Bio-inputs

Bio-inputs are defined as biological substances derived from biotic organisms used to improve soil fertility, support plant growth, and enhance crop health (FAO n.d.). They include biofertilisers[1], biostimulants[2], biopesticides[3], and natural farming inputs[4] that can provide sustainable alternatives to chemical inputs.

India's per-hectare consumption of chemical fertilisers surged from 135.76 kg in FY 2015-16 to 141.2 kg in 2022-23 (Fertilizer Association of India 2023). This increase in chemical inputs has had indiscriminate effects on biodiversity and human health (Pathak et al. 2022). In response, the Government of India has advocated for the widespread adoption of organic and natural farming practices, exemplified by initiatives like the National Mission for Natural Farming. Additionally, under the GOBARdhan scheme[5], the Indian Government plans to establish 15,000 decentralised bio-input resource centres (BRCs)[6] across the country (PIB 2023).

In Odisha, per-hectare fertiliser consumption is 68 kg, significantly lower than the national average (Department of Agriculture and Farmers' Empowerment, 2020). This lower usage results from fragmented land holdings, lack of irrigation facilities, and increased salinity due to frequent flooding, which limits the efficacy of fertilisers and makes farmers reluctant to invest in chemical fertilisers (Hoda et al. 2021; Cao et al. 2022). Additionally, Odisha's promotion of organic farming through policies like the Odisha organic farming policy[7] favours organic inputs over chemical fertilisers. These factors uniquely position Odisha to scale up organic and natural farming practices effectively. By leveraging its existing low-input usage, and prioritising the production and use of bio-inputs, Odisha has the potential to become a 'champion state' in scaling sustainable agriculture for the entire country. The growing opportunities in organic and natural farming will increase the demand and scope for the production and marketing of bio-inputs, leading to more investment and job creation.

[1] Biofertilisers are substances that contain microorganisms, which when added to the soil increase its fertility and promote plant growth.
[2] Biostimulants are biological catalysts derived from natural sources that are used to improve plant processes like nutrient uptake, photosynthesis, and stress tolerance.
[3] Biopesticides are pesticides that are derived from natural materials, such as plants, animals, bacteria, and minerals and are used to control pests and manage agricultural diseases without harming the natural ecosystem
[4] Natural farming inputs are the inputs such as Jeevamrutham and beejamrit that are prepared using local ingredients by farmers practising natural farming.
[5] Galvanizing Organic Bio-agro Resources Dhan (GOBARdhan) scheme aims to promote a circular economy by promoting conversion of organic waste to wealth through CBG/biogas plants.
[6] A bio-input resource centre is a decentralised centre that produces and distributes bio-inputs like vermicompost and jeevamrutham to support sustainable farming practices.
[7] The Odisha Organic Farming Policy was launched by the Department of Agriculture and Farmers' Empowerment Department in 2018 to cover two lakh hectares of land under organic farming.

Opportunities for 2030

Jobs, market and investment opportunity:

- Assuming that, by 2030, Odisha will scale up organic and natural farming to 6.4 per cent and 5.1 per cent of its gross cropped area, respectively, producing the necessary bio-inputs will result in creation of ~2,000 jobs. The total investment and market opportunity for scaling required bio-input production would amount to USD 1.07 million and USD 11.77 million, respectively.

    - If Odisha follows Madhya Pradesh's trajectory and scales up organic farming to 6.4 per cent of its gross cropped area by 2030, it would require ~4000 metric tonnes (MT) of biofertilisers and biopesticides, along with ~400 MT of biostimulants for ~326,000 hectares of land. This will create an investment opportunity of USD 0.3 million to set up additional centralised biofertiliser and biopesticide facilities. These facilities would produce 4562 MT of bio-inputs, with a market opportunity of USD 1.2 million.

    - Similarly, scaling up natural farming to 5.1 per cent of its gross cropped area by 2030, following India's natural farming trend, would necessitate ~14,000 MT of natural farming inputs for ~413,000 hectares of land. This would require USD 0.75 million to establish ~2,000 bio-input resource centres, each catering to 50 hectares of land. These units will produce ~14,000 MT of natural farming input, with a market opportunity of USD 8 million.

