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ANNUAL REPORT
2024 - 2025

M S Swaminathan
Research Foundation
SCIENCE FOR SUSTAINABLE DEVELOPMENT

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FOREWORD BY CHAIRPERSON

Participatory Science for Sustainability: Building Resilient Communities

The Foundation's journey over the past year exemplifies our unwavering commitment to translating science into sustainable solutions for India's farmers, tribal and coastal communities. Through targeted interventions across coastal ecosystems, biodiversity hotspots, and agricultural landscapes, our work has reached more than 400,000 individuals—small farmers, fishers, tribal families, and rural women—by improving livelihoods and strengthening resilience against climate change.

Our efforts continue to bridge the gap between scientific innovation and grassroots implementation, ensuring that research translates into tangible benefits for marginalised communities. This year, we finalised our 5-year Strategic Plan, which provides a more holistic framework to strengthen and amplify our health and climate lens across our legacy programme areas. This direction positions MSSRF as a vital catalyst, harnessing the power of interdisciplinary and participatory science, and deepening partnerships with both government and our other stakeholders, to address contemporary challenges in ways that provide economic benefits while ensuring equity and ecological sustainability.

Coastal Conservation and Marine Restoration

The Coastal Resources and Fisheries programme achieved significant milestones in ecological restoration and marine conservation. Large-

scale coastal clean-up initiatives mobilised nearly 1,800 fisher volunteers, who together removed 40 tonnes of marine debris, including 15 tonnes of ghost gear, across 303 hectares—a four-fold increase from earlier efforts. These results highlight the power of grassroots ownership in marine conservation.

Our successful pilot seagrass restoration in Pulicat Lake marks an important step in blue carbon conservation. Digital transformation has also strengthened coastal communication systems. The Fisher Friend Mobile Application now has nearly 110,000 users—a major increase from previous years—and incorporates new features such as ghost gear location marking. The newly launched *FisherWomenConnect* app has reached 1,550 fisherwomen, many of whom are now running small businesses thanks to access to real-time weather information, marketing tools, and other practical digital resources.

Our Microsoft-funded Geo-AI Blue Carbon initiative applied artificial intelligence to marine ecosystem mapping, using drone imaging and machine learning to map seagrass, mangroves, and tidal marshes along the Tamil Nadu coast. This innovative project highlights our commitment to leveraging advanced technologies for conservation.

International recognition came through UNESCO's selection of our Tsunami resilience case study for the "Resilience and Remembrance" event in France, underscoring the global relevance of our community-centred approaches to disaster preparedness.

Biodiversity Conservation and Agroecological Innovation

Our biodiversity initiatives have created integrated models that combine conservation, agroecology, and livelihood development. In Kolli Hills, agroforestry interventions across 500 farms improved soil fertility and crop diversification, while women-led nurseries strengthened local economies. The JIVA agroecology programme transformed farming practices with botanical inputs, intercropping, and livestock integration, leading to higher yields, healthier soils, and lower input costs.

In Odisha, the Tribal Agrobiodiversity Centre advanced indigenous seed conservation through molecular profiling of finger millet and large-scale seed production led by women's groups and youth. This effort boosted yields and food security. The documentation of all Community Seed Banks nationwide, mapped with FNI Norway, is a milestone for farmer-managed seed systems, particularly for women farmers, and for preserving agricultural biodiversity.

In Wayanad, the Community Agrobiodiversity Centre made remarkable progress conserving endemic species through the M.S. Swaminathan Biodiversity Park, ex-situ orchid conservation, and agroforestry models. An assessment of sacred groves established many years ago showed a >85% survival rate, with many endemic and threatened species conserved. A unique conservation stewardship programme designed for tribal youth was designed and the first 11 students have completed their training and will receive a diploma from the Transdisciplinary University.

Agricultural Innovation and Climate Resilience

Our agricultural research yielded new insights into salinity stress in mangrove, rice, and millet species, identifying sodium transporters and root adaptations. Microbiome research profiled microbial communities in rice varieties, isolating key plant growth-promoting rhizobacteria. Methylorubrum strains showed strong potential for drought resilience and methane emission reduction, paving the way for climate-smart agriculture.

The facilitation of the development of 3,135 GIS-based Gram Panchayat Development

Plans (GPDPs) for water security and climate adaptation across 10 districts in five states has transformed rural planning. Training more than 2,000 district functionaries and integrating tools with MGNREGS through mobile applications improved implementation. Demonstrations of 25 climate-resilient measures across ecosystems provided practical solutions for both public land and agriculture.

Our regenerative agriculture initiatives reached more than 20,000 farmers across Gujarat, Maharashtra, Odisha, Assam, Tamil Nadu, and Puducherry through bio-input resource centres and customised advisories. Plant Clinics and digital tools supported pest and disease management for over 40,000 farmers, reducing costs and improving yields.

Nutrition and Health Advancement

The Agriculture, Nutrition, and Health programme strengthened food security and sustainable farming among tribal and smallholder communities. Increased productivity of rice, millets, pulses, and maize—combined with mechanisation and strong market linkages through Farmer Producer Companies—enhanced both household incomes and nutrition security.

In Odisha, our initiatives supported nutrition gardens in more than 200 households, 39 Anganwadi Centres, and 7 tribal residential schools, while training 245 women in mushroom cultivation. Nutrition-sensitive agriculture with 875 farmers improved dietary diversity. A four-year initiative in Koraput District supported 2,000 tribal households with larger, more

diverse gardens that reduced dependency on markets and improved year-round food availability.

Our landmark study on gender and heat stress surveyed over 3,300 women in seven states, revealing how extreme heat disproportionately affects women in informal work, poor housing, and low-income groups. The report recommends urgent, gender-responsive reforms in health systems, infrastructure, and policy, including workplace protections, mental health integration, and inclusive communication strategies.

Climate Policy and Technology Integration

The MSSRF climate team contributed to international policy debates, developing alternative frameworks for global mitigation pathways that prioritise energy access and climate equity. Our collaboration with NIAS Bengaluru advanced new modelling approaches that challenge conventional IPCC methodologies, ensuring Global South perspectives are represented. The Climate Equity Monitor platform remains a leading evidence tool, attracting about 2,000 new users across 78 countries this year.

Educational Outreach and Capacity Building

Our *Every Child A Scientist* (ECAS) programme expanded to five sites -Chennai, Pudukkottai, Pichavaram, Poompuhar, and Kolli Hills. The programme nurtures scientific curiosity among underserved students through digital learning, hands-on experiments, and life skills education. More than 100 Irular students, a historically marginalised tribal community, have now been enrolled, which is a particularly encouraging development.

Digital Communications Transformation

This year marked a turning point in our communications capacity. We built a four-member digital communications team specialising in multimedia content and social media strategy. With this foundation, we are reaching new audiences with stronger, more engaging content.

The relaunch of our website in May 2025 positioned MSSRF as a hub for critical research and knowledge, bridging scientific evidence with public communication. We are also expanding our social media presence through dynamic campaigns that share knowledge and amplify the impact of our fieldwork. Our goal is to inform and influence policymakers, researchers, journalists, and global communities alike.

Onward and What's Ahead

As climate change disproportionately affects rural, tribal, and marginalised communities, MSSRF's mission has never been more vital. By combining ecological restoration, digital innovation, policy research, and community empowerment, we are building a robust foundation for scaling sustainable development interventions.

Our ability to work across diverse ecosystems—from mangroves and marine environments to drylands and biodiversity hotspots—while nurturing strong community partnerships, uniquely positions MSSRF to address interconnected challenges of climate change, food and nutrition security, and social inclusion.

I extend my heartfelt gratitude to our donors, partners, trustees, scientists, development professionals, and the MSSRF team whose collaborative spirit makes this transformative work possible. Together, we remain committed to building resilient and sustainable futures for India's most vulnerable communities through the power of interdisciplinary and participatory science.

Soumya Swaminathan

Dr. Soumya Swaminathan
Chairperson, M.S. Swaminathan Research Foundation


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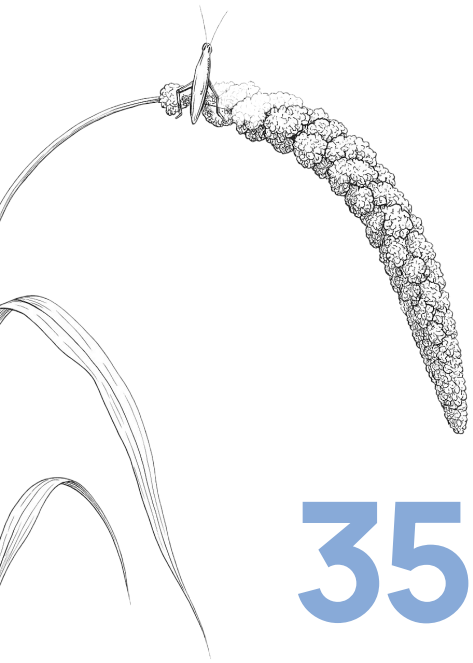


4,00,000

Farmers and Fishers reached

35 new projects were initiated, and the implementation of the previous **78** projects continued

8

National and state-level government and research institutions partnership initiated

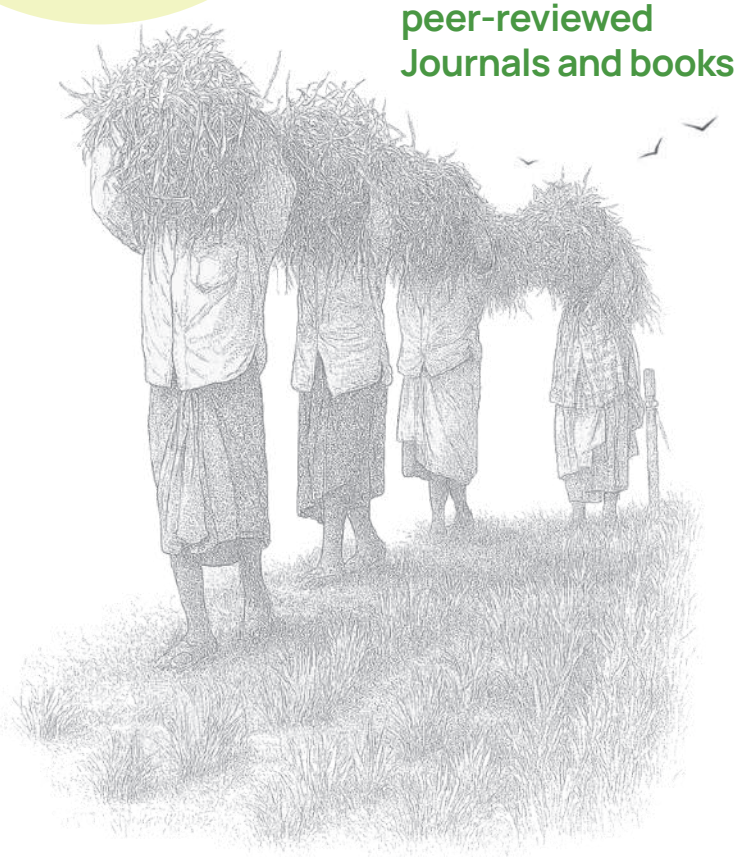
IMPACT METRICS

Two

Expanded the geographical areas to two states; Arunachal Pradesh and Maharashtra

38

Research articles published in peer-reviewed Journals and books



PA100

COASTAL RESOURCES AND FISHERIES

3,21,629

Mangrove saplings planted over **70 hectares**, engaging more than **300 coastal community members** in the process.

1.1 lakh

Mangrove saplings were raised with the active participation of **213 fishers,** including **187 women**

Tools for Seagrass mapping

Applied **GeoAI and Machine Learning** (RF, XGBoost) on high-resolution SkySat data for high-accuracy seagrass mapping has been developed

Preserving coastlines, sustaining life

Restoration of Seagrass

The protocols of Seagrass restoration were finalised. For scaling up, three potential sites for seagrass restoration were mapped using ecological and environmental indicators. Four different species of Halophila seagrass and three aquatic macrophyte species were identified

Marine debris removal from Bay of Bengal

1,745 fishers involved
40+ tonnes of debris removed, including
15 tonnes of ghost gear
25 tonnes of other debris

30 women fishers/groups enabled to produce quality dry fish using solar dryers

12 women SHGs initiated seabass nursery. Integrated Multi-Trophic Aquaculture and integrated mangrove fishery farming.

6,037 women

Access to digital skills: 6,037 women gained new knowledge and skills on digital tools for learning. Seventeen digital learning modules on post-harvest fisheries management were developed, and 1,045 women started using UPI-based transactions in marketing and 982 fisherwomen used emails for market communications.

Co-management committees in fish resource management

Developed four village based plans for effective fisheries resource management involving fishers and the government

Ecological restoration

Restored 50 ha of Muthupet Mangrove forest by desilting canals and strengthening bunds to regulate natural water flow, which is crucial for the health of Mangrove trees.

16 Health and safety awareness sessions were conducted with **392 participants**

150 Irular Tribal men and women received protective gumboots to avoid occupational health hazards during backwater fishing

Awareness creation on ghost gear prevention

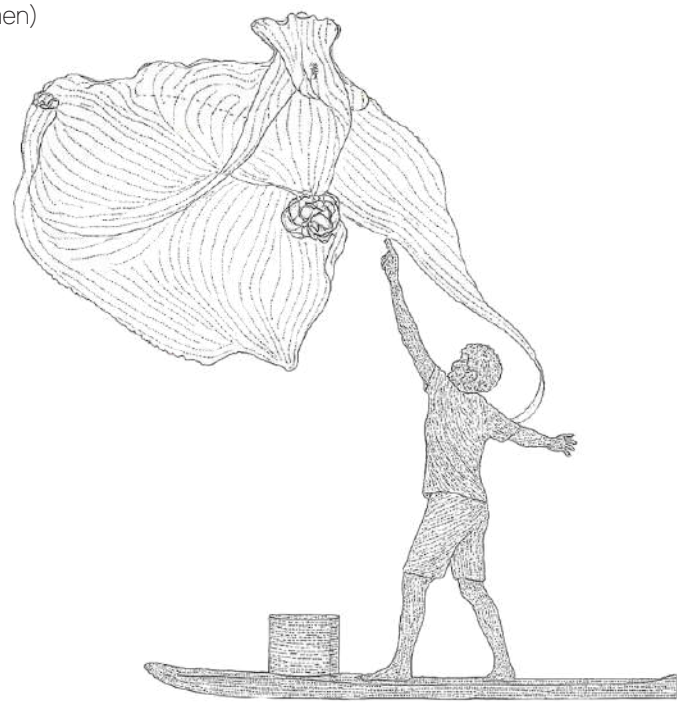
1,303 fishers from 16 villages
837 students, and
151 other stakeholders
93 women trained on repurposing ghost gear.

Strengthening the on-farm livelihoods

35 women farmers who closely interact with the mangrove forest in Muthupet Mangroves. Initiated restoration of integrated Pokkali Rice–Shrimp Farming among 27 farmers in Kerala.

11,536 fishers

Capacity building and access to information: 11,536 fishers (47% women) trained and 2,253 fishers accessed information (49% women)



COASTAL RESOURCES AND FISHERIES

In 2024 - 2025, the programme advanced resilience, digital inclusion, and ecological restoration through various projects. A seagrass restoration pilot was launched in Pulicat Lake using GeoAI-enabled SkySat mapping. Over 1,745 fisher volunteers removed 40 tonnes of marine debris, including 15 tonnes of ghost gear, across 303 hectares. The Fisher Friend Mobile App saw 2,779 new users bringing the overall count to 1,06,556 users with ghost gear tracking, while "FisherWomenConnect" reached 1,550 downloads. The GeoAI Blue Carbon Project was launched along the Tamil Nadu coast. A case study on tsunami survivors was showcased at the UNESCO Tsunami Memorial Corridor, marking 20 years since the 2004 Indian Ocean Tsunami.

The Coastal Resources and Fisheries Programme made notable strides in 2024–2025, advancing ecological restoration, livelihood security, and digital transformation in coastal communities. As part of its activities, 3.6 lakh mangrove saplings were planted, and 11 lakh saplings were ready in the nursery for planting. The seagrass restoration efforts in Pulicat Lake were also continued. In addition, large-scale coastal and offshore clean-up drives were conducted with 1,745 fisher-volunteers, collecting 40 tonnes of marine debris (including 15 tonnes of ghost gear, which is lost or abandoned fishing gear) over an area of 303 hectares. The user base of Fisher Friend Mobile Application has been expanded to 1,06,551 individuals, along with the addition of the new ghost gear location marking feature. Besides this, another mobile app, "FisherWomenConnect", targeting fisherwomen was recently launched. The app was downloaded by 1,550 individuals and provides real-time weather information, market trends, and digital marketing support to them. A policy brief on fisherwomen's contributions and advocacy for equitable resource access was developed and released. A new strategic action plan 2030 for the programme was developed. It reiterated the comprehensive framework of integrating coastal and fisheries interventions and linking the eco-restoration of coastal resources and livelihood security of dependent communities. The fifteenth annual day of the Fish for all Research and Training Centre (FRTC) was

commemorated, marking a decade and a half of transformative work with coastal communities, and several new initiatives were also launched. like the applied Geospatial Artificial Intelligence (Geo AI) and machine learning (RF, XGBoost) on high-resolution SkySat data for seagrass mapping with high classification accuracy. In addition, mangrove cover change from 1990 to 2023 was analysed using Landsat imagery and shoreline dynamics using DSAS and ArcGIS were monitored.

Strategic plan for Coastal Resources and Fisheries Programme 2025–2030

The Coastal Resources and Fisheries Programme developed a five-year strategic plan for 2025 to 2030, with a target to empower 2,00,000 coastal households from 60 districts across India. The plan broadens the existing themes with the addition of enhancing coastal resilience and conservation of marine ecosystems. The core areas include restoring vital coastal habitats (mangrove forests, seagrasses, coastal salt marshes, coral reefs, etc.) and securing livelihoods by tackling issues like overfishing, habitat loss, and climate impact. This is achieved through ecosystem conservation and restoration, improved marine and coastal fisheries, and innovative seawater farming techniques. Targeting small-scale fishers, fish farmers and coastal tribal communities, the programme area's Strategic Plan 2030 promotes climate adaptation, biodiversity conservation, poverty reduction, livelihoods, and food security.

101. COASTAL RESOURCE RESTORATION AND MANAGEMENT

101.1 MANGROVE AND NON-MANGROVE COASTAL BIOSHIELDS

Mangrove plantation and management

Significant progress was made in mangrove plantations across Tamil Nadu and Andhra Pradesh, enhancing ecological resilience and community participation. Over 3.21 lakh mangrove saplings and propagules, including *Avicennia marina* and *Rhizophora* spp., were planted at key sites such as Muthupet, Kovalam, Gadilam, and Pichavaram (Tamil Nadu; TN), Pulicat Lake and Uppeteru Estuary (Andhra Pradesh; AP) in 70 hectares. In Muthupet, 1.5 lakh saplings and seeds were planted along desilted canals, with 35% mortality due to tidal water stagnation. In Kovalam replantation was done after floods, achieving a 50% survival rate aided by 1.25 km of protective fencing. In Uppeteru, 29,500 *Rhizophora* species were planted, with a 60% survival rate, while Pulicat Lake achieved an 80% survival rate among 50,000 propagules. The Gadilam Estuary received 35,000 saplings near Kudikadu village, and Pichavaram's Integrated Mangrove Fishery System added 7,129 saplings over 6 hectares (Table 1). Over 300 community members participated in planting activities, and replantation was done in the areas of tidal depression. The awareness events held on World Wetlands Day and International Mangrove Day bolstered public engagement.

Table 1: Mangrove plantation across sites

Site	Species	Number of seedlings planted	Area covered (ha)
Muthupet, TN	*A. marina*	1,50,000	50
Kovalam, TN	*Rhizophora* spp.	50,000	3
Gadilum Estuary, TN	*Rhizophora* spp. *A. marina*	35.000	2
Chinnagollapalem near Uppeteru Estuary, Krishna, AP	*Rhizophora* spp.	29,500	3
Pichavaram, TN	*Rhizophora* spp.	7,129	6
Pulicat Lake, AP	*Rhizophora* spp.	50,000	4
	Total	**3,21,629**	**70**

Mangrove nursery and management

Extensive nursery development was carried out to support the restoration drive, and over 1.1 lakh mangrove saplings were raised in nurseries across Tamil Nadu, Andhra Pradesh, and Kerala. At Muthupet, a mangrove nursery was established in November 2024, where 40,000 *A. marina* seeds collected from 15-year-old trees in Maravakadu Reserve Forest were planted in 5x7-inch biodegradable polybags. These nurseries were shielded with HDPE nets (reducing sunlight by 50%) and irrigated regularly. Casualties were replaced by January 2025 to ensure high survival rates. The nursery was managed by 213 community members (187 women and 26 men) . In Kerala, 10,000 saplings were raised in Malipuram and monitored for three months before being transplanted to the site. In Chinnagollapalem (Krishna district, Andhra Pradesh), 20,000 *Rhizophora* saplings were raised for future replantation.

The excavation of canals over 50 hectares was completed in Muthupet during October 2024, enabling better tidal water flow during summer. Further, desilting of canals dug planned in the previous year was completed in February and March (2025) to mitigate water stagnation and support sapling survival. These actions enhanced ecological conditions for sapling establishment and deepened community engagement, particularly empowering women through their sustained participation in nursery operations and plantation drives.

