree actually served two purposes: it established the regulatory instrument and also established the process under which the concession contract would be conducted.

The regulator, called Entre Tripartito de Obras y ServiciosSanitarios (ETOSS), is responsible for regulating the following:

- price cap (tariffs);
- investment/expansion;
- efficiency;
- public relations;
- customer code/levels of service;
- inspection of assets; and quality control.

ETOSS utilises independent consultants to carry out technical audit and certification services, as used by Ofwat in England and Wales.

A2.2 Australia

Australia is a federation made up of 8 states and territories. The water systems are state government owned and operated. The regulatory bodies are also divisions within the same state governments. Of the 384 water utilities supplying potable water throughout Australia, only two are currently operated by the private sector. A small number are corporatised, but the majority are either state or local government bodies.

The water industry has been undergoing reform in recent years. The National Competition Council has announced that:

- Most jurisdictions have successfully separated utility service provision from regulatory functions and introduced a commercial focus for their utilities. Water corporations have begun returning significant dividends to government owners.
- All jurisdictions have made progress on the pricing commitments. As a consequence consumers' water and sewerage bills have generally fallen.
- Water rights are being separated from land rights with a consequential increase in the tradeability of those rights. The trade of allocations assists sustainable resource use by ensuring that the resource goes to the highest economic value use.

The problems associated with stressed rivers and associated environmental priorities are being dealt with by establishing environmental flow requirements, strategies for reducing withdrawals from over-allocated systems, support for integrated catchment management approaches and implementation of the National Water Quality Strategy. In all jurisdictions, particularly in NSW and Victoria, community groups are involved in the management of water resources.

A2.2.1 South Australia

In South Australia, SA Water carries out service provision. SA Water is a corporatised entity and the Board of Directors reports directly to the State Minister of Government Enterprises. In 1996, SA Water entered into a 15-year contract to outsource the management of the provision of water and wastewater services for the city of Adelaide. The concessionaire is a private company, United Water. United Water does not have any involvement in the tariff setting process. The contract includes for a fixed and variable fee, which is adjusted every five years to give recognition to any productivity gains made during the period. There are also several BOOT contracts for treatment works with another private company, River Water. The Board of SA Water proposes tariff changes directly to the State Ministry of Government Enterprises, together with any justification for the proposed changes. The Minister may take advice from the Competition Commissioner, before making a recommendation to the State Cabinet who make the final decision.

Each state has established an Environmental Protection Agency (EPA). The EPA is a corporatised entity with a Board operating independently of the state government. The State EPA issues licences for discharges to the environment. The EPA can impose penalties for any breaches of the licence conditions. The EPA relies heavily on SA Water to test samples for monitoring purposes, although it does have a testing facility on its own. However, the Minister responsible for the EPA makes the final decisions on whether prosecutions should proceed.

Drinking water quality is self-regulating with SA Water managing its own sampling programme to ensure compliance with the minimum requirements. The Department of Human Services is the competent authority with respect to public health issues. If SA Water allowed water to be supplied that was unfit for human consumption, this department would be responsible for investigation and actioning the incident. The department does not carry out any routine monitoring.

A2.2.2 New South Wales

New South Wales has established an independent regulator called the Independent Pricing and Regulatory Tribunal (IPART). IPART is a multi-utility regulator functioning as a tribunal, holding public meetings and making final decisions taking into account "the protection of consumers from the abuse of monopoly power", "the appropriate rate of return-on assets" and "the need to promote competition"

IPART is empowered, under the IPART Act, to determine maximum tariffs and to carry out periodic reviews of tariff policies. IPART may involve public participation by advertising public hearings, seeking public comments on terms of reference, providing public access to submissions, inviting public comment on issues and submissions, holding public seminars and workshops, releasing reports and determinations to the public and public reporting of compliance by agencies.

When making determinations and recommendations, IPART is required to consider a range of issues, which can be grouped as follows:

- Consumer protection: tariffs, tariff policies and standards of service, general inflation of tariffs, social impact of decisions;
- Economic efficiency: greater efficiency in the supply of services, impact of exercise of functions by some other body, the next to promote competition;
- Financial stability: rate of return on assets, impact of borrowing, capital and dividend requirements; and
- Environmental and other standards: protection of environment by appropriate tariff policies, considerations of demand management, standards of quality, reliability and safety.

IPART recently rejected a tariff increase proposed by Sydney Water on the basis of ineffective use of its capital funds, which led to a public debate on acceptable commercial rates of return for capital investment.

There is no mechanism currently in place for decisions of IPART to be appealed in relation to water, although such mechanisms do exist under the national gas and electricity codes for those sections.

A2.2.3 Western Australia

In 1996 Western Australia had a re-organisation of its water industry. The Water Corporation is the major service provider and was established from the Water Authority of Western Australia. Two regulatory bodies were also established. The Water and Rivers Commission provides management protective regulatory functions, whilst the Office of Water Regulation administers a licensing scheme for both the Water Corporation and other water service providers. The licensing scheme involves a set of service quality standards.

A2.2.4 Victoria

Victoria established an Office of the Regulator General (ORG) in 1994. It is set up as a single person, multi-utility regulator. The ORG's objectives, as set out in the Office of the Regulator General Act 1994, are:

- To promote competitive market conduct;
- To prevent misuse of monopoly or market power;
- To facilitate entry into the relevant market;
- To facilitate efficiency in regulated industries; and
- To ensure that users and consumers benefit from competition and efficiency.

ORG does not set tariffs for the electricity, gas and water sectors. Tariffs are controlled directly by the State Government.

A three-person appeal body appointed by the Minister may hear appeals from decisions of ORG. The appeal must be decided within 14 days. Appeals are limited to those based on bias or misinterpretation of facts.

A2.3 Chile

The water section in Chile is currently composed of 53 service companies, which are mainly regional and provide both drinking water and waste water services.

In 1988/9, laws were passed which:

- Established the system of concession and operation of the water services, regulated the relations between the concessionaire companies, the state and the consumers, and structured the control of the sector;
- Authorised the State to develop entrepreneurial activities in relation to drinking water and waste water and the formation of joint stock companies regulated by the rules applying to open companies;
- Created the Superintendence of Sanitation Services (SISS);
- Established subsidy for payment of the consumption of drinking water and use of waste water services, to the benefit of consumers on low incomes; and
- Established the tariff system regulating the sector.

In 1997 state companies represented about 92% of customers in the country and coverage of service in these companies about 99% for drinking water and 91% for sewerage. However, only about 17% of the sewage collected received any treatment. The private sector owned certain companies and also participated in the development of services through service contracts, management contracts (with investment), BOOT contracts, and partial concession contracts in respect to certain aspects of the service or a geographical area.

The regulatory framework was further updated in 1998 with new legislation that:

- Established rules applying to all of the companies in the sector, whether privately or publicly owned, with regard to concessions, tariffs, development plans and quality of service;
- Provided greater powers for SISS to supervise the fulfilment of the commitments of the service providers (development plans, levels of quality of the water and of the service). Regulations on the quality of service were introduced and the amount of the penalties for failure to comply was significantly increased.
- Introduced improvements in the tariff fixing process and reduced the fixed component of tariff charges;
- Established safeguards to avoid a concentration of ownership between water and wastewater companies and the concessions of different monopolistic services; and
- Determined the percentage of participation of the State in the ownership that could be transferred to the private sectors (a maximum of 65%, more if the State is not involved in increases in capital contributions).
- In addition to SISS:
- The National Health Service and the General Direction of Waters (DGA) manages water resources at a national level and form dates water rights. The DGA reports to the Ministry of Public Works (MOP).
- The National Environmental Commission (CONAMA) is responsible for applying State policy on environmental issues. CONAMA is responsible for all environmental regulation and operates through Regional Commissions of the Environment. It reports

to the Ministry of the General Secretariat of the Presidency;

- The Ministry of Economics, through the System of Administration of Companies (SAE), regulates and administers those companies that remain primarily under public ownership. The SAE appoints the Boards, controls meetings and sets policies.
- The Ministry of Finance authorises any external debt in relation to state owned companies. The state budgeting rules also constrain the financing of public companies through controls over divided policy, budget allocations, reinvestment of funds and borrowing.
- The SISS is a decentralised entity with financial independence. It reports to the President through the MOP. The Superintendent is the head of SISS and is appointed by the President for an indefinite term.
- Responsibility for setting tariffs rests with the SISS. However, tariffs do not become official until the Ministry of Economics issues a decree. Resolutions of the SISS can be contested before the SISS itself. Further appeals can be heard before the Chilean Courts of Justice.

Subsidies have been established under the law. These subsidies relate to drinking water and wastewater for low-income families. The Municipalities pay the subsidies to the companies concessionaires. The Municipalities receive funds from the State for this purpose. The rules on subsidies state that the percentage of the bill to be subsidised may not be less than 25%, nor higher than 85% of the total of the monthly account of the customer up to a consumption of 20m3. The subsidy must be equal for all beneficiaries of the region who are subject to the same tariff and have a similar economic situation. The subsidies are only payable for a period of three years.

A2.4 England and Wales

This section only relates to the situation in England and Wales. In 1989, the UK Government passed the Water Act (WA), which provided the necessary provisions for privatisation of the ten Water Authorities in England and Wales and enabled the Secretary of State (SoS) to issue Instruments of Appointment to the respective undertakers. Undertakers may be water and sewerage companies (the privatised Water Authorities) or water only companies (pre-existing private companies. The relevant SoS is the SoS for the Environment in relation to English companies and the SoS for Wales in relation to the Welsh companies. The Instruments of Appointment (licenses) set out the appointees' areas of operation and also include the conditions of appointment that the undertakers much comply with. The WA 1989 also set up the Office of Water Services (Ofwat), under a Director General, as the economic regulator for the ten water and sewerage companies formed under the Act, together with a number of already privately - owned water only companies. The Secretary of State appoints the Director General of Ofwat for a fixed term, which may be renewable. The Director is able to exercise wide discretionary powers in order to undertake his duties. Whilst he is politically independent, recent legislative changes have resulted in the Director being required to take account of ministerial guidance in the performance of his duties.

The Director requires companies to submit Business Plans every five years. The Director reviews the Business Plans in order to determine the price limits for the next five-year period. The price limits are set to give the companies incentives to be come more efficient. Increased efficiency results in more profits, which are shared with shareholders and customers. In the event of a relevant change in circumstance or notified item significantly altering the assumptions made at the time of the periodic review, companies may apply for interim determinations to restore the status quo.

The companies submit annual reports that enable Ofwat to monitor the performance of each company in relation to various aspects of service delivery. In addition to investment levels and compliance with drinking water and environmental standards, the companies also report on performance against nine levels of service indicates. The data provided by the companies have to be independently audited by technical auditors (called Reporters) to verify the information and to ensure that it has been collected and reported satisfactorily. Ofwat publishes a series of reports annually to distribute the information obtained from the companies.

The WA 1989 set up a National Rivers Authority (NRA) to act as the environmental regulator in relation to water. The Water Authorities had been responsible for these functions in addition to service provision. They thus acted as "poacher and gamekeeper". The regulatory departments of the Water Authorities were split off from the operational companies and formed the nucleus of the NRA. The NRA was empowered to issue licences for abstraction of water from surface and ground water sources. It was also made responsible for licensing discharges of wastewater into controlled waters, as defined in the Act. In 1995, the Environment Act was passed and the Environment Agency (EA) was established by the amalgamation of the NRA, Her Majesty's Inspectorate of Pollution and local authority waste regulatory authorities. The EA thus has responsibility for monitoring and enforcing environmental standards in all environmental media (air, land and water). The Drinking Water Inspectorate, which is responsible for monitoring the quality of potable water, was not included in the EA.

A close working relationship is required between Ofwat, EA and DWI. During the periodic review process, the EA and DWI are required to work with the companies to identify improvements necessary to ensure compliance with EU Directives. The quality regulators are required to approve the list of improvements, which Ofwat then reviews and ensures that adequate funding is made available to complete this work.

In monitoring compliance, the EA takes a significant number of statutory samples. The companies take additional samples for operational purposes. Performance is measured based on 95% compliance of the statutory samples with the licensed consent. Failure to comply with the consents can lead to prosecution under Section 85 of the Water Resources Act 1991.

The DWI relies mainly on the data submitted by the companies, but carries out extensive audits of the operations and procedures and investigates customer complaints. Where water quality fails to meet the standards, the DWI can order the companies to effect remedial measures.