- Prime locations for establishing bio-input resource centres include Keonjhar, Koraput, Mayurbhanj, Rayagada, and Sundargarh. These areas are particularly suitable due to their alignment with Odisha's natural farming policy objectives and their significant tribal population.

Why should Odisha invest in bio inputs?

1. **Enhancing climate resilience:** Adopting bio-inputs on a large scale can enhance Odisha's agricultural resilience to climate change by boosting biodiversity (Padma 2019; Protergium n.d.), improving soil fertility, and increasing water retention (Jiménez et al. 2023). These inputs reduce the need for chemical fertilisers, cutting CO2 emissions by 0.58 tonnes per tonne of chemical fertiliser produced, thereby aiding India's net zero goals (Patidar et al. 2024).

2. **Monetary savings:** Shifting to bio-inputs significantly lowers fertiliser subsidy expenses and health costs for the state (Gupta et al. 2020; Charyulu et al. 2011). Fertiliser subsidies have skyrocketed by nearly 158 times since 1980-81, reaching ₹795.30 billion in 2021-22, straining the nation's finances (Ansari et al. 2022). The

misuse of chemical inputs has also driven up health costs, due to physiological disorders such as cancer and congenital anomalies (Asghar et al. 2016; Pathak et al. 2022; Medina, Rotondo, and Rodríguez 2023).

3. **Community empowerment:** Making bio-inputs more accessible locally can boost farmers' adoption of sustainable agricultural practices. BRCs are especially valuable in remote areas with limited access to roads and chemical inputs. These centres provide information and distribute soil-friendly products, serving as a one-stop solution for farmers practising sustainable agriculture in these regions (Natividad 2022).

Inspiration from a success story

WASSAN has established six BRCs in Sathya Sai and Annamayya districts of Andhra Pradesh to support natural farming by producing bio-inputs. A major challenge in preparing these inputs is the collection of cow urine, a key ingredient, which is often lost through seepage. Therefore, these BRCs are essential for increasing the adoption of sustainable agriculture. Each centre employs 20-30 entrepreneurs who provide bio-inputs to 100 farmers, with each entrepreneur producing around 11 MT of bio-inputs annually. This initiative not only provides financial stability to farmers but also reduces reliance on chemical fertilisers, enhances soil health, and promotes biodiversity[6].

Who could support in scaling bio-inputs?

1. **Role of departments:**

a. **Department of Agriculture and Farmers' Empowerment:** The Department of Agriculture and Farmers' Empowerment plays a crucial role in scaling up bio-input production by offering incentives for producing and certifying biofertilisers and organic manures. They facilitate the formation and training of farmer producer organisations (FPOs)/self-help groups (SHGs) to produce natural farming inputs and promote bio-input adoption among farmers through awareness drives and training programmes that encourage farmers and SHGs to become BRC entrepreneurs. The department also promotes the use of bio-inputs in cultivating indigenous crop

varieties in tribal areas, thereby enhancing the adoption of sustainable agricultural practices and generating demand for bio-inputs in these regions.

b. **Department of Animal Husbandry and Dairying:** The Department of Animal Husbandry and Dairying has a critical role to play in scaling up bio-input production by promoting the use of animal waste, such as dung and urine, which are key raw materials for natural farming inputs. The department could facilitate the collection and transportation of these materials from dairies and animal husbandry centres to BRCs through FPOs and SHGs. The department could also support the formation of cow urine collection centres at community level to ensure a reliable supply of cow urine for bio-input production, thereby enhancing the capacity to produce natural farming inputs.

c. **SC & ST Department:** The SC & ST Department can significantly scale up bio-input production by leveraging its oversight of the zero budget natural farming programme. Also, by mobilising existing women SHGs through Mission Shakti in tribal areas to produce and distribute bio-inputs, the department not only empowers women economically but also fosters collective action within communities. Additionally, the Odisha Tribal Development Society (OTDS) can enhance this effort by organising regular stakeholder review meetings at the block level, ensuring effective coordination and addressing any challenges that arise in scaling up bio-input production.

d. **Industrial Development Corporation of Odisha (IDCO):** The Industrial Development Corporation of Odisha (IDCO) plays a crucial role in scaling up bio-input production by providing essential infrastructure support for establishing biofertiliser, biopesticide, and biostimulant plants. IDCO could facilitate support in land allocation, developing industrial parks, and offering logistical support necessary for setting up centralised bio-input production centres.

e. **Odisha Skill Development Authority (OSDA)**: OSDA could collaborate with the Department of Biotechnology to organise training programmes that ensure a skilled workforce for the efficient operation and maintenance of centralised biofertiliser and biopesticide production plants. OSDA could help in developing customised training modules, partner with industry experts to deliver high-quality content, and facilitate job placements for trainees.

f. **State Agricultural Universities (SAUs):** SAUs conduct research and development, identifying new strains and developing effective formulations through rigorous field testing. After successful testing, SAUs mass-produce and supply selected strains to local farmers, ensuring accessibility to high-quality bio-inputs. SAUs could also

advocate for bio-input usage and provide extension support to farmers, guiding them on effective application methods.

g. **Odisha Agro Industries Corporation Limited (OAIC):** Odisha Agro Industries Corporation Limited (OAIC) plays a significant role in marketing and supplying both chemical and bio-inputs to enhance agricultural productivity in the state. To enhance the availability of bio-inputs in the state, the department could mandate or incentivise retailers to allocate a portion of their inventory to bio-inputs.

h. **Odisha State Co-operative Marketing Federation Limited (MARKFED):** Odisha State Co-operative Marketing Federation Limited (MARKFED) could warehouse and supply bio-inputs to primary agricultural cooperative societies (PACS). To enhance bio-input distribution, MARKFED can implement strategies that streamline logistics and ensure timely delivery to PACS, thereby improving access for local farmers.

i. **Agricultural Promotion and Investment Corporation of Odisha Limited (APICOL):** APICOL could promote investment in agricultural enterprises such as biofertiliser, organic fertilisers and biopesticides production units through the capital investment subsidy under the Mukhyamantri Krishi Udyog Yojana (MKUY). It could guide such enterprises by offering support in project formulation, counselling, enterprise development, and project implementation.

2. **Role of the private sector:**

a. **Investments across value chain:** Private investors and financiers can supply the capital needed to establish and expand bio-input production facilities. They can invest in infrastructure development and technology upgrades to enhance the efficiency and scale of bio-input production. They can also invest in research and development initiatives to discover new formulations, improve production techniques, and enhance the efficacy of bio-inputs. Private companies can establish distribution networks and marketing channels to effectively reach farmers and promote the adoption of biofertilisers, biopesticides, and organic fertilisers. They can provide technical assistance, training, and extension services to help farmers understand the benefits and proper use of bio-inputs.

b. **Collaboration:** Industries, such as agriculture, food processing, and biotechnology, can collaborate with bio-input manufacturers to develop innovative products and solutions tailored to the specific needs of Odisha's agricultural sector. These industries can also serve as potential bio-input customers, further driving demand and market growth. By partnering with academic institutions and research organisations such as ICAR and OUAT, they can accelerate innovation and bring new bio-input products to market.

3. **Role of local administration and civil society organisations (CSOs):** CSOs can play a significant role in motivating and providing technical and financial support to motivated

farmers or SHGs to set up bio-input resource centres. CSOs could also provide other forms of hand-holding support such as creating business plans and establishing market linkages.

Overcoming challenges to scale bio inputs

1. **Low awareness and adulteration issues:** Farmers are unaware of the benefits of bio-based fertilisers. A general lack of trust is further exacerbated by the prevalence of adulterated bio-input products in the market. As producers resort to cost-cutting measures such as using lower-quality raw materials or reducing production time, the use of these cheap adulterated organic fertilisers disappoints farmers with their ineffectiveness, leading to a generalised mistrust of organic fertilisers among farmers and genuine bio-input producers (Khurana and Kumar 2020).

   Way forward: Implementing targeted education programmes aimed at enhancing farmers' understanding of bio-based fertilisers can help them identify fake and adulterated products. There needs to be stricter implementation of quality assurance and regulatory frameworks to ensure that only safe and effective bio-based fertilisers are available. Facilitating rigorous testing of products and conducting frequent inspections of bio-input production units to check for substandard and fake products, with severe punishment for producers failing to meet the quality standards, could help address the issue of low-quality bio-inputs (Khurana and Kumar 2020).