Table 2: Raising mangrove nurseries

Site	Species	Total Nursery Raised
Muthupet, TN	*A. marina*	40,000
Chinnagollapalem near Uppeteru Estuary, Krishna, AP	*Rhizophora* spp.	20,000
Vypin (Malipuram), Kerala	*Rhizophora* spp.	10,000

Non-mangrove bioshield : Chinnagollapalem in Krishna District, Andhra Pradesh

The non-mangrove bioshield established in previous years (2022–2023 and 2023–2024) was maintained during the reporting year with post-care and replanting. The *Casuarina* saplings planted during 2022–2023 attained a 7-metre height, while those planted in 2023–2024 attained a 3-metre height. About 11,300 dead saplings of *Casuarina* sp. were replaced in the 2023–2024 plantation drive, and 22,200 *Casuarina* saplings were planted in October 2024.

Restoration of Seagrass in Pulicat Lake: During this year, a comprehensive survey was carried out to map the status of seagrasses in Pulicat Lake, to identify suitable sites for restoration and to map healthy seagrass beds - an important blue carbon ecosystem. Two sites with robust, healthy seagrass beds, ideal for collecting planting materials and one site with sparse seagrass cover, suitable for restoration, were identified. Restoration site selection was based on the assessment of ecological and environmental parameters, including the degree of human disturbance, water depth, sunlight penetration, and water movement, all factors playing a crucial role in the survival and growth of seagrasses. Data on species diversity, water salinity and pH, water depth, and spatial coverage were collected. The occurrence of seagrass species, namely *Halophila ovalis, Halophila beccarii, Halodule pinifolia*, and *Halodule uninervis* were recorded. Other aquatic macrophytes, such as *Ruppia maritima, Najas marina,* and *Najas minor,* were also observed. The water quality parameters revealed salinity values ranging between 17.8 and 27 ppt, pH from 7.5 to 8, and water depths from 0.7 to 9.5 meters. These parameters suggest a moderately brackish environment with good light penetration and varied depth gradients that are suitable for seagrass restoration.

101.2 ALTERNATE LIVELIHOOD INITIATIVES FOR THE MANGROVE-DEPENDENT COMMUNITIES IN MUTHUPETTAI MANGROVE FOREST

Fifty women were selected for allied livelihood activities from Veerankoil and Thamarankottai South in Thanjavur District, Tamil Nadu; of which, 35 women received support to purchase goats, 11 women were supported for country chick rearing, and four women received support for broom production from coconut fronds.

102. GEOGRAPHICAL INFORMATION SYSTEM AND REMOTE SENSING

102.1 BLUE CARBON ASSESSMENT: GEOSPATIAL ARTIFICIAL INTELLIGENCE

The Blue Carbon ecosystems, namely mangroves, seagrass meadows, and tidal marshes, are vital natural carbon sinks, storing carbon for millennia and supporting climate resilience and biodiversity. In Tamil Nadu, the Gulf of Mannar and Palk Bay host extensive blue carbon habitats like seagrass, yet data on their extent and health are not available for planning. The project is planned for three years with a focus on mapping and quantifying these ecosystems using advanced tools such as drone-based multispectral imaging, Light Detection and Ranging (LiDAR) and GeoAI.

An official consultation was conducted with the Department of Environment, Forest and Climate Change, Government of Tamil Nadu to discuss project objectives, scope, and expected outcomes, ensuring alignment with departmental priorities, environmental regulations, and policy frameworks, and facilitating administrative approvals for smooth project execution. The Drone Research and Development Facility at Vellore Institute of Technology (VIT), Chennai, was consulted to assess the relevance of Unmanned Aerial Systems (UAS) for project-specific applications, evaluate drone operational capabilities, sensor payload compatibility, and geospatial data acquisition efficiency. Also, potential collaboration was explored with VIT for drone equipment supply, customisation, and maintenance to support monitoring, mapping, and data collection.

Seagrass ecosystem assessment and blue carbon estimation

A reconnaissance survey was conducted along the Mandapam coast, Tamil Nadu, to assess the seagrass ecosystem, recorded in-situ measurements of water quality parameters and sediment samples to estimate organic carbon content. The survey aimed to delineate the spatial extent of seagrass meadows, estimating biomass, and quantifying total carbon stock in the Kattumavadi and Manalmelkudi regions of North Palk Bay using a hybrid methodology that combines field-based sampling with high-resolution Planet Scope satellite imagery and machine learning algorithms, such as Random Forest regression and classification techniques.

GeoAI-based Seagrass Mapping

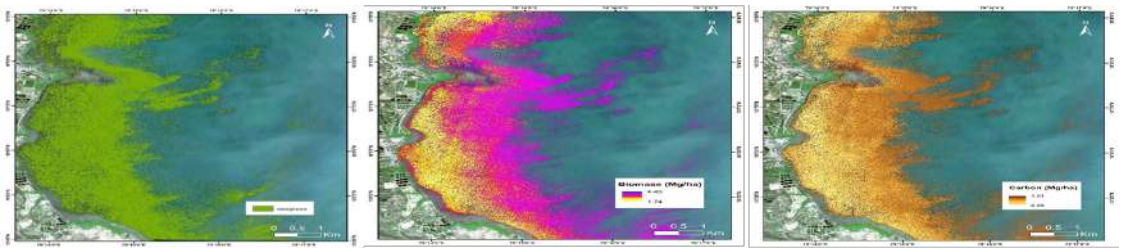


Figure 1: Mapping of the seagrass ecosystem with the GeoAI tool

To further strengthen seagrass monitoring, a GeoAI-driven comparative analysis was conducted using high-resolution SkySat imagery (0.5 m spatial resolution) in the Palk Bay region (Fig. 4). Multiple machine learning (ML) algorithms including Random Forest (RF), Logistic Regression (LR), Support Vector Machine (SVM), Gradient Boosting (GB), Extreme Gradient Boosting (XGBoost), and a Stacked Ensemble Model were evaluated for their classification accuracy (Fig. 2). Performance was assessed using standard metrics, with Random Forest and XGBoost classifiers outperforming others in terms of precision and consistency in mapping seagrass habitats.

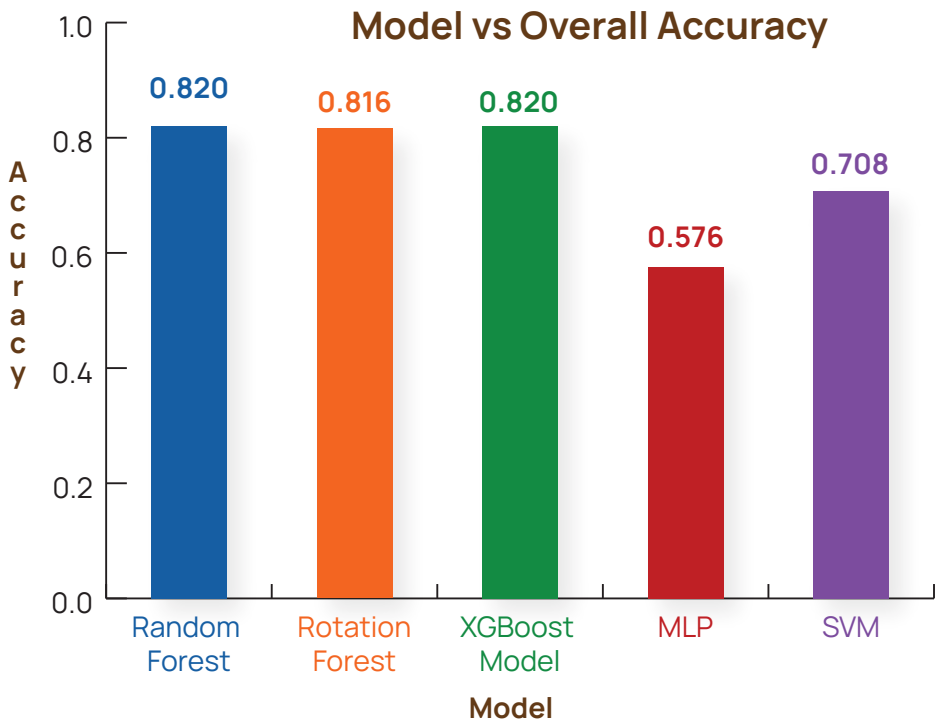


Figure 2: Comparison of GeoAI models for Mapping of Seagrass Ecosystem

102.2 MANGROVE ATLAS: MAPPING, MONITORING, AND SPECIES ZONATION IN KRISHNA AND GODAVARI REGIONS

A comprehensive assessment of mangrove forests was carried out in the Krishna and Godavari delta regions of Andhra Pradesh using remote sensing and machine learning techniques, which included mangrove forest cover analysis (Fig. 3), change detection mapping, land use and land cover (LULC) classification, and species-wise zonation. The study analysed decadal changes in mangrove cover from 1990-2023 using Landsat satellite imagery, revealing spatial and temporal trends in forest loss and regeneration. High-resolution LISS IV satellite data (five-meter spatial resolution) were used for species-level classification, identifying three dominant species in the Krishna mangrove ecosystem *Avicennia sp., Rhizophora sp.,* and *Excoecaria agallocha*, and five species in the Godavari mangrove ecosystem such as *Avicennia marina, Avicennia officinalis, Excoecaria agallocha, Rhizophora sp.,* and *Aegiceras corniculatum*. Furthermore, the shoreline dynamics for the Krishna and Godavari coastal regions were analysed using the Digital Shoreline Analysis System integrated with ArcGIS for the years 1990, 2000, 2010, and data on coastal erosion and accretion patterns, to support coastal zone management and mangrove protection planning.

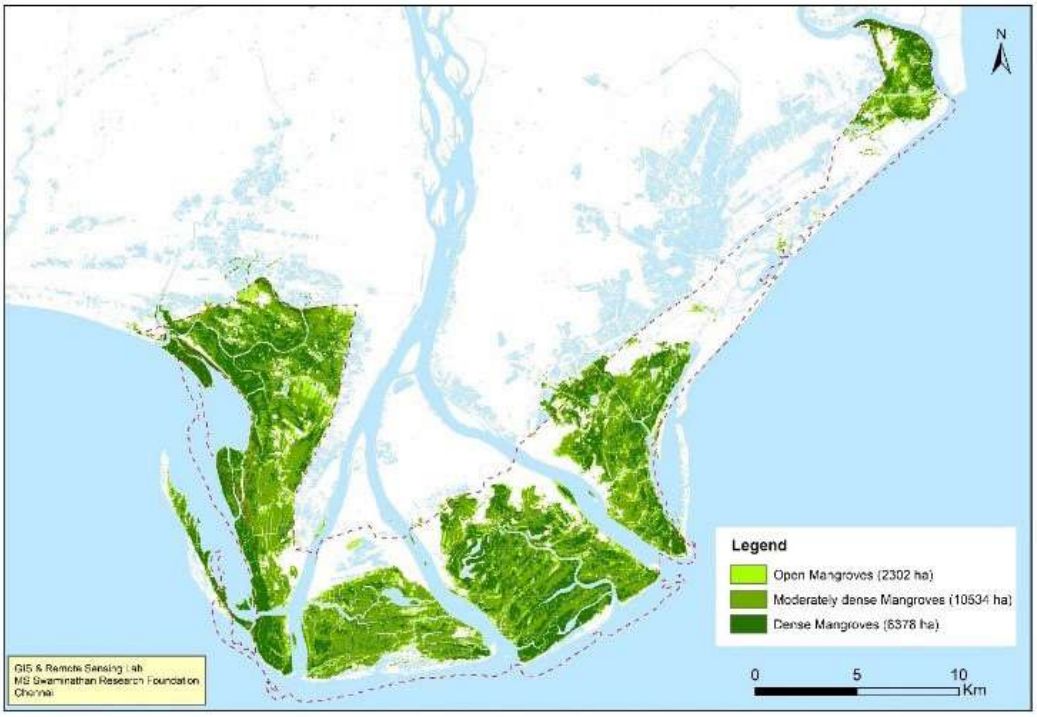


Figure 3: Mangrove Cover in Krishna Wetland, Andhra Pradesh

102.3 INTERNSHIP PROGRAMMES: GIS, REMOTE SENSING, AND ARTIFICIAL INTELLIGENCE (2024–2025)

A structured internship programme on GIS, AS, and AI was conducted during 2024–2025 to build technical capacity among students from leading academic institutions. The programme offered hands-on training in geospatial data processing, satellite image interpretation, and AI-based classification techniques using real-world environmental datasets. A total of 24 students from different institutions participated. The curriculum combined classroom instruction with software training in tools like QGIS, Google Earth Engine, and Python for AI, along with field exposure to drone-based data acquisition and wetland mapping. The interns actively contributed to projects on seagrass mapping, wetland catchment delineation, and blue carbon monitoring, gaining practical experience in climate-resilient ecosystem management.

103. MARINE AND COASTAL FISHERIES MANAGEMENT

103.1 STRENGTHENING COMMUNITY CAPACITY ON FISHERIES CO-MANAGEMENT

Two villages in Mayiladuthurai district, Tamil Nadu, were selected, and Village Level Co-Management Committees (VLCMCs) were formed in each village to facilitate the effective co-management process of fisheries resources. An orientation-cum training program was conducted to strengthen the understanding of co-management principles, governance, and decision-making processes among VLCMC members. Comprehensive situation assessment,

livelihood analyses, and stakeholder mapping were conducted in Vanagiri and Madathukuppam villages through participatory methods, including focus group discussions and structured interviews. This process provided a clear understanding of the socio-economic conditions, existing fisheries practices, and stakeholder roles to guide the inclusive formation of co-management committees. Initiatives are underway to develop village-specific co-management plans, which were implemented in collaboration with all community and government stakeholders. Based on the needs identified, targeted training programmes, such as diesel engine maintenance and the use of Global Positioning System (GPS), were conducted for fishermen to enhance technical capacities. The core livelihood intervention focused on income generation for women through the distribution of 30 solar dryers to support hygienic dry fish production; this direct livelihood support motivated their active and sustained participation in fisheries co-management processes.

103.2 MINIMISING THE IMPACT OF GHOST GEARS IN THE GULF OF MANNAR AND PALK BAY

In a significant stride toward removing marine debris and conserving coastal fisheries and marine biodiversity, a large-scale, community driven initiative was undertaken across the Gulf of Mannar and Palk Bay regions. This initiative successfully led to the removal of 40 tonnes of marine debris during the year, covering an area of approximately 303 hectares. Of the total debris collected, 15 tonnes consisted of ghost gear, while the remaining 25 tonnes comprised of various forms of marine litter, including plastic bottles, plastic packaging materials, glass bottles, discarded ropes, footwear, synthetic fibres, textiles, and other similar waste. With 1,745 fisher volunteers actively involved, the clean-up drive addressed the urgent issue of marine debris and exemplified the strength of collective action in tackling environmental challenges.

Four capacity-building workshops were organised, and 406 fishersfolk (300 men and 106 women) were trained. Comprehensive village-level outreach efforts, including awareness meetings and vibrant street plays, were conducted; reaching 1,303 fisherfolk (665 men and 638 women) across 16 villages. Additionally, 837 school and college students were educated about these hazards. Multi-stakeholder consultations were convened in Tuticorin and Ramanathapuram, where 151 participants representing policymakers, scientists, fisheries experts, and community leaders participated. These multi-stakeholder dialogues fostered a collaborative environment for knowledge exchange and policy dialogue and evolved a Ghost Gear Voluntary Code of Practice. Three batches of ghost gear upcycling training empowered 93 women to create marketable products from discarded gears. Ghost gear management committees and segregation centres were established in Vethalai and Vellapatti villages, involving women's Self-Help Groups (SHGs). Additionally, 100 trawlers were equipped with onboard wooden boxes to collect ghost gear at sea, promoting responsible waste management and ocean stewardship.

Marine debris levels were highest in September 2024 (Fig. 4), exceeding 8,246 kg, likely due to monsoon runoff and post-monsoon fishing. Other significant peaks in January, February 2025, and December 2024 correspond with intensive fishing activity. Minimal debris was recorded during the fishing ban periods, underscoring the impact of seasonal regulations and environmental conditions.

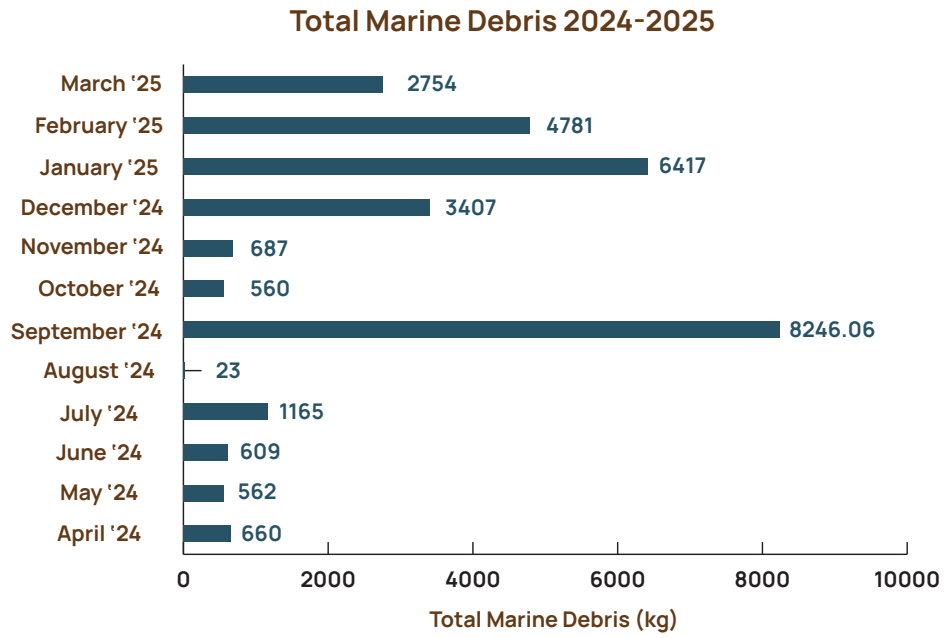


Figure 4: Quantity of marine debris collected from April 2024 to March 2025

The ghost gear collection peaked in January 2025 at over 5,754 kg, (Fig. 5, and the maximum collections were in the months of February, December, June, and September 2024, aligning with periods of intensive fishing. In contrast, April, May, and August 2024 recorded minimal collection, likely due to fishing bans or reduced activity, highlighting seasonal influences on ghost gear generation.

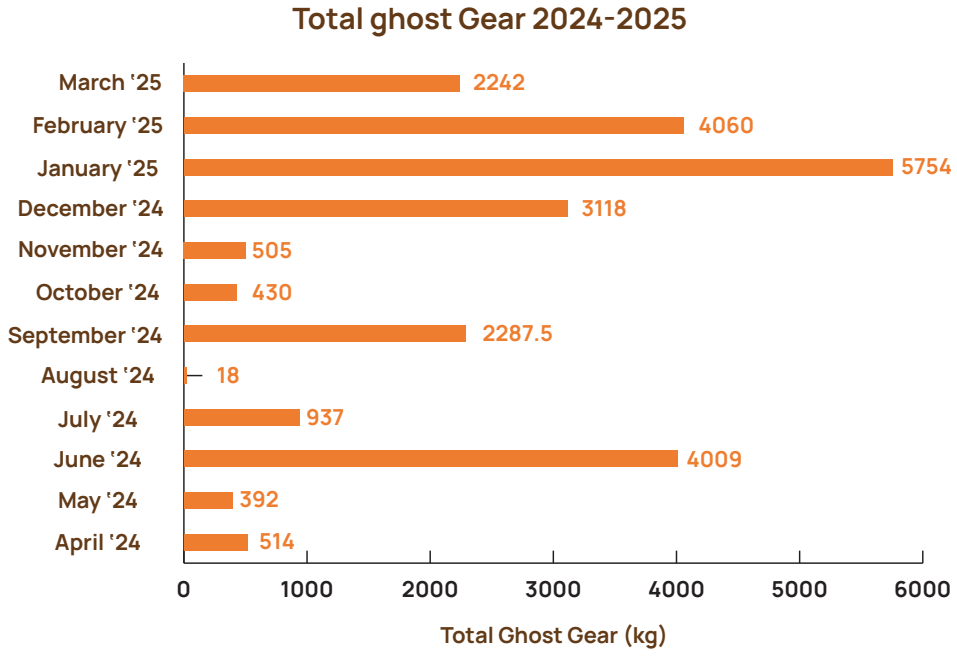


Figure 5: Seasonal trends in ghost gear retrieval (2024–2025)

103.3 FISHER FRIEND MOBILE APPLICATION

The Fisher Friend Mobile Application (FFMA), a flagship initiative of MSSRF, has achieved a positive growth with 2,779 new users, bringing the overall user count to 1,06,551. Additionally, the total screen views for the year are 16.46 lakh, adding up to the overall screen view of 166.72 lakhs, reflecting substantial engagement and utilisation by the fishing community. In terms of technical advancements, two new customised versions of the app (FFMA 5.5 and 5.6) were released on the Google Play Store. The application is now compatible with Android devices running up to version 13. A major milestone in the advancement of the application was achieved with the introduction of FFMA version 5.6, which includes a new feature on "Ghost Gear Location Marking", designed to address ghost gear pollution in coastal and offshore waters. This addition enables users to mark locations where lost or abandoned fishing gear is present at sea to help map ghost gear hotspots.