A2.5 France

France is divided into 21 Administrative Regions. There are 96 Departments, each administered by an elected general council. In total there are about 37,000 Local communities, each with an elected municipal council. These municipalities have powers for ensuring public order, security and health. Water and wastewater services are a municipal responsibility. The services may be managed directly, in conjunction with other municipalities or sub-contracted to a private undertaking. Most municipalities have entered into concessions or lease-type (affermage) contracts with private companies. There are three major operators Suez Lyonnaise des Eaux, SAUR and Vivendi. There is no national regulation of these operations. The contracts are administered at the municipal level. There is, however, a national audit agency (the Cour des Comptes) responsible for reviewing these contracts to ensure that there are no irregularities in the award. Over the last few years, several cases of corruption have received major publicity.

Environmental regulation is the responsibility of the Ministry of Environment. This ministry is also responsible for management of water resources. There are six river basin agencies. The responsibilities of these agencies include:

- Collection of service charges from local communities for services provided;
- Re-investment of the revenue on improvements in the service and in protection of water resources;
- Review of plans and conflicts of interest regarding implementation of the Water Law, using consultative committees set up in each river basin area; and
- Pollution control.

Under the Control of Pollution Law 1964, the State may determine standards and codes of practice and prohibit the use of certain substances.

In addition to the Ministry of Environment, there are a number of other government departments having an interest in aspects of water. To enable efficient liaison between these organisations, a National Committee for Water has been established.

A2.6 Germany

Water and wastewater services are predominantly publicly run. Water is considered to be a common resource, the management of which is subject to collective and democratic decision-making. These decision-making powers are divided between the federal parliament, the 16 federal states and the local municipal authorities. Generally, framework legislation is enacted at the federal level. The key legislation relating to water supply and wastewater disposal is the Federal Water Act 1957, as amended in 1996. Each state then provides the detailed requirements as appropriate to its area. The municipalities are responsible within this structure for the provision of water supply and wastewater services and are responsible for the local environment.

Generally the water and wastewater activities are managed separately for each other on a single function basis. There are a large number (over 15,000) of different organisations providing water and/or wastewater services. Economic regulation is vested in the municipalities. The municipalities impose and enforce service standards set in conformity to Federal and State requirements. The municipalities also control tariffs, either directly for companies operating under public law or through management or concession contracts for independent companies.

Water suppliers and municipal councillors set the water tariffs. As the councillors act as political representatives of the consumers, both suppliers and users achieve agreement on tariffs. As the municipal councils are usually the major shareholders they control the level of prices. Consequently, state authorities can investigate whether tariff increases are justified under the legislation against monopoly abuse.

Environmental legislation is formulated at Federal level and implemented and monitored at state level. The Federal Ministry of the Environment carries out Federal duties and the Federal Environment Agency and State Environment Offices enforce regulations. A system of licences has been set up and monitoring and enforcement is generally effective. There is a well-defined system of penalties for failure to comply with the licence conditions.

Water resource management regulation is within the remit of the States and municipalities. The municipalities and the operators monitor water abstractions and effluent discharges and the collection of charges. A Joint Water Commission of the Federal States (LAWA) has been set up to co-ordinate common problems and to handle legislative instruments. Whilst the decisions and recommendations of LAWA are not legally enforceable, the co-operative approach has achieved common reporting procedures and brought about a convergence on water resource protection and management.

A2.7 Italy

The Galli Law, enacted in 1994, set up a mechanism whereby the 8,075 municipal administrations could be rationalised into 100-120 water areas. The whole water cycle should be managed as an integrated organisation and the water areas should be loosely based on natural river basins. The law allows a more entrepreneurial approach to the management of the water industry. Operating licences can be granted to either public or private companies following a competitive tendering process. Mixed companies are the most popular model (with 51% ownership by the municipality or area authority).

Under the 1994 legislation the regulatory bodies responsible for the water industry are:

- The Ministry of Public Works, through the Supervising Committee for the use of Water Resources.
- The Area Authority to co-ordinate, control and define tariffs within each Water Area.
- The regional administrative tribunals, at first instance, and the ordinary Law Courts, at second instance, as the competent appeal bodies for disputes arising from granting of concessions by public bidding. The move to competitive bidding has not yet generally been effected. Consequently licences are granted by councils and provinces. For these licences, the competent appeals body at second instance is the State Council.

There has been considerable delay in the implementation of the Galli Law Provisions. All of the Italian Regions had adopted the necessary regional legislation governing the co-operation between the local entities for the establishment and functioning of the Water Areas by the end of 1999. There have, however, been significant problems in drafting the co-operation agreements within the defined Water Areas. There has also been opposition from the incumbent operators who benefit from the existing arrangements.

The Galli Law also defined new tariff arrangements, based on price cap criteria. The tariff should reflect the nature of the resources, the quality of the service provided, the investment needed to improve the service, operating costs, a return on capital invested and productivity gains. The tariff is to be defined at Water Area level. Unfortunately, in view of the delays in implementing these reforms, many areas still use a cost - plus approach, whereby each year the old tariff adjusted for new investment, increased productivity and inflation.

The public health authorities regulate drinking water quality. There is no national organisation responsible.

Environmental regulation is carried out at regional level. However, Italy does not have a good record in the enforcement of EU environmental regulations.

A2.8 Poland

Water and wastewater services in Poland are primarily the responsibility of the municipal service sector. This sector also deals with housing stock management, district heating, solid waste management, green areas, roads and municipal transport.

There are approximately 300 water and wastewater utilities serving cities and towns in Poland. A large proportion of these (70%) are organised as Commercial Code Companies, whilst a further 12% are managed as in-house budgetary enterprises. Municipal associations are often formed where a single water and wastewater utility serves multiple ,municipalities. Commercial code companies can recover depreciation and profit in tariffs and can reserve funds for investment.

There is no central regulatory authority responsible for reviewing tariffs, investment proposals and levels of service. Local governments are largely responsible for such regulation. Decisions on water pricing are commonly based on short-term political criteria rather than the economic costs of investment and service delivery.

The Official Protection of Competition and Consumers and the Anti-Monopoly Courts may review tariffs in the event of customer complaints or if the utility is considered to be abusing its monopolistic position to take unfair advantage. The administrative or civil courts may also review disputes between the utilities and either the municipality or customers.

The Office of Housing and Urban Development has developed legislation to improve the tariff system and economic regulation. It has effected changes to the Ordinance on water supply and wastewater disposal to allow for greater recovery of investment - related costs and differentiation in tariffs for different classes of customers based on the cost of service provision. It has also covered the Standards Board of Pricing, Service Availability and Economic Regulation of the Water and Wastewater Sector. The Board's composed of representatives of the various ministries and agencies involved in regulating the sector together with representatives from industry and municipal associations.

The Standards Board has developed a series of standards relating to economic regulation of the sector. A new law has been drafted with the objective of achieving the provision of an uninterrupted supply of water with suitable quality, reliable discharge and treatment of wastewater, the achievement of more rapid environment conservation requirements, the protection of customers' interests, and improvement of the economic effectiveness of utilities and institutions in the sector.

The Ministry of Environment is the competent authority charged with the approximation of

EU directions into Polish law. A new Water Law covering administration of water resource management and water and wastewater quality requirements was drafted in 1999, but has not yet been given assent as some aspects are contentious. New Regional Water Boards will probably be set up to administer environmental controls within their regions

A2.9 Scotland

The water industry in Scotland remains in public ownership. There is one water authority.

The regulation of the authority was initially under the Secretary of State for Scotland. A referendum was carried out in 1997, the result of which was to devolve some power from the UK Parliament to a new Scottish Executive. An election was held in 1998, resulting in the establishment of a new Scottish Parliament from which the Scottish Executive was formed. Powers relating to the regulation of the (then three) water authorities were transferred from the Secretary of State for Scotland to the Scottish Executive. In 1999, the Scottish Executive established an office of the Water Industry Commissioner to promote the interests of the customers. This office is committed to ensuring value for money and sets rigorously analysed, challenging, but realistic targets to be achieved by the water authority.

Environmental regulation is carried out by the Scottish Environment Protection Agency (SEPA). This body was established under the Environment Act 1995, at the same time as the Environment Agency was set up in England and Wales. Prior to 1998, SEPA was under the auspices of the Scottish Office Environment Department. It now reports to the Scottish Executive Environment and Rural Affairs Department.

A2.10 The United States

The US is a federal republic comprising 50 states. Water and wastewater operations are normally under municipal control. There are in total about 55,000 service providers. Most of these are small, municipally owned supply and distribution systems. Investors mostly own the privately owned companies, although there are some mutuals owned by customers or landowners within the service area. These private companies serve about 15% of the total population of the US.

All 50 states, together with the District of Columbia, have regulatory commissions. These commissions set tariffs based on a "fair rate of return" that they can earn on their assets. Various approaches have been adopted. The "future test year" approach looks at the costs and revenues estimated for a future year, usually the first year of the application of the increase in tariff, to enable the company to achieve a reasonable rate of return. A variation of this is the "historic test year" approach, where by past costs and revenues are used and adjusted (often arbitrarily) to provide the required rates. This approach often results in wide, unpredictable swings in the company's earnings because actual future net earnings do not correlate well with historic net earnings.

Alternative Rate Plans (ARP's) have been implemented in some states. The ARP's are voluntary agreements between regulated utilities and the state regulatory commissions which set out in contract the obligations of the utility over several years and the allowed returns, often in the form of a price cap. The ARP's also set down procedures for dealing with foreseeable changes, give the regulators the ability to revert to "normal" regulatory procedures. Normally, the ARP's include the period between tariff reviews, the types of cost that can be passed through, penalties for failure to meet quality standards, reporting requirements, review procedures and dispute resolution/arbitration.

Justification for increased tariffs must be submitted by the utility to the state regulatory commission. The evidence submitted is examined in a public rate-hearing inquiry, often presided by a hearing examiner or administration law judge. There is a right of appeal from a regulatory decision to the State Supreme Court, but these are limited to procedural irregularities.

An example of a state regulatory commission is the New Jersey Board of Public Utilities, which consists of three commissioners appointed by the State Governor for overlapping terms of 6 years each. Funding of the commission comes from a levy on the utility companies. A Rate Payer Advocate represents the customers in the tariff determination process. This is an independent body affiliated with the commission and funded by a levy on the utilities.

Environmental regulation is the responsibility of the Federal Environmental Protection Agency (EPA). Each state has its own Department of Environmental Protection, which is a department of the Federal EPA. The EPA ensures that drinking water meets the federal and state Drinking Water Standards, is responsible for managing water resources (both surface water and ground water) and protects the environment against pollution from wastewater discharges.

Appendix A3: Water Supply Regulator - some thoughts on the detailed considerations that are required for FYP 12

The basic objective of water sector regulation is to regulate prices, quality and access to services in a way that encourages efficiency and enables the long-term sustainability of the service systems, while preventing monopoly profits. For private companies and investors, the objective of good regulation is to protect investments and reasonable profits from arbitrary decisions by government (or other public authorities) and to allow companies sufficient freedom to manage their operations according to their business judgement. These two perspectives are not inconsistent since the willing participation of private operators and investors is necessary for the long-term sustainability of water services system that involve PSP (Private Sector Participation).

There are many ways that a regulatory system for water and wastewater companies can be designed, and different countries have chosen different approaches. If there is one lesson that has been learned over the past few years, it is that a "cut and paste" approach – based on regulation in England, the U.S., Chile, Australia or some other county – is not appropriate. Regulation is a system that has to be tailor-made to suit each country's institutions and underlying policies. Nevertheless, there is much than can be learned from the experience of other countries.

A3.1 Administrative location of the regulator

An important question is whether the function of a water regulator for water supply should be kept within the existing water sector organisations such as the State Water Committees but strengthened both legislatively and by comprehensive technical assistance, or whether an entirely new organisation should be established.

Although there are many similarities between the water sector and other utility sectors, such as electricity and telecommunications, in terms of the need and objectives for regulation, there are also key differences that arise primarily from the different forms of PSP that are employed in the water sector compared with other utility sectors. Water sector PSP, with the exception of asset sales under full privatisation, takes place under some form of contract, i.e. a management contract, lease or concession.

Behind the oft-cited – and often misleading – distinction between "regulation by license" and "regulation by contract" usually lies a more fundamental issue: the division of responsibilities between the central government level and a decentralised administrative level. The decentralised level is often the municipality. In many countries there is confusion between the responsibilities of central, state and municipal levels to set water tariffs or services performance standards. The issue may still be relevant after any restructuring, and a way will have to be found in a new regulatory system to allocate responsibilities between the national regulator and the regional interests. It is this kind of decision that has to be taken first. The technical details of whether this is best implemented by a system of licenses or contracts are a secondary issue.