2. **Regulatory and licensing hurdles:** The bio-input industry needs to work on a cumbersome regulatory landscape for biopesticides and biostimulants as the licensing authority rests with the central government, which results in extensive paperwork, the need for multiple certifications, and more expensive licensing processes than chemical inputs. Another challenge is non-inclusion of natural farming inputs in the fertiliser control order (FCO), despite continued government focus and attention on promoting natural farming.

   Way forward: Establishing a single clearance window and developing streamlined process manuals outlining regulatory requirements can expedite the registration process by simplifying the licensing procedures for manufacturers. These measures could reduce the complexity and costs associated with licensing. Inclusion of natural farming inputs in the fertiliser control order can help establish product formulation specifications and provide the necessary support, such as access to the growth of the bio-input industry.

3. **Raw material availability:** Despite the promising growth of the biostimulant market in India, the industry faces challenges related to raw material availability. Seaweed, a crucial raw material for seaweed-based biostimulant, is not widely cultivated within the country, leading some traders to import water-soluble seaweed powder from other countries, dilute it, and sell it as a biostimulant at inflated prices, which negatively impacts domestic biostimulant producers. Furthermore, there is a shortage of essential raw materials like cow urine to make natural farming inputs, hindering the scale up of natural farming (CNI SBSS 2022).

Way forward: Government should provide incentives for the establishment of seaweed cultivation farms in India, ensuring a reliable and cost-effective supply of this critical raw material for the biostimulant industry. Establishment of cow urine collection centres in tribal areas can help in improving access to cow urine among farmers. These centres could collect and store urine from local farmers by making their cow sheds waterproof and providing appropriate slopes to ensure drainage of cow urine into village collection chambers, which would then serve as central storage tanks, facilitating distribution to natural farming practitioners in collaboration with local CSOs and government agencies (WASSAN 2022).

4. **Limited demand for bio-inputs:** Farmers practising sustainable agriculture may initially show great interest in purchasing bio-inputs, but this enthusiasm often wanes after one or two crop cycles due to the increased tendency of farmers to revert to conventional farming methods. Moreover, there is demand for only selected natural farming inputs, like Beejamrut, which often limits the market potential for a broader range of natural input products. This low and uncertain demand prevents the bio-input industry from maximising capacity utilisation and deters further investment in the sector (Khurana and Kumar 2020). Successful bio-input production is insufficient as it needs to be backed by a large sales team to generate demand among farmers. This demand generation should be backed by the availability of these biological products at input shops near farmers, a critical factor in increasing their utilisation and demand.

   Way forward: One way to increase the availability of bio inputs is by mandating government-regulated input shops to stock bio-inputs as some percentage of their overall inventory. Another way is to leverage the existing supply chains of fertiliser cooperatives to distribute bio-inputs, ensuring their availability at every local input shop (Khurana and Kumar 2020).

5. **Infrastructure-related challenges:** Shelf life of natural farming inputs such as jeevemruthum is limited. This along with the lack of adequate storage facilities at the community level significantly impacts distribution of bio-inputs.

   Way forward: Investing in decentralised storage facilities, leveraging existing distribution networks of public sector undertakings (PSUs) handling chemical fertilisers, and implementing robust inventory management systems can help minimise losses by ensuring timely delivery of bio-inputs.

6. **Lack of systematic research:** ICAR institutes and state agriculture universities need to refine the package of practices (PoP) and build credibility regarding the efficacy of natural farming inputs to increase farmers' uptake. Similarly, technology transfer for biofertilisers and biopesticides is extremely slow from laboratory to mass production (Khurana and Kumar 2020), and even then, the performance of biofertilisers and biopesticides under in situ conditions needs to be significantly improved.

Way forward: There is a need for systematic research to address the effects of dung and urine from various species on jeevamritha and beejamritha, optimal application quantities and frequencies, creating longer-lasting concentrates, and the impact of natural farming under different crop combinations and agro-climatic conditions (Kumar et al. 2020). There is a pressing need for multidisciplinary research to bridge the gap between laboratory findings and field applications (Yadav and Yadav 2024).

Risk-proofing the scale-up of bio-inputs

1. **Risk to food security:** Despite the promise of natural farming to enhance soil and human health while reducing the cost of cultivation, its adoption remains low. One of the major reasons for farmers' non-adoption is fear of production loss when switching to natural farming (Smith et al. 2020).

   Mitigation: Farmers should adopt a phased transition to increase the chances of successful adoption of natural farming by prioritising rainfed areas in tribal regions where the usage of chemical fertilisers is already low (Abraham et al. 2022). Supportive policy initiatives, including financial incentives like subsidies or grants, can offset initial costs and reduce financial risks. These initiatives could include grants for training in natural farming methods or insurance schemes to protect against production loss during the transition period. More research by state agriculture universities is needed to assess the impacts of natural farming input on crop yields and soil health.

2. **Risk of drudgery for women:** The drudgery faced by women in agriculture is significant, particularly in the context of natural farming input production, which is labour-intensive and often relies heavily on female labour (Paliath 2022).

   Mitigation: To alleviate this burden, it is essential to explore the integration of technological solutions, such as the solar-based drava jeevamrutham (DJ) unit developed by WASSAN (WASSAN 2023)[8]. By mainstreaming such technologies, we can reduce the physical strain on women and enhance their efficiency in agricultural activities, ultimately promoting gender equity in farming practices.

3. **Risk to biodiversity:** Improper handling of biopesticides can accidentally release pathogens into the wild, potentially harming beneficial insects, wildlife, and even humans.

   Mitigation: Researchers must conduct extensive screening to select strains targeting pests without affecting beneficial organisms. Before releasing any biopesticide into the market, rigorous laboratory studies and field trials that simulate real-world conditions must be carried out to observe any unintended effects on non-target species (Chakraborty et al. 2023; Yadav and Yadav 2024).

[8] Stakeholder consultation

Annexure

Scoping of the bio-inputs value chain

The bio-input value chain consists of the following sub-value chains: 1) biofertilisers and biopesticides, 2) biostimulants, 3) natural farming inputs, 4) organic fertilisers, and 4) indigenous seed value chain. Each sub-value chain consists of four phases: 1) business development, 2) design and pre-construction, 3) construction and commissioning, and 4) operations and maintenance. The scope of the bio-input value chain is limited to only biofertilisers and biopesticides, biostimulants, and natural farming inputs sub value chains. Within these sub-value chains, we have restricted the scope to only direct jobs from the operations and maintenance phase.
Below are the additional considerations for scoping-

- Our analysis captures only value chain-related activities that create additional employment. Therefore, we excluded the indigenous seed production value chain, which refers to producing seeds from locally adapted plant varieties, because it mirrors crop production, and existing seed processing units can process the additional indigenous seeds produced.

- The rationale behind the exclusion of organic fertilisers from our scope of work is that the government already supports the production, marketing, and supply of organic fertilisers, such as FOM and PROM, through the market development assistance (MDA) programme. This programme specifically targets the production of FOM and PROM as a byproduct during CBG production (PIB 2023). Our calculations show that only ~1 per cent of the FOM/PROM generated during the production of CBG by 2030 is needed to meet Odisha's organic fertiliser requirements. Therefore, the creation of additional organic fertiliser production units is unnecessary.

Jobs and market estimation

Market sizing (in units):

Bio-inputs are demand-driven, meaning their production depends on market demand rather than raw material availability. Therefore, we assess their potential using demand-based scenarios. Bio inputs like biofertilisers, biopesticides, and biostimulants are centrally produced on a large scale and used mainly by farmers practising organic farming. In contrast, natural farming inputs are produced in decentralised units on a small scale and used by farmers practising natural farming. Since the end-users, production processes, and scales differ for these two types of bio inputs, we considered two different scenarios for them.

1. Natural farming inputs: India aims to convert 10 million hectares to natural farming (Kumar 2023), representing 5.1 per cent of the country's total gross cropped area by 2027. If Odisha follows this national trend and aims to adopt natural framing on 5.1 per cent of its gross cropped area, given its current base in organic farming and its low fertiliser usage, it is likely to surpass the national average. This would equate to ~ 413,000 hectares of Odisha’s gross cropped area.

2. Biofertilisers, biopesticides and biostimulants: To benchmark Odisha's potential for biofertilisers, biopesticides, and biostimulants, we used Madhya Pradesh as a model. Madhya Pradesh has the highest percentage of gross cropped area under organic farming at 6.4 per cent, excluding smaller states like Tripura and Sikkim. Currently, Odisha has 2.6 per cent of its gross cropped area under organic farming. If Odisha follows Madhya Pradesh's trend and transitions 6.4 per cent of its gross cropped area to organic farming by 2030, this would amount to approximately 326,000 hectares.

Estimating the market sizing in units for respective bio inputs:

1. Biofertilisers and biopesticides: To determine the amount of biofertiliser and biopesticide required to scale up organic farming by 2030, we distributed the gross cropped area among 27 commonly grown crops based on their percentage of Odisha's total gross cropped area. We calculated each crop's biofertiliser and biopesticide needs according to the recommended package of practices (PoP). We assumed that 100 per cent of farmers practising organic farming would adopt these centrally produced bio-inputs following the recommended PoP for respective crops.

2. Biostimulants: We assumed a 100 per cent adoption rate of biostimulants with farmers practising organic farming in Odisha using centrally produced biostimulants as per the recommended dosage of 1.2 litres per hectare per year. The required dosage of biostimulant, which does not vary significantly for different crops, is 1.2 litres per hectare per year (Sagarika n.d). We multiplied this dosage by the total area in hectares under the ambitious scenario to calculate the total biostimulant requirement for all crops in 2030.

3. Natural farming inputs: India uses over 50 different natural farming inputs. However, we included only Jeevamrutham, handi khata, and neemastra in our analysis because Odisha's farmers have traditionally prepared and used these inputs, making them compatible with local agricultural practices (Malkangiri n.d). Since the amount and type of natural farming input required do not vary significantly across crops (NCNF 2022), we multiplied the dosage required in litres per hectare per year for each input by the total area in hectares under the ambitious scenario. This calculation provided the total natural farming input requirement for all crops in 2030.

Jobs estimation:

1. Biofertilisers and biopesticides:
    a. An average production facility produces biofertilisers for the first nine months and biopesticides for the remaining three months of the year. Industry consultations with five players producing biofertilisers and biopesticides provided data to calculate the FTE per MT of biofertilisers and biopesticides. This was done by dividing the total number of full-time employees at the production facility by its annual capacity. This information gathered from industry consultations aligns with the information in the

detailed project report (DPR) on a 200-tonne production unit for biofertilisers and biopesticides.

b. Total number of jobs that can be created during operation and maintenance of biofertilizer and biopesticide production units in Odisha by 2030 is calculated using full-time equivalent (FTE) per MT of biofertiliser and biopesticide coefficient and potential market size.

Total FTE = FTE/MT of biofertilisers and biopesticides X Total MT biofertilisers and biopesticides required as per scenario considered

2. Biostimulants:
    a. Industry consultations with two players producing seaweed-based biostimulants provided data to calculate the FTE per MT of biostimulant produced by dividing the total number of people employed full-time in the production facility by the facility's annual capacity.
    b. We calculated the total jobs by multiplying the FTE required to produce the amount of biostimulant needed for one hectare of land by the total area in hectares considered in the ambitious scenario.
3. Natural farming inputs:
    a. Natural farming inputs, such as beej amruthum, are primarily liquid-based, have a short shelf life, and require large quantities per hectare, making centralised production models impractical (Khurana and Kumar 2020). Therefore, the government has proposed a 50-hectare local radius within which BRC entrepreneurs will operate, supplying inputs to nearby villages (PIB 2023).
    b. The production of natural farming inputs, such as jeevamrutham, is demand-driven and seasonal, with a shorter shelf life. Families or communities managing BRCs often perceive bio-input sales as a supplementary activity rather than a core business, with their primary motivation being personal use and surplus products distributed within limited social networks (Mohan et al. 2023).
    c. A BRC operating within a 50-hectare radius can generate an average annual profit of approximately 2.8 lakh INR ($3,351)[9], sufficient to cover the average household expenditure in rural areas of Odisha[10]. In the local village economy, these BRCs play a crucial role in helping farming households earn a decent wage. Therefore, evaluating the total number of entrepreneurs created, based on whether the average annual profit of a BRC exceeds the average rural household expenditure, is a more accurate measure of livelihood generation.
    d. Consultations were held with nine BRCs (six from Andhra Pradesh, one from Odisha, and two from Madhya Pradesh) to capture data on the number of people employed, types of inputs produced, average capacity utilisation, and production capacity.

[9] Stakeholder consultation

[10] Authors' analysis of average annual household expenditure in rural areas of Odisha based on the average rural household size in Odisha from Global Data Lab and the Monthly Per Capita Consumption Expenditure (MPCE) - Rural (2022-23) with imputation.

e. Note that the 50-hectare model currently relies on the net cropped area. To convert this into the gross cropped area, we multiply it by Odisha's cropping intensity, which is 1.57. We then calculate the total number of 50-hectare models required to transition 5.1 per cent of Odisha's gross cropped area to natural farming (NF). This calculation assumes that 37.4 per cent of the farmers will produce their own inputs. We based the 37.4 per cent rate of NF input adoption on an analysis of primary data received from CEEW's large-scale longitudinal impact assessment of the community-managed natural farming programme in Andhra Pradesh, India.

f. Each local BRC entrepreneur will run a BRC model, leading to one job generation. We calculate the total number of 50-hectare BRC models required using the formula:

Total number of 50 hec BRC models required = (0.374(5.1/100)*total gross cropped area in Odisha in hec)/(50*Odisha's cropping intensity)*

Table 1: The bio input wise FTE considered are as follows:

Sl. No.	Phase	FTE/MT
1.	Operations and maintenance of biostimulants	0.012
2.	Operations and maintenance of biofertilisers and biopesticides	0.15

The maximum number of jobs are created in the production of natural farming units. These jobs are low-skilled, compared to jobs created during the operation and maintenance of biostimulants, biofertilisers and biopesticides.

Market opportunity (in value) estimation

1. **Biofertiliser and biopesticides:** To estimate the potential market opportunity for biofertilisers in Odisha, we multiplied the total amount required by 2030 by the sale rate of INR 230/kg from the OUAT biofertiliser production unit. For biopesticides, we used the price of Azadirachtin 1500 ppm, set at USD[11] 9.6 /litre. This price is based on the Meghalaya government's approved rate[12] of USD[16] 0.48 for 50 ml of Azadirachtin 1500 ppm.
2. **Biostimulant:** To estimate the potential market opportunity for biostimulants in Odisha, the total amount of biostimulants required by 2030 for BAU and the ambitious scenario was multiplied by the sale rate of the biostimulant production unit, set at USD[16] 6.63/litre (CSMCRI n.d).
3. **Natural farming inputs:** To estimate the potential market opportunity for natural farming in Odisha, we multiplied the total amount of natural farming inputs required by 2030 for an ambitious scenario by the selling prices of the inputs. The selling prices in USD[11] per litre are USD 0.18 for jeevamrutham[7], USD 0.30 for neemastra[7], and USD 0.30 for handi khata[13].

[11] 1 USD = INR 83
[12] https://megagriculture.gov.in/public/dwd_docs/ApprovedRatesofBioPesticides2018.pdf
[13] Stakeholder consultation

Investment opportunity estimation

1. To calculate total investment required to realise projected market opportunity, we only considered capital expenditure (CAPEX) costs. When the total number of units needed by 2030 resulted in decimal places, the number was rounded off to the nearest whole number.

Total Investment Opportunity = (Total number of units required by 2030) x (CAPEX required to set up one unit)

2. The capital cost for setting up a bio-input production unit varies significantly depending on capacity, type of input, technology, raw materials used, and other factors. Tentative project costs for different bio-input types are provided below:

S. No.	Bioinput type	Plant capacity	Capital cost	Source
1	Biofertiliser and biopesticide	200 metric tonnes per day	INR 162 lakhs	NABARD
2	Natural farming input	Caters to 50 hec	INR 30,000	Operational guidelines - special programme for promotion of millets in tribal areas of Odisha (2022-2026)
3	Biostimulant	1500 metric tonnes per annum	INR 5.3 Cr	Stakeholder consultation

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