103.4 OCEAN OBSERVATORY SYSTEM FOR MEASUREMENT OF REAL-TIME OCEAN STATE DATA

The Wave Rider Buoys were deployed in three strategic locations; Puducherry, Tuticorin, and Muttom, in the coastal waters of Bay of Bengal. They continue to provide crucial data on wave characteristics, sea surface current and sea surface temperature for making accurate advisory services. During Cyclone Fengal between 26–30 November 2024, in the Bay of Bengal, the Puducherry buoy remained operational, recording valuable real-time data that enabled the Indian National Centre for Ocean Information Services (INCOIS) to deliver accurate forecasts, supporting disaster preparedness and response. Timely swell alerts in December 2024 from MSSRF's coastal (Village Resource Centre) network, based on INCOIS warnings, facilitated early evacuations in two villages of Puducherry, ensuring the safety of coastal communities.

Wave Rider Buoy Performance during Fengal Cyclone

The Puducherry buoy successfully operated throughout Cyclone Fengal from 26–30 November 2024, capturing continuous real-time data that significantly aided INCOIS in enhancing the accuracy of cyclone forecasts. (Fig. 6).

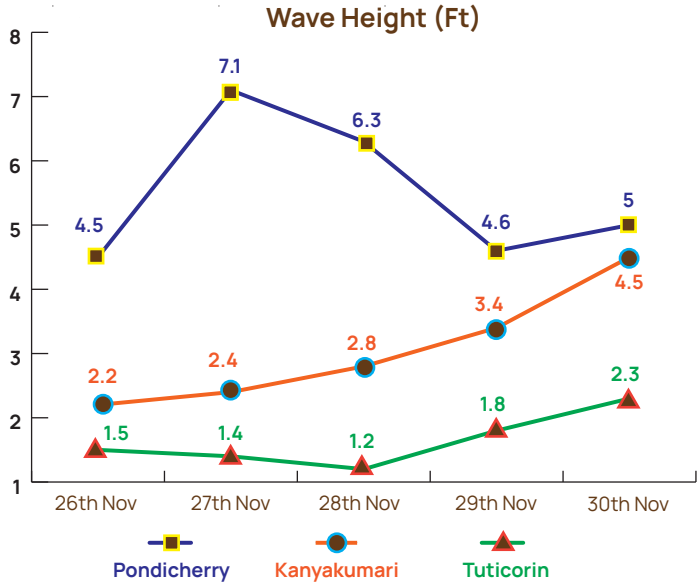


Figure 6: Wave height observations during Cyclone Fengal

In this reporting year, 42 awareness campaigns on early warning and marine fishery advisory services were conducted at the village, district, and regional levels, orienting 1,064 fisherfolk (967 men and 97 women) based on INCOIS forecast services. Table 3 provides the detailed numbers of forecast advisory users through different ICT tools.

Table 3: User statistics of ICT tools for marine fishery advisory services

ICT Tools	Users up to March 2024	New users added April 2024 to March 2025	Total Users
FFMA	1,03,777	2,774	1,06,551
Audio advisories	5,172	588	5,760
Helpline	5,491	165	5,656
WhatsApp's	1,752	171	1,923
Total	**1,16,192**	**3,698**	**1,19,890**

103.5 POLICY ADVOCACY FOR ADDRESSING WOMEN'S ISSUES IN POST-HARVEST FISHERIES

The Fish for All Training Centre released its first policy brief on women in fisheries, highlighting the challenges faced by fish vendors in Tamil Nadu and Puducherry. Based on field evidence, the brief emphasises the diverse roles of women in post-harvest activities and exposes systemic inequalities that limit their access to resources, training, and decision-making. It offers actionable recommendations for equitable access to assets, gender-responsive skill development, and inclusive market linkages, aiming to strengthen the rights, recognition, and resilience of fisherwomen.

103.6 LAUNCH OF PORTABLE MINI SOLAR FISH DRYER

The centre advanced its fish drying technology with the development of a portable mini solar fish dryer—a compact, hybrid (solar-electric) model tailored to fisherwomen's needs. With a 20 kg capacity, the dryer operates at 53°C, enhancing drying efficiency, reducing post-harvest losses, and improving hygiene. Thirty dryers were distributed in two coastal villages of Mayiladuthurai and received positive feedback on efficiency and product quality. Recognising its usefulness, the Government of Puducherry announced the free distribution of 100 dryers in the budget speech for 2025–2026, highlighting replication of this innovative model for technology-driven empowerment in fisheries.

103.7 WOMEN CONNECT CHALLENGE FOR STRENGTHENING POST-HARVEST FISHERY VALUE CHAIN

The Women Connect Challenge has made remarkable strides in empowering fisherwomen through digital solutions, transforming the landscape of post-harvest fisheries. Over 6,037 fisherwomen participated in 216 intensive digital training sessions, and learned essential digital skills such as internet usage, Unified Payments Interface (UPI) transactions, cyber safety, and leveraging online platforms for business growth. Additionally, 1,206 women from 100 SHGs received special training on post-harvest fisheries, which have been instrumental in reducing fish waste and loss by 91.27%. The initiative has also introduced critical support systems, including a helpline facility where women can call and obtain clarification related to post-harvest fisheries. Overall, 863 calls on topics such as value-added product preparation, certification, credit linkages, and banking schemes were addressed. Furthermore, ten thematic video conferences were conducted that engaged 1,875 fisherwomen and mobilised a credit turnover of ₹ 39.84 lakhs from banks, improved market access (66% of participants from end line survey), and resulted in increased profits of 73%. Significant advancements were made in the development of learning content for fisherwomen as part of the Women Connect Challenge. Seventeen interactive learning modules were developed on fish value-added products preparation techniques to improve post-harvest knowledge.

Table 4: Digital empowerment outcomes for women

Female participation in UPI-based fish marketing (new)	1,045
Number of new email IDs self-created by women	982
Number of women who acquired foundational digital skills (making calls, using Google Maps, watching YouTube for learning new skills, using phone features for daily life)	2,480
Number of women using social media tools for business promotion, online marketing, entertainment, gaining knowledge, and networking (WhatsApp, Facebook, Instagram, FisherWomenConnect)	1,336

103.8 FISHERWOMENCONNECT MOBILE APPLICATION

An exclusive mobile application, the FisherwomenConnect, was launched on 7 August 2024, by Thiru K.V. Shaji, Chairman of the National Bank for Agriculture and Rural Development (NABARD). The FisherwomenConnect app is designed to support women engaged in post-harvest fisheries by providing real-time weather updates, market trends, and information on government schemes. The content is available in both Tamil and English languages, with features like visual and audio guides on fish processing to promote better hygiene and efficiency. The FisherwomenConnect app has been downloaded more than 1,550 times within a short period, effectively supporting fisherwomen with real-time information and improved market access. Significant progress has also been made in expanding online sales and diversifying product offerings through this platform. At present, 32 dry fish products, 4 fresh fish products, and 9 value-added products have been successfully uploaded for online sales on the app. (Table 5).

Table 5: FisherwomenConnect App: Key features and benefits

Key features	Benefits
Learning modules	Encompassing hygienic fish processing, value addition, fish safety, and the implementation of best practices.
Real-time weather & disaster alerts	Empowering fisherwomen to make safe, informed operational decision on day-to-day basis.
Market trends & Government schemes updates	Informs strategic business planning and access to vital support.
Regular news & fisheries sector updates	Informs users of current developments and opportunities.
Online store	Connects fisherwomen to buyers, ensuring equitable pricing and new economic avenues
Occupational health hazard information	Guides users on minimizing and managing risks in post-harvest fisheries.
Community & inclusivity features	Bridges the information gap and fosters a supportive, empowering environment for fisherwomen.

103.9 STRENGTHENING LIVELIHOODS OF SMALL-SCALE FISHERFOLK

A new initiative, "Strengthening and Sustaining the Livelihoods of Small-Scale Fishers in Two Coastal Districts of Tamil Nadu," was launched with the support of the Azim Premji Foundation in October 2024. This initiative addresses the economic, social, and ecological dimensions of fisheries-based livelihoods, aiming to improve the socio-economic resilience of traditional fishing populations in six coastal villages across Mayiladuthurai and Cuddalore districts. To ensure participatory implementation, five village-level consultations were conducted, engaging 287 community members. A detailed baseline survey covering 1,500 households was completed, which provided critical insights on livelihood practices, vulnerabilities, and aspirations, served as a base for an evidence-based intervention framework development.

103.10 INTEGRATED IRULAR TRIBAL FISHERS DEVELOPMENT PROGRAMME IN PICHAVARAM

The 'Integrated Development of Irular Tribal Fishers in Pichavaram' initiative, launched with support from Five Star Limited (Chennai), aims to address the multifaceted challenges faced by Irular tribal fishers along the Pichavaram coast. This holistic programme focuses on enhancing education, livelihood, health, and digital inclusion, with a special emphasis on empowering women, children, and youth in these marginalised communities. A major component

is educational development through the "Every Child A Scientist" (ECAS) and "Evening Learning Centres" in Irular settlements. These centres offer academic support, regular assessments, and promote physical well-being through sports, resulting in better school attendance and reduced dropouts. Traditionally involved in fishing, many Irular children had limited access to formal education. The ECAS programme in MGR Nagar and Kalaingar Nagar provides hands-on science learning for 101 students. Summer camps were also held to continue learning during the holidays. To promote digital inclusion, a Village Knowledge Centre (VKC) was set up with basic Information and Communication Technology tools and a Public Announcement System. The VKC supports over 506 users, offering training in basic computer skills, internet use, and resumé writing, which greatly improves digital literacy and job readiness among the youth. Among women, 16 health and occupational safety awareness sessions were held, reaching 392 participants (102 men, 130 women, and 160 students). Specifically, the sessions covered fishing-related injuries, musculoskeletal pain, hearing loss, sun exposure, dehydration, malnutrition, and anaemia.

Irular women who hand-pick prawns in the backwater of Pichavaram face numerous health hazards, including frequent foot injuries from sharp objects like shells and oysters, causing severe blood loss. Normal shoes offered little protection, and the gumboots provided in the past were too rigid and not comfortable for use. However, after exploring alternatives, 150 Irular fisherwomen received flexible yet sturdy gumboots, significantly improving their safety, reducing foot injuries, and enhancing comfort during daily fishing activities. This small, appropriate initiative significantly reduced blood loss due to oyster wounding and cuts is a positive health outcome of the project.

104. SEAWATER FARMING INTEGRATING AQUA-AGRI COMPONENT

104.1 SEABASS NURSERY DEVELOPMENT

Collaborative efforts with the Indian Council of Agricultural Research - Central Institute of Brackish water Aquaculture (ICAR-CIBA) under the Scheduled Caste Sub Plan in Mathampattinam village, Mayiladuthurai district, have yielded impressive results. In the seabass nursery rearing project, the women members stocked 17,000 fingerlings, achieved a 51% survival rate and a feed conversion ratio of 2.4. Within a short period, the project generated a total sales revenue of ₹2,67,000. Of this, ₹2,16,000 was distributed among 12 SHGs, strengthening community-based aquaculture and livelihoods, while the remaining amount was deposited in their bank account as corpus money. Notably, 15 households involved in this initiative earned an additional income of ₹17,000 within three months, effectively doubling their income.

104.2 INTEGRATED MANGROVE FISHERY FARMING SYSTEM

Around the Integrated Mangrove Fishery Farming System (IMFFS) in Pichavaram, 1,750 mangrove saplings were planted and are being maintained by local stakeholders, aiding shoreline protection and long-term aquaculture sustainability. Aquaculture activities in IMFFS yielded 69.75 kg of marketable crabs from 141.95 kg of stocked water crabs, earning ₹66,290, that was divided among 15 tribal families. Additionally, 65 kg of seabass and 11 kg of other fish species were harvested, generating ₹21,700 of income, which was shared among SHG members. A training programme

for 90 participants, held in collaboration with the Marine Product Export Development Authority, addressed aquaculture challenges and facilitated the adoption of sustainable and bio-secure practices.

104.3 INTEGRATED MULTI TROPHIC AQUACULTURE

A new initiative, Integrated Multi-Trophic Aquaculture (IMTA), was launched this year in the Palk Bay region of Ramanathapuram district. This approach integrates seaweed, seabass, and mollusc culture to address environmental challenges such as biomass loss and marine pollution while promoting species diversification and efficient waste recycling. Two fishing villages, Meenavar Kudiruppu and Munaikadu in Palk Bay, were selected for the initiative. Participatory micro-planning exercises, household selection, and baseline data collection were implemented, identifying 25 highly committed households. A two-day hands-on training programme on IMTA was conducted in collaboration with the Central Marine Fisheries Research Institute (CMFRI) for the selected households, focusing on technical aspects of integrating seaweed, shellfish and seabass cultivation.

105. BIOSALINE AGRICULTURE

105.1 SALINE TOLERANT PADDY CULTIVATION

Building on the success of saline-tolerant paddy cultivation in Vadakadu, 25 women farmers from Karunkulam, Thamarankottai South Panchayat, adopted these practices. A baseline survey and needs assessment guided the interventions on soil testing, use of green manure and organic fertilizers to enhance soil health and reduce impacts of soil salinity. TRY-3, a high-yielding saline-tolerant variety, was recommended. Each farmer received inputs and ₹6,500 for operational costs and invested ₹6,000 for land preparation and harvesting. The 2024–2025 cultivation cycle (September–February) yielded an average of 3,625/ha, with a profit of around ₹55,500. Simultaneously, 25 women farmers in Vadakadu village continued the cultivation.

Table 6: Bio-inputs for saline-tolerant paddy cultivation provided to women farmers in Thamarankottai South, Thanjavur District.

Inputs (Bio, organic and in-organic)	Quantity
Saline-tolerant paddy - TRY-3	30 kg
Dhaincha *(Sesbania aculeata)*	2 kg
Bio-pesticide	4 kg
Zinc Sulphate (Micro-nutrient)	10 kg
EM power (Root promoting and saline resistance)	10 kg
Potash (Macro-nutrient)	50 kg
Micronutrients – soil application	50 kg
Pesticide	500 ml
Liquid micronutrients – foliar application	250 ml

105.2 INTEGRATED POKKALI RICE AND SHRIMP FARM IN KERALA

Launched in December 2024, the programme aims to revive integrated Pokkali rice–fish/shrimp farming in Ernakulam district, Kerala, promoting bio-saline agriculture as a nature-based solution for smallholder farmers. A baseline survey of 46 farmers across six panchayats was completed from which 27 eligible farmers with ≤ 2.5 hectares of land holding were selected. Twenty-one stakeholder consultations and five community meetings were held, with over 250 participants, to co-develop revival strategies. Capacity-building sessions included four technical trainings on seed preservation, mechanisation, climate resilience, and value addition, benefiting 72 farmers, along with exposure visits for 33 farmers. Field interventions included the distribution of protective nets (4,320 kg) and analysis of soil samples (90), and policy engagement through "Karakam 2025," a state-level workshop with 150 stakeholders. The issues addressed were branding, seed banks, mechanisation, and sustainable practices. These collective efforts focus on revitalising the Pokkali system while supporting livelihoods and ecological sustainability.

106. CAPACITY BUILDING AND OUTREACH

106.1 TRAINING

In 2024–2025, Fish for all Research and Training Centre significantly expanded its outreach and capacity-building efforts, training a total of 11,536 individuals (6,129 men and 5,497 women) participants across diverse thematic areas critical to the fisheries sector in 266 training sessions. The training programmes covered marine pollution, recycling of ghost gears, disease management in fish culture systems, seabass nursery rearing, post-harvest fish management, and business planning for Fisher Farmer Producer Organisations (FFPOs). Structured pre and post-assessment evaluations were integrated into all programmes. The FRTC streamlined its training calendar and developed a detailed curriculum outlining training topics, targeted groups, and durations.

Table 7: Overview of thematic trainings in fisheries and coastal management

Thematic area	No. of training sessions	Participants		Total
		men	women	
Sustainable Marine Fisheries	48	4861	269	5130
Brackish water Aquaculture	4	123	64	187
Post-Harvest Fisheries Technologies	76	-	1326	1326
Marine Pollution & Conservation	48	1145	1348	2493
Information and Communication Technologies	90	-	2400	2400

106.2 LIVELIHOOD ENTERPRISE DEVELOPMENT PROGRAMME

The FRTC served as a vital capacity-building hub for women engaged in post-harvest fisheries, with a targeted focus on quality dry fish production and value-added products using tunnel solar dryers. Through the Livelihood Enterprise Development Programme, supported by NABARD, a total of 89 fisherwomen from Sirkazhi and Sembanarkovil blocks successfully attended a 15-day training module between July and December 2024. Conducted in three intensive batches at the Hazard Analysis and Critical Control Points-certified Fish Processing Unit, the training curriculum integrated practical and theoretical modules on hygiene protocols, enterprise development, and market linkage strategies. Post-training, 37 women successfully started their own fish-based value-added fish businesses, including Ms. Thenkala, who started 'Thenmathi Kadal Unavagam' in Poompuhar, marketing certified dry fish products online. Ms. Usha from Keezhamoovarkarai initiated Sri Amirtha Feeds and Masala in Mayiladuthurai, catering to local markets with value-added fish products and spice blends.

106.3 VILLAGE KNOWLEDGE CENTRE AND VILLAGE RESOURCE CENTRES

Two Village Resource Centres (VRCs) in Thangachimadam and Poompuhar, along with three VKCs in Panithittu, Kalaignar Nagar, and MGR Nagar, supported 2,253 users (1,140 men and 1,113 women) across 33 fishing villages in 10 coastal districts of Tamil Nadu, Kerala, and Puducherry. These centres served as community hubs, offering services in fisheries, health, education, government schemes, aquaculture, animal husbandry, and digital literacy, including training in computer skills, spoken English, and online applications. A 30-day 'Programming Basics Summer Course' in Java and Python was conducted for 31 students from class 12, all of whom showed marked improvement in post-assessments. Additionally, an Artificial Intelligence course for children aged 8–14 attracted 34 participants, introducing them to fundamental concepts in AI and its applications. A key highlight was a 'Jellyfish Sting First Aid Awareness' webinar, attended by 240 fishers from eight coastal districts. The session educated participants on immediate response methods to prevent complications from jellyfish stings, a critical but often overlooked health concern in fishing communities.

106.4 INSTITUTION BUILDING

Fish Farmer Producer Organisation

In 2025, a total of 184 new shareholders joined four FFPOs: VetriPaavai Fisherwomen Producer Company Limited (VPFWPCL), Mayiladuthurai Kaveri Fish Farmers Producer Company Limited (MKFFPCL), Bharathidasan Freshwater Fish Farmers Producer Company Limited (BFFFPCL), and Kanara Cage Fish Farmers Producer Company

Limited (KCFFPCL). Operating across Tamil Nadu, Puducherry, and Karnataka, these FFPOs have expanded their reach through partnerships with institutions and private players like Naveen Aqua Feeds, Sai Aqua Tech, CIFT, Himalayan Aqua Farm, and the Rotary Club, Kumta, improving technical support, input quality, and market access. A total of 554 members participated in stakeholder consultations and share certificate distributions, strengthening engagement and cohesion. VPFWPCL showed strong growth by launching its brand, 'Samudra', offering dry and fresh fish products, masalas, and pickles. Thirty members were Food Safety and Standards Authority of India certified, and 40 registered on the National Fisheries Digital Platform, enhancing compliance and access to digital services. VPFWPCL recorded a turnover of ₹11.26 lakh between 2022 and 2024.

MKFFPCL supported its shareholders by facilitating 6,000 seabass fingerlings and 2.5 tonnes of fish feed, generating a turnover of regular 3.97 lakh. BFFFPCL set up a live fish sales unit at Ulavar Sandhai, Puducherry, boosting direct consumer sales and achieving a regular 1.52 lakh turnover. In coastal Karnataka, 100 shareholders registered with KCFFPCL with regular 1,00,000 in share capital. A key effort included stocking 40,000 seabass seeds in a river nursery with Rotary project support, highlighting a commitment to sustainable aquaculture.

106.5 OTHER MAJOR EVENTS

Fish For All 15th Year Annual Day Celebration

The 15th anniversary of the FRTC highlighted its significant contributions to coastal resilience and sustainable fisheries. Attended by government officials, researchers, NGOs, and community leaders, the event featured the release of the Centre's 15-year impact report, a policy brief on women fish vendors, a new livelihood project, digital literacy modules, and hybrid solar dryers for fisherwomen. Expert discussions focused on climate resilience, marine pollution, and community-led fisheries management.

World Fisheries Day celebration 2024

On 21 November 2024, World Fisheries Day was celebrated in Poompuhar with 80 participants. The event centreed on the theme "Investing in Social Protection for Equitable Blue Transformation," and included expert talks from ICAR-CIBA and community discussions. Fishers from Poompuhar, Vanagiri, and Madathukuppam shared how technical interventions improved their livelihoods and strengthened community empowerment.

Exposure and Educational Visits

As part of its academic outreach, the FRTC at Poompuhar hosted exposure visits for 37 students from Nehru Memorial College and 168 from Sri Kailash College for Women, Salem, providing hands-on learning in fisheries and coastal sustainability. A government visit included 18 Tamil Nadu Fisheries Department officials (2 Inspectors and 16 Sub-Inspectors) undergoing departmental training. Additionally, 22 postgraduate students and 2 faculty members from Annamalai University visited the Mudasalodai field site for a one-day internship on integrated aquaculture, mangrove-based farming, and ecosystem-based fisheries management.