A typical way to decentralise significant regulatory responsibilities would be to use a contract (e.g. a concession contract) as a key legal instrument for regulating the private company, where a State entity of some kind is designated as the public sector contracting party. But, even if a contract is the primary legal vehicle, the regulator would play an important role also, notably in the some or all of following areas:

- Providing guidance, or even mandatory input, for certain contract provisions (e.g. setting certain standards; risk allocation; tariff setting rules). (The idea might be considered to give the regulator the power to approve the contracts at the start, based on clear criteria.)
- Setting reporting requirements; gathering, analysing and disseminating information about the service system and company performance (including benchmarking); and investigating specific incidents. (We consider this to be an essential function of the national regulator, regardless of other aspects of the system.)
- Issuing complaints relating to the company's performance and taking appropriate steps to enforce compliance.
- Playing a direct role during the course of the contract in carrying out certain activities and by taking certain key decisions (e.g. some aspects of periodic price reviews).
- Playing a role in the resolution of disputes and in contract re-negotiations.

Different arrangements are possible, each one shifting responsibilities between the regulator and the regional entity in a different way. For example, the power to issue complaints about the company's performance under the contract could be left with the regional entity as contracting party instead of the regulator.

One thing that seems clear is that, to reduce transaction costs and facilitate regulation, there should be a large (but not necessarily complete) degree of standardisation in the terms of the PSP contracts used by States and local authorities. How this is best achieved is a question that needs further consideration. The overall central-regional balance in regulatory responsibilities is a policy and political decision. The purpose of a consultation in this respect will need to be (i) to facilitate discussion of these issues by pointing out advantages and disadvantages of different solutions and (ii) to translate the broad policy position of the government into a concrete regulatory strategy.

A3.2 Basic approach for setting tariffs

Although we would not go into detail at this stage, it will be important to outline our basic ideas about how tariffs will be set under the regulatory regime. . An important issue will be how to achieve a good balance between creating strong incentives for efficiency and ensuring that, ultimately the gains from efficiency improvements are shared in a fair way between companies and consumers. Another issue to take into consideration is the administrative burden on the regulator of using different methods.

Most water supply regulators around the world puts an emphasis on the use of benchmarking as the way to set allowable costs. An important issue is how benchmarking can best be used by the national regulator in the new system. A data base will need to be developed of companies in order to mathematical metric (performance) benchmarking techniques (e.g. econometric or data envelopment analysis) in a purely mechanical way to determine allowable costs or efficiency targets. This might be efficiently done at a State level with a smaller number of water service providers and there are certain advantages in working with a small number of companies in a benchmarking exercise: more attention can be given to ensuring standardisation of reporting and definition of measures and to careful interpretation of the benchmarking results for each company. Moreover, dealing with only five companies opens up exciting and novel possibilities for the regulator to play a role in facilitating process benchmarking among the companies.

A3.3 Publicly owned versus privately owned companies

If concessions or privatisation is selected as the preferred PSP option then the regulator will be faced with the task of regulating only privately controlled companies. If management or lease contracts are used for any of the water companies, certain functions (notably investments) will remain in the hands of the publicly owned company.

In the case of management or lease contracts, the regulatory strategy becomes more complicated because there are now two components: regulation of the PSP contract and regulation of the overall water company, including total customer tariffs. There are different ways to handle this and a typical problem to be avoided occurs when overall tariffs are regulated by a more discretionary type of regulation, and this then increases regulatory risk for the private operator if it is relying (directly or indirectly) on tariff revenue for its remuneration.

There is also the question of whether a specific regulatory regime should be developed that would apply to a company during any period of time in which there is no PSP in the company. This might occur during the initial period, especially if the boards of the water companies or authorities will need to be set up first and will then play a role in deciding on the mode of PSP. Regulation of a publicly owned company would also be necessary if the PSP arrangements are terminated without new ones immediately being put in their place.

For a number of reasons, the best methods for the regulation of publicly owned companies will generally not be exactly like those for the regulation of privately owned companies, the main reason being that publicly owned companies are generally not driven to the same extent by the profit motive – they have multiple objectives . To develop a sound regulatory regime for a publicly owned company, attention also has to be given to the corporate governance of the company.

A3.4 Appeals mechanisms

Although it is important for the regulator to be independent so that it is not subject to short-term political pressures and to capture by private interests, there need to be ways of making sure that the regulator complies with the laws and (insofar as the regulator has discretionary powers) stays aligned with fundamental national policy positions. In other words, independence should not lead to a “rogue” regulator. A sound system of appeals for the regulator’s decisions is essential to enhance the accountability of the regulator and give added comfort to the private sector.

Appeals of a regulator’s decisions can be handled by courts (generally by high-level courts), special tribunals, a competition commission or sometimes even by ad hoc dispute resolution bodies, such as expert panels. Different kinds of regulatory decisions can be appealed in different manners. One advantage in using ad hoc independent expert panels for certain issues is that this can enhance the credibility of a regulatory regime, especially in its start-up phase. (Expert panels are widely used in Chile for appeals from the regulator's decisions concerning price reviews.)

A3.5 Legal constraints and opportunities related to regulation

At this stage of planning the PC will be most concerned about any constraints posed by the Constitution and other fundamental national legislation that might affect the basic strategic decisions. It is pointless to propose an approach that could be implemented only with major changes in current legislation (beyond the adoption of a new law specifically concerned with setting up the regulator) if there is another acceptable approach that would be easier to implement legally. From past experience certain areas where problems can occur include:

- responsibilities and rights of entities at different administrative levels;
- tariff setting powers and other controls on prices for public services or on natural monopolies;
- restrictions on financing in the sector;
- environmental laws and regulations (including environmental liability issues);
- laws and regulations specific to water and wastewater services (e.g. right to be served; right of company to disconnect; who may be allowed to bill and collect tariff revenue);
- ownership of fixed assets used for public services;
- any powers of other government agencies that might directly or indirectly interfere with the water company's business;
- procurement rules;
- permitted dispute resolution mechanisms and any conditions pertaining to them.

A detailed plan for new (or modified) regulatory arrangements will need to cover and include the following topics, possibly among others:

- creation of the regulator, (legal status, administrative location, composition, qualifications of members, appointment and dismissal of members, term of office, staffing, etc.);
- funding of the regulator's office;
- scope of regulation;
- general objectives of regulation in the sector;
- description of the regulator's powers, duties and functions;
- manner in which firm regulatory commitments are made (this can be by licenses or by contracts);
- in the case of contracts, general types of contracts that can be entered into;
- procedure for selecting private partner and entering into contracts (to the extent that this is not dealt with adequately in other legislation);
- possible role of regulator in giving guidance on (or providing mandatory terms for) and approving or commenting on PSP contracts;
- items that must be contained in a license or contract;

- procedures for modification of licenses; or in the case of contracts, role of regulator in contract re-negotiation;
- basic duties of regulated companies;
- role of regulator in setting service standards;
- role of regulator in tariff setting (and setting other customer charges);
- transparent and consistent principles and procedures for the setting of the average tariff level (more or less specific – the degree of specificity is an important topic to discuss);
- principles for tariff structures (different classes of users, different locations, etc.);
- mechanisms to allow appropriate pro-poor policies to be included in the specific regulatory arrangements; reporting requirements of companies;
- powers of the regulator to make investigations;
- role of regulator in benchmarking;
- public access to certain information;
- special provisions for the regulation of publicly owned companies;
- role of regulator in disputes between companies and customers;
- enforcement powers;
- types of rulings, orders and decisions that the regulator is permitted to issue;
- interface with other public entities involved in the regulation of the sector;
- any advisory or ancillary bodies (e.g. in some countries, consumer bodies are mentioned);
- accountability of regulator (e.g. periodic reports to be submitted by the regulator);
- appeals of the regulator's decisions (for which decisions; who can appeal; who decides the appeal; procedures; criteria by which appeals body must decide the case).

An important consideration for inclusion in any new law will be enough detail about the tariff setting methodology to give sufficient comfort to private investors. They have to feel confident that, if the companies operate and invest efficiently, shareholders will make an acceptable return on the equity they have invested, after debt service payments. On the other hand, putting too much detail in the law itself may not be advisable, because if conditions change, the methodology may become inappropriate. More detail can be developed in the regulations or licenses issued by the regulator. A careful balance is needed.

If a system involving both decentralised contracts and a central regulator is proposed, it will be important to avoid conflicts between the rules set out in the contract and those imposed by law, decree or administrative regulation. This can be done in a number of ways, but the key point (sometimes ignored in drafting these laws) is that the law has to provide the framework for avoiding conflicts of this sort: the law should make it clear, among other things, (i) which rules in the law and rules issued by the regulator are mandatory (in the sense that they override the contract) and which are non-mandatory (in the sense that they come into play only if the contract is silent on the issue); and (ii) how this may depend on whether the administrative rules come before or after the contract is signed.

For example, it might be decided, to give comfort to private investors, that the basic methodology for determining the permitted rate of return for the company is something that is to be decided in the law or in an administrative ruling, but once a contract is signed, it is (roughly speaking) as if that methodology is part of the contract – it cannot be changed unilaterally. On the other hand, it might be wise to allow the regulator to modify the reporting and monitoring requirements from time to time and to provide that these changes (if reasonable) will apply to companies even after they have concluded their contracts. This will be important for the continual improvement of comprehensive and consistent benchmarking.

Another important area where good co-ordination is needed is in dispute resolution and appeals: What are the scopes of jurisdiction of the dispute resolution mechanism set up under the contract and the appeals mechanism set up under the regulation law? Do they function together in a sound way?

It should be understood that, at the moment, there simply is no generally accepted "best practice" for many of these issues involving the interaction between contracts and a central regulator.

Finally an associated action will involve estimating a budget for the regulator. As for the method of funding (which would be described in the law), we would note that the most commonly employed method for financing independent regulatory agencies is through the use of licensing fees, which are paid directly to the agency by licensed operators. This mechanism ensures that the financing of the regulatory agency is insulated from the government budgetary processes. An alternative mechanism to license fees is the use of a levy on utility bills, with the revenue collected on behalf of the regulatory agency by the regulated utilities. This mechanism is also capable of securing the budgetary independence of a regulatory agency, provided that appropriate arrangements are in place concerning the level at which this levy is set. The disadvantage of this mechanism, however, compared to license fees, is that it exposes the regulatory agency to significantly more budgetary uncertainty. In particular, the funds available to the agency would be impacted by factors such as the level of demand and collection rates.

National Water Resources Framework Study

Urban and Industrial Water; Regulatory Framework

Working Paper No.12:

Governing the Entrepreneurial Sector Providing Water Services

Simon Gordon-Walker

Contents

1. Introduction

There is a tendency to consider the significant involvement of those with an entrepreneurial drive from the private sector in the supply of water for urban and rural use as a recent development. This is because, with a few notable exceptions, for much of the 20th century and in most parts of the "urban" world, water services have been provided and operated by the public sector. However, the private supply and sale of water has been practiced for thousands of years – and not just on a small scale.

In considering the present and future involvement of entrepreneurs in the water service industry in developing countries, guidance can be obtained from the experiences of the developed countries. The present European manufacturing and service-based economies developed out of predominantly agricultural economies over a long period, for some the process having begun some 300 years ago. Then, as now, the earlier stages of industrialisation were characterized by a massive movement of population from rural to urban areas, which rapidly became densely-populated leading to difficult, often unsanitary, living conditions. The effects of this major social change had not been sufficiently predicted or appreciated and happened too rapidly to plan a structured development of basic services such as water supply. In these circumstances, it was frequently the private sector that responded to the water supply and sanitation needs of the rapidly growing towns and cities; and this seems to be happening in many parts of the developing world including India and other countries of South Asia.

A brief literature review demonstrates a wide range of private sector and PPP initiatives underway around the world. The fact that such a variety of efforts can be documented[157] suggests that the search for alternatives to community management is a natural and growing response by communities and policy-makers to improve rural water supply services. The ambition of the policy maker must be an effort that attempts to develop a more comprehensive and encouraging approach to PPP in community water supply

While it is clear that new approaches are being explored, it is also clear that a more rigorous assessment needs to be made for certain critical elements of these initiatives, including: dealing with low-population density areas; developing an effective regulatory framework in the rural context; correctly estimating the cost recovery potential across a service area; creating viable service areas across multiple local government jurisdictions; understanding relationships between technology choices and management choices; assuring a steady flow of investment funds over time; setting and collecting tariffs; identifying the types of consumer safety nets and operator risk mitigation that might be needed; and, understanding and utilizing the existing legal framework.

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[157]Triche, Thelma, Sixto Requena, and Mukami Kariuki. 2006. Engaging Local Private Operators in Water Supply and Sanitation Services: Initial Lessons from Emerging Experiences in Cambodia, Columbia, Paraguay, The Philippines, and Uganda. Volume 1: Overview of Experience. Water Supply and Sanitation Working Notes No.12. Water Supply and Sanitation Sector Board. Washington D.C.: World Bank.

Valfrey-Visser, Bruno, David Schaub-Jones, Bernard Collignon, and Emmanuel Chaponnière. 2006. Access through Innovation: Expanding Water Service Delivery through Independent Network Providers. London: Building Partnerships for Development in Water and Sanitation.

Requena, Sixto and Thelma Triche. 2006. Engaging Local Private Operators in Water Supply and Sanitation Services - Emerging Experiences in Five Countries. Volume II: Case Studies. Washington D.C.: Water and Sanitation Program.

Making the distinction between regulated and un-regulated water providers is an important one. Unregulated water providers - particularly investors in small-scale piped supplies of varying quality and extent - are an extremely important group, but also the most vulnerable. Recent work through the IFC has exposed their true importance to developing economies. Whereas the large international water companies can only justify investment in foreign countries where their networks will serve large populations – normally where populations exceed 300,000; the small, national water providers represent a local, private capability that can, under the right circumstances, grow to eventually take on water service responsibilities for whole towns and beyond. In absence of official recognition and acceptance, they sometimes operate in constant fear of prosecution and expropriation. Acceptance and regulation recognizes their investment, protects them from unfair competition and provides them with the security to invest well, secure in their longer-term future. This also acts to the benefit of the customer base and society and the economy overall.

Therefore, one of the greatest current challenges facing governments and the international agencies is how to recognize and encourage the entrepreneurial capability of local business in water service provision. An approach needs to include “gentle” regulation, i.e. sufficient to ensure that assets are constructed for the longer term and water quality safeguarded but not so heavy that it stifles small-scale private initiative. If an acceptable regulatory compromise can be reached, rapid progress could be made to meet targets for worldwide access to piped water.

Private water companies have a long history in developed countries, particularly Europe and countries that have experienced European colonial rule. In England, the major private sector company presently serving London, Thames Water, has humble, private origins in a number of small private water companies, the first dating back to the end of the 1500s. In addition to Thames Water, a number of smaller private water companies that originated in the 1800s remain in active existence supplying the areas surrounding London. The experience gained by these companies in creating, owning, managing, maintaining and extending water infrastructure assets is well-documented. Early experiences were both negative and positive in respect to the service they provided. As much of this experience was gained whilst England was a developing country, it can serve to guide present-day developments where it is planned to develop a local private sector capability in water company management and regulation in developing countries.

These companies grew out of private entrepreneurial initiatives sometimes in partnership with public entities and, on occasion, had to convince the public authorities of their capabilities and relevance to communal water supply systems. Most began with customer connections numbered in the hundreds and low thousands. Over time, relatively short periods in the cases of the later companies, they grew into undertakings capable of owning and managing networks measured in 1000s of kilometres and connections in the 100s of thousands. Their experience should serve to encourage the nurturing of local water company management capability throughout the developing world.

2. Forms of private water service

For ease of comparison and discussion of the conditions governing, and resulting from, the provision of a water service by private sector entrepreneurs and companies, the various forms of private supply will be dealt with under three categories:

- Water Vendors
- Private Water CompaniesDeveloping Country Context - Un-regulated
- Private Water Companies Developing Country Context - Regulated

Although bottled water can be the only form of safe potable supply for many in developing countries they are a fringe activity which cannot be considered to have management model significance and are not considered further.

Private water companies are considered, for the purposes of this report, to be those that offer a water service and have invested their own or borrowed finance in the infrastructure needed to achieve this - piped distribution systems and, frequently, source works and storage. A distinction has been drawn between private water companies operating in developed and developing country contexts. This is principally on the basis of the complexity of regulation imposed, hence the further distinction made between regulated and un-regulated situations in developing countries. These distinctions have been drawn to enable comparisons to be made on the basis of those categories used in this report and related reports in the series.

2.1 Water Vendors

Water vendors, whether as individuals or small groups, have served communities throughout the world for millennia. Their market is created wherever urban households do not have their own source on-site, can neither use their own servants to carry water nor collect it by their own labours and where housing is neither connected to a piped supply nor within an acceptable radius of a public standpipe.

The very poorest households purchase small quantities from individual water carriers, hand-drawn water carts and fixed points-of-sale; larger volumes are available from water carts, either drawn by animals or motorized. For those who are not limited by price, the volume they purchase may only be limited by the size of their on-site storage. Even where piped systems are installed, water carts and tankers may be the only means of supplementing supplies where insufficient volume is available due to an intermittent or irregular service.

In many situations in the developing world, the number of persons in gainful employment from water vending outstrips those employed by the “official” water service. Competition between vendors for territory and custom may be fierce and can, at times, degenerate into violent confrontations. However, although significant in their effect on the economy of a town or city, it is rare for vendors to be licensed and they are almost never subjected to regulation by the public authorities.

A study of Latin American vendors in a number of countries indicated that water vendors were normally charging prices that were in the range of 1.5 to 3 times the price of water from the distribution networks. However, it cannot be denied that much higher prices are commonly demanded when restrictions and market circumstances allow.

Water vendors are an essential and important service in urban situations not yet completely served by a piped distribution system – and will continue to play a major role in supplying developing world situations. They are the most basic form of private sector involvement but are almost impossible to regulate, due to the informal nature of their business and the large numbers of individuals and small businesses involved. Nevertheless, to limit the risk of transmission of waterborne disease, consideration should be given to some form of licensing of their operations possibly linked to requirements to draw from officially-sanctioned sources and to use clean vessels for transporting the water.

The sale of relatively small volumes of water by individual water vending concerns means that they can rarely compete with an effective and efficient piped water system. As such a system develops to cover an area, water vending is eased out of its market. This factor, combined with the difficulties of regulating the quality of water supplied, means that water-vending is never likely to form the basis of a long-term strategy where a distribution system is proposed.

2.2 Private Water Companies in a Developing Country Context – Un-regulated

The supply of water through a network of pipes is a commercial activity with a relatively high public profile. Being a "visible" commercial activity, most water suppliers will establish a registered company in accordance with national law and custom and operate their supply business through this company, even though their business activities are neither regulated by the authorities nor, in most cases, substantial. However, once again, whether this is, in fact, the case will depend upon the effectiveness of the authorities in ensuring compliance with the law.

Un-regulated water companies, being generally small-scale operations, are generally owner-managed and operated, under similar conditions to those described for water tanker companies. Ownership is also similar, by individuals or, for the larger companies, groups of individuals or families.

The operations of an un-regulated water company are, in effect, supervised by the customers of the company. The relationship between company owner and customer is a very personal, direct one and sanctions can be imposed by the customer for inadequacies in service provided can be sanctioned by withholding all or part of payment due.

Where a water company's source of water is derived from a public water company and sold on, the public company may well control the price at which the water is sold by the private company. Rarely, they might also impose a restricted range of minimum levels of service to be provided. However, the service levels provided by the private companies are often better than those of the public company, due in no small part to the close company-customer relationship.

The principal limitations on private water service providers, generated by lack of regulation and acceptance of private initiatives, are that of the insecurity of their tenure and the ever-present risk of expropriation of their infrastructure assets. This generates the "short-termist" approach to their business, reduces the quality of the service they might otherwise provide and limits their access to legitimate sources of finance.

The result is that, once again, the extent of the supply areas are normally limited to between 500 and 2,000 connections, the average for an "aguateros" system in Asuncion, Paraguay being 1,000 connections. One experienced "aguateros" has observed that it is a more prudent business policy to restrict the size of an area served to 1,000 connections for water and to expand by diversification into other services within that area than to seek to extend the area and numbers of connections served with water.

In the past, private water companies have supplied large areas with tens of thousands of connections. Although this was achieved in absence of regulation, or very little regulation, their rights to serve the area were enshrined in law, providing security of tenure.

The natural breeding ground for private initiatives to supply areas with water services in an un-regulated environment is the developing country context. It is not necessarily a question of whether the model is replicable - it will occur spontaneously wherever there are entrepreneurs who spot a commercial opportunity – but whether it is something to encourage.

The practice of providing a water distribution system purely on grounds of commercial attractiveness in an un-regulated environment has too many negative aspects to be an approach that should be encouraged. However, it becomes highly desirable in a regulated environment.

Lack of effective competition in an un-regulated environment has too many negative aspects to be tolerated:

- the boundaries of an area considered of commercial interest to a private investor to stake a claim do not necessarily coincide with the natural boundaries of a supply area, e.g. they may well exclude areas of development with a low potential to pay for the water service;
- areas will be “cherry-picked” by the private investor (they would be commercially naïve not to) and this makes it all the more likely that a service to remaining areas will suffer progressively greater delays;
- even if the investor were to wish to do otherwise, there are few incentives for ensuring that infrastructure installed will be suitable for the longer term – due to uncertainties of tenure inherent in an un-regulated situation – and experience shows that it is far more effective to invest in water systems for the long term (due both to the high cost of initial investment and the high cost of maintaining systems constructed from inferior materials);
- similarly, there are few incentives to ensure that the quality of service provided is no higher than the level demanded at the time of investment and it may be costly to raise standards as aspirations of customers rise;
- due to the “short-termism” which pervades this type of environment, a system installed by the investor which may have appeared to be so beneficial at the outset may limit potential to improve health and the economy of an area once demand is limited by its capacity.

Private water companies, whose water service activities are subject to little or no regulation, have operated for many years in Latin America and, more recently, in Africa and Asia. These companies come into existence where public authorities fail to provide a piped water service to all of the area falling within their jurisdiction or to recently-developed areas adjoining them. This failure to provide a service on the part of the public authorities may be because development has been unauthorized or their inhabitants perceived, generally from prejudice rather than fact, to be families with too low an income to pay for the service. Failure may also be due to lack of resources to keep pace with rapid development. On occasion, but more rarely, the population in un-served areas may have a clear ability to pay and the public authorities simply lack the finance and commitment to extend their networks to those areas.

Whatever the reason for failure of the public authorities to supply water, all urban areas need water and local private entrepreneurs detect a market and a business opportunity.

The manner by which these private companies deliver water to households, both individual units and groups, takes many forms. Perhaps the simplest is the re-sale of water purchased from a public utility and distributed through a number of small-bore plastic or polyethylene pipes, laid on the surface, each line serving a single customer. The next stage in complexity, but still involving re-sale of water produced by others, would be the construction of a storage facility and of a small network of underground mains, each branch main serving a number of households. By insisting on customers providing taps within their premises, a private provider might well offer water on a continuous supply basis, even where the public utility is only offering an intermittent supply. More ambitious private providers offer a service which covers production through to delivery. A private water company becomes a water utility in embryo once it constructs its own source works, a well or a reservoir with or without a small dam, provides storage at source and local to its customers and pumps the water into a system of mains and distribution pipes.

Literature consulted described private water company activities where little or no regulation is practiced in Peru and Colombia in Benin, Ivory Coast and Mali in Africa and Cambodia and Vietnam in Asia and recent work has shown that, in Latin American countries, it is not uncommon for un-regulated water companies to serve between 20 and 50% of the population. Prices charged for the water supplied are competitive with those of public utilities within a town or country and may, on occasion, be significantly lower.

Lack of regulation of the service by government, national or local, can occur by default but more often it indicates lack of support for private water service activity. In some cases, active government opposition is generated by a perceived need to protect public water service providers or to avoid putting off interested international water companies that, in absence of a guaranteed monopoly, might not invest in a country's water service.

However, lack of any regulation can have negative effects for both the customer and the company and, ultimately, upon a national economy. The principal of these negative effects are:

- insecurity on the part of the investors, who are under constant threat of prosecution or expropriation, resulting in short term strategies for recovering their investments;
- this insecurity frequently manifests itself in the use of an unsatisfactory quality of materials and workmanship that may well serve adequately for the short term but that produces infrastructure that will be unable to form part of a long term service (although, paradoxically, the same constraint can also generate novel and appropriate technology to meet investment limits set by the investor);
- the quality of water supplied may be unacceptable for potable use;
- the level of service provided – water quality and quantity, pressure and continuity – may initially improve the economic and health situation of the communities they serve but be to so low a level as to eventually limit further improvement.

On the positive side:

- any piped supply is, under most circumstances, better than none;
- some un-regulated water companies provide an excellent level of service but this is either at the discretion of enlightened owners or stimulated by competition between providers within an area;
- private water companies have a better record for rapid connection of customers, extend credit facilities for connection payments, and more surprisingly, appear to be more ready to connect low-income households than public utilities and more tolerant of non-payment;

- small-scale water service companies are an excellent training ground for the private water industry of any country – the large international water companies had their beginnings in similar circumstances and a country's water service will only make sustainable progress if it can develop its own, home-grown capability.

To ensure that the facilities and service provided by private water service providers fits into a long-term, sustainable strategy, governments should:

- actively consider recognizing and encouraging the development of water companies by their national private sector, and if adopted as a policy,
- develop the "gentle" regulation that would recognize the right of private water companies to offer their service and that would underwrite the value and sustainability of the private sector's contribution – whilst preserving the commercial attractiveness of the situation.

Therefore, one of the greatest current challenges facing governments and the international agencies is how to recognize and encourage the entrepreneurial capability of local business in water service provision. An approach needs to include "gentle" regulation, i.e. sufficient to ensure that assets are constructed for the longer term and water quality safeguarded but not so heavy that it stifles small-scale private initiative. If an acceptable regulatory compromise can be reached, rapid progress could be made to meet targets for worldwide access to piped water.

2.3 Private Water Companies in a Developing Country Context - Regulated

Regulated water companies are normally established and operated in accordance with national corporate law and custom. Within the context of this report, the legal forms most commonly employed are privately-owned, limited liability companies and co-operatives.

In so called developed countries, all private water companies are established and operated in accordance with national corporate law and custom. However, mature private water companies can take a number of forms, such as:

- partnerships between individuals
- limited liability companies with few individuals and entities as owners
- public limited companies, either with few individuals and entities as owners or a diffuse ownership, all or part of its equity being quoted for sale and purchase on the capital markets.

Water companies which are owned by a group holding company, i.e. where the water company is just one of a number of commercial ventures owned by the group, will normally be required to ring-fence the activities of the water company within an independent company. This isolates the business of water service provision from other higher risk commercial ventures in order to protect the interests of the customers of the water company. Ring-fencing renders regulation of the water company's activities transparent and safeguards it from any eventual losses or failures suffered by other group companies.

Once a country's government has accepted the concept of private sector involvement in water service provision – and established a regulatory system appropriate to the nature of the involvement they will accept - there is no reason why private water companies, deriving their origins locally, and operating within a regulated environment, should not be able to make a substantial contribution to the water services of a country.

Limitations on the development of a local capability under these circumstances relate to the willingness of commercial institutions to fund the operations of companies with unproven track records or only restricted experience. However, it is in the long-term interest of the country and its citizens that development of a local capability be both encouraged and fostered.

An embryo private sector is unlikely to have the capability to undertake the largest projects. The large international water companies are only interested in contracting to invest in large centres of population and service provision in the medium to small sized towns will be left to the local companies to develop.

Once a government has accepted the concept of private sector involvement in water services, particularly its national private sector, it should encourage its replicability through legislation and by establishing an appropriate system of regulation – as described in a number of sections of this report. The spontaneous initiatives taken by businessmen in a number of developing countries – e.g. Paraguay, Argentina, Bolivia, Colombia, Vietnam and Cambodia – are eminently replicable but they need to be formalized into a regulated environment, formed with sensitivity to the need to foster, and not stifle, private initiative.

In undergoing this process, it would be prudent for governments and international lending agencies to draw lessons from experiences of the past, similar to those for a developing London, and from situations in current state of development and evolution, such as the "aguateros" of Paraguay.

Ownership of small-scale, regulated, private limited liability water companies does not differ much from those of unregulated companies. Ownership is generally in the hands of individuals or groups of individuals or families. However, as they grow and establish themselves as entities with a stable income and profitability, they may be perceived as good investment opportunities by sources of venture capital and banks, pension and insurance companies that may be interested to invest in the equity of the company.

Ownership of cooperatives is spread amongst the members of the organization. In Bolivia, those who commission a connection to the system, and pay the charges for that connection, are automatically members. The extent of their ownership is limited to the capital sum that they pay, as a lump sum or by instalments, for connection. As a member, they have the right to vote in management decisions, a right that, in practice, is normally exercised through a representative elected to the Board of Management.

Dependent upon the size of the water company, the extent of the area served and numbers of connections to its system, it will either manage and staff it with extended family members or employ personnel if it exceeds the capability of their family resources. Cooperatives always have to establish a company structure staffed by employees most, if not all, of whom will have no family relationship to members. Larger companies and cooperatives may outsource some of their activities, particularly those requiring specialist knowledge and experience.

The entity or entities responsible for supervising the operations of regulated private water companies and cooperatives will depend upon which public sector organization has contracted with them to undertake the service or granted them the licence to operate. This organ of government which permits the company to provide the service may be at national, regional or municipal level or responsibility may be delegated by one of these to a third party. In practice, most local governments of small towns do not have the trained staff to supervise the private water companies and supervision, if any outside of the regulatory process, is provided from regional or national levels.

It is difficult to avoid monopolistic situations in water service provision. Many attempts have been made to break this natural monopoly – most unsuccessful. Competition within a monopolistic situation has to be artificially created and, under these circumstances, regulation is extremely important. Companies can be made to compete for the rights to operate in a monopolistic environment but the rules of that competition need to be clearly set out.

The benefit of regulation, for a developing country which uses (or intends to involve) the private sector in development of its water service, is that it establishes a level playing field for those involved. The negative aspects of an un-regulated environment, particularly the "short-termism" which drastically reduces the benefits of private initiatives are avoided through regulation by:

- officially acknowledging and defining the rights of the private sector in water service provision, particularly in respect to length of tenure;
- defining the minimum acceptable standards for water service assets;
- establishing minimum service levels;
- setting out the procedures and factors to be taken into consideration when establishing and reviewing charges.

Regulatory provisions can either be used as the basis for competition between companies wishing to provide a water service to an area or it can be used to generate comparative competition between companies which effectively have a monopoly in their respective areas of supply.

The distinction between regulated and un-regulated water providers in developing countries is an important one. Unregulated water providers - particularly investors in small-scale piped supplies of varying quality and extent - are an extremely important group, but also the most vulnerable. Recent work has exposed their true importance to developing economies. The large international water companies can only justify investment in foreign countries where their networks will serve large populations – normally where populations exceed 300,000. The small, national water providers represent a local, private capability that can, under the right circumstances, grow to eventually take on water service responsibilities for whole towns and beyond. In absence of official recognition and acceptance, they operate in constant fear of prosecution and expropriation. Acceptance and regulation recognizes their investment, protects them from unfair competition and provides them with the security to invest well, secure in their longer-term future. This also acts to the benefit of the customer base and society and the economy overall.

Therefore, one of the greatest current challenges facing governments in countries such as India is how to recognize and encourage the entrepreneurial capability of local business in water service provision. An approach needs to include "gentle" regulation, i.e. sufficient to ensure that assets are constructed for the longer term and water quality safeguarded but not so heavy that it stifles small-scale private initiative.

These challenges need to be undertaken close to the community and often with NGOs working in the community. Again the solution seems to be one based on partnership and alliance; a relationship that could have "business planning" at its centre, thereby attracting a long-term relationship with LOCAL private sector investors and involving local credit and capital finance schemes. Contracts based on partnering concepts and intelligent incentives, which allow the parties to share the project benefits, as well as risks, are most likely to achieve success and best value in practice.

Far less common than their un-regulated counterparts, regulated private water companies in developing countries have, for the most part, come through the same development phases. In the course of their development, they have frequently experienced an early period without regulation of their activities.

3. Some examples

Literature consulted described regulated private water companies in Paraguay, Argentina, Bolivia and Guatemala in Latin America and in Mauritania, in Sub-Saharan Africa. The companies cited are quite different in character and size. As far as is possible to determine, regulation appears to mitigate the negative aspects previously described as characteristics of un-regulated water companies, without losing the positive aspects. However, in the case of the “aguateros” of Paraguay, the regularized companies have only just been established and it is too early to draw any conclusions.

For the two main cities in Paraguay, Asuncion and Ciudad del Este, the public authorities have had difficulty in providing a water service to the newer, low-income developments at their peripheries. For more than a decade, without any legal basis for their operations, private entrepreneurs, the so-called “aguateros”, have been constructing wells and distribution networks, not infrequently in anticipation of development, and serving relatively small populations. It is considered that presently there are between 400 and 500 “aguateros” serving about half a million people. For the most part, these small companies, run by individuals or families, remain outside a regulated environment, providing a good level of service compared with their public counterparts. By the end of 1998, the “aguateros” are estimated to have invested $30M in the sector, about $250 per household served. Service quality is highly variable – intermittency, low pressures, questionable quality - newer systems generally providing a better service than earlier ones. Recently, the government has launched bid processes for concessions to provide the “aguateros” service in a few areas under regulated conditions. There has been a good response for taking the bid documents but it is, as yet, too early to determine whether this regularization of the “aguateros” will be successful and whether the advantages of the system will be retained.

In Cordoba, Argentina, about 15% of the population, approximately 170,000 persons, are provided with a water and sanitation service by independent operators, PIAPS. These organizations work in parallel with, and independently from, the main concessionaire, Aguas de Cordoba, which serves 75% of the population, whilst the municipality provides a service to the areas of informal housing. Included in the PIAPS are private water companies, cooperatives and tanker operators, serving respectively 10%, 3% and 2% of the population. Some of the private water companies have existed for more than 40 years and both they and the cooperatives grew out of a planning consent requirement that all new developments had to provide their own basic services. The difference between the 39 private water companies and the 5 cooperatives is that the former are owned by a few individuals and the latter by all members of the cooperative connected to the system, each of which has one vote in major decisions of the Board of management. The service provided by the private water companies and the cooperatives is good with annual charges at between 45 and 55% of those of the main concessionaire, Aguas de Cordoba.

The city of Santa Cruz in Bolivia has experienced incredible growth over the last 30 years, its population rising from 150,000 to over a million. In 1973, a municipal water company was formed, which was corporatised 5 years later and in 1979 transferred to the newly-formed cooperative, SAGUAPAC. The city has developed along a radial plan. To date, 9 administrative rings have been designated, the limits of each ring being delineated by a major road. SAGUAPAC is responsible for the water and sanitation services for the inner 5 rings of city development (75% of the population). Nine other cooperatives are responsible for water and sanitation to the outer 4 rings (25% of the population). The cooperatives are owned by its members, a member being anyone who requests and pays for connection to the system. The Board of the cooperative is elected, in part, from its members and part from the public fiscal authorities. The cooperatives are regulated by a State body, INALCO, the National Institute for the Cooperatives and the Super Intendencia de Aguas regulates their water service activities. SAGUAPAC has a well-deserved reputation as one of the most efficient and effective providers of water and sanitation services in Latin America.

Guatemala is home to one of the oldest of Latin America's private water companies, the Aguas de Mariscal, named for the river source of its water. Founded in 1928 by three investors, and established as a limited company, it signed a contract with the national government to serve Guatemala City and has been in continuous operation since that date. It produces 0.25 m3/sec and serves 75,000 in 13 zones of the city and has plans to extend its operations to other parts of the city.

The situation of private suppliers of water services in Mauritania is not as developed as the 4 cases cited for Latin America. In general, the Mauritanian government has encouraged the development of a local capability for small town water services. It conducts bidding processes for the engagement of "concessionaires" normally for short terms. However, in the great majority of cases, these private companies are not required to make personal investments in the system, only to manage and maintain systems provided with public funds. In this sense, they are more service contracts or management contracts. However, in a few cases, for example the small town of Guerou, investments have been made by private individuals to extend systems, building mains and connections.

4. Proposals for reforms

- The water supply sector reform process needs to embrace the opportunities and services that entrepreneurs could bring to improving water and sanitation services to people living in urban and rural situations.

- Sound principles of regulation need to be adopted to ensure the there is no abuse of customers in the delivery of services, which will often be provided on a monopoly basis. Acceptance of entrepreneurial contributions through regulation will recognise their investment, protect them from unfair competition and provide them with the security to invest well, secure in their longer-term future. This also acts to the benefit of the customer base and society and the economy overall.

- Entrepreneurship needs to be regarded in its widest context, to be adopted in the wider context of services that could be more effectively provided by the NGO or private sector; and working in partnership with public authorities. This context includes maintenance, out-sourcing of services, suppliers of equipment.

- Once the government has accepted the concept of private sector involvement in water services, particularly its national private sector, it should encourage its replicability through legislation and by establishing an appropriate system of regulation.

- The spontaneous initiatives taken by businessmen in a number of developing countries – e.g. Paraguay, Argentina, Bolivia, Colombia, Vietnam and Cambodia – are eminently replicable but they need to be formalized into a regulated environment, formed with sensitivity to the need to foster, and not stifle, private initiative.

Table 1: Forms of Private Water Service - Country Examples

Forms of Private Service	Country Examples
Water Vendors	All forms of water vendor – individual water carriers, hand-drawn & animal-drawn water carts, motorized water tankers & fixed points-of-sale - are found throughout Africa & in many parts of Asia. Carts and tankers, particularly the latter, are used in some parts of the former Soviet Union and in Latin America and the Caribbean
Private Water Companies, - Developing Country Context - Un-regulated	Americas - Colombia; Honduras; Peru Asia - Cambodia; Vietnam Africa - Benin; Burkina Faso; Guinea; Ivory Coast; Mali; Senegal
- Regulated	Americas - Argentina; Bolivia; Guatemala; Paraguay; Africa - Mauritania; Uganda
Water Bottling Companies	Found throughout the world. Initially, they were founded to provide a safe source of drinking water, in some cases of so-called “mineral water” claiming a capability to improve health. In most countries, their raison d’etre remains the provision of safe drinking water. In the developed world, they have become an expensive fashion statement!

Table 2: Ingredients for Success

Ingredient for Success	Water Vendors		Private Water Companies					
			Developing Country Context				Developed Country Context	
			Un-regulated		Regulated			
	Rating	Comment	Rating	Comment	Rating	Comment	Rating	Comment
Financial & management autonomy	5	Owner-operators	5	Owner-operators	5	Owner-operators	5	Owner-operators
Competition	3	Depends on alternatives available to customer	2	High asset cost precludes much competition	3	Award by private treaty possible; bid basis or private treaty may not be transparent	3	Comparative competition cannot substitute for commercial competiton
Demand responsiveness (inc low income)	5	Tendency to be flexible towards low-income custom	5	Responding to opportunities & flexible to low income custom	4	Obligations established by contract or regulation	4	Obligations established by contract or regulation
Expansion incentives	1	Limited by personal resources	1	Expropriation risk	4	Obligations established by contract or regulation	4	Obligations established by contract or regulation
Professional support	1	Tanker trade associations	1	Trade association assistance	5	Commercial pressures; employ trained staff or train; outsource specialist activities	5	Commercial pressures; employ trained staff or train; outsource specialist activities
Regulation	0	Not applicable	0	Not applicable	3	Not usually adequate	5	Good regulation
Transparency, accountability	0		0	Accountable to tax authorities	2	Not usually as much as desirable	4	Company reports; regulatory reports
Summary rating	2	Essential but uncontrolled service	2	Rating severely limited by unofficial nature	3 - 4	Regulation improves situation but imperfectly	4	Mature companies plus strong regulation – good combination

Table 3 Risk Analysis and Mitigation

Type of Risk	Water Vendors		Private Water Companies					
			Developing Country Context				Developed Country Context	
			Un-regulated		Regulated			
	Risk Allocation	Risk Mitigation	Risk Allocation	Risk Mitigation	Risk Allocation	Risk Mitigation	Risk Allocation	Risk Mitigation
Raw water quantity	Customer	Change vendor	Customer	Withdraw custom	Government	By contract	Government	By contract
Raw water quality	Customer	Change vendor	Customer	Withdraw custom	Government	By contract	Government	By contract
Effluent quality	Not applicable	Not applicable	Private Water Co.	None possible	Private Water Co.	By law or contract	Private Water Co.	By law
Land rights	Not applicable	Not applicable	Private Water Co.	None possible	Private Water Co.	By law	Private Water Co.	By law
Tariff regulation risk	Customer	Change vendor	Customer	Withdraw custom	Private Water Co.	By bid & contract or regulation	Private Water Co.	By licence and/or regulation
Collection risk	Vendor	Withdraw service	Private Water Co.	Withdraw service	Private Water Co	Experience & possibly sanctions	Private Water Co	Experience & possibly sanctions
Operating cost level	Vendor	Withdraw service	Private Water Co.	Management experience	Private Water Co	Management experience	Private Water Co	Management experience
Financing risk	Not applicable	Not applicable	Private Water Co.	Management experience	Private Water Co	Management experience	Private Water Co	Management experience
Construction risk	Not applicable	Not applicable	Private Water Co.	Management experience	Private Water Co	Management experience	Private Water Co	Management experience

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National Water Resources Framework Study

Legal Framework

Working Paper No.13:

National Water Commission

Arunabha Ghosh[158]

Contents

[158] Research assistance from Disha Sharma.

Questions raised

The Planning Commission raised the following questions on the rationale for a national water commission:

- Does India need a National Water Commission on the lines specified in the Planning Commission presentation to the Prime Minister?
- If so, what should be the functions of such a Commission?
- What legal changes would be required for such an NWC to be constituted?
- What precise functions should the NWC perform?
- What should be its human resource profile?
- Can the CWC be conceivably modified to play these roles?

1 Premise

Historically, water resources management in India has been considered synonymously with irrigation. Whereas water resources remain a national resource, the Constitution lists water as a state responsibility, except that the regulation and development of interstate rivers falls under the Union list. Whether managed at the state level or addressed at the Union level, the policy approach towards water has been to divide its administration across different ministries with irrigation receiving the greatest attention.

Two key trends force a re-think of this approach. First, it is estimated that usable supply of water by 2025-2030 could fall short of projected demand by 40-50 per cent.[159] Secondly, there is expected to be a shift in the sectoral demand for water. With an estimated additional 250 million people migrating to urban areas in the next two decades, it will no longer be feasible for agriculture and irrigation to maintain the share of water use that prevails currently.

If supply is not expected to increase and demand is expected to both rise and shift, there is no alternative than to view the planning *and* management of water from a national perspective. In its absence, the country is headed towards a major water crisis. This situation demands an institutional response and much wider public participation in a national water debate.

A national perspective and debate does not, however, imply a shift in the constitutional authority of states over the management of water resources. In fact, this report has described in detail a reformed organisational structure for water resources management in each state, led by a State Water Council (see Working Paper 6, section 4.2). But recent legal precedents suggest that by applying the public trust doctrine to water resources, a national water framework law may be drawn up, which could serve as a set of guidelines and principles for states to voluntarily adopt and implement.[160]

Should such a framework or programme evolve, its implementation would also have to be monitored by an agency with the appropriate mandate and capacity to support the actions taken by states. Moreover, centrally-funded programmes or projects (such as the construction of large-scale irrigation infrastructure) would also have to be assessed against their contribution to a national water framework. The departments responsible for allocating financial resources would need regular information on the progress of such projects. In other words, strategic, long-term and professional management of water resources requires the requisite institutional apparatus.

[159] Bhattacharya, Amit (2011) 'India's water estimates inflated? Plan panel to find out.' *Times of India*, 17 April; 2030 Water Resources Group (2009) 'Charting Our Water Future: Economic frameworks to inform decision-making', October.

[160] See the draft National Water Framework Act prepared by the Sub-Group on a National Water Framework Law set up by the Working Group on Water Governance for the Twelfth Five Year Plan.

2 What are the gaps in water management?

Working Paper 6 underlines the current challenges with the structure of water management in India. They may be summarised as follows:

- The need to move towards planning which takes account of water resources requirements for all uses, including agriculture, domestic, industry and environment;
- A rise in the share of the urban population to 40 per cent by 2030, and to between 48 and 60 per cent by 2050,[161] with concomitant shifts in water demands;
- With many river basins already "closed" better water management rather than new construction is the imperative;
- In water-scarce basins a continued focus on the irrigation sector is no longer sustainable, and a more inclusive planning and management of available resources is required;
- The need for professional management of water resources by either restructuring existing Irrigation Departments to cater for all water uses and users, or a new water resources management organisation in each State, leaving the Irrigation Departments to continue with their focus on irrigation;
- The need to support and encourage the conjunctive use of surface and groundwater resources, so that the relative benefits of surface water and groundwater are recognised;
- The need for a long-term vision on water resources management in India in conjunction with a political initiative to support the transition to new institutional structures;
- The need to engage with stakeholders and end-users to better harness their resources for sustainable water practices.

Whereas earlier working papers have explored the need for reform in irrigation departments and water resources management at the State level, here we highlight the gaps in the mandate and functions of institutions at the Central level.

2.1 Functions of the Central Water Commission

The Central Water Commission (CWC) is organised into three divisions: a designs and research (D&R) wing; a river management (RM) wing; and a water planning and projects (WP&P) wing. Their stated functions can be roughly described as follows:[162]

- D&R
    - Conducting studies on dam safety;
    - When requested, preparing river valley and power development schemes (in conjunction with the other two wings)
    - Coordinating research on schemes for flood management, irrigation, navigation, etc.
- RM
    - Collect and analyse data on tidal rivers, rainfall runoff, silting;
    - Publish statistical data on water resources and use (serving as a 'Central Bureau of Information' on water resources)
    - Study river morphology and conduct experiments on optimum use of water

[161] Verma, Shilip and Sanjiv J. Phansalkar (2007) 'India's water future 2050: Potential deviations from "Business as Usual",' *International Journal of Rural Management* 3 (1): 149-179.

[162] http://www.cwc.nic.in/

- WP&P
  - Undertake construction for central and state government river valley development schemes;
  - Advise the central government on water resources development;
  - Advise the central government on basin-wise development of water resources;
  - Introduce modern data collection technology

Appendix A1 offers more detail regarding the CWC's specific activities relating to irrigation and water management. These key functions may be classified as: strategic advisory (for overall water management at the national or state level); policy advisory (related to a particular scheme or project); monitoring (establishing methodologies and collecting data from different projects); assessment (undertaking studies on various aspects of river valley development, such as irrigation, flood control, etc.); construction (of irrigation projects when requested by the Central or State governments); and information dissemination to the wider public. Some of these functions are performed by all three wings of the CWC and many of them have the support of other agencies and departments within the Ministry of Water Resources (MoWR).

To be sure, not all of the above functions are of equal importance in the CWC's mandate. The CWC has issued numerous guidelines to prepare detailed project reports, which must be submitted by States *before* construction commences to get CWC and Central government clearance. These guidelines mostly cover technical and financial aspects of the projects. However, the CWC guidelines for monitoring and assessment of projects are only suggestive. It is not compulsory for State governments to follow them or even prepare studies *during* the course of a project. Again, monitoring project construction is also restricted to the physical and financial aspects, not the overall basin or sub-basin, let alone the ecosystem of surface and groundwater. Only when Central government funds are used, do the Central government's monitoring guidelines become relevant. Even then, the CWC's role is restricted only to the portion of construction held under its supervision.

2.2 **Unfilled gaps**

Thus, despite the extensive list of activities at the CWC, there remain at least four gaps in the planning and management of water in the country as a whole.

- <u>Technical assessment of projects</u>: Currently, Government of India performs three important technical functions: (1) technical assessment and cost-benefit analysis of large and medium water projects; (2) monitoring of current water flows in order to determine the hydrological feasibility of projects; and (3) monitoring of floods in order to inform disaster management agencies in advance. However, the current guidelines for the technical assessment of water projects do not give the mandate for assessing the state of water resources *as a whole* or expected deficiencies in the management and delivery of major water projects, which, in turn, affect project delays and cost overruns. There is a strong emphasis on evaluating irrigation projects in the CWC's list of activities but little attention to basin-wide water management. To the extent that projects are assessed for safety concerns regarding river valley development, there is no obligation to continue assessments *after* clearances have been awarded. Therefore, more detailed and refined technical analysis is needed *before* the Planning Commission can sanction funds for large and medium water projects.

- Treating water as a national resource: There is no ministry or department that considers the overall state of water resources in the country. The management of water is, of course, important for equitable distribution across regions and the productive and consumptive sectors of the economy. But it is also critical to maintain the environmental integrity of the country's water resources and ensure their sustainability over time. No institution is currently mandated with the responsibility of planning for shifts in the sectoral demand for water, the response to closed or overexploited river basins, or more efficient conjunctive use of surface and groundwater. Even, if a national water strategy were developed, it is not obvious which institution would have the mandate to independently monitor its implementation and suggest corrections in the course as more evidence is collected and analysed

- Availability of timely and usable information: Information on water resources, inflows and outflows from the main canals, etc. are available with different parts of the government. But information is not made available readily and, most importantly, in a usable format. There are discrepancies even in the number of projects monitored that the CWC claims in its annual reports and the data available from the MoWR. It is also unclear what share of total projects these assessments account for. One reason could be that the human and technical resources available to the CWC/MoWR fall short of the requirements. The deficiencies have to be evaluated against the need for more frequent and comprehensive assessments. At present, there is not sufficient information on resources used and projects monitored and assessed to determine the quantum of the shortfall in skills. Moreover, for a national debate to begin on water it is imperative that an institution has the mandate to collate information from different government and non-government sources, analyse the data and submit such analysis on a periodic basis in the public domain. Voluntary guidelines for monitoring and assessment militate against such needs.

- Capacity for management: The country faces a massive deficit in skills to manage and deliver services in the irrigation as well as water supply sectors. The National Water Academy in Pune, operating under the CWC, focuses primarily on developing skills for civil engineers; in fact, the entire core faculty of the institution comprises civil engineers. While these skills certainly need strengthening, there is no countrywide institution that has the responsibility to assess gaps in other kinds of skills (hydrology, hydrogeology, agricultural practices, ecosystem management, energy experts, social scientists, etc.), or to identify the balance of human resources in different water subsectors and support the development of such capacity.

3 Role of the Australian National Water Commission

Australia's National Water Commission,[163] was created by the National Water Commission Act in 2004, as an 'independent, expert body with a national – rather than state of Commonwealth – perspective on water reform'.[164] Its main role, envisaged in the National Water Initiative and the aforesaid Act, is to advise on national water issues, assess progress on reform efforts, and support the implementation of the National Water Initiative (NWI).[165] The NWI, initially signed in 2004 by some of the states and joined by others in 2005 and 2006, represented a blueprint to increase efficiency and productivity in overall water use, both for rural and urban areas. All signatory governments agreed to develop water plans keeping in mind the need for environmental sustainability, address over-stressed water systems, improve storage and delivery, expand trade in water, among other objectives.

The National Water Commission's role is to accredit plans under the NWI and monitor actions and timelines. As Appendix A2 shows, its programmes and projects span the full spectrum of water-related themes addressed in this study: groundwater; water accounting; water planning and management; water-dependent ecosystems; irrigation and rural water use; urban water management; and knowledge and capacity building. The most striking feature of the Commission's activities is the emphasis on assessing the state of the country's water resources as a whole combined with finding connections between surface and ground water. Moreover, projects between multiple states address issues concerning regional water allocation or to benchmark water use standards for crops. Thirdly, ecological aspects receive direct attention again through national or multi-state projects. Fourthly, the Commission encourages greater competition in urban water service provision assessing practices against water availability. Finally, a national water skills project is aimed at training for water management rather than only irrigation.

4 Rationale for an Indian National Water Commission

A comparison between the existing mandate of the CWC and the more integrative role of the Australian institution suggests the rationale for an Indian National Water Commission (NWC). The NWC is not envisaged as a regulator; rather it will exist to provide vigorous leadership in the pursuit of solutions to counter the challenges that India has in its water sector, with regulation continuing to occur at the level of the States or Local Authorities. The NWC would serve as a proactive overseer of the country's water resources to ensure their sustainability. Its power will derive from its neutrality in monitoring the work of relevant water agencies, assessing water resources across sectors and promoting a national water strategy, delivering timely information to the public at large, and developing a broad base of skills for water management at different levels of government.

One of the main issues that supports the creation of the NWC in the context of establishing a practical route to improving water resources management, rural and urban water supply and wastewater services is the clear lack of capacity, understanding and political will at a central, state and local government level to introduce reforms for the longer period (rather than

[163] See www.nwc.gov.au

[164] See http://www.nwc.gov.au/www/html/3105-external-review-of-the-national-water-commission.asp.

[165] Ibid.

beholden to short term political cycles). The NWC, if properly constituted as **statutory agency and with independent authority** to influence the direction of reform and flow of infrastructure funds, would have the potential to become a catalyst for reform as an information provider, watchdog of the rights of different stakeholders and advocate for improved water management capacity and practices.

5 What would be the role of the NWC?

In this national leadership role it is envisaged that the NWC would operate as:

(1) an independent **technical assessor** to offer more refined analysis to support the Planning Commission and the Ministry of Environment and Forests *before* project clearances are issued, to monitor progress *during* construction and timely completion of projects, and to continuously assess the management of projects *after* completion;
(2) the **guardian or watchdog of national water resources**, states' rights and individual entitlements, a promoter of the Government's principles for water sector reform, and an independent monitor for the implementation of a long-term National Water Strategy;
(3) an **aggregator and public communicator of data and information**, so that water authorities at the central and state levels have an objective basis for discussing the state of the country's water resources *and* to organise and implement a nationwide and continuous water and wastewater performance benchmarking programme for irrigation, rural and urban drinking water management, including setting service standards for ensuring resource and financial sustainability;
(4) a **facilitator and capacity developer** in order to support states (if requested) with advice on institutional design, capacity and skills development in various departments, and to offer technical advice and inputs, if sought, to institutions authorised to regulate, arbitrate and/or resolve disputes.

In the pursuit of these four roles – assessor, watchdog, communicator, and facilitator – the NWC will be not merely an outcome of the 12th FYP but a continuously evolving institution. The 12th FYP would be the beginning of a long-term process of institutional and management reform in the water sector and it is important to set the right tone and pathway for reform.

6 What would be the specific functions of the NWC?

Establishing an NWC would require a multi-year process, in order to convey the rationale for a new institution to stakeholders in the water sector (central government ministries, state governments, political parties and legislators, water consumers (including productive sectors) and civil society at large.

6.1 Evolution of the NWC

Table 1 suggests how the NWC could evolve incrementally with a gradual broadening of its mandate, resources and capacity. The following steps are proposed for the phased approach.

Table 1: Evolution of the National Water Commission

	Phase I	**Phase II**
Mandate	Improved technical analysis of major and medium water projects	Social-economic-environmental assessment of the country's water resources to develop and monitor compliance with a National Water Strategy
Functions	• Revised guidelines for project cost-benefit analysis • Dynamic assessment of project implementation to enable staggered funding • Technical advice to the Planning Commission & the MoEF	• Dynamic assessment of project implementation (before, during and after completion) to enable staggered funding • Guardian/watchdog/proactive overseer of the country's water resources to ensure their integrity and environmental sustainability and defend the rights of different stakeholders • Aggregate, analyse and communicate information on water resources to the public at large • Develop capacity in central and state water agencies to support the transition to a service delivery mode
Representation	No particular change envisaged from the existing CWC	Broad-based representation to include water stakeholders, including industry, agriculture, consumers, civil society organisations
Capacity	• Existing staff will have to be given additional skills to undertake more complex analyses • Technical committee to continuously review and revise assessment guidelines	• Technological improvements needed to monitor and assess water resources on a periodic basis • Panel of technical advisers • Skills for legal, economic, social, political and sustainability analyses • Improved public communication and informational dissemination capacity • Multi-disciplinary faculty for training and capacity building; introducing water resource management curriculum in universities
Origination	• A revision in the mandate and responsibilities of the CWC (through a decision of the Union Cabinet via the Ministry of Water Resources) • Assessment of projects *during* construction and management phases to be made mandatory • A Provisional National Water Commission could be created to begin preparations for a broader set of activities, such as information dissemination and capacity building	Act of Parliament to establish the NWC as an independent body, accountable to President of India
Legal changes	No major legal reforms needed	No constitutional amendment necessary
Timescale	Immediately	Within 12th FYP period

<u>Year 1</u>

- Government of India constitutes an Empowered Working Group with the mandate to develop a National Water Strategy
- Empowered Working Group regularly reports to the National Development Council
- Empowered Working Group takes the lead in collating up-to-date data on national water resources; central and state governments would be mandated to supply the information
- Empowered Working Group begins reviewing and revising the guidelines and assessment methodologies for the technical review of water projects

<u>Years 2-3</u>

- More detailed data is collected and collated to substantiate the framework National Water Strategy
- A 25-year Perspective Plan on Water is prepared by the Empowered Working Group as the key component of the National Water Strategy
- The Perspective Plan on Water is discussed within the National Development Council before being adopted as the National Water Strategy
- Empowered Working Group starts to publicly communicate and disseminate information about the state of the country's water resources, shifting trends and plausible future scenarios
- Empowered Working Group, meanwhile, begins to advocate the key elements of the Perspective Plan to various water stakeholders throughout the country

<u>Years 4-5</u>

- On the invitation of state and municipal governments, the Empowered Working Group begins to support capacity development in their respective water-related agencies and departments
- Growing public and political acceptance of the National Water Strategy, confidence in increased access to data and the resulting transparency, and positive results from capacity building activities offer opportunities create a more institutionalised National Water Commission
- The NWC is created by an act of Parliament and with autonomy from the central government; the provisions of the act are accepted and legislated upon by state governments

6.2 Specific functions during the 12th Five Year Plan

In light of the above described process, the NWC could most usefully pursue the following specific functions during the 12th Five Year Plan:

- **Development of revised technical guidelines** in order to continuously monitor projects and undertake dynamic assessments, not just of construction activities but of the management of basin- or sub-basin-wide water resources.

- A second function relates to **coordination and networking across sectors and levels of government**, both across line ministries and departments and between central and local levels of government, to facilitate information sharing and developing the case for a national water management strategy and programme.

- **Information collection and dissemination** on successes and failures at the individual project level, in order to allow successes to be emulated and failures not to be repeated. In this area, there may be a comparative advantage in having a systematic and compulsory approach to information collection followed by analysis at the central level, in order to have maximum benefits from benchmarking individual project experiences against emerging national best practices.

- Two different but related types of **capacity-building activities** may be envisaged: a comprehensive web portal; and periodic advanced practitioner workshops. The NWC could also focus on facilitating the involvement of public and private service providers in water utilities as a declaration and signal of strong and unconditional support and political commitment towards such joint arrangements.

- Finally, a fifth function would be communication and **engagement with potential local and foreign investors** as well as all other stakeholders. In any outreach programme with other stakeholders, the benefits of increased or full transparency concerning all contract details of individual projects should be seriously considered.

6.3 NWC functions over the longer term

- Guardian and overseer of the **National Water Strategy** once it has been approved and adopted by the National Development Council.
- Offering **technical advice** to central and state water administrations, including State Water Councils.
- Watchdog of the rights of all water stakeholders and particularly the state of the country's water resources; this function would be largely accomplished by **"naming and shaming"** rather than by quasi-judicial enforcement.
- Continuous **benchmarking** of best institutional practices, efficiency standards, human resource and capacity requirements.
- Continuing role in **information dissemination**, transparency, **capacity building** and public education and advocacy.

7 Commitment required

The NWC cannot succeed, either in its formation or future evolution, unless two aspects are clearly recognised.

- <u>Financial support</u>: There must be adequate financial support for the Empowered Working Group and the NWC over at least ten years.
- <u>Institutional reform</u>: Once the NWC is created by an act of Parliament, one of its key roles will be to support institutional reform at the state and central government levels. This is not to suggest a dilution of the states' constitutional authority. But the shift in the tasks, technical capacity, information requirements and public engagement necessarily require institutional arrangements vastly different from what exist today.

- Institutional coordination: Continuing from the above, coordination with the State Water Councils envisaged in Working Paper 6 will be central to an integrated approach to water management in the country.

8 What legal changes would be required?

As conceived, the evolution of the NWC in an incremental manner over the course of the 12th Five Year Plan would not require any constitutional amendments. The case for the NWC is not based on a shift of constitutional authority for the management of water resources in the country. Instead, the rationale for the NWC, if accepted in principle by central and state governments (based on work accomplished by the core Working Group), could translate into an autonomous, statutory institution created through an act of Parliament.

Appendix A1: Functions of the Central Water Commission for Irrigation Management and River Basin Management

Themes (as per NWRF Study)	Key Functions	Detailed Functions	Programmatic Relevance		Information Available		Jurisdiction / Authority
			CWC Wing	Other Supporting Organisations	Publication	Periodicity	
IRRIGATION MANAGEMENT							
	Assessment	To initiate studies on socio-agro-economic and ecological aspects of irrigation projects for the sustained development of irrigation	Water Planning & Projects	CGWB, CII, IARI, IARI, CRIDA, CAZRI, ICRISAT, Agricultural Universities/ ICAR institutes/ Engineering colleges/ WALMIs, MoWR	-Farmers Participatory Research Action Programme I (FPRAP I), 2006 - Farmers Participatory Research Action Programme II (FPRAP II), 2009	-2006 publication available and institutional progress till 2008 available -2009 overview	A separate committee formed
				Project Appraisal Organisation	-Guidelines for Submission, Appraisal and Clearance of Irrigation and Multi-Purpose Projects	2010	CWC
				Irrigation Directorate - CWC	-Guidelines for Less Water Consuming (leaner) Cropping Pattern for Irrigation System in Draught Monitoring Areas	1992	
	Strategic Advisory + Assessment	To conduct studies on dam safety aspects for the existing and future dams and standardise the instruments for dam safety measures	Designs & Research	Dam Safety Organisations (DSOs), National Committee on Dam Safety and dam owning agencies	-National Register of Large Dams	Reports in 1990, 1994 and 2002 (only 2002 available on the website)	CWC
					-Standardised Data Book Format, Sample Checklist and Performa for Periodical Inspection of Dams	1988 publication	CWC

					-Dam Safety Procedures -Guidelines for Safety Inspection of Dams -Guidelines for Development of Emergency Action Plan (EAP) for Dams	1986 1987 2006	CWC CWC CWC
	Construction/ Infrastructure + Monitoring	To standardise instruments, methods of observation and record, materials for construction, design and operation of irrigation projects	-	Dam Safety Organisations	Guidelines for Planning of Parallel Canals	2002	
RIVER BASIN PLANNING / WATER RESOURCES MANAGEMENT							
	Strategic Advisory	To advise and assist, when so required, the State Governments (Commissions, Corporations or Boards that are set up) in the investigation, surveys and preparation of river valley and power development schemes for particular areas and regions	Designs & Research + River Management				CWC & State governments
	Strategic Advisory + Assessment	To conduct studies on dam safety aspects for the existing and future dams and standardise the instruments for dam safety measures	Designs & Research	Dam Safety Organisations (DSOs), National Committee on Dam Safety and dam owning agencies	National Register of Large Dams -Standardised Data Book Format, Sample Checklist and Performa for Periodical -Dam Safety Procedures	Reports in 1990, 1994 and 2002 (only 2002 available online) 1988 1986	CWC CWC CWC

					-Guidelines for Safety Inspection of Dams -Guidelines for Development of Emergency Action Plan (EAP) for Dams	1987 2006	CWC CWC
	Assessment (+ monitoring) + strategic advisory	To undertake necessary surveys and investigations as and when so required, to prepare designs and schemes for the development of river valleys in respect of power generation, irrigation by gravity flow or lift, flood management, environmental management, rehabilitation and resettlement, soil conservation, anti-water logging measures, reclamation of alkaline and saline soils, drainage and for drinking water supply	Designs & Research + River Management + Water Planning & Projects	-Dam Safety Assurance and Rehabilitation Project (DSARP) with World Bank assistance in 1991	-Dam Rehabilitation and Improvement Programme (phase II of DSARP) -Report on Environmental Impact Assessment and Environment and Social Management	Six year- long project starting from January 2011	CWC & State governments (Kerala, Madhya Pradesh, Orissa and Tamil Nadu)
				-Central and State governments (data collection), Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture	-Integrated hydrological data book	2006	CWC & State governments
					-Handbook of Water Resources Statistics	2003, 2005 (2005 available)	
				Basin Planning Organisation and WRIS (Water Resources Information	-Real time integrated operation of reservoirs	2005	CWC

				System) State governments, Finance and Revenue Accounts of Union and State governments published by Controller and Auditor General of India -for financial data	 Pricing of Water in Public System in India	 2010	 CWC & State governments
	Assessment	To conduct and coordinate research on the various aspects of river valley development schemes such as flood management, irrigation, navigation, water power development etc., and the connected structural and design features	Designs & Research + River Management + Water Planning & Projects				
	Monitoring and Assessment	To collect, coordinate the collection of, publish and analyse the data relating to tidal rivers, rainfall, runoff and temperature, silting of reservoirs, behaviour of hydraulic structures, environmental aspects etc. and to act as the Central Bureau of Information in respect of these matters	River Management	MoWR, NIH Basin Planning Organisation	-Preliminary consolidated report on effects of climate change on water resources 2008 – Hydrological data at CWC sites used -Evaporation Control in Reservoirs	2008 1988, 1990, 2006 (only 2006 available)	MoWR report

	Strategic Advisory + Assessment	To initiate morphological studies to visualise river behaviour, bank erosion/coastal erosion problems and advise the Central and State Governments on all such matters	River Management	MoWR, NIH, m MoWR, GFCC, Brahmaputra Board, CWPRS, NRSA, SAC Ahmedabad, GSI, IWAI, Water Resources/ Irrigation departments and SAC of concerned State Governments are represented	General Guidelines for Preparing River Morphology Reports	1991, 2009 (only 2009 available)	Central & State governments
	Construction/ Infrastructure	To undertake construction work of any river valley development scheme on behalf of the Government of India or State Government concerned	Water Planning & Projects				Central & State governments
	Monitoring	To promote modern data collection techniques such as remote sensing technology for water resources development and river forecasting and development of computer software	Water Planning & Projects				CWC
	Policy Advisory	To advise the Government of India in respect of Water Resources Development, regarding rights and disputes between different States which affect any scheme for	Water Planning & Projects				Central government

		the conservation and utilization and any matter that may be referred to the Commission in connection with river valley development					
	Policy Advisory	To advise the Government of India and the concerned State Governments on the basin-wise development of water resources	Water Planning & Projects				Central & State governments
	Policy Advisory	To advise the Government of India with regard to all matters relating to the Inter-State water disputes	Water Planning & Projects				Central government
	Information dissemination	To promote and create mass awareness in the progress and achievement made by the country in the water resources development, use and conservation	-				CWC
	Capacity building	To initiate schemes and arrange for the training of Indian engineers in India and abroad in all aspects of river valley development	-	National Water Academy, Pune			

***Source*: NWRFS team analysis; CWC Annual Reports; MoWR Annual Reports**

Appendix A2: Functions and Programmes of the Australian National Water Commission

Programme	Function	Programmatic relevance/project	Information available / periodicity	Jurisdiction
GROUND WATER				
		Harmonisation of groundwater definitions and standards, and improved governance and management practices		
	Strategic advisory	*Mapping potential surface water/groundwater connectivity across Australia*	Over $2 million for catchment scale analysis to determine connectivity between groundwater resources across Australia	National
	Policy advisory	*National standards on groundwater mapping, definitions and assessment*	Over $5 million to develop a nationally-consistent groundwater mapping, definitions and management guidelines to improve water management in and between jurisdictions.	National
	Policy advisory	*Scoping a decision-support system for assessment of groundwater trades*	$75,000 diverted for determining the costs and benefits of a nationally transferrable decision support system	National
	Policy advisory	*National groundwater information system (phase 1)*	To scope the implementation of a compatible national groundwater information system by all jurisdictions and the Bureau of Meteorology (BoM)	National
	Assessment	Northern Australia groundwater stocktake *Northern Territory groundwater stocktake Project details*	$825,000 plus allocated for updating current groundwater resource understanding in the Northern Territory	Northern Territory

	Strategic advisory	National assessment of sites suitable for managed aquifer recharge and recovery *Feasibility of implementing managed aquifer recharge (MAR) schemes for agricultural purposes*	For studying the influence of economic feasibility, regulatory frameworks and implementation barriers for MAR schemes in agriculture, $100,000 allocated.	National
	Policy advisory	*Facilitating recycling of stormwater and reclaimed water via managed aquifer recharge in Australia*	To provide a policy framework to be adopted by the jurisdictions and would serve as an assessment tool to determine viability of MAR in the area of interest and its suitability	Multi State
	Assessment	Vulnerability of groundwater dependent ecosystems *Rollout and adoption of framework for assessing environmental water requirements of groundwater-dependent ecosystems*	An assessment of water requirements of groundwater dependent ecosystems by states and territories	National
	Assessment	*Atlas of groundwater-dependent ecosystems*	National inventory for identification and characterization of major terrestrial, wetland and base-flow ecosystems across Australia that are groundwater-dependent - $5,545,000	National
	Assessment	Investigation of groundwater/surface water inter-connectivity	For assessing groundwater response to recent rainfall	National
	Assessment	*Rapid assessment of 2010-11 rainfall and flooding events on groundwater recharge*	$2,000,000 project	National
	Assessment	*National assessment of surface water/groundwater connectivity*	To develop field equipment and a proven scientific methodology to quantify surface	National

		Quantifying surface water/groundwater exchange using thermal and chemical measurements	water flux to groundwater below stream beds; $210,000 project	
	Policy advisory	*Interconnection of surface water and groundwater systems - river losses from losing/disconnected streams - NSW*	A review to validate approaches and determine connectivity in losing/disconnected streams	NSW
	Strategic advisory	Strategic aquifer characterisation to quantify sustainable yields *A consistent approach to groundwater recharge determination in data-poor areas*	More than $1,329,000 allocated to develop methodologies to determine recharge and discharge in areas where detailed investigations have not been conducted	National
	Advisory: strategic & policy	*Strategic assessment and management of priority groundwater systems*	To provide assistance to jurisdictions to carry out strategic assessment and management of priority groundwater systems.	Multi State
	Assessment	National review of groundwater potential for deep fresh, saline and brackish waters *Deep Australian Water Resource Information System (DAWRIS)*	To determine the availability and location of data to develop a Deep Australian Water Resource Information System.	National
	Monitoring	Managing risks to groundwater quality *Impact of groundwater pumping on groundwater quality*	Capacity to manage risks to highly developed aquifers in NSW resulting from groundwater pumping	NSW
	Assessment	*Assessment of groundwater bore deterioration*	$100, 000 to determine the impact of deterioration and the cost of rehabilitation	National

	Assessment + monitoring Assessment Assessment + advisory	 National Centre for Groundwater Research and Training National Ground Water Action Plan The National Groundwater Assessment Initiative National Centre for Groundwater Research and Training Knowledge and Capacity Building component	$30 million to improve understanding of ground water related issues $50 million; eighty priority investment themes $30 million joint venture between NWC and Australian Research Council $2 million allocated	National National National National
WATER ACCOUNTING				
	Monitoring & Assessment Assessment Policy Advisory	Developing an Australian environmental water report Developing national water accounting Resolution of knowledge gaps for irrigation metering installation and verification requirements for Australian standards	To promote environmental water management reporting and management This project enabled work to develop the water accounting model for national adoption, through the development and pilot of new Australian Water Accounting Standards (AWAS)	National National National

WATER PLANNING & MANAGEMENT				
	Strategic Advisory	Improving the effectiveness of water allocation planning	$4.5 million	National
	Assessment	National inventory of water stressed systems		National
	Policy Advisory	Incorporating climate change impacts in water allocation planning	To assist National Water Initiative partners in regional water allocation processes; $100,000	National & States
	Policy Advisory	Australian Indigenous Water Roundtable	To establish and support a National Indigenous Reference Group for water issues	National
	Strategic Advisory	Baseline assessment of water governance arrangements	To examine priority water governance issues impacting on the achievement of NWI outcomes, and examine how, over time, better practice water governance arrangements can be encouraged and implemented across Australia	National
KNOWDLEDGE & CAPACITY BUILDING				
		Supporting Australia's water industry export capability	$100,000 allocated	National
		National water skills resource project	Consistent standards and resources for the training and assessment of people undertaking accredited courses for improved water management in Australia	National

IRRIGATION & OTHER RURAL WATER				
	Monitoring	Measuring, monitoring and reporting systems for improved management of regional water resources at farm to national scales	Measuring regional irrigation evapo-transpiration to benchmark crop water use and improve water use efficiency.	Multi State
	Policy Advisory	Identification of factors that potentially influence uptake of smart metering technology	$195,000 the Australian Government, University of South Australia and CRC for Irrigation Futures.	National
WATER-DEPENDENT ECOSYSTEMS				
	Monitoring & Assessment	Ecological outcomes of flow regimes	$1,281,000 to model flow regimes for accurate assessment of ecologically sustainable levels of extraction in the Murray Darling Basin	Multi State
	Strategic Advisory	Water-dependent ecosystems - Part 1 and 2	Understanding high-priority issues relating to aquatic ecosystems in Australia	National
	Monitoring & Assessment	Optimising environmental watering protocols to maximise benefits to native fish populations	Evaluating fish community response to inundation in actively managed wetlands on the Murray River	Multi State

INTEGRATED URBAN WATER MANAGEMENT				
	Policy Advisory	Developing future directions for urban water reform	Identify reforms to improve urban water performance and better manage future risks and challenges; $0.78 million	National
	Policy Advisory	Exploring opportunities for further competition in the urban water sector	Information and analysis for further competition and market reforms in the urban water sector; $200,000	National
	Assessment & Strategic Advisory	Australian integrated resource planning framework and manual	To develop resources and tools to assist urban water service providers and government agencies to determine more accurately how much water is used in their region, how much water is available and how they can best provide or support water services for their region in the future; up to $700,000	National
***Source*: NWRFS Team Analysis; Australia National Water Commission (www.nwc.gov.au)**				