

## ACTION BRIEF

# Bio-input Resource Centres (BRCs): Restoring Soil Biological Capital and Reducing Agrochemical Dependency in Smallholder Agroecosystems

SCALAGRO Project - Centre for Sustainable Agriculture (CSA)

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Intervention	Location	Phase	Period
Bio-input Resource Centres (BRCs)	Zaheerabad, Telangana	SCALAGRO India -Phase 1	2024-2026
<b>&gt;150</b> Individuals Trained	<b>96,000 L</b> Annual Capacity	<b>~4,500 acres</b> Coverable per Cycle	<b>~50%</b> Input Cost Reduction

## 1. Scientific Rationale and Problem Statement

Soil health, understood as the continued capacity of a living soil to sustain plant, animal, and human life through functional biological communities (Doran & Zeiss, 2000), is the foundational ecological determinant of long-term agricultural productivity. Years of dependency on synthetic fertilisers and pesticides in semi-arid Telangana have progressively degraded the microbial biomass, enzymatic activity, and structural diversity of the soil biome, resulting in a well-documented pattern of diminishing productivity returns despite sustained or intensified expenditure on chemical inputs (Gattinger et al., 2012). Farmer testimony from SCALAGRO's (Scaling up Agroecology in India, Bolivia and Burkina Faso) participatory baseline research consistently confirmed this trajectory: crop yields have declined season upon season; however, fertiliser application rates remain high, reflecting the biological impoverishment of soils that can no longer efficiently convert inorganic nutrients into plant-available forms.

A persistent structural market failure compounds this ecological degradation: microbial inoculants, biofertilisers, and biopesticides are almost absent from rural agricultural input markets across the studied areas of Telangana and Andhra Pradesh, India. Government extension programmes that promote indigenous biological preparations, including Jeevamrutam (a bovine manure-based fermented microbial inoculant) and Panchagavya (a multi-substrate botanical-microbial formulation), have achieved limited adoption because neither the production skills nor the supply infrastructure to make these inputs reliably available at the field scale currently exists at the village or cluster level. Bio-input Resource Centres (BRCs) are designed to address this institutional gap by embedding standardised biological input production within community governance structures, thereby simultaneously generating livelihood opportunities and restoring agronomic conditions for agroecological farming.



*Bio-Resource Centre (BRC) established at DDS-KVK, Bio-inputs produced*



*Training program on Agroecology, demonstration of BRC at DDS-KVK*



*Bio-inputs distribution for farmers at DDS-KVK*

## **2. Theoretical Framework**

The BRC intervention is grounded in the agroecological principle of input reduction and ecological recycling (Wezel et al., 2014). However, it operates on a systems-redesign logic that goes beyond first-generation input substitution. Replacing a synthetic pesticide with a biological one, without restructuring the governance and supply chain conditions that effect external input dependency, shifts the source of dependency without building community agroecological capacity. The BRC model, therefore, integrates four coequal functions: (i) community-scale biological input production, (ii) enterprise development for women's collectives and rural youth, (iii) soil health monitoring and farmer education, and (iv) institutional infrastructure for Participatory Guarantee System (PGS) organic certification (Down to Earth, 28 April 2025). In doing so, it embodies the multifaceted character of mature agroecological systems (Gliessman, 2015) rather than the single-objective logic of input-market replacement.

## **3. Intervention Design and Operational Profile**

A pilot BRC was established at the DDS-KVK (Deccan Development Society-Krishi Vignan Kendra) research and training farm science centre in Zaheerabad, with support from the SCALAGRO project. The facility operates four open-vessel fermentation tanks, each with a 5,000-litre capacity, yielding a theoretical annual production volume of approximately 96,000 litres under full utilisation over eight to twelve months. Modular design enables replication at the village level in units of 200 to 1,000 litres, using locally available materials and infrastructure. Table 1 documents the full biological input portfolio produced at the facility.

Input Category	Biological Agent(s)	Primary Agronomic Function
Biofertiliser -N Fixation	<i>Rhizobium spp.</i> , <i>Azospirillum brasilense</i>	Biological nitrogen fixation in legume root nodules and the rhizosphere reduces inorganic nitrogen requirement by 25-40% in compatible crops.
Biofertiliser -Phosphorus	<i>Phosphate-Solubilising Bacteria (PSB)</i>	Solubilisation of soil-bound inorganic phosphates, improving phosphorus bioavailability without diammonium phosphate application
Biofertiliser - Micronutrients	<i>Potassium-Solubilising Bacteria (KSB)</i> ; <i>Zinc-Solubilising Bacteria (ZSB)</i>	Mobilisation of soil-fixed potassium and zinc; addresses micronutrient deficiencies associated with long-term monoculture systems
Dual-Function Biofertiliser	<i>Trichoderma harzianum</i>	Root colonisation promoting plant growth; antagonism against soil-borne pathogens, including <i>Fusarium</i> and <i>Pythium spp.</i>
Biopesticide-Fungal	<i>Beauveria bassiana</i> , <i>Metarhizium anisopliae</i>	Contact infection of sucking and chewing arthropod pests via spore germination reduces the need for spraying compared with synthetic insecticides.
Biopesticide -Bacterial	<i>Bacillus thuringiensis (Bt) var. kurstaki</i>	Lepidopteran larval control through delta-endotoxin ingestion; highly target-specific with no documented non-target ecological harm
Biopesticide -Antibiotic	<i>Pseudomonas fluorescens</i>	Induction of systemic plant resistance; suppression of bacterial and fungal foliar pathogens through antibiotic and competitive exclusion mechanisms

Table 1. Biological input portfolio of the DDS-KVK BRC with primary agronomic functions.

Training throughput has exceeded 150 individuals, including Farmer Producer Organisation (FPO) members, women's collective leaders, and prospective rural entrepreneurs. During the Rabi season pilot, twenty households received fifty litres each for application on jowar (*Sorghum bicolor*) and maize (*Zea mays*), reporting reduced incidence of stem-boring pests attributed to *Metarhizium anisopliae* and improved soil moisture retention associated with *Trichoderma*-mediated organic matter decomposition.

**Key Finding - Ecological Benefits of Bio-Input Use (BRC-Supported Systems)** The adoption of bio-inputs produced through BRCs contributes to a measurable reduction in synthetic fertiliser and pesticide use, addressing a key driver of soil degradation in smallholder systems. Field-level observations from the SCALAGRO pilot indicate partial to complete substitution of chemical fertilisers (DAP, urea, NPK) with microbial consortia such as *Rhizobium*, *Azospirillum*, and phosphate-solubilising bacteria, alongside the elimination or significant reduction of chemical pesticide and fungicide applications. This transition supports the restoration of soil biological functions, including enhanced microbial activity, improved nutrient cycling, and increased organic matter decomposition. Farmers also reported early agronomic effects such as reduced pest incidence and improved soil moisture retention, particularly in plots treated with *Trichoderma* and entomopathogenic fungi. While long-term soil health impacts require systematic monitoring, the observed reduction in chemical input dependence represents a critical first step toward rebuilding soil ecological resilience and enabling sustainable agroecosystem functioning.

## 4. Cost-Benefit Analysis

### 4.1 Input Cost Comparison: Conventional vs Natural Farming

Table 2 presents a season-level comparison of agricultural input expenditure under conventional chemical-intensive farming versus bio-input-based natural farming on a representative six-acre smallholding in the study region, based on field-validated cost data from writeshop deliberations (DDS-KVK, February 2026).

Input Item	Conventional Farming (₹)	Natural Farming (₹)
Diammonium Phosphate - 4 bags @ ₹ 1,500	6,000	300 (replaced by PSB + ZSB)
Urea - 3 bags @ ₹ 350	1,050	300 (replaced by Azospirillum + Rhizobium)
NPK fertiliser (drip-applied)	2,400	300 (replaced by NPK Consortium bio-input)
Chemical pesticide -3 sprays @ ₹ 800	2,400	0
Fungicide - 2 sprays @ ₹ 600	1,200	0
Bio-input procurement (50 L x 2 seasons @ ₹ 40/L)	0	4,000
Jeevamrutam preparation (labour only; substrates near zero-cost)	0	800
Botanical deterrents (neem-based, home-prepared)	0	400
<b>TOTAL INPUT COST PER SEASON (6 acres)</b>	<b>13,050</b>	<b>6,100</b>
Input cost per acre	2,175	1017
Estimated savings per season	-	₹ 6950 (<50% reduction)

Table 2. Seasonal input cost comparison: conventional vs natural farming, six-acre smallholding, study region, 2025-2026.

### 4.2 BRC Enterprise Viability Model

Table 3 presents a simplified enterprise viability analysis for a village-cluster BRC operating at a monthly production capacity of 1,000 litres, under conservative and optimistic market scenarios.

Parameter	Conservative Scenario (₹)	Optimistic Scenario (₹)
Monthly production volume (litres)	800	1,200
Average sale price per litre	35	45
Monthly gross revenue	28,000	54,000
Raw material costs (substrates, cultures)	6,000	9,000
Labour - 2 part-time operators	5,000	7,000
Packaging and local transport	2,000	3,500
<b>TOTAL MONTHLY OPERATING COST</b>	<b>13,000</b>	<b>19,500</b>
<b>MONTHLY NET SURPLUS</b>	<b>15,000</b>	<b>34,500</b>
<b>ANNUAL NET SURPLUS (8-month operating season)</b>	<b>1,20,000</b>	<b>2,76,000</b>
Capital recovery period (infrastructure ₹ 1.2 lakh)	~1 season	< 1 season

Table 3. BRC enterprise viability: monthly and annual projections for a 1,000-litre capacity village-cluster unit.

### Key Finding - BRC Cost-Benefit

Bio-input-based natural farming reduces seasonal input expenditure by an estimated 60% on a six-acre smallholding (₹ 13,050 reduced to ₹ 6,100 per season). At the NGO/collective level, BRCs are not purely commercial enterprises; they are designed primarily to serve farmer needs and enable an agroecological transition. Operational break-even can be achieved within the first year, assuming consistent demand and utilisation. Capital investment (₹ 3-5 lakh) is typically recovered over a longer horizon (~2 years) under conservative sales scenarios. Sustained viability depends not only on production and sales but also on strong extension support and farmer engagement, which are critical for demand generation and continued adoption.

## 5. Constraints, Risks, and Mitigation

Three interrelated risk categories were identified during the writeshop discussions. Microbiological contamination of production batches during open-vessel fermentation represents the primary technical risk: competitive exclusion of target organisms by environmental microbes can reduce product efficacy and erode farmer trust. Mitigation requires standardised substrate sterilisation protocols, routine quality checks using culture-based or colorimetric methods accessible at the village level, and a transition toward semi-closed fermentation-vessel designs. Demand aggregation risk threatens enterprise viability if seasonal crop failures or market disruptions reduce farmer offtake; pre-season collective procurement agreements facilitated through Sangam/women networks and product portfolio diversification to include off-season horticultural and nursery applications can reduce this exposure. The absence of Minimum Support Price (MSP) coverage for organically certified produce constitutes a structural policy risk that constrains farmers' willingness to invest in input transition costs and requires advocacy at the state-government level, independent of the project's operational mandate.

## 6. Expected Impact and Scale-Up

At full scale across approximately 47 villages identified by DDS and KVK for BRC expansion, a network of community units at 200-1,000 litre capacity is projected to supply biological inputs to 3,000-5,000 smallholder households, covering an estimated 9,000-15,000 cultivated acres. Longitudinal monitoring of soil organic carbon, microbial biomass carbon, and available phosphorus across adopting farms will provide the biophysical evidence base required to document transition progress and substantiate the long-term productivity case for agroecological systems. Women's collective management of BRCs generates leadership and entrepreneurial capacity with cumulative effects on gender equity in rural economic governance that extend well beyond the direct financial returns of the enterprise.

*"At the established BRC at DDS-KVK under SCALAGRO, the first batch was used for jowar and maize during the Rabi season. Results were very positive, especially since youth farmers are very much interested and coming forward. It is good for soil, participation is increasing, and unemployed youth can benefit." - Dr N. Snehalatha, Plant Protection Scientist, KVK Zaheerabad, Writeshop proceedings, February 2026*

**Agroecological Principles Addressed** Recycling • Input Reduction • Soil Health • Economic Diversification • Connectivity • Co-Creation of Knowledge

## 7. Recommendations

1. Conduct systematic village and Sangam/Women collectives mapping within 10-kilometre clusters across the ~47 identified villages and establish BRC units before the Kharif 2026 season.
2. Register all transitioning farmers with the CSA-supported PGS certification system during the current season and develop at least one non-chemical farming demonstration village per mandal.
3. Train a minimum of one to two technically proficient resource persons per village cluster in microbial production, quality assurance, and agronomic application protocols.
4. Develop pre-season collective procurement agreements through Sangam networks to guarantee minimum product offtake and BRC financial viability.
5. Advocate through appropriate policy channels for MSP coverage for organically certified millets in Telangana, replicating the Odisha Millet Mission policy architecture.

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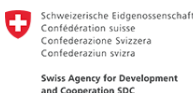
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## About the SCALAGRO Project

SCALAGRO (Scaling Agroecology) is a collaborative international research project operating across India, Bolivia, and Burkina Faso. In India, the project is implemented in partnership with the Centre for Sustainable Agriculture (CSA). Phase 1 focused on baseline qualitative research to understand existing agroecological knowledge systems and the structural conditions shaping transitions.

If you would like more information <https://www.graduateinstitute.ch/scalagro>



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