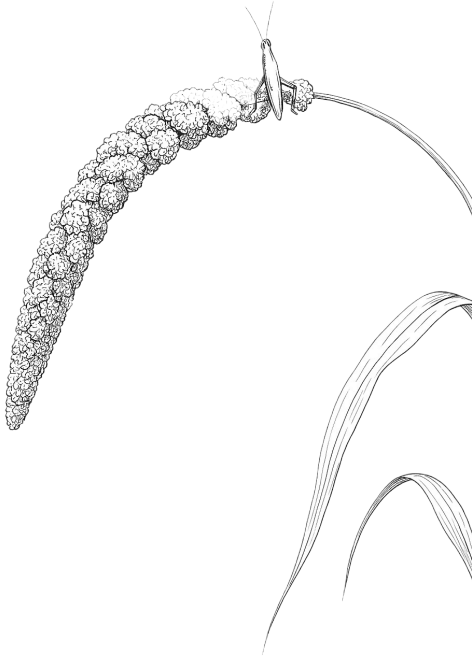
Programme Summary

- Successfully implemented a pilot seagrass restoration programme in Pulicat Lake.
- Conducted large-scale ghost gear retrieval and coastal clean-up programmes with 1,745 fisher volunteers.
- Removed 40 tons of marine debris, including 15 tons of ghost gear, across 303 hectares.
- Expanded the Fisher Friend Mobile App to 1,06,551 users, adding ghost gear location tracking.
- Launched the FisherWomenConnect App, reaching 1,550 downloads, providing weather updates, market trends, and digital marketing support.
- Got a case study featured on tsunami survivors as the best-case study at UNESCO's "Resilience and Remembrance" event and two fisher survivors shared their stories at UNESCO's Executive Committee Council Meeting in Paris.
- Applied GeoAI and machine learning (RF, XGBoost) on high-resolution SkySat data for high-accuracy seagrass mapping.
- Launched the GeoAI Blue Carbon Project for mapping blue carbon ecosystems along the Tamil Nadu coast, Honourable Minister Dr. P. T. R. Palanivel Thiaga Rajan inaugurated this intitiative.


On Sea Ghost Gear Clean-Up Drive
Date:
Place:

PA200

BIODIVERSITY



8800 households are engaged in ***in-situ*** on-farm conservation of crop genetic resources, including paddy, small millets, pulses, tubers etc.

140+ tonnes of quality seeds of paddy landraces produced

65,100 saplings reintroduced of which

30 are rare, endangered and threatened species of the Western Ghats

Boosting ecosystem health, livelihoods and diversity

500

households adopted Agroforestry in **250 ha** for crop diversification and effective land management

1722

home nutrition gardens established to promote diet diversification and strengthen the knowledge and skills of women farmers

67%

Annual farm income increased from **₹30,000 to ₹50,000 per ha** as good agricultural practices were adopted in **2,520 ha** by the tribal farmers. Practices increased productivity, enhanced climate resilience, and improved food and nutrition security.

1,97,355

farmers reached (42% female farmers) from 12 districts and 3873 villages in Odisha on nutrition-sensitive agricultural practices, seed production, and crop diversification

BIODIVERSITY

In 2024–2025, the Programme integrates conservation, sustainable agriculture, and community resilience across Kolli Hills (Tamil Nadu), Koraput (Odisha), and Wayanad (Kerala). In Kolli Hills, agroforestry, agroecology, and natural farming initiatives boost livelihoods and biodiversity, supported by the JIVA programme and tribal producer companies. Koraput's Tribal Agrobiodiversity Centre advances seed sovereignty through community banks, molecular profiling of landraces, and women-led value chains. Wayanad's Community Agrobiodiversity Centre conserves endemic species via ex-situ efforts, tuber value chains, and climate-resilient landscapes. Key innovations include seed fests, digital adaptation tools, and youth stewardship programmes—creating a replicable model linking biodiversity, food security, and local climate action.

The Biodiversity interventions demonstrate an integrated approach that synergises conservation, sustainable agriculture, and livelihood enhancement across three key regions: Kolli Hills in Tamil Nadu, Koraput in Odisha, and Wayanad in Kerala. These initiatives employ climate-smart agroforestry systems, agroecological practices, and seed system strengthening while prioritising community participation. In Kolli Hills, agroforestry expansion and natural farming adoption have improved soil health, enhanced cropping diversity, and boosted livelihoods through vegetable cultivation, orchard development, and nursery enterprises, supported by the JIVA programme's innovations in local input production and agroecological restoration. Odisha's Tribal Agrobiodiversity Centre has made progress in indigenous seed conservation, groundnut value chain development, molecular characterisation of finger millet landraces, and nutrition-sensitive farming systems, complemented by community seed banks and women-led seed production networks that reinforce seed sovereignty. Wayanad's conservation efforts focus on *ex-situ* protection of threatened species through the M.S. Swaminathan Botanical Garden, landscape restoration initiatives, tuber crop value chain development, and specialised training programmes building tribal youth capacity in biodiversity stewardship. Notable innovations cutting across regions include participatory seed festivals, community food diversity events, digital tools for climate adaptation, and scalable

agroforestry models that contribute to carbon-neutral agricultural landscapes. Together, these interventions present a transferable framework that successfully intertwines biodiversity conservation with food and nutrition security while strengthening community resilience and establishing local stakeholders as active guardians of both ecological and climate stability.

201. COMMUNITY CONSERVATION PROGRAMMES IN KOLLI HILLS

To strengthen resilience and promote conservation, an integrated, climate-smart agroforestry approach has been adopted in Kolli Hills. This strategic framework simultaneously champions the vital conservation of agrobiodiversity and empowers local farmers. This is achieved through the promotion of innovative farming methods, integrated soil and water conservation techniques, specifically designed for the region's unique ecosystem. Our comprehensive community conservation programmes are meticulously focused on driving holistic development. Key pillars include dynamic crop intensification and diversification, fostering robust support systems, and fundamentally transforming agroecology for truly sustainable production. The promotion of nutrition-sensitive agriculture, dedicated biodiversity conservation, and responsible, sustainable resource management were prioritised. Crucially, these efforts are complemented by extensive capacity-building workshops for community empowerment, raising awareness, and ensuring substantial livelihood enhancement for the residents of Kolli Hills, ensuring a resilient and thriving agricultural future.

201.1 INTEGRATED TRIBAL LIVELIHOOD ENHANCEMENT THROUGH AGROFORESTRY

The agroforestry programme in Kolli Hills has continued since 2020 in 500 farms. The key interventions are enhancing soil fertility through enriched manure with bio-inputs in 500 orchards, mulching in 200 hectares and diversifying the cropping system with intercrops in 21.5 hectares, such as vegetables, banana, pineapple, millet, and sweet potato. Soil and water conservation are ensured through the renovation of stone and earthen bunds in 130 hectares, and establishing new mini-percolation ponds and one common well in the northern cluster. Twenty-three training and capacity-building programmes were conducted for 575 farmers, focusing on overall farm management, including pruning, use of bio-inputs and enriched farmyard manure, post-plant care, nursery development as an enterprise, vegetable cultivation practices, and women's health.

The intercropping system was expanded to 21.50 hectares, covering 120 farm families. The intercrops cultivated were brinjal, radish, tomato, field bean, banana, pineapple, millet, and sweet potato. The total harvests were 4.5 tonnes of radish, 1.2 tonnes of tomato, 0.6 tonnes of field bean, 1.5 tonnes of brinjal, 2.7 tonnes of pineapple, 4.3 tonnes of millet, and 1.5 tonnes of sweet potato from the 21.5 hectares orchards, besides the production of main tree crops.

The farm management in 200 hectares of orchard farms includes the regular maintenance: basin formation, weeding and life-saving irrigation. These combined activities generated 9,500 labour days for soil and water conservation in the intervention villages. The higher survival rate of the saplings was ensured through effective post-planting care:

85% in jackfruit, 84% in mango, and 80% in acid lime. Concurrently, the Pusanikuli nursery unit successfully raised 8,000 pepper cuttings (cost at ₹12 each) and 9,500 coffee seedlings (cost at ₹10 each). This nursery operation yielded a net return of ₹65,000 over four months.

201.2 JIVA - AGROECOLOGY PROGRAMME FOR REVITALISING NATURAL RESOURCES

JIVA, is a comprehensive agroecology-based natural resource management initiative. Its core strategy encompasses reviving biological pest management and enhancing soil nutrients, integrating livestock with crops, conserving vital soil moisture through cover crops, and diversifying cropping systems. It empowers farmers by driving behavioural change through targeted knowledge sharing, effective communication strategies, site-specific innovations, and capacity building.

In the pilot phase, thirty lead farmers were supported to learn, practice, experiment and observe the natural farming method, practices and their potential benefits through training, exposure visits and demonstrations. The contents of the programme focused on crop diversification, botanicals, and organic inputs preparation, soil and water conservation, fodder management, nutri-garden and ethno-veterinary practices. Overall, it covered 63 themes conducted over 71 trainee days through external and internal resource people in three clusters (Gundur Nadu, Alathur Nadu and Gundani Nadu). Through this capacity-building programme, 30 lead farmers were trained over 120 training days. Nine potential internal farmer resource persons were selected for upscaling the interventions in three more clusters.

Crop combinations appropriate for the local crop systems were evolved through a survey with experienced lead farmers and learning by the farmer groups from the Participatory Rural Appraisal exercises. Thirty natural farms have been developed covering 18.21 hectares. The planting materials, such as suckers, seeds, and saplings treated with *bijamirtham* and applied *jivamirtham* as a foliar application. The banana and tuber crops have started to yield in all the clusters.

Gourd vegetable seed kits, 300 bamboo seedlings and 7,500 Cumbu Napier fodder slips were planted across all 30 JIVA farms, serving as an effective soil binder. JIVA farm families initiated harvesting forage in June 2024, with an approximate monthly yield of 360 kg. The JIVA farm families have renovated stone bunds in 20.2 hectares through collective action for effective soil and water conservation.

On the input side, farmers applied 5,000 litres of *Jivamirtham* and 6,500 kg of *Ganajivamirtham* for soil enrichment. Various pest and disease management solutions were deployed, including 160 litres of *Bijamirtham*, 100 litres of Neem *astra*, 120 litres of *Agni astra*, 50 litres of *Prama astra*, and 580 litres of a specialised *Trichoderma viride* with added Neem oil and Perungayam mix for root-

knot nematode control. Additionally, 1,600 kg of *Sapthathaniya Karaisal*, 73 litres of *Panchagavya*, and 120 litres of Egg Amino Acid were applied for comprehensive plant nutrition and growth. Other notable applications included 632 litres of *Perngaya Thiravagam*, 150 litres of *Nochi Karsiasal,* 40 litres of *Pulicha Mor Karaisal*, 30 litres of Coconut Milk *Thiravakam*, and 20 litres of Dried Ginger Milk *Kasayam*, which were applied to enhance soil health and crop resilience.

Agricultural custom hiring centres provide access to modern farm machinery and equipment services managed by the JIVA producer groups. Three centres were established in three clusters; the machinery available to the farmers are a seeder, sprayer, weeder, chaff cutter and bush cutter.

Community Seed Banks serve as vital repositories for indigenous and locally adapted seeds (millets, paddy, pulses, vegetables). 230 farm families accessed seeds from community seed banks, and over 32.14 hectares were covered with indigenous varieties.

To maintain the purity and prevent genetic erosion of indigenous varieties, nine quality seed production demonstrations were conducted in Kolli Hills, covering 1.2 hectares with millets, paddy, and maize. These were cultivated by adopting natural farming practices.

In Maruthankulam, a fully automated chick hatching-cum-brooder unit has been established to promote local poultry breeds. These units provide crucial controlled environment for incubating eggs and rearing young chicks. It ensures their healthy growth and survival with an 80% hatch rate.

The project team has established 30 nutrition gardens in Maruthankulam, Orpuram and Ettaiparai villages, combined with nutrition literacy programmes. The project promoted healthy eating habits, improved food security, diet diversity and balanced diet among 30 farm families. Nutrition gardens encouraged the cultivation of a variety of vegetables; green leafy vegetables, tomato, carrot, brinjal, bendi, chilli and gourds. 480 kg of tomato, 42 kg of carrot, 650 kg of brinjal, 460 kg of bendi, 740 kg of chilli and gourd vegetables, 210 pumpkin, 65 kg of bitter gourd, 80 kg of bottle gourd harvested in the nutrition garden. All the produce was consumed by the farm families.

The lead farmers in Kolli Hills played a vital role in taking forward the natural farming and agroecology model to other tribal farmers. They played a key role in mobilising and building rapport with farmers, raising awareness on natural farming practices, clarifying the doubts, conducting training on natural farming practices: crop management, livestock rearing, and integrated farming practices.

On 6 January 2025, a Food Mela was conducted, gathering 75 JIVA farm families. This event served as a crucial platform to showcase and promote diverse local, traditional, and nutritious food products. It raised awareness about Kolli Hills' rich agro-biodiversity and fostered appreciation for traditional food systems. The Mela also provided a vital opportunity for small-scale local entrepreneurs, particularly women, to demonstrate their culinary skills and generate immediate sales, thereby strengthening the local food economy. Totally 25 kinds of millet-based traditional and modern dishes were served to participants.

On 31 December 2025, a pivotal buyer-seller meet was organised in Kolli Hills to establish direct market linkages, to understand the expected quality of the produce, as well as the transparent market price for various produce. This event brought together 40 buyers, 10 Farmer Producer Organisations (FPOs), and 50 JIVA farmers. A follow-up is ongoing for market links for pepper, banana, millets, and pineapple.

201.3 QUALITY SEED PRODUCTION AND VALUE CHAIN PARTICIPATION OF FARMERS IN NAMAKKAL DISTRICT

An integrated approach to sustainable groundnut production is promoted by demonstrating technologies, capacity building and linking with relevant institutions in the Namakkal district. Thirty on-farm demonstrations on improved farming methods were conducted, and 73 farmers were trained. The results showed that the average pod yield in the traditional variety is between 1.96 to 2.98 tonnes per hectare, while the improved variety (Girnar 4) provided 51% higher yield than the traditional variety, with a concurrent increase in income by 26.48%.

Groundnut seed festival was conducted in two seasons at four clusters, and 35 groundnut farmers participated. At least 2.6 metric tonnes of groundnut seeds of different local and improved varieties were distributed to them. The Agrivalam Farmers Producers Company Limited consists of 200 shareholders, and the FPC has entered into a partnership with an export company and has exported 15 metric tonnes of groundnut.

201.4 KOLLI HILLS AGRI-BIORESOURCE PRODUCER COMPANY LIMITED

The Kolli Hills Agri-Bioresource Producer Company Limited has shareholders of 1,034 small and marginal tribal farm households from five local panchayats. They produce and market cashew, pepper, clove, millets, groundnut, coffee and a variety of fruits produced on their farm. Up to 425 shareholders have contributed to the business, and the annual turnover is ₹115 lakhs in 2024–2025 with a net return of ₹4.8 lakhs.

202. TRIBAL AGROBIODIVERSITY CENTRE, JEYPORE, ODISHA

The Tribal Agrobiodiversity Centre (TAbC) focuses on conservation and sustainable utilisation of plant genetic resources, facilitation of access and benefit sharing and strengthening of biodiversity management committees to deal with conservation of agrobiodiversity. A seed bank was established at the premises of the tribal agrobiodiversity centre to commemorate the late Ms. Kamala Pujari, Padma Shri Award winner for her contribution to the conservation of landraces of paddy and millets. The centre organised a national consultation on 'Building climate resilient, sustainable and inclusive seed systems for food and nutrition security' on 27 and 28 February 2025. The consultation recommended the need for strengthening the farmer-managed seed systems and the establishment of community seed banks.

202.1 PEOPLE'S BIODIVERSITY REGISTER AND CAPACITY BUILDING OF BIODIVERSITY MANAGEMENT COMMITTEES IN ODISHA

A training programme was organised in January 2025 in partnership with Odisha Biodiversity Board (OBB), and Jeypore Forest Divisions to orient the team on People's Biodiversity Register and Biodiversity Management Committee (BMC). The registration of five farmers' varieties of finger millets with the Protection of Plant Varieties and Farmers' Rights Authority, Government of India, was facilitated through the BMCs of Kundra and Boipariguda. Besides, recognising the growing

commercial importance of Lakshmipur turmeric and its conservation challenges, seven BMC's of Lakshmipur and Kakiriguma blocks have applied to OBB for access and benefit sharing/collection of royalty from traders. In line with the directives of the Ministry of Environment, Forest and Climate Change, Government of India, a tree plantation campaign titled "Plant4Mother" (*Ek Ped Maa Ke Naam*) was conducted in Khutuguda village and Lima High School campus of Kundra block. Approximately 350 saplings were planted while 70 villagers and 120 students participated.

202.2 MOLECULAR PROFILING OF INDIGENOUS FINGER MILLET GENOTYPES

Under this initiative, a systematic survey, collection and molecular profiling of indigenous finger millet genotypes for nutritional traits and climate resilience was carried out in partnership with the Department of Biodiversity, Central University, Koraput, Odisha. A total of 82 landrace accessions were collected from eight districts: Kalahandi, Nawarangpur, Kandhamal, Nuapada, Ganjam, Gajapati, Mayurbhanj and Keonjhar of the Northern Eastern Ghats of India. The screening of genotypes for superior agronomical traits was carried out under controlled conditions, followed by a multilocational trials in Bandhiyaguda, Kundra block, and in the fields of Central University, Sunabeda. The molecular profiling was completed for 40 landraces of finger millet, and work is in progress to be completed for the remaining accessions.

202.3 RURAL TECHNOLOGY COMPLEX FOR QUALITY SEED PRODUCTION OF PADDY LANDRACES

The intervention has been implemented in 29 tribal villages (organised in four clusters) of Koraput district for conserving and scaling-up the seed production of eight landraces of paddy for two years from 2023 to February 2025. In 2024–2025, 287 farm families were engaged in seed production, covering 142.8 hectares and multiplied 141.2 tonnes of seeds. Twenty women SHGs have been involved in seed production and marketing. The local landraces promoted are *Machhakanta, Kalajeer, Umuriachudi, Basanti, Raghusai Kudaichudi, Dialibhog*, and *Sunachudi*. Training and exposure visits were conducted to build their knowledge and skills on integrated management of nutrients, pests, diseases and soil health, seed production and post-harvest technology, grading and marketing covering. Field trials were completed for 101 farmers' varieties collected from the region. The crop cutting experiment (CCE) report shows that *Basanti* topped with 3.89 tonnes/hectares, followed by Umuriachudi with 3.44 tonnes/hectares.

At least 20 SHGs and 100 youth incubators were strengthened and empowered in seed production and marketing of local landraces of paddy. The SHGs are well-equipped with a set of threshers, graders, winnowers and tarpaulins to process the paddy seeds, and maintain quality standards and packaging.

202.4 SCIENCE, TECHNOLOGY AND INNOVATION HUB FOR UPSCALING SUSTAINABLE TECHNOLOGICAL SOLUTIONS FOR FOOD AND NUTRITION SECURITY

The main purpose of the initiative is to facilitate the farmers to achieve food and nutrition security by adopting appropriate technological solutions; bio-input and quality seed-based community enterprise, sustainable management of soil and water resources in three blocks of the Koraput district (Boipariguda, Koraput and Kundra). The project has been implemented since 2021 in 34 villages covering 2,840 households. The key activities include promoting a nutrition garden, certified seed production of local landraces of paddy, millets and vegetables, and knowledge transfer. The knowledge partners for this initiative are the Indian Council for Agricultural Research (ICAR) - Indian Institute of Soil and Water Conservation (IISWC), Sunabeda, Koraput and the Institute of Life Sciences, Bhubaneswar.

The outcome of this study highlights that 70% of the trained farmers are adopting seed treatment, line transplanting in millet, paddy, and line sowing in maize. By adopting improved technologies and intensification through paddy fallow and off-season vegetables cultivation the farm income has increased from ₹30,000 to ₹50,000 per annum per household.

3,000 farmers from 34 villages in three blocks received soil test-based advisory and trained on preparation of bio-inputs like botanical extract, *Jeevamruta, Bijamtuta, handi khata* etc.

- Baman Dai Producer Company Ltd. was formed. The company promoted the production of bio-input production units and trained the farmers on the decentralised production of vermicompost, azolla, *handikhata, jeevamruta, neemastra*, etc.
- At the hub level bio-inputs such as *Trichoderma viride* (3,017 kg) and *Rhizobium* sp. (700 kg) are produced and distributed to farmers.

At the farmers' level in all 34 villages – the adoption rate of technologies showed an increasing trend: line transplanting of paddy and finger millet is adopted in 713.6 hectares and 1,068 hectares respectively in 34 villages; millet seed production in 40 hectares, establishment of 1,682 nutrition garden, 699.2 hectares of vegetable for increased crop intensity and by diversified diet with 10,000 farmers in 34 villages.

The land terracing, trenching, and bunding has been completed in 500 ha covering 370 farmers from 202.3 hectares in 2024; four solar based pump system for drinking water in 2024–2025 at community level; 161.8 hectares agroforestry model was established during 2023–2024; nurtured ten community change makers on seed production and bio-input production and 253 training programmes covering 9,954 trainee days were conducted.

202.5 POLICY STUDIES ON MILLETS

A study was conducted to reflect on over two decades of MSSRF's work in scaling finger millets as a nutri-cereal in Odisha. This effort has been pivotal for enhancing food security, promoting healthy and diverse diets, building climate resilience, ensuring environmental sustainability, and improving the economic security of rural livelihoods, particularly through gender empowerment.

The study revealed that MSSRF's millet-focused initiatives in Odisha have entered a mature scaling phase, marking more than 20 years of sustained innovation across the local

economy, the agricultural innovation system, and the broader food system. Initially launched to address malnutrition, soil degradation, and crop vulnerability in tribal districts such as Koraput, Rayagada, and Malkangiri, the millet programme has evolved from a grassroots biodiversity conservation initiative into a policy-integrated, state-wide transformation strategy.

Between 2004 and 2025, finger millet yields increased significantly, from just 0.19 tonnes/hectares in the early 2000s to 1.80 t/ha in 2025. The area under finger millet cultivation expanded from 47.4 hectares in 2004 to 2029 hectares in 2024. MSSRF's outreach now spans 196 villages across Koraput, Malkangiri, and Rayagada, demonstrating the environmental, economic, and social viability of finger millet. Notably, the active participation of women in millet production, processing, storage, and marketing has led to substantial empowerment, with women playing key roles in FPOs and local Mandis.

The study also highlighted MSSRF's ability not only to promote and scale viable innovations like millets but also to influence policy, particularly through its contributions to the Odisha Millet Mission. These efforts culminated in the National Consultation held in February 2025 at the TAbC in Jeypore (For more details refer to the Communication section). The consultation reaffirmed a shared commitment to scaling up millet cultivation and recognised MSSRF's leadership in transforming the food and seed systems. Capturing the key messages from the consultation, *The Hindu* featured MSSRF's millet and seed conservation efforts in an op-ed titled "Saving Traditional Varieties of Seeds." The article reinforced MSSRF's position as a national thought leader in transforming food and seed systems.

203. COMMUNITY AGROBIODIVERSITY CENTRE, WAYANAD

The biodiversity conservation activities of the Community Agrobiodiversity Centre (CAbC), Wayanad, are primarily focused on the conservation, sustainable use, and promotion of threatened and underutilised plant genetic resources. Special emphasis was placed on initiating the M. S. Swaminathan Biodiversity Park, and on the conservation of endemic orchids, threatened tree species, riparian vegetation, and neglected tuber crop varieties that are integral to the agroecological and cultural landscape of Kerala part of southern Western Ghats. To conserve these plant genetic resources, the centre conducted a range of targeted training programs aimed at building the capacity of tribal communities, students, farmers, and grassroots institutions.

203.1 *MANIVANAM* - M. S. SWAMINATHAN BIODIVERSITY PARK: A MODEL FOR ECOLOGICAL RESTORATION OUTSIDE FOREST AREAS

The M. S. Swaminathan Botanical Garden (MSSPG), which has served as a research hub and conservatory for endemic and threatened plant species of the Western Ghats for over 25 years, is undergoing a significant transformation into the *Manivanam* - M.S. Swaminathan Biodiversity Park (MSSBP). This transition marks a strategic shift towards demonstrating ecological restoration beyond conventional forest areas. The initiative envisions bringing a 12 hectares core area under effective conservation, incorporating vegetation types aligned with forest types such as evergreen, semi-evergreen, and moist deciduous forests. The broader vision is to create a replicable model of eco-restoration in non-forest landscapes. A comprehensive plan has been developed, demarcating the total 16.8 hectares site into Zone A and B. Implementation has commenced

with foundational activities in Zone A, including the construction of nurseries and seed and tissue culture laboratories. The architectural and engineering consultants have been engaged in the design and development process. The park's master plan encompasses 21 key components, focusing on diverse ecological zones such as evergreen, semi-evergreen, and moist deciduous forests, mid-elevation grasslands, and wetlands. Special attention is given to conservation of threatened tree species, *Strobilanthes* species, endemic orchids, Neglected and Underutilised Species (NUS), medicinal plants and the creation of a vibrant pollination meadow. The technical documents has been prepared, which includes detailed maps, land measurements, and cost estimates. Infrastructure planning includes fencing, a state-of-the-art nursery complex with a production capacity of up to 5,00,000 seedlings annually, and facilities for seed bank and tissue culture laboratories. To ensure scientific rigour and guidance, an advisory committee comprising of 10 eminent personnel having expertise in ecological restoration, environmental health and climate change, biodiversity documentation, landscape ecology and participatory conservation, has been constituted, and the inaugural meeting was held in February 2025. Upon full establishment, the MSSBP is envisioned to evolve into a holistic conservation model, integrating ecological restoration, scientific research, and environmental education, serving as a model project for biodiversity conservation outside designated forest areas.

203.2 QUALITY GREENING FOR CONSERVING THREATENED SPECIES IN THE WESTERN GHATS

During the reporting period, a year-long assessment was undertaken to evaluate CAbC, MSSRF's past efforts in conserving plant genetic resources. This involved extensive fieldwork, systematic evaluation of field data, collection of primary and secondary data, expert consultations, detailed data analysis, and multiple interim reviews. Based on these findings, a detailed project report was prepared on *"Conservation of Rare, Endangered, Threatened, and Endemic Tree Species and Underutilized Food Plant Species for Ensuring Biodiversity, Food, and Nutrition Security in the Western Ghats and Beyond,"* outlining a structured 10-year work plan for implementation through a Hub-and-Spokes model, with the MSSBP serving as the central hub. Leveraging over two decades of experience and collaboration with diverse stakeholder communities. This initiative emphasizes quality greening as a strategic approach to conserving threatened, endemic and underutilized species.

Conservation of Endemic Orchid

As part of efforts to conserve orchid diversity, 52 endemic orchid species (40 epiphytic and 12 terrestrial) were collected from various ecoregions of the Western Ghats and conserved *ex-situ* through the establishment of an orchidarium at M.S. Swaminathan Botanical Garden. This facility also serves to raise awareness about the importance of conserving orchids among students, researchers,

and the public. The initiative further promoted *in-situ* conservation through partnerships with custodian farmers and networking with satellite gardens, generating significant interest in community-based orchid conservation.

Reviving Riverine Ecosystems of Kabani through Riparian Tree Conservation

An initiative was piloted to restore the riparian ecosystem of the Kabani River in Wayanad, focusing on the collection, propagation, and distribution of 25 native riparian tree species. Over 15,000 seedlings were raised through a combination of traditional and modern techniques. Despite challenges such as seed recalcitrance and varied seed-setting seasons, strategic partnerships with local communities, BMCs, and research institutions enabled effective multiplication. Awareness and capacity-building initiatives further enhanced community participation, laying a strong foundation for long-term restoration of the riverine ecosystem.

203.3 ASSESSMENT OF CARBON STOCK IN ARBORETUM AND COFFEE AGROECOSYSTEM OF M.S. SWAMINATHAN BOTANICAL GARDEN

This ongoing study aims to assess and compare the total carbon stock of a 10.4 hectares arboretum and a 0.4 hectares coffee plantation within the MSSBG, both having similar land-use histories. The arboretum, established in 1997 on land previously used for coffee and rubber cultivation, now serves as a conservatory of rare and endangered tree species. The assessment includes measuring tree biomass (using height and girth data from 330 arboretum trees and 487 coffee plants), estimating leaf litter and deadwood biomass through quadrat-based sampling, and analysing soil organic carbon at different depths. Tree data have been geotagged, wood densities are being sourced from global databases, and samples of leaf litter and deadwood from the coffee plantation have been collected and prepared for analysis. Carbon stock assessment will be carried out using the respective allometric equations for both above-ground and below-ground carbon stocks. The study is expected to generate valuable insights into the carbon sequestration potential of contrasting land-use systems.

203.4 MAINTENANCE OF EXISTING COLLECTIONS AT M.S. SWAMINATHAN BOTANICAL GARDEN

MSSBG continued to maintain and strengthen its diverse plant collections, with a focus on threatened, endemic, and underutilised species. The garden-maintained germplasm collections of both cultivated and wild species: wild dioscorea – 9 species, traditional dioscorea – 40 varieties, colocasia & *alocasia* spp. – 9 varieties, traditional turmeric – 9 varieties, wild turmeric – 4 species, wild pepper – 5 species, and cowpea – 20 varieties.

During the reporting period, 13,119 seedlings with medicinal (41 species and 4,407 seedlings), RET, and ornamental value (65 species and 8,712 seedlings) were propagated, maintaining a total stock of approximately 32,600 seedlings. The nursery generated a revenue of ₹6,16,749 lakh from the sale of 13,886 seedlings. A total of 13 M.Sc. dissertation studies were also conducted on various aspects of biodiversity conservation, including carbon stock assessment, ethno-botanic documentation and plant species diversity studies. The garden also hosted 668 visitors, primarily students from various institutions, reflecting its continued role in conservation education and outreach.

203.5 EMPOWERING TRIBAL YOUTH AS CONSERVATION STEWARDS IN THE WESTERN GHATS

Recognising the critical need to empower tribal youth through skill development and meaningful livelihood opportunities, a six-month Conservation Stewardship Course (Green Skills Training) was launched as a pilot initiative in October 2024. The programme was designed to equip indigenous youth with practical skills in ecological restoration, nursery management, and conservation leadership. During this pilot phase, 12 tribal youths from the Paniya community were trained through a well-structured curriculum that combined theoretical learning with intensive hands-on experience in nursery operations, biodiversity monitoring and sustainable land use. To enhance experiential learning, the trainees were given exposure to the Auroville Botanical Garden, Gurukula Botanical Sanctuary and Malabar Botanical Garden, where they interacted with practitioners and observed community-led ecological restoration efforts. A comprehensive curriculum has been developed for this course, and in partnership with the University of Trans-Disciplinary Health Sciences and Technology, Bengaluru. The program will now be institutionalised as a university-accredited six-month diploma course. As the first batch of trainees approaches graduation, this pilot has provided valuable insights and baseline data to continue the course as a long-term initiative for creating dignified green jobs for tribal youth and nurturing a new generation of community-rooted conservation stewards in the Western Ghats.

Apart from the Conservation Stewardship Course, a wide range of training programmes and outreach activities were conducted during the reporting period, covering themes such as plant genetic resource conservation, sustainable use of NTFPs, biodiversity education, and agroecological awareness (Table. 8). Skill development initiatives focused on terrarium making, agricultural model building, and livelihood restoration for landslide-affected women. Farmer-oriented programmes included training on improved agricultural technologies, farmer-scientist interactions, and input distribution in collaboration with ICAR-Indian Institute of Horticultural Research. Special events such as World Food Day, and World Science Day further engaged schools, tribal communities, and local stakeholders, promoting biodiversity conservation and community empowerment.

203.6 PROSPECTS OF WILD AND CULTIVATED TUBERS IN ATTAINING NUTRITION AND LIVELIHOOD SECURITY

An effort was made to document and promote the nutritional and economic value of underutilised wild and cultivated tubers across seven districts of Kerala, with a focused intervention in Wayanad. A total of over 50 species and varieties were documented, including locally important varieties such as Inji Kachil, Gandhakashala, Neela Kachil, Kavala Kizhangu, and Noora.

Table 8: Training and other events

S No	Training/Event Topics	Participants
1	1 Day medical camp at Madamkunnu Tribal Settlement	46 (M16 F30)
2	1 Day World Food Day Programme	120 (M4 F116)
3	1 Day World Science Day Quiz	37 (M5 F32)
4	1 Day supportive camp for Vellarimala GVHSS	45 (M17 F28)
5	1 Day Farmers Scientist interaction programme	88 (M78 F10)
6	1 Day Training on terrarium making	18 (M5 F13)
7	1 Day Training on sustainable management of Non Timber Forest Produce	42 (M33 F9)
8	1 Day Training on conservation of plant genetic resources	31(M17 F14)
9	1 Day Farming agriculture model making	35 (M17 F18)
10	2 Days Bird watching	47 (M23 F24)
11	7 Days Training on Bag making and Soft skills for landslide affected Vellarimala Women	30 (M0 F30)
13	15 Days Biodiversity short course	15 (M2 F13)
14	1 Day Training programme on New varieties and improved technology from ICAR-IIHR	94 (M68 F26)

Table 9: Tuber species & varieties documented from Wayanad

S No	Tubers	Varieties
1	Cultivated Yams (Kachil)	19
	Dioscorea alata (Greater Yam)	16
	Dioscorea esculenta (Lesser Yam)	2
	Dioscorea bulbifera (Potato Yam)	1
2	Wild Yams (Kachil)	15
	Dioscorea pentaphylla	6
	Dioscorea hispida	1
	Dioscorea hamiltonii	2
	Dioscorea kalkaparashadii	1
	Dioscorea oppositifolia	1
	Dioscorea bulbifera	1
	Dioscorea tomentosa	1
	Dioscorea spp.	2
3	*Colocasia* and *Alocasia* (Chemb)	11
4	*Amorphophallus companulatus* (Elephant Foot Yam/Chena)	4
5	*Manihot esculenta* (Tapioca/Kappa)	6
6	Coleus & Sweet Potato	2 & 3

A tuber value chain mapping in Wayanad (Fig. 7) involving 71 tuber traders revealed that local processing is minimal, with most tubers being sold raw or sourced from neighbouring states like Karnataka. Elephant Foot Yam (EFY) emerged as the most traded tuber (over 4,100 tons annually), followed by *Colocasia* and *Dioscorea*.

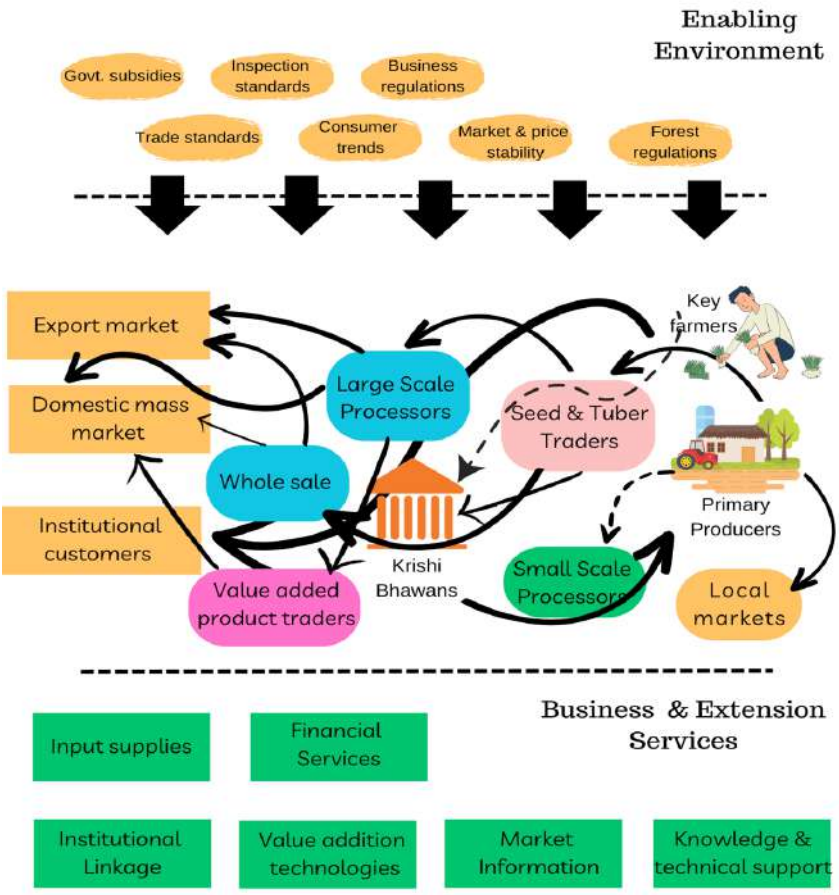


Figure 7: Market Map of Wayanad Tuber Value Chain

Further, a sensory analysis of 10 Dioscorea varieties showed that Gandhakashala Kachil scored highest in taste, aroma, and texture, followed by Inji Kachil and Neela Kachil, indicating their potential for wider promotion and culinary use.

Table 10: Sensory Analysis of Cultivated varieties of Dioscorea alata

S No.	Characteristics	Preference
1	Appearance	Neela Kachil > Gandhakashala > Inji Kachil
2	Colour	Neela Kachil > Gandhakashala > Inji Kachil
3	Aroma	Gandhakashala > Inji Kachil > Mullan Kachil
4	Taste	Gandhakashala > Inji Kachil > Mullan Kachil
5	Fibrosity	Gandhakashala > Inji Kachil > Neela Kachil
6	Texture	Gandhakashala > Neela Kachil > Mullan Kachil
7	Overall	Gandhakashala > Inji Kachil > Neela Kachil

A one-day Tuber Fest was also organised to understand consumer awareness & acceptability toward tubers and their value-added products with 54 participants from the tribal community, the public, officials, academicians, chefs, and students attending the fest. Twenty five tuber based recipes were documented, and an acceptability test for 15 recipes was conducted as part of the event. The results indicated the highest rated recipes are Kappa cutlet, followed by Kachil Payasam, Puzhukku, Kachil squash, Koorka Achaar, Ube pockets, Ube chia pudding, Avil Kappa, Madhur kizhanga gulab jamun, Kizhanga mixture, Kachil chapathi, Kappa upma, Chemb chips, Madhur kizhanga leaves pakora, Kappa puttu and Kappa bread roll.

203.7 BUILDING CLIMATE RESILIENT SOCIO ECOLOGICAL PRODUCTION LANDSCAPES

The project that provides information, knowledge, and skills in climate change mitigation, adaptation, and disaster preparedness at the Local Government's and community level with a focus on the Socio Ecological Production Landscapes (SEPLs) for achieving Carbon-Neutral Development in Sugandhagiri, a tribal village located in Pozhuthana Grama Panchayath (GP). A three-pronged approach has been adopted. First, formation and empowerment of Climate Warriors. Second, sensitising the local government authorities through meetings, trainings, and awareness programmes. Third, use of the mobile application – (NIRAVU) and technology-based interventions to mobilise youngsters and public towards climate-related real-time data sets. In the project, training and capacity-building programmes of various kinds have been organised for multiparty stakeholders, starting from students (5 programmes), farmers (4 programmes), and local administration (2 programmes). Climate Warriors were formed (9 women and 3 men) in the village, and they functioned as the local mobilisers and change makers. The activities of the project are implemented through them. Awareness programmes such as Zoonotic diseases and preventive measures, importance of soil and water conservation in connection with World Water Day, Venal Koottu—exclusively for school students and climate adaptive farming practices for farmers and students were taken up during the period. In addition to this, status assessment of the invasive alien species to the village agricultural ecosystem, bird diversity and odonates (dragonflies) diversity were also recorded and documented. The schools and educational institutions of the region were provided with training on disaster preparedness since the region is categorised as critically prone to natural disasters.

Another important activity taken up during the period was the promotion of the rare endemic and threatened (RET) plant species and indigenous tree species through various government programmes through the GOD Tree (Grow Our Dying Tree) campaign. In this connection, biodiversity augmentation programme was taken up for the sacred grove, namely Koottakkavu of Sugandhagiri village by planting RET species and GOD trees. A total of 36 tree species were planted in the sacred grove. In addition to that, the existing trees were scientifically labelled by fixing name boards in a participatory manner. In Aneri sacred grove, Pozhuthana GP, 65 RET and GOD trees were planted with the support of the Temple Protection Committee. Development of a mobile application (EbA-APP) by synthesising location-specific data in Agriculture and allied sectors, forestry and other land uses, transportation, energy, and waste management were also a part of the programme. Consequently, a mobile application, NIRAVU, has been developed that provides real-time climate information, agriculture practices, success stories for climate-resilient farming practices, land use changes and support services for farmers. The application has been transferred to farmers and local self-government authorities, and Disaster Management authorities.

Programme Summary

- Agroforestry and orchard development programmes expanded to 500 acres in Kolli Hills.
- Under agroecological interventions, 30 natural farms covering 45+ acres established in Kolli Hills.
- Annual turnover of Kolli Hills Agri-business Producer Company rose to ₹115 lakhs.
- Trained farmers in Koraput district, Odisha, produced 141.2 tonnes of quality paddy landrace seeds.
- Improved farming practices (paddy, maize, and vegetable cultivation in fallow fields) increased farmers' annual net income per acre from ₹30,000 to ₹50,000 in Odisha.
- 52 endemic orchids from the southern Western Ghats conserved in the M.S. Swaminathan Botanical Garden Orchidarium (Wayanad).
- 15,000 seedlings of 25 riparian tree species distributed for riverine protection in Wayanad.
- 32,600 seedlings of RET and medicinal plant species raised for ecological restoration programmes.
- Biodiversity Conservation Stewardship (6-month course) launched for young tribal women and men in Wayanad.
- Wayanad Community Seed Fest facilitated farmer exchanges of landrace seeds and traditional varieties.

PA300

BIOTECHNOLOGY

Evaluated the adoption of farmers' behaviour

in growing green manure in paddy fields to effectively manage soil health among 5000 farmers across Tamil Nadu

12

Pink Pigmented Facultative Methylotrophs identified and characterized from rice phyllosphere

94

rice accessions phenotyped for salinity tolerance

1500

farmers (40% women) trained in agroecological farming practices

Implementing biotechnological solutions for agriculture

50

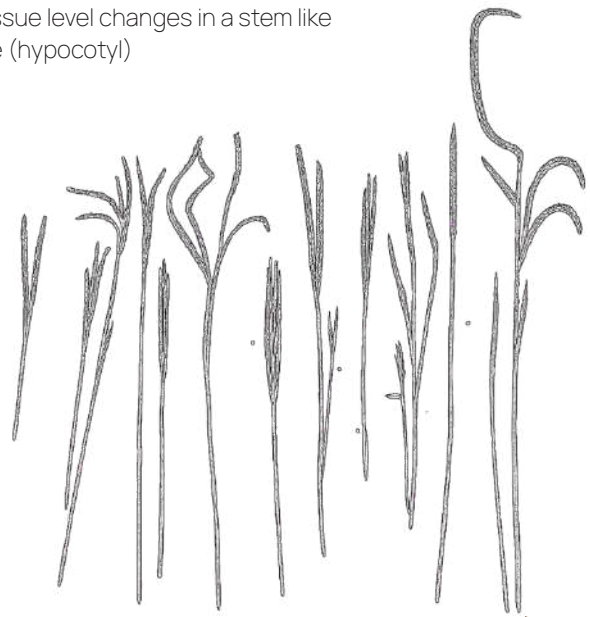
metagenomic datasets of microbial communities generated from 5 rice varieties

3

threshold settings determined for estimating rice root diameter classes using scanned images

New finding

Young mangrove seedlings straighten to upright themselves when disturbed from vertical position due to tissue level changes in a stem like structure (hypocotyl)



14

accessions of C3 and C4 crop species evaluated for tissue ion accumulation under salinity

BIOTECHNOLOGY

In 2024–2025, the programme advanced understanding of salinity stress in crops and its mitigation through plant and microbial innovations. Studies revealed Avicennia marina seedlings reorient upright via hypocotyl growth and root displacement. In rice, O.glaberrima showed poor salinity tolerance compared to O. sativa, with key HKT1;5 gene haplotypes linked to tolerance. Root architecture in landraces demonstrated genotype-specific plasticity. C4 millets exhibited superior sodium exclusion over C3 crops. Microbiome studies identified key plant-growth-promoting bacteria and methylotrophs enhancing drought resilience in rice. Agroecological interventions under SuATI and green manuring improved soil health, productivity, and farmer uptake, supporting sustainable, climate-resilient agriculture and microbiome-informed natural farming practices.

This programme focuses on understanding and mitigating the impacts of salinity, a major abiotic stress, on plant growth and development. This year, work on salinity-tolerant mangrove, *A. marina* seedlings, suggests rapid reorientation to an upright position occurs after displacement, largely due to hypocotyl base asymmetric growth (anti-gravitropic response) and tension wood formation. This reorientation is also influenced by root displacement to balance plant weight, suggesting inter-organ communication is essential for stability against tidal forces. The phenotyping for salinity in hydroponics shows that relative to Asian cultivated rice (*Oryza sativa*), African cultivated rice *(O. glaberrima)*, is sensitive to salinity, attributable to inferior sodium exclusion and potassium retention observed. Phenotyping for salinity in *O.sativa* identifies haplotypic combinations of the sodium transporter, *HKT1;5* gene, in rice accessions from the 3000-Rice genome dataset that are associated with salinity tolerance. In a different study, optimised methods were developed to analyse RSA in rice landraces. Significant genotype-dependent changes in crown root diameter and total second-order lateral root lengths were observed, highlighting RSA plasticity under stress. Finally, in a study comparing the role of C3 and C4 crop species in relation to salinity tolerance, C4 millet species demonstrated enhanced ability to control sodium delivery to shoots, suggesting superior sodium exclusion traits relative to C3 species.

The comparative microbiome profiling of traditional and cultivated rice varieties revealed the association of distinct core bacterial communities with key plant-growth-promoting and biocontrol traits. Notably, *Singulisphaera* spp. was the predominant PGPR spp. in Seeraga samba, while isolates like *Paenibacillus* spp. and *Burkholderia* spp.

were dominant in CO-55 and ADT 55, respectively. The Methylotrophic communities, especially *Methylorubrum* spp., isolated from BPT rice varieties, exhibited strong plant growth-promoting and drought-tolerant traits that significantly enhanced root/shoot growth, biomass, and chlorophyll content, a sustainable solution to boost rice productivity under stress. The study on Kodo millet grains revealed significant fungal contamination, including toxin-producing species like *Aspergillus flavus* and *Penicillium oxalicum*, linked to food safety concerns. Under the SuATI initiative in Madhya Pradesh, over 1,650 farmers adopted agroecological practices, leading to increased productivity, reduced cultivation costs, and improved benefit-cost ratios. ICT-enabled plant clinics, and the establishment of a Biological Resource and Knowledge Centre, is driving a farmer-led shift toward sustainable, chemical-free agriculture. The impact assessment of green manure scheme revealed improved soil nutrient levels, high seed germination rates, and strong farmer demand for timely and diversified green manure seed supply to maximise soil health and crop productivity. The new study focuses on the role of soil and rhizosphere communities in driving the microbiome dynamics and nutrient cycling in agroecological practices, particularly in the natural farming model, compared to conventional farming. The research aims to develop crop-specific strategies that enhance soil health and sustainable productivity.

301. ABIOTIC STRESS IN PLANTS

The research investigates salinity, which is a major abiotic stress focusing on the impact on plant growth, especially mangrove species and rice. Findings suggest that mangrove seedlings rapidly self-upright using unique hypocotyl differential growth and root displacement, demonstrating inter-organ communication for stability. Further, the studies also revealed that African rice is more salt-sensitive than Asian varieties due to poorer sodium exclusion, while specific *HKT1;5* gene haplotypes link to tolerance in Asian rice. Additionally, methods have been developed to analyse root architecture changes under salinity in rice. Comparative data show that C4 millet species have superior shoot sodium exclusion traits compared to C3 crops that may play a major role in salinity tolerance.

301.1 EXAMINING GROWTH RE-ORIENTATION IN *AVICENNIA MARINA* SEEDLINGS UPON DISPLACEMENT USING MORPHOMETRIC, SCANNING, AND CELL BIOLOGICAL APPROACHES

Mangrove species, like *A. marina*, have intricate root systems, which play a crucial role in anchoring the plant and slowing tidal waters, thereby promoting sediment buildup. Previously, we could distinguish three adventitious roots in *A. marina* seedlings, with a fixed angular arrangement (120° apart; largest diameters, R1>R2≈R3), apparent seven days after sowing, with root R1 being the largest and aligning with the plant axis.

This year, we focus on the contribution of hypocotyl and root tissues in reorienting the *A. marina* plant axis when displaced from a vertical position. This is particularly relevant for understanding seedling establishment in the face of tidal disturbances in their natural habitats. To investigate this, seven-day-old seedlings, initially grown perpendicular to the soil surface, were uprooted. Root R1 was identified and then either removed or left intact before replanting the seedling at approximately a 45° angle from the soil surface. This displacement was performed in all

four cardinal directions: North, South, East, and West (Fig. 8A).

Within 24–48 hours of displacement, the seedlings visibly righted themselves. This rapid re-establishment of an upright posture was partly attributable to a significant increase in diameter and bending of the hypocotyl base (shoot-hypocotyl junction), especially when compared to un-displaced seedlings (circled in yellow; Fig.8 B-E). Root displacement from the plant axis, measured two weeks later, also contributed to this reorientation. At the point where the hypocotyl was bent, differential lignin staining indicated the development of tension wood, which is crucial for structural support (Fig. 8F, left, marked by box). Further, strong gravitropic responses were evident in the hypocotyl, as seen by intense blue-black staining of amyloplasts in the hypocotyl endodermal tissue (Fig. 8F, right), is visible in contrast to un-displaced seedlings.

High-resolution scanning revealed interesting patterns in root diameters. Adventitious root diameters were significantly smaller in seedlings replanted in the East, West, and North directions compared to both un-displaced and South-displaced seedlings (Fig. 8G). Conversely, lateral root diameters showed an inverse relationship with adventitious roots (Fig. 8H). However, there were no significant differences in either the number of adventitious or lateral roots across any of the groups. These findings strongly suggest that the gravitropic responses of the hypocotyl tissues in *A. marina* are vital for realigning the plant with the vertical axis, thus restoring its upright position. The large cotyledons of *A. marina* and the observed root displacement away from the inclination direction also play a part in reorienting the plant axis and balancing its weight. This study highlights the hypocotyl as a critical organ for gravity sensing, with the formation of tension wood at the flexion point directly contributing to the plant "straightening" process. It also hints at a fascinating inter-organ communication between the hypocotyl and adventitious roots, working in concert to help *A. marina* seedlings recover an upright stance.

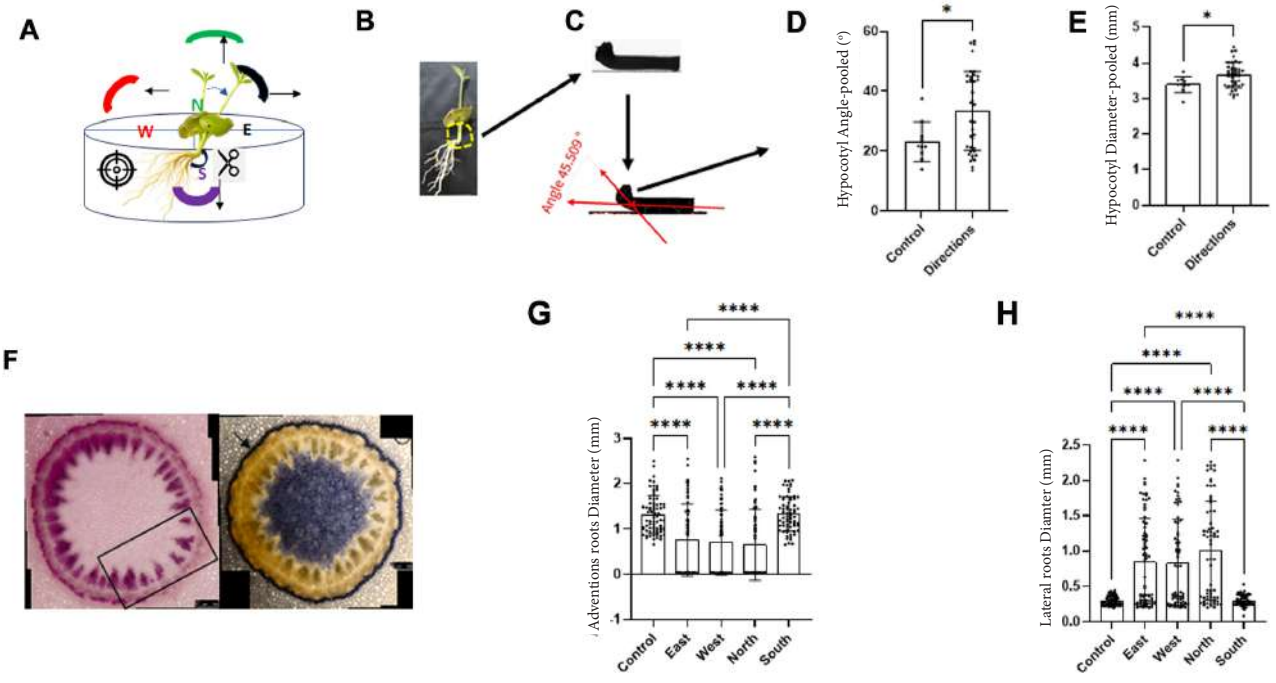


Figure 8: Examining growth re-orientation in Avicennia marina seedlings upon displacement using morphometric, scanning, and cell biological approaches

301.2 INVESTIGATING THE LINK BETWEEN SALINITY TOLERANCE IN AFRICAN AND ASIAN RICE ND THE ROLE OF THE *HKT1;*5 SODIUM TRANSPORTER GENE.

HKT1;5, a sodium transporter gene, is crucial for salinity tolerance in rice. This study investigated its role in both African (*Oryza glaberrima*) and Asian (*Oryza sativa*) cultivated rice, aiming to inform breeding strategies. Previous work isolated the HKT1;5 cDNA from *O. glaberrima* and studied its sodium transport properties. This research further involved phenotyping *O. glaberrima* alongside known salt-tolerant (FL478, Pokkali-4) and sensitive (IR28, Koshihikari) *O. sativa* varieties. Rice seedlings were subjected to increasing salinity stress (60 mM followed by 120 mM NaCl) for three weeks, and their tolerance was scored using the International Rice Research Institute's (IRRI) Standard Evaluation System (Fig. 9 A and B).

Results showed *O. glaberrima* to be highly salt-sensitive, while Koshihikari and IR28 were moderately tolerant, and FL478 and Pokkali-4 were tolerant (Fig. 9 C and D). Salt-tolerant varieties (FL478, Pokkali-4) maintained higher potassium (K^+) and lower sodium (Na^+) levels in their shoots. This Na^+ exclusion and K^+ retention are key salt tolerance mechanisms, vital for cellular function. In contrast, *O. glaberrima*, being highly sensitive, accumulated more Na^+ in both roots and shoots, suggesting its HKT1;5 transporter may be less efficient than in *O. sativa*. This highlights the importance of efficient Na^+ exclusion for salinity tolerance in rice.

In parallel, phenotyping studies on *O. sativa* genotypes were carried out to correlate possible impacts of Single Nucleotide Polymorphisms (SNPs) within the *HKT1;5* gene coding (H) and promoter (PH) regions. Previously, analyzing a publicly available re-sequenced dataset (3000-Rice Genome - 3K-RG) from IRRI, we had reported identifying 14 combined haplotypes (SNP combinations) potentially influencing HKT1;5 function in plants.

Ninety-four rice genotypes from the 3K-RG set, encompassing these 14 haplotypes, were phenotyped for salinity tolerance using the same protocol as for *O. glaberrima,* including FL478 (tolerant) and IR28 (sensitive) checks. Highly tolerant accessions were primarily associated with the H4+PH6 haplotype (also found in tolerant FL478) and H10+PH3 (present in salt-tolerant Pokkali rice). However, genotypes with the H10+PH3 haplotype exhibited considerable variability in tolerance, ranging from highly to moderately tolerant (66 %) to highly sensitive to moderately sensitive (34 %). Further analysis of tissue sodium and potassium levels in samples is needed to explain this variability, which may stem from differences in HKT1;5 expression (transcript or protein) or other genotype-specific factors. All the mentioned tolerant haplotypes above are from *indica* rice. In contrast, *japonica* accessions, represented by haplotypes H2+PH2, H2+PH5, and H7+PH8, generally showed moderate to high sensitivity to salinity. Tissue sodium and potassium estimations are now underway to clarify these observations further.

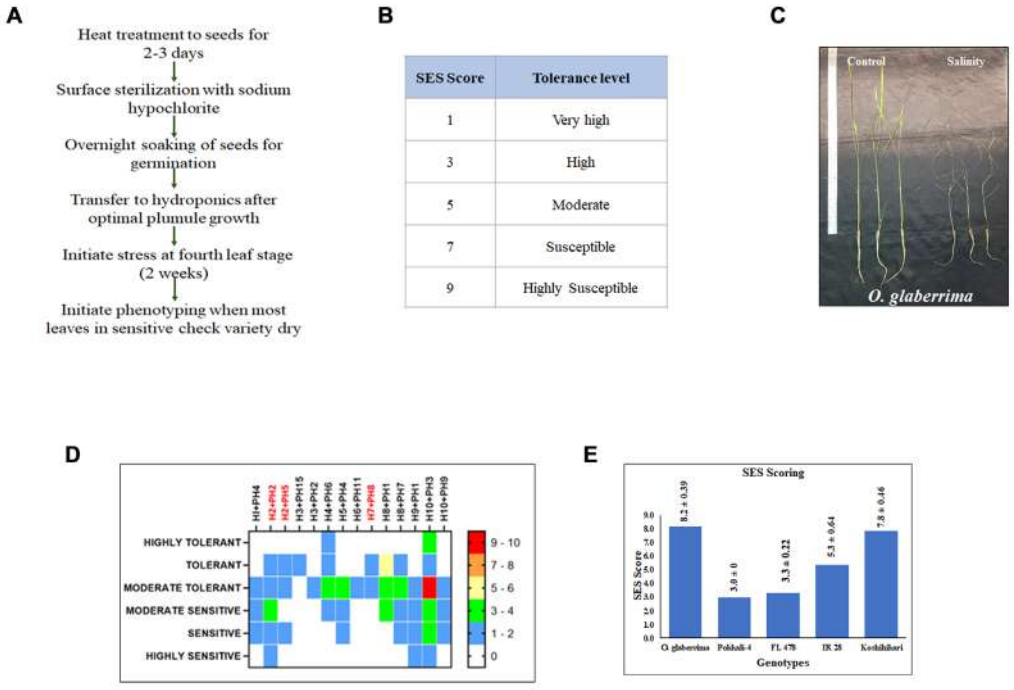


Figure 9: Investigating the link between salinity tolerance in African and Asian rice and the role of the HKT1;5 sodium transporter gene

301.3 OPTIMIZATION OF METHODOLOGY FOR MAPPING ROOT SYSTEM ARCHITECTURE RELATED CHANGES IN COASTAL RICE LANDRACES UNDER SALINITY

The Root System Architecture (RSA), the 3-dimensional arrangement of plant roots in soil, shows plasticity in response to environmental changes. This study investigated RSA alterations in rice landraces under salinity. Building on previous work optimizing soil-based RSA methods, this research focused on refining root scanning and image analysis using the open-source software, RhizoVision Explorer.

RhizoVision Explorer converts scanned greyscale root images to binary. This binary image is examined using different intensity thresholds (relative system of pixel classification). Differential thresholds are crucial for accurately estimating root diameters and lengths, especially for various root types in rice: nodal/crown roots (CRs), first-order lateral roots (FOLRs), and second-order lateral roots (SOLRs). Lower thresholds suffice for CRs, but higher settings are needed for FOLRs and SOLRs, which are often underestimated otherwise. Initial thresholding, validated with copper wires of defined diameters, was performed on hydroponically grown roots (less complex, easier to distinguish) and thresholds of 1,81, 200, and 225 were set for CRs, FOLRs, and SOLRs, respectively.

Rice seeds were surface-sterilised and germinated on petri plates. After two days (post-root emergence), uniformly grown seedlings were transferred to Polyvinyl Chloride (PVC) pipes. At the fourth leaf stage (21 days after germination), salinity stress was gradually imposed (60 mM, followed by 120 mM after two days). On day 35, seedling evaluation scores (SES) indicated salinity injury (IRRI, 2021). Growth measurements, including primary root and shoot lengths, leaf number, crown root number, and root, shoot fresh and dry weights, were recorded for untreated controls and treated plants (SES 7-9, ~35 DAG). Three genotypes were used: salt-tolerant Pallipuram Pokkali, Patnai-23, and salt-sensitive IR28 (Fig. 10A). Genotype-dependent differences in root fresh and dry weights were noted. Roots were washed (Fig. 10B), CRs were individually cut

and scanned to prevent overlap-induced under- or overestimation of root diameters (Fig. 10C). Analysis revealed significant genotype-dependent changes in crown root diameter and total SOLR lengths under salinity (Fig. 10D-E). Our data suggests that RSA is altered under salinity in rice and can be captured using scanning methods. Using the method optimised above, a larger set of rice landraces will be mapped for RSA changes under salinity.

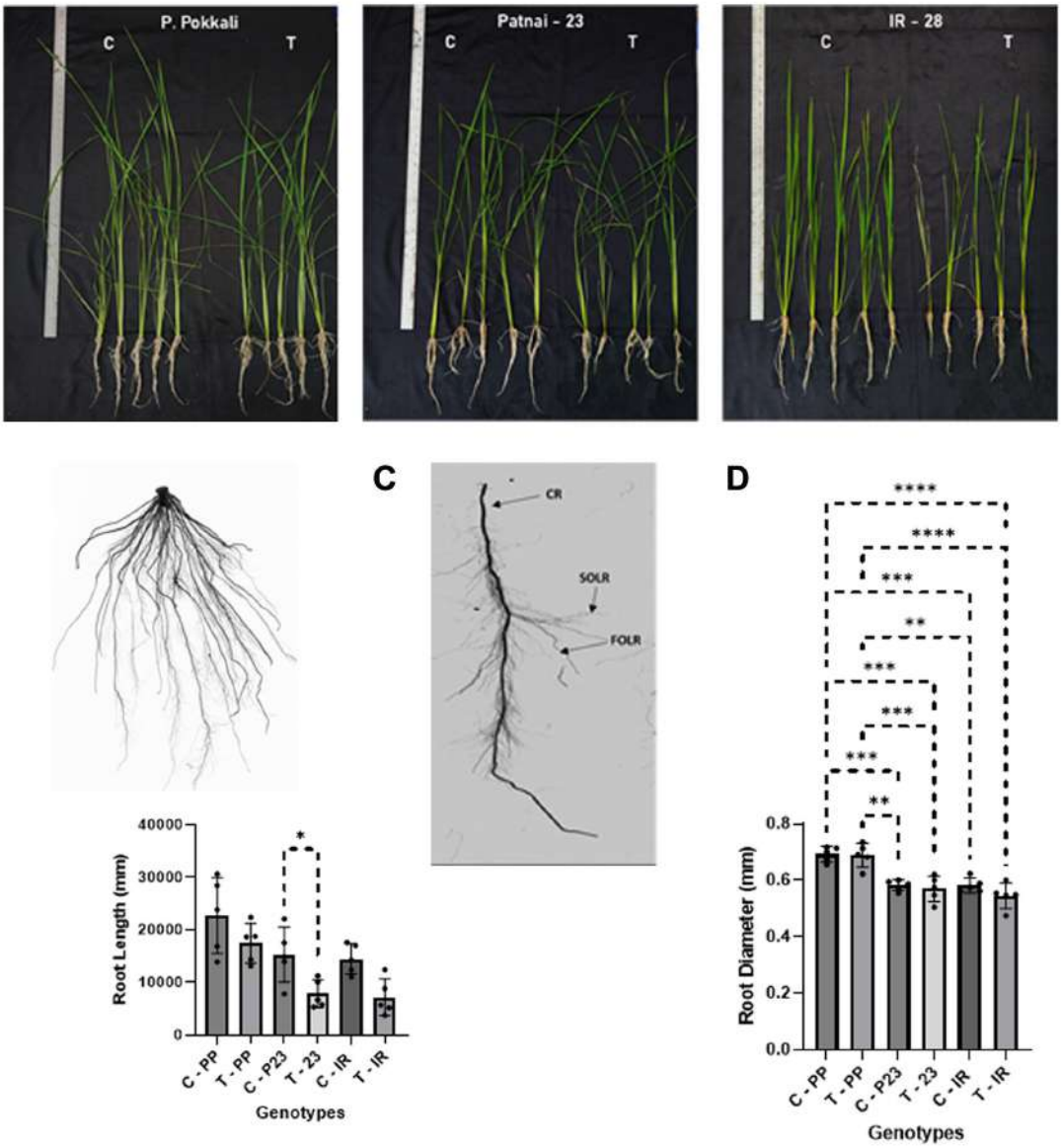


Figure 10: Optimization of methodology for mapping root system architecture related changes in coastal rice landraces under salinity

301.4 COMPARATIVE ANALYSIS OF SODIUM ACCUMULATION IN TISSUES OF C4 AND C3 SPECIES UNDER SALINITY

C3 and C4 plants differ in their initial carbon fixation pathway during photosynthesis. C3 plants produce a 3-carbon compound first, while C4 plants initially form a 4-carbon compound. All millets constitute C4 species, while monocots like rice and barley constitute C3 species. The overall objectives of the project were to comparatively examine salinity tolerance of C4 (pearl millet, finger millet, and barnyard millet; abbreviated as PM, FM and BM, respectively) and C3 (barley; abbreviated B) species using physiological, molecular and anatomical methods. Previously, comparative salinity tolerance assessments for C3 and C4 species were carried out under three

experimental conditions (0, 150, 250 mM NaCl) and tolerant and sensitive accessions for each species identified.

This year sodium (Na+), potassium (K+) ion estimations were made in each case for the youngest leaf (top leaf-TL) remaining shoot tissue and roots (Fig. 11 A). The data shows that stronger controls are operational in top leaves of C4 species relative to C3 species, limiting sodium accumulation under salinity. This probably contributes towards positive outcomes for photosynthesis. Thus, barley C3 shows increased top leaf Na+ content under salinity versus the examined C4 species. All species, that is, whether C3 or C4 show significantly elevated Na+ content in remaining shoot tissue under salinity. However, under both control (unsalinised) and treated conditions, C3 (barley) shows significantly higher Na+ content in the rest of the shoot compared to all the C4 species in this study (Fig. 11B). This suggests that C4 species have better control of sodium delivery to both the top leaf and lower leaves under salinity compared to C3 (barley) species. The ability to exclude sodium from shoot tissues under salinity is called shoot 'exclusion' of sodium and is a major mechanism of salt tolerance in cereal species. The data above suggests that C4 species have significantly superior ability to 'exclude' sodium from photosynthesizing tissues (shoot) and are therefore more salt tolerant relative to C3 species. In all cases except FM, shoot and root sodium were positively correlated under salinity (Fig. 11C).

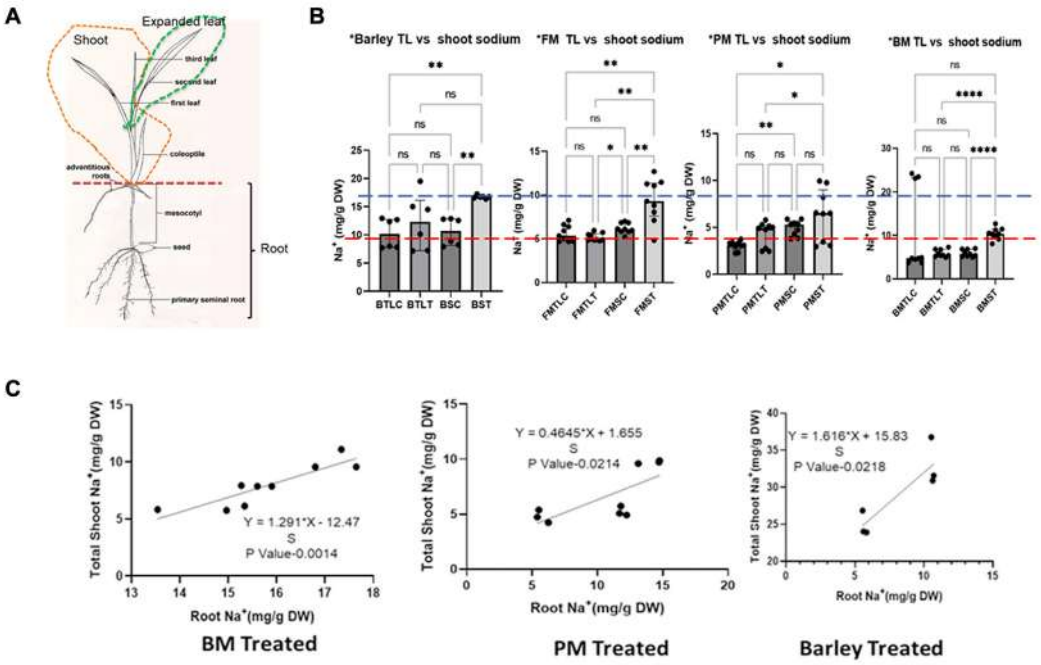


Figure 11: Comparative analysis of sodium accumulation in tissues of C4 and C3 species under salinity

302. RESEARCH HIGHLIGHTS ON PLANT-MICROBE INTERACTIONS, AGROECOLOGICAL PRACTICES, AND SUSTAINABLE AGRICULTURE

This programme presents key research in plant-microbe interactions, microbial community dynamics, and adopting agroecological practices that enhance soil health and crop productivity. The culturable and metagenomic diversity associated with traditional and cultivated paddy varieties revealed a significant difference across traditional and cultivars. Exploring the diversity of the fungal

species responsible for aflatoxin contamination in kodo millet, 13 different pathogenic isolates were identified. Continuation of the integration of microbial inputs and ecological farming methods to improve yield, reduce chemical dependency, and support climate resilience, thus contributing to developing sustainable and resilient ag ricultural systems.

302.1 EXPLORING THE RICE MICROBIOME OF TRADITIONAL AND CULTIVATED RICE VARIETIES

Last year, research focused on a comparative analysis of the total bacteriome of the rhizosphere soil, root and stem of *Rhizoctonia solani* infected rice varieties compared to healthy plants. This year, the research focused on the comparative studies of core microbiome distribution of 4 rice varieties, one traditional – Seeraga samba and 3 cultivars: Dular, ADT 55, and CO 55 and their different plants-rice rhizospheric soil, root, and aerial stem.

The plant microbiome, a dynamic and symbiotic microbial consortium, holds significant promise for enhancing crop productivity and sustainability. Understanding the diversity and functional properties of the microbiome will help in unveiling the role of the different bacterial communities and their functions. A comprehensive study was conducted using both culturable and metagenomic approaches to analyse the microbiomes associated with cultivated (Dular, ADT 55) and traditional (Seeraga samba, Karuppu kavuni) rice varieties. A diverse range of bacterial genera were identified, with *Acinetobacter pittii, Microbacterium saperdae, Delftia tsuruhatensis, Enterobacter quasiroggenkampii, Enterobacter sichuanensis, Flavobacterium acidificum, Enterobacter cancerogenus, Pseudomonas aeruginosa, Enterobacter asburiae*, and *Serratia nematodiphila* being the predominant groups. These isolates exhibited multiple plant growth-promoting traits such as nutrient solubilization, phytohormone production, nitrogen fixation, biocontrol activity, and abiotic stress tolerance. Nearly 40 bacterial isolates were identified using 16S rDNA sequence analysis, and a Plant Growth Promoting Rhizobacteria (PGPR) trait was recorded. The metagenomic data obtained from these experiments provided valuable insights into the microbial diversity, distribution, abundance, and richness associated with the different rice varieties. While comparing the genus-level classification of bacteria among 4 rice varieties the *Bacillus, Cystobacter, Singulisphaera, Exiguobacterium, Microbacterium,* and *Calothrix* communities were the most prevalent across all rice varieties, with notable enrichment of *Singulisphaera* (OTU 4045) in Seeraga samba. The Genus-level analysis showed a dominance of PGPR bacteria such as *Exiguobacterium* and *Paenibacillus* in CO55 and Dular rice variety, potentially linked to nutrient mobilization and production of phytohormone IAA. Similarly, the abundance of biocontrol bacteria, such as *Bacillus, Erwinia, Lysobacter, Enterobacter, Burkholderia,* and *Bradyrhizobium*, was distributed across all rice varieties, with high Operational Taxonomic Units (OUT) (3874) of *Burkholderia* in the ADT 55. Thus, a significant difference in the diversity and distribution of the different bacterial communities was observed. (Fig. 12).

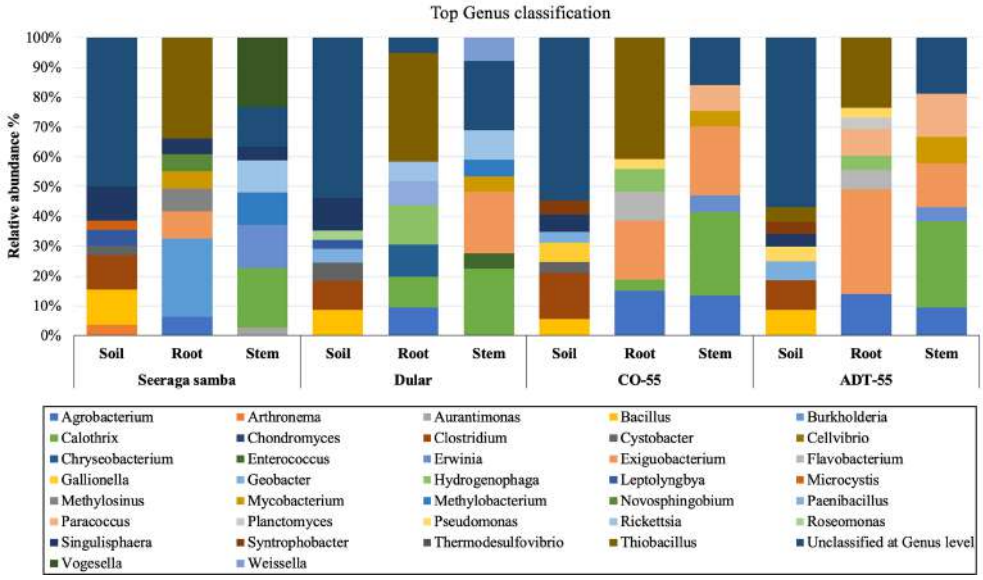


Figure 12: Comparison of the metagenomic diversity of the different rice varieties

302.2 UNDERSTANDING THE DIVERSITY OF THE METHYLOTROPHS IN RICE ECOSYSTEMS

Understanding the methylotrophic communities associated with traditional rice varieties—Karuppukavuni and BPT (cultivar)—was initiated this year, and *Methylorubrum* was identified as a prominent genus. Around 12 diverse methylotrophs were isolated using methanol-amended enrichment and adaptation procedure (Fig. 13 A). These communities exhibited plant growth-promoting (PGP) traits and drought tolerance. Currently, exploring the methylotrophic communities associated with other rice varieties is underway.

The diversity of the Pink Pigmented Facultative Methylotrophs (PPFMs), primarily from the genus *Methylobacterium*, associated with the rice ecosystem was extensively studied. The PPFMs exhibit diverse roles, including plant growth promotion, bioremediation, and methane utilisation. These bacterial communities utilise single-carbon compounds like methanol, formate, formaldehyde, and methyl amines, as well as multi-carbon substrates for growth and energy. A few strains of methylotrophs can also oxidise both methane and methanol as an energy source. Additionally, they possess PGPR traits that include nitrogen fixation, phosphate solubilization, phytohormones production, ACC deaminase activity, siderophore and ammonia production, and biocontrol against *R. solani* capabilities (Fig. 13 B). Significantly, methylotrophs can reduce methane emissions by upto 57–68% at various growth stages of rice. The methylotrophs such as *Methylorubrum rhodinum* (MSSRFCR208), *Methylorubrum aminovorans* (MSSRFCR219), *Methylorubrum thiocyanatum* (MSSRFCR215), *Methylorubrum salsuginis* (MSSRFCR213), and *Methylorubrum populi* (MSSRFCR214) isolated and identified in this study showed strong drought tolerance and PGPR traits. *In vitro* drought tolerance assays in BPT rice variety revealed that PPFMs-treated seeds showed a 76% increase in root and shoot length and a 13% increase in biomass under drought stress. Chlorophyll content was significantly higher in MSSRFCCB219 treated plants (e.g., Chl *a* = 22.1 µg/ml, Chl *b* = 9.1 µg/ml) compared to controls (Chl *a* = 12.5 µg/ml, Chl *b* = 4.4 µg/ml). The elevated chlorophyll content observed in the PGPR–treated plant strongly indicates the enhanced photosynthetic efficiency, nutrient assimilation, and overall plant productivity. Thus, these improvements support the role of PGPR as an effective biofertilizer in sustainable crop management.

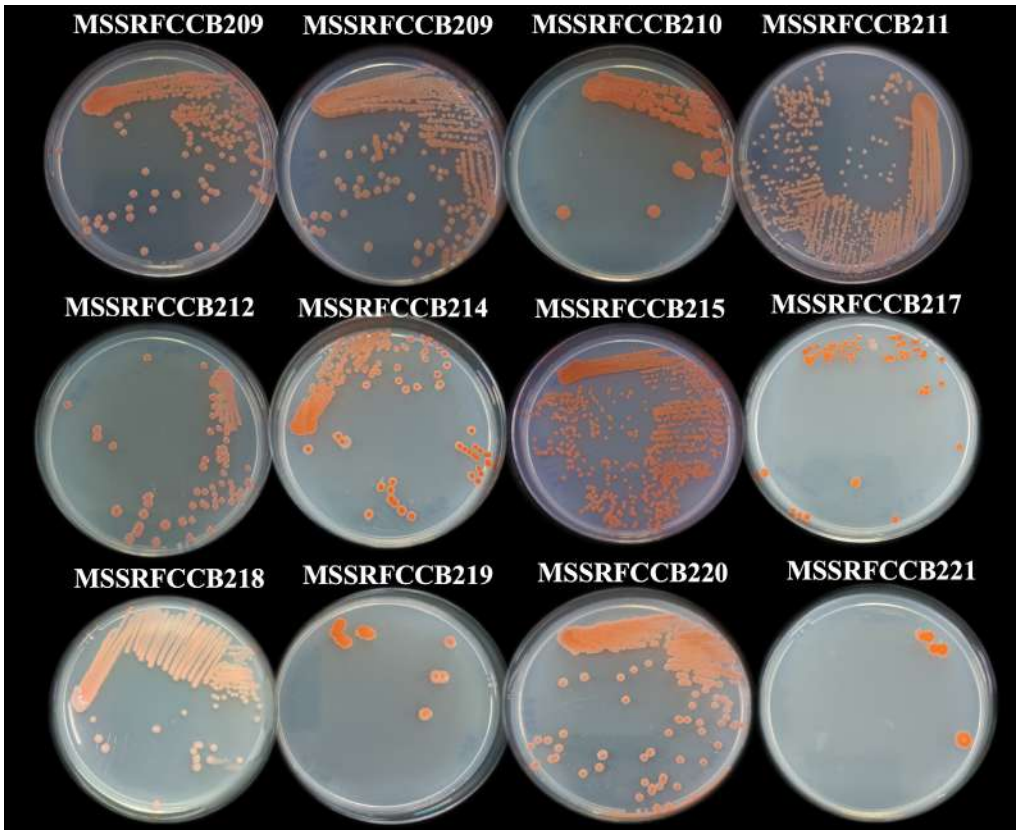


Figure13a: Methylorubrum diversity

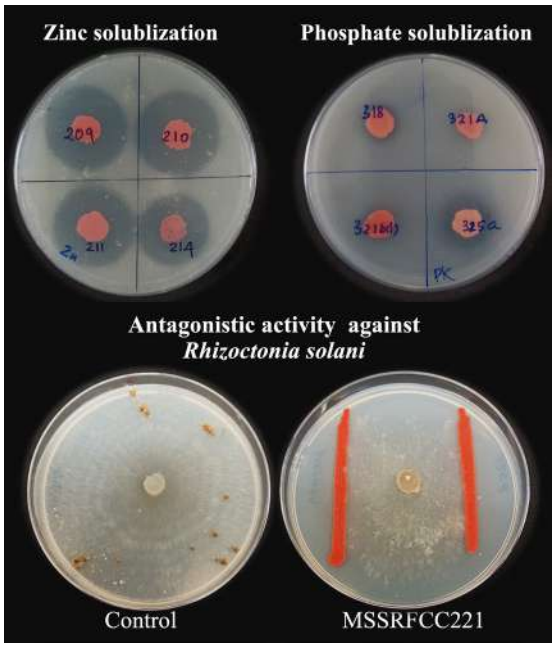


Figure13b: Biocontrol efficiency of Methylotrophs

302.3 EXPLORATORY STUDY ON FUNGAL TOXIN CONTAMINATION IN KODO MILLET

Kodo millet (*Paspalum scrobiculatum*), a drought-resilient and nutritionally rich small millet, is traditionally cultivated in rain-fed regions and consumed across different states of India. Throughout the year, adverse environmental conditions such as increased humidity and

unseasonal rainfall led to a marked rise in fungal contamination of grains at the field level, impacting overall yield quality and necessitating enhanced monitoring and mitigation efforts, also raising food safety concerns. Field-level contamination by toxin-producing fungi such as *Aspergillus flavus* and *Penicillium oxalicum*, producing cyclopiazonic acid (CPA), has been reported, including the recent incident of the death of 10 elephants in Madhya Pradesh due to CPA contaminated grains. Hence, the current study aimed to explore fungal diversity associated with kodo millet grain samples collected from three districts in Tamil Nadu. Fungal diversity was studied following moisture, seed, and seed grinding methods. A total of 35 fungal strains were isolated and taxonomically identified through Internal Transcribed Spacer region sequencing. Species included *Fusarium verticillioides, Curvularia lunata, Lasiodiplodia pseudotheobromae, Aspergillus flavus,* and *Penicillium oxalicum* (Fig. 14 B). Ongoing research involves mapping CPA biosynthesis genes *(maoA, dmaT, pks-nrps),* and planned activities include genomic analyses, biocontrol assays, and LC-MS toxin profiling. The findings from this study provide critical insights into the contamination of CPA producing fungus associated with kodo millet grain and its diversity. The work has the potential to ensure contamination free grains through targeted biocontrol strategies.

Figure 14a: Infected Kodo millet panicle

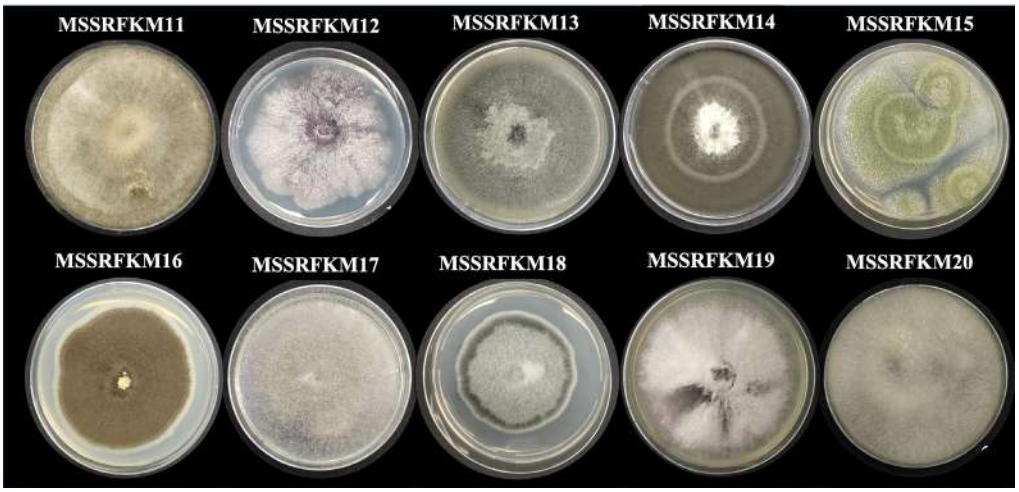


Figure 14b: Diversity of fungal isolates from panicles

302.4 AGROECOLOGICAL TRANSFORMATION: SUATI

The Support to Agroecological Transformation Processes in India (SuATI), is an initiative of GIZ (Gesellschaftfür Internationale Zusammenarbeit) to create sustainable and climate-resilient agriculture landscapes adopting the principles of agroecological farming. It is being implemented across 10 villages in Sagar District, Madhya Pradesh. The focus is to strengthen the capacity of the small and marginal farmers to adopt agroecological approaches. On-farm demonstrations using natural farming in green gram, groundnut and okra were carried out in 20 hectares with 1,850 trained farmers. Knowledge products such as a package of practices for 16 crops, and fact sheets on crop and soil health management were developed and shared with farmers. 1,650 farmers were trained in agroecological practices in 95 training sessions, covering preparation and application of microbial and biological input, diagnosis of pest and diseases through plant clinics and management practices. Around 500 farmers (25% women) from 10 villages were trained in ICT-based plant health management through plant clinic sessions. These champion farmers adopted 90% of agroecological practices in soil and crop health, adopting non-chemical methods. The adoption of the agroecological practices resulted in 7% increase in productivity, a 15% reduction in the cost of cultivation, and a significant shift in the benefit-cost ratio for green gram by 1:3.1 compared to conventional practices. To institutionalise and sustain these efforts, a Biological Resource and Knowledge Centre is being established in Pappat village. This centre integrates scientific knowledge, digital tools, and local farmers' leadership that promotes adoption of the agroecological practice.

302.5 IMPACT ASSESSMENT OF GREEN MANURING SCHEME

The Tamil Nadu Chief Minister's *Mannuyir Kaathu Mannuyir Kaappom* Scheme has been implemented in Tamil Nadu through the Department of Agriculture to improve the soil health. Under this scheme, green manure seeds were supplied to 2 lakh farmers across 34 districts in Tamil Nadu. The impact assessment across 34 districts (51,182 respondents) was carried out. The key results are 82% of the farmers have been practising green manuring practice in the last five years; 99% of them found that the scheme was beneficial; 97% of them reported that the seeds supplied were of good quality with germination rates >60%. The soil nutrient profiles of the samples collected from Tiruvallur showed enhanced nutrient levels: nitrate (49.48 mg/kg), phosphorus (32.60 mg/kg), potassium (147 mg/kg), and iron (78.59 mg/kg), compared to the conventional field. This practice of green manure application is largely adopted for paddy cultivation by 4,230 farmers, followed by 102 farmers for groundnut, 58 farmers for coconut and 33 farmers for maize. If green manure seeds were made available for farmers in time, farmers would be willing to adopt them for the management of soil health. The choices of the species expressed by the farmers are *Sesbania aculeata, Crotalaria juncea, Tephrosia purpuria*, also known as Kozhinji in Tamil. Around 99% of the 5,168 farmers responded that the green manure distribution scheme was beneficial for soil health improvement. This strong positive response reflects the scheme's effectiveness in improving soil fertility, enhancing crop yield, and reducing input costs.

302.6 SOIL MICROBIOME DYNAMICS, UTRIENT PROPERTIES AND CROP PRODUCTIVITY IN AGRO- ECOLOGY FARMING SYSTEMS

Agro-Ecological Farming practices (AEF), supported by *Rythu Sadhikara Samstha (RySS)*, promoted sustainable and resilient agriculture by enhancing biodiversity, soil health, and resource

use efficiency. The Andhra Pradesh Community Managed Natural Farming model exemplifies this shift through its community-led, chemical-free approach based on nine ecological principles. Despite AEF's benefits, limited knowledge exists on its impact on soil and rhizosphere microbiomes compared to conventional practices. The APCNF model is built upon nine core principles: (i) maintaining year-round soil cover with diverse crops (365 days), (ii) cultivating 9–18 diverse crops in a season; (iii) minimising soil disturbance—no tillage, (iv) using bio-stimulants as catalysts, (v) promoting indigenous seed varieties, (vi) integrating farm animals for nutrient cycling, (vii) increasing crop and organic residues to enrich the soil, (viii) practicing Integrated Disease Management (IDM) with botanical extracts, and (ix) eliminating synthetic fertilisers, pesticides, and herbicides. This research aims to explore microbiome dynamics and nutrient cycling in AEF *vs.* conventional systems to support crop-specific strategies for improved soil health. Different crops host distinct microbiomes based on their nutritional needs and growth habits, highlighting the need to tailor AEF practices to crop-specific microbiome interactions to sustain soil health and productivity. The focus is to understand and compare the paradigm shift in soil microbiome communities and their functional annotation in agroecological and conventional farming practices.

Programme Summary

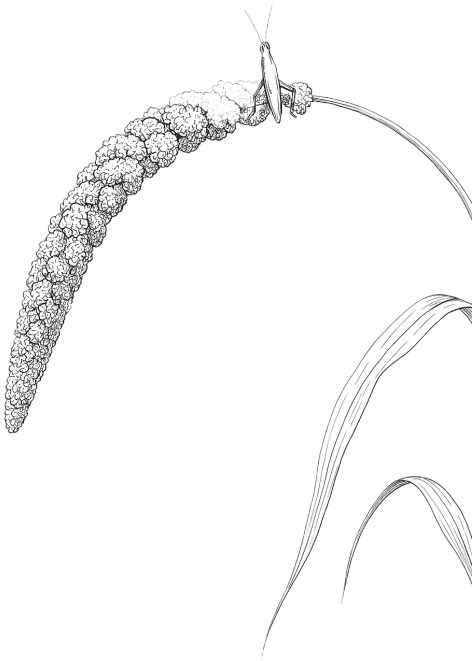
- A study on salinity-tolerant mangrove, *A. marina* seedlings, suggests rapid reorientation to an upright position occurs after displacement, largely due to hypocotyl base asymmetric growth (anti-gravitropic response) and tension wood formation. This reorientation is also influenced by root displacement to balance plant weight, suggesting inter-organ communication is essential for stability against tidal forces.
- A study on phenotyping for salinity in hydroponics shows that, relative to Asian cultivated rice (*O. sativa*), African cultivated rice (*O. glaberrima*) is sensitive to salinity, attributable to inferior sodium exclusion and potassium retention. Phenotyping for salinity in *O. sativa* identifies haplotypic combinations of the sodium transporter, HKT1;5 gene, in rice accessions from the 3000-Rice genome dataset that are associated with salinity tolerance.
- Phenotyping for salinity in hydroponics shows that relative to Asian cultivated rice (*O. sativa*), African cultivated rice (*O. glaberrima*), is sensitive to salinity, attributable to inferior sodium exclusion and potassium retention observed. Phenotyping for salinity in *O. sativa* identifies haplotypic combinations of the sodium transporter, HKT1;5 gene, in rice accession from the 3000-Rice genome dataset that are associated with salinity tolerance.
- Study on root system architecture (RSA) in rice landraces developed optimised methods for RSA analysis. Significant genotype-dependent changes in crown root diameter and total second-order lateral root lengths were observed, highlighting RSA plasticity under stress.
- A study comparing the role of C3 and C4 crop species in relation to salinity tolerance found that C4 millet species demonstrated enhanced ability to control sodium delivery to shoots, suggesting superior sodium exclusion traits relative to C3 species.
- Comparative microbiome profiling of traditional and cultivated rice varieties revealed the association of distinct core bacterial communities with key plant-growth-promoting and

biocontrol traits. Notably, *Singulisphaera* spp. was the predominant PGPR spp. in Seeraga samba, while isolates like *Paenibacillus* spp. and *Burkholderia* spp. were dominant in CO-55 and ADT 55, respectively.

- Methylotrophic communities, especially *Methylorubrum* spp., isolated from BPT rice varieties, exhibited strong plant growth-promoting and drought-tolerant traits that significantly enhanced root/shoot growth, biomass, and chlorophyll content, a sustainable solution to boost rice productivity under stress.
- The study on Kodo millet grains is an ongoing investigation looking at fungal contamination, including toxin-producing species like *Aspergillus flavus* and *Penicillium oxalicum* that are linked to food safety concerns.
- Under the SuATI initiative in Madhya Pradesh, over 1,650 farmers adopted agroecological practices, leading to increased productivity, reduced cultivation costs, and improved benefit-cost ratios. ICT-enabled plant clinics, and the establishment of a Biological Resource and Knowledge Centre are driving a farmer-led shift toward sustainable, chemical-free agriculture.
- The TNCMs MKMKS green manure scheme revealed improved soil nutrient levels, high seed germination rates, and strong farmer demand for timely and diversified green manure seed supply to maximise soil health and crop productivity.
- The study on the role of soil and rhizosphere communities in driving the microbiome dynamics and nutrient cycling in AEF practices, particularly the APCNF model, compared to conventional farming. The research aims to develop crop-specific strategies that enhance soil health and sustainable productivity.

PA400

ECOTECHNOLOGY



2.92 Lakh

farmers (51% women) gained access to technology, knowledge and skills in good agricultural practices.

Combining technology with ecological solutions

Nallavur FPO

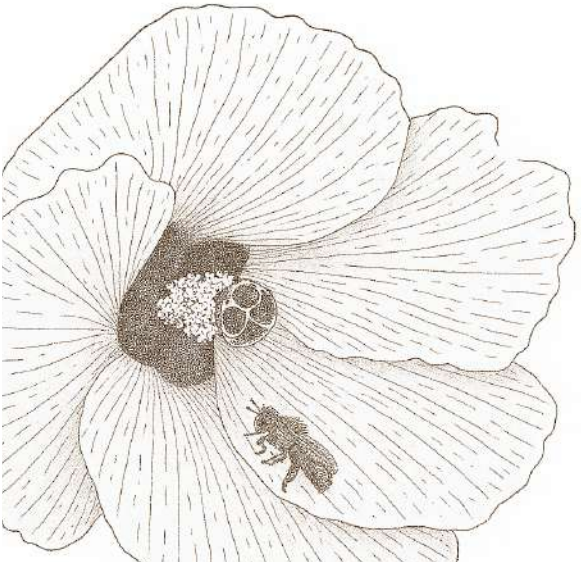
Nallavur FPO has been awarded First Place in the FPO Turnover Category by NABARD.

18 Virtual Village Knowledge hubs were established in climate hotspots of Odisha and Assam

21,600 farmers accessed information and advisories

25

climate resilient measures demonstrated to build resilience in common/ public land and agriculture sectors under MGNREGS



3,135

GIS -based GP Development plans - Facilitated in preparing 3,135 GIS-based Gram Panchayat Development Plans for water security and climate adaptation as per the guidelines of the Ministry of Rural Development, GoI

₹2 crore

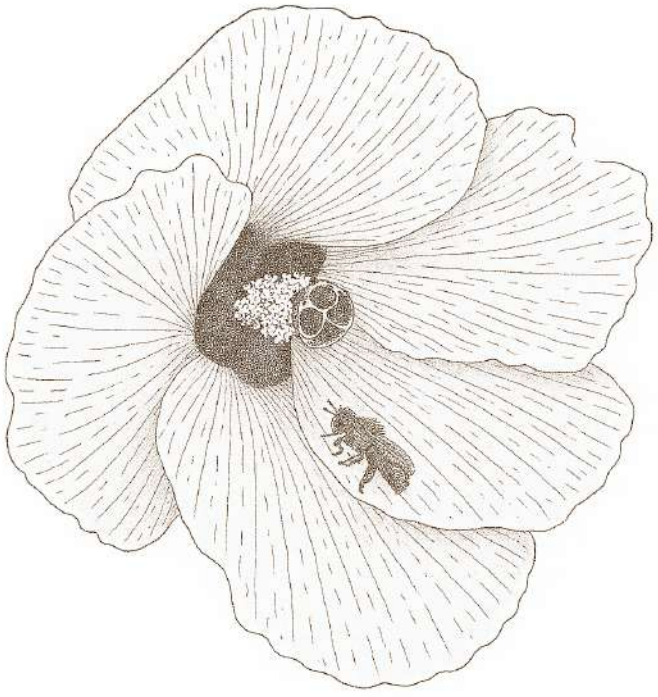
annual turnover reached by three FPOs. Facilitated seven FPOs with ~10,000 small farmers, of which approximately 55% are women. Enhanced the role of women directors in governance and major decision-making across these FPOs, ensuring inclusive leadership.

9 Bioinput Resource Centres were established to promote sustainable Cotton production among

2000 farmers

300+

Community Seed Banks (CSB) were mapped and created their profiles, and a CSB Atlas of India was developed



FPO Digitization

7 FPOs have adopted the ERP system, a financial platform that helps record day-to-day transactions and generate financial reports. FPOs have also registered on the ONDC platform for business expansion.

40,000

farmers realised an increase in yields up to 25% and reduced costs up to 30% while adopting climate smart agriculture practices. This was complemented by accessing advisories through digital tools and plant clinics

ECOTECHNOLOGY

In 2024–2025, through the programme, more than 15,000 farmers gained access to productive resources through farmer producer collectives and bio-input resource centres. In collaboration with the Department of Rural Development, 3,135 GIS-based water security plans were completed, supported by a mobile app for field-level verification. In Maharashtra and Gujarat, 150 farmers were trained in eco-friendly pest management for cotton and set up decentralised bio-input units. Water-saving methods were promoted across 546 ha. ICT-based agro-advisories improved yields for over 40,000 farmers. MobiMOOC training in crop and livestock management reached 3,000 farmers (30% women). Over 300 Community Seed Banks were mapped, with a national atlas and web portal created.

The Ecotechnology Programme Area strengthened science-society linkages by promoting sustainable livelihoods and participatory technology adoption and dissemination. Seven farmer producer organisations spread across different agroecological zones in three states, supported more than 10,000 farmers by facilitating access to productive resources and services. Digital tools further extended access to information and skills to 1.98 lakh farmers. The programme prioritised climate resilience approach through agro-advisories and climate-smart agriculture, significantly boosting adoption rates among farmers. Initiatives such as bio-input production centres contributed to both economic and environmental sustainability. Water conservation efforts, addressing both demand and supply sides, included practices like alternate wetting and drying and direct seeding in rice on demand side. Over 3,135 gram panchayat-based water security development plans were prepared for 10 districts from five states. The community level of empowerment was advanced through women-led enterprises in self-help groups (SHG's), information dissemination via Village Knowledge Centres (VKC's), plant clinics, and agro-advisories. These efforts contributed to reduce the pesticide use and increased farmer incomes. Gender integration was central to the programme, reaching over more than half of the women farmers. These women adopted climate-smart agricultural practices and actively participated in decision-making processes. A new initiative was launched to map community Seed Banks across the country, aiming to strengthen farmer-managed seed systems. By combining agroecological models, digital outreach, and inclusive approaches, the programme delivered scalable solutions for sustainable agriculture, climate resilience, and equitable development—aligning with national goals.

401. SUSTAINABLE LIVELIHOODS AND GRASSROOT INSTITUTIONS

401.1 COASTAL AGROECOSYSTEMS: MANNADIPET REGION, PUDUCHERRY

The Bio village initiative promotes eco-friendly practices and sustainable livelihoods to minimise environmental impact in rural communities. During the reporting period, two tonnes and 500 litres of bio-input, including *Pseudomonas, Bacillus*, Panchakavya, Agniasthiram, Fish amino acid, Neem seed derivatives, and plant extracts, were produced and distributed through the FPO to local farmers. With the support of CIMMYT (International Maize and Wheat Improvement Centre), two online courses were developed on "Production of Panchakavya" and "Preparation of Fish Amino acid" to support the organic farming in Puducherry. A total of 39 plant clinics were organised across 15 villages, with 496 farmers (177 men and 319 women) receiving expert guidance on soil health and eco-friendly farming methods. Eleven video conferences were held, including ten on 'Nutritional Literacy' and one on 'Rural Women's Day', engaging 194 participants (16 men and 178 women). In addition, 30 training and awareness programmes were conducted at the Bio Village Resource Centre, covering digital marketing, Integrated Pest Management for eco-safe vegetable production, honeybee cultivation, and agricultural digital tools benefitting 801 participants (265 men and 536 women). More than 200 farmer queries were addressed through these online programmes.

To foster sustainable livelihoods, a cluster-based approach was adopted to enhance 190 women SHGs financial access, establishing four active clusters in Kunichampet, Pillaiyarkuppam, Mangalam, and Sethanatham villages, each with over 70 groups. A key milestone was the signing of an MoU with Puduvai Bharathiyar Grama Bank to promote credit linkages. Joint Liability Groups (JLGs) were formed to facilitate financing for farming, dairy, and non-farm enterprises. The centre also organised livelihood development training programmes tailored to FPO and SHG members, including skill-building for rural youth through SAMETI, tailoring, livestock management, value addition, and digital tools for agriculture. The all-women FPO, Innuyir Grama Sangha Women Farmer Producer Organisation, actively procured groundnut and neem seeds from farmers, processed them into oil and other value-added products, and marketed them, successfully demonstrating the viability of community-led value chains. The FPO mainly concentrated on Groundnut, Gingelly and Moringa value-added products and kernels. This year, the turnover during year 2024–2025 is ₹27 lakhs.

Pasumai Farmer Producer Company Limited

Pasumai Farmer Producer Company Limited (PFPCL) recorded significant growth during the fiscal year 2024–2025, marked by a ₹20.6 lakh increase in turnover and a notable expansion in its shareholder base. A key contributor was the grocery business, which generated ₹8.78 lakhs through the distribution of 255 grocery kits during Deepavali and Pongal. Strengthening its outreach, PFPCL signed an MoU with Pandit Jawaharlal Nehru College of Agriculture and Research Institute to promote agricultural technologies through demonstrations, training, exposure visits, and on-farm trials. The organisation also conducted an FPO awareness training in Vinayagampet village, where 156 participants from six villages, including many women farmers, attended. This led to the addition of 76 new shareholders, reflecting the growing trust and participation in the company.

To ensure financial transparency and operational

efficiency, two books of accounts training sessions were conducted for 32 farmers' producer groups, aimed at fostering transparency and responsible financial management among the shareholders. Furthermore, six board of directors' meetings were convened to streamline business operations and enhance the capacity of the board members. In support of crop cultivation, PFPCL distributed ₹28.40 lakhs in loans to 146 members for black gram and groundnut cultivation, along with 366 kg of black gram (VBN 4) seeds for 18.3 hectares and 221 kg of groundnut (G-7) seeds. These initiatives reflect PFPCL's commitment to member empowerment, cost-effective operations, and sustainable agricultural development.

401.2 SEMI-ARID AGROECOSYSTEMS: KANNIVADI REGION, DINDIGUL DISTRICT, TAMIL NADU

Under the SAARC Development Fund-supported project on "Livelihood Enhancement of Small Farmers in the SAARC Region through Small-scale Agro-business Focusing on Value Chain Development," MSSRF has successfully trained 50 moringa farmers in both cultivation and value addition, with technical support from the Horticulture College and Research Institute and EDII, Periyakulam. A fully equipped moringa value addition centre was established, housing essential machinery including a moringa stripper, electronic dryer, pulveriser, blender, capsule and tablet making units, and packaging equipment. Commercial production and branding of a range of moringa-based products such as moringa raw leaf powder, soup powder, rice mix, *idli/dosa* mix, and *chappathi* mix has commenced. Additionally, under a convergence initiative, around 70 moringa farmers from Andhra Pradesh's DAY-NRLM programme visited the centre to gain hands-on exposure to value addition technologies. MSSRF also participated in the online orientation and regional workshop organised by SAARC Agriculture Centre in Bangladesh, where the organisation's work on moringa productivity and entrepreneurship was well appreciated.

To further improve its reach, a dedicated logo and packaging was designed for the moringa value-added products. The commercial sale of products worth □ 3.72 lakhs through RESAPCOL Farmer Producer Company was facilitated during the financial year 2024–2025. To boost market access, MSSRF launched an e-commerce portal (www.madhuramshop.com) for online sales of oil products, organic inputs, and moringa-based items. Promotion efforts were undertaken via social media platforms including WhatsApp Business, Twitter, YouTube, Google Market, and Instagram. In addition, MSSRF organised a national consultation on "Corporate Literacy for Sustainable Farmer Producer Organisations through Open and Distance Learning" on the 7th of March 2025 in Chennai. The consultation brought together 34 participants from TNSFAC, the Coconut Development Board, SFAC, Basix, and various FPOs from Dindigul and Karur districts to deliberate on strategies for scaling the L3F programme at the national level.

Kulumai SHG Federation

The Kulumai SHG Federation (KSF), operating in the Reddiarchatram block of Dindigul district, is dedicated to empowering rural women through livelihood training, technology adoption, and financial inclusion. With a network of 365 SHGs (360 women led and 5 men led SHGs) across 68 villages, KSF reaches out to 4,358 members, 75% of whom are landless agricultural labourers, 17% small and marginal farmers, and 8% other labourers. KSF has facilitated credit linkages amounting to ₹517.50 lakhs from local banks and NABARD Financial Services Limited (NABFINS) to 1,150 women SHG members, who have invested in various off-farm and non-farm enterprises such as dairy, goat rearing, country chick rearing, textiles, petty shops, tailoring, and

small hotels. Additionally, KSF's community bank extended ₹61.25 lakhs in credit to 245 women SHG members for starting small enterprises such as tailoring units, vegetable vending, and grocery shops. With CSR grant support from NABFINS Ltd, Bengaluru, KSF established the Kulumai Skill Training Centre (KSTC), offering affordable vocational training. Aari embroidery courses were initiated for rural young women to enhance their entrepreneurial skills and income-generating capabilities. Till date, 25 women have completed the course and launched their enterprises with individual credit support of ₹25,000 each. Beyond financial services, KSF also supports social protection efforts by facilitating insurance services for 3,450 members. Through village-level meetings, KSF promotes awareness and enrolment in centrally sponsored social security insurance schemes, ensuring broader safety nets and resilience for rural families.

Kulumai Milk Producer Company Limited

KSF promoted a milk producer collective namely Kulumai Milk Producer Company Limited (KMPCL) as around 62% of the KSF members were engaged in milch animal rearing to enhance the milk quality and quantity and provide better quality-based price for their milk. KMPCL has the membership of 1,050 women milk producers as its shareholders from the region. It facilitated access to credit from the local commercial bank of worth ₹256.50 lakhs to 285 shareholders for the purchase of milch animals. KMPCL provided technical training on scientific dairy and clean milking methods in collaboration with Veterinary University Training and Research Centre (VUTRC) to around 300 women milk producers with the grant support of NABARD. Also, KMