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VERMICOMPOSTING IN INDIA

This summary document provides an overview of the state of vermicomposting in India. And also covers a literature review of impact studies conducted on vermicomposting in India. **It is a part of the larger CEEW study,** *Sustainable Agriculture in India 2021: What We Know and How to Scale Up*

Sustainable Agriculture in India 2021: What We Know and How to Scale Up, is a handbook on the prevalence, practices and state of affairs of the 16 most promising sustainable agriculture practices in the country. It presents the economic, social and environmental impacts of these practices with recommendations on their potential to scale-up sustainable agriculture in India.

The study is available at: https://www.ceew.in/publications/sustainable-agriculture-india-2021

Image: Dr. Girish Chander, ICRISAT

Vermicomposting is a simple biotechnological composting process that uses certain earthworms to enhance the process of waste conversion to produce good-quality compost. The resultant product is a stabilized, uniformly sized substance with a characteristic earthy appearance known as vermicast/vermicompost.[1]

Vermicomposting differs from composting in several ways as the earthworms are active between 10–32°C (not ambient temperature but temperature within the pile of moist organic material), and the process is faster than composting.[2]

Image: Dr. Girish Chander/ICRISAT

Vermicomposting's linkages to FAO's agroecological elements

In principle, vermicomposting adheres to and promotes many agroecological elements as defined by the FAO

Elements	Description of agroecological linkages
Diversity	Vermicompost enhances soil biodiversity and the population of microbial communities that further improve soil health upon which agricultural production depends, positively impacting human health, flora, and fauna.
Co-creation and sharing of knowledge	The vermicompost technique is a blend of traditional or indigenous knowledge infused with scientific ways of producing and applying vermicompost.
Synergies	Vermicompost enhances soil biodiversity by promoting beneficial microbes, enhancing plant growth directly by producing plant growth-regulating hormones and enzymes, and indirectly controlling plant pathogens, nematodes, and other pests.[3]
Efficiency	It reduces the need to use chemical fertilisers while lowering associated costs. Second, it is a cost-effective measure that transforms biodegradable waste into useful manure using low-cost materials.[4]
Recycling	Vermicomposting is one of the best methods to recycle agricultural and domestic waste, allowing for the safe disposal of garbage and preventing environmental pollution[5] that could pollute landfills.
Resilience	Vermicomposting is considered a climate-resilient practice as it manages soils and crops in a sustainable manner with fewer chemicals and improves soil health and crop productivity. It also minimises fertilizer use and related emissions.[6]
Human and social values	Several vermicompost micro-enterprises run by women's Self-Help Groups (SHG) and farmers have improved their economic and social status, empowering them in the process.

A brief context in India

In India, vermicomposting has been practised intermittently for more than three decades. The deteriorating conditions of soil from chemical fertiliser use and unhealthy foods associated with pesticide use has popularised organic farming in which vermicompost is the basic ingredient. The practice has received increased attention in the last decade, with many research institutes and NGOs exploring feasible vermicompost production options that vary from small backyard units to large-scale production units. It is also being taken up by farmers on an individual basis to fulfil their own needs. However, commercial production has not yet taken off.

Farmers adopting the practice can apply for subsidies and financial assistance to set up vermicompost units through government programs. These include the *National Mission for Sustainable Agriculture (NMSA), National Food Security Mission (NFSM), Mission for Integrated Development of Horticulture (MIDH), and RKVY - Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY-RAFTAAR).* For instance, the *NMSA* finances 50 per cent of the total cost of setting up vermicomposting units, up to a limit of INR 5000 (USD 70) per hectare and INR 10,000 (USD 140) per beneficiary.[7]

Vermicomposting in Chhattisgarh

In July 2020, Chhattisgarh State launched the new scheme, *Godhan Nyay Yojana,* with the focus on rural livelihood and organic farming. Under the scheme, the state government purchases cattle dung at INR 2 per kgs (3 cents/kgs) from farmers, which is collected in cowsheds (Gothan Samiti) and used by women self-help groups (SHGs) to prepare vermicompost. It is then sold through local co-operative societies at INR 8 per kgs (12 cents/kgs). Further, the scheme is merged with other bigger schemes like *PKVY; RKVY* and *MGNREGS.* The scheme has registered around 4,419 *Gothans* (day care centre for livestock) and 63,500 tonnes of total cow dung had been purchased as of 20th August 2020.[8]

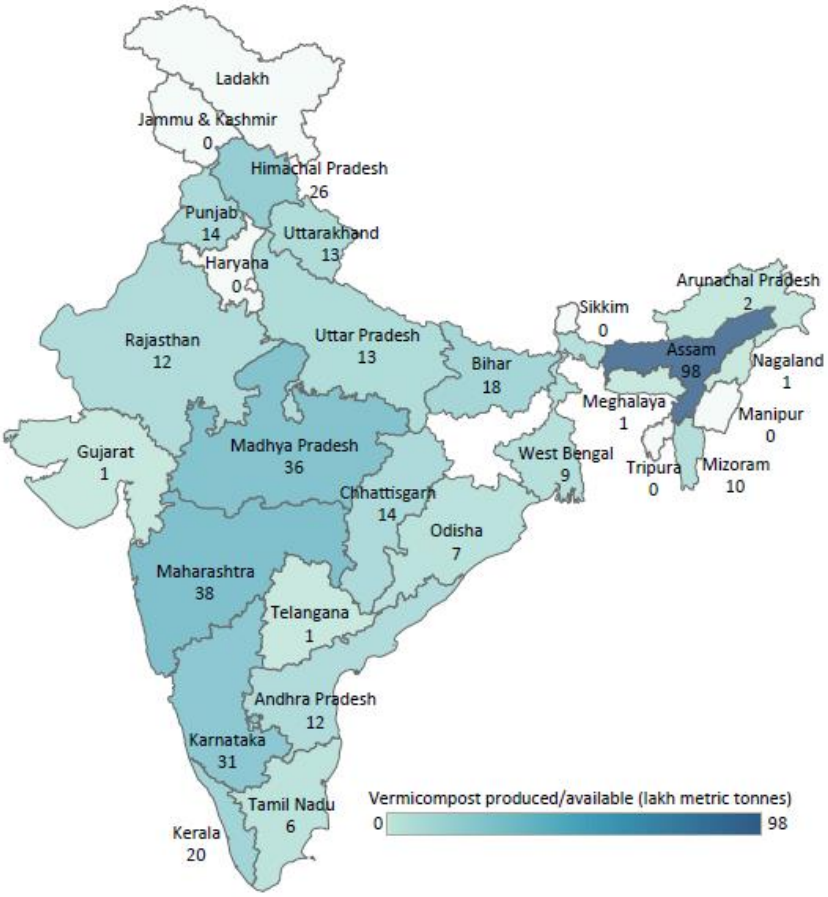
Vermicomposting: acreage, geographies, and cultivation details

How much area in India is under vermicomposting? It is difficult to find recent and reliable area estimates of vermicompost coverage. According to the National Centre of Organic Farming (NCOF), the total agricultural land where vermicompost is practised is around 3.5 million hectares, covering 19 states.[9]

At what farm size is vermicomposting practised? According to the stakeholders consulted (see below), vermicompost is practised mainly by small and marginal farmers across all topographies, and in both rural and urban areas. They further added that large landholding farmers are less convinced about using vermicompost due to the quick results given by chemical fertilisers in terms of crop yields and nutrients.

How many farmers in India are practising vermicomposting? The practice is increasingly gaining acceptance among farmers and entrepreneurs; however, there is no information on the number of farmers adopting it. Stakeholders consulted estimated that 1.5 million farmers are practising vermicomposting.

Figure 1. Geographical coverage of states producing vermicompost



Source: National Centre of Organic Farming 2018;
Note: Data for Jharkhand is omitted due to its unreliability

Where in India is vermicomposting prevalent? Vermicompost is practised

in many states, particularly in the southern and central parts of the country (Figure 1). According to the NCOF, Assam, Maharashtra, Madhya Pradesh and Karnataka are the states with the highest levels of production.[10]

Which are the major crops cultivated under vermicomposting in India? A variety of crops are cultivated using vermicompost, however, it is more cost-effective in high value horticultural crops (vegetables, fruits, ornamental crops, spices, medicinal).

Impact of vermicomposting

This section considers the economic, social, and environmental impacts of vermicomposting.

ECONOMIC IMPACT

1. Yields

There is widespread consensus in India on the positive role of vermicompost in crop productivity. Various case studies from across the country show that yield changes compared to conventional cultivation depend on the quality and quantity of vermicompost and the combinations applied. There is also evidence that a few crops gave higher yields when enriched vermicompost[1] was applied rather than standard vermicompost alone or in combination with chemical fertilisers.[11,12,13,14]

According to several case studies, it is evident that when vermicompost is applied with vermicast (worm castings) it can increase yields significantly compared to conventional fertilisers. For instance, one study shows yield growth of more than 40 per cent when applied in wheat.[15] Whereas the integrated approach of using half vermicompost and fertilisers did improve yields over the balanced nutrient management approach,[2] the rate was lower – ranging from 2 per cent to 16 per cent for various crops.[16] Even fruits such as strawberry and grapes show interesting yield increases (32.7 per cent and 23 per cent) when vermicompost is applied alone.[17]The combination of vermicompost, fertiliser, and biofertilizer gave medium rates of yield growth in rice.[18]

2. Income

The practice of producing vermicompost is said to be an economical enterprise compared to chemical fertilisers. Generally, there is direct marketing of vermicompost from producer to consumer which is the strongest channel for marketing the product, but marketing is also done through cooperatives and traders. Vermicomposting used as an alternative to chemicals can significantly reduce input costs.

Estimates show that applying only 6 tonnes per hectare of vermicompost instead of the recommended dose of N, P, K for cereal crop production, can reduce the cost of fertiliser by up to INR 4,000 (USD 55) per hectare and the cost of pesticides by 40 per cent in the subsequent three to four years. Further, vermicompost can be sold for INR 10-50 (USD 0.15-0.70) per kg on the e-commerce market. Farmers

[1] The enrichment of vermicompost with nutrients and microorganisms using different organic and inorganic materials and microbial inoculants.

[2] Soil test-based addition of deficient nutrient fertilizers as balanced nutrition.

can also fetch INR 5-30 (USD 0.15-0.45) per kg in the wholesale market in India. These are estimated prices for vermicompost, not earthworms, which sell at INR 300-500 (USD 4-7) per kg.[19,20]

Income and livelihood opportunities arising from the sale of the vermicompost itself, as well as increased agriculture productivity, makes vermicomposting an attractive proposition. However, the process of making vermicomposting is labour intensive which can raise input costs for farmers.

SOCIAL IMPACT

1. Human health

Relevant literature on the health impact of vermicompost is scarce, other than those which suggest human and environmental health benefits by reducing chemical use in food production.[21,22]However, these studies have not probed deeper into the subject. Vermicompost is considered as an alternative to industrial farming methods involving heavy fertilizer and pesticide use,[23] but there is a lack of systematic studies.

2. Gender

Vermicomposting is an essential activity for generating employment and income for women, especially women SHGs, many of which have benefitted from participatory vermicomposting activities. Several case studies highlight how vermicomposting has impacted women's groups[24] is by facilitating rural finance to women groups for vermicompost production, which helped to raise their economic status.[25] Vermicompost training programmes programs improved women's livelihoods, together with imparting peer to peer knowledge to help women SHGs initiatives expand in the region.[26]

A more recent example is the *Godhan Nyay Yojana*, a project initiated by the Chhattisgarh Government, in which women SHGs have benefited from selling vermicompost. The women SHGs collect and prepare vermicompost from the community, which is then purchased by the government.[27]However, the evidence suggests that women in eastern India have lesser participation in vermicomposting activities due to the fear of untouchability, diseases, and the foul-smelling nature of vermicomposting sheds.[28]As most of these impacts were reported in case studies and articles, efforts need to be made to conduct experimental studies that capture the impact on women more comprehensively.

ENVIRONMENTAL IMPACTS

1. Soil and nutrients

The practice has gained prominence due to its prime role in converting a variety of waste materials (agricultural waste, household waste) into rich nutrients that can increase agricultural productivity. Earthworms, the core element of the practice, essentially live in the soil and turn organic debris into worm casts through vermicomposting. These worm casts are vital as they add fertility to the soil and invigorate soil health. They are known to have more than 5 times the available nitrogen, seven

times more potash and one and a half times more calcium than generally found in topsoil.[29]Especially NPK (nitrogen, potassium, phosphorus) is known to be higher in vermicompost than other composts (farmyard manure, bacterial compost).[30]

Mounting evidence also suggests that the earthworm casts have certain features that complement soil health as they aerate the soil (8-30 per cent) and have high moisture-holding capacity,[31]they maintain soil temperature conditions, and increase oxygen availability. Even the nutrient content of vermicompost varies depending on the waste materials used for compost making, as a wider variety of waste materials gives a diverse nutrient profile.[32]

However, compost worms are subject to predation by certain animals and insects and to a disease known as "sour crop" caused by environmental conditions which could pose a challenge to cultivators.[33]

2. Water

Water is a very important medium for vermicomposting as it not only sustains the earthworms which are the core of the practice, but it is needed to dissolve the organic waste created by the earthworms into water-soluble substances. Vermicompost also makes the soil more aerated, with a high moisture-holding capacity (nearly 40-60 per cent) that can save water and reduce irrigation costs.[34]

3. Energy and emissions

Vermicompost is produced using low energy inputs, thus making it a cost-effective and efficient method for recycling waste products.[35]Another vital use of vermicompost is its use in producing biogas energy, as it is used as a raw material along with cow dung for generating gas and slurry from biogas plants.[36]

Vermicompost finds relevance in the context of climate change mitigation and emissions in two ways. Firstly, the use of vermicompost reduces the need to apply nitrogenous fertilisers which are responsible for emitting GHG gases like nitrous oxide (N_2O) and ammonia (NH_3).[37] Secondly, when waste materials decompose through vermicomposting it reduces the waste which are generally left unattended in landfills, and which are a source of harmful methane emissions.[38] One study found that vermicomposting of waste released less N_2O and had a higher potential for reducing GHGs than centralized composting and anaerobic digestion facilities, landfilling, incineration, etc.[39] More efforts are needed to understand the impact on emissions and carbon sequestration.

4. Biodiversity

The practice usually enhances activity beneath the soil, increasing the soil microbial diversity. Vermicompost is usually richer in microbial populations and diversity, particularly fungi, bacteria, and actinomycetes, than conventional composts,[40,41] directly enhancing soil biodiversity and plant growth. While these are mentioned in limited studies, the linkages are not very profound, thus more of investigative studies are required to understand its genuine impact on biodiversity.

Impact evidence

State of available research discussing the impact of vermicomposting on various outcomes.

Evidence Type	Yield	Income	Health	Gender	Soil and nutrients	Water	Energy	GHG emissions	Bio-diversity
Journals	46	4	1	6	47	2	1	2	0
Reports	1	2	0	1	4	0	0	1	0
Articles/case-studies	0	3	0	10	3	0	0	0	0
Others **	6	6	0	1	2	0	1	1	0
Total	**53**	**15**	**1**	**18**	**56**	**2**	**2**	**4**	**0**

*** Thesis, guidelines, conference papers, etc*

Source: Authors' compilation

Note – The evidence is from the first 75 results examined in Google Scholar Advanced search and the first 30 results from Google Advanced Search. Only those papers which clearly established the evidence for different indicators were selected.

Stakeholder mapping

The following institutions are involved in the research and promotion of vermicomposting; a few were consulted for this research:

Government institutions	Research/implementation institutions	NGOs/Civil society organisations
Central Research Institute for Dryland Agriculture (CRIDA)	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	Centre for World Solidarity (CWS)
National Centre of Organic Farming (NCOF)	Tamil Nadu Agricultural University (TNAU)	Apna Kheti
National Program for Organic Production (NPOP)	Kerala Agricultural University	M.S. Swaminathan Foundation (Tamil Nadu),
ICAR-Mountain Livestock Research Institute, Manasbal	Andhra Pradesh Horticultural University	PRADAN
Central Research Institute for Dryland Agriculture (CRIDA)	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	Centre for World Solidarity (CWS)

Source: Authors compilation

Note – The stakeholders list is indicative and not exhaustive

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Suggested citation: Gupta, Niti, Shanal Pradhan, Abhishek Jain, and Nayha Patel. 2021. *Sustainable Agriculture in India 2021: What We Know and How to Scale Up*. New Delhi: Council on Energy, Environment and Water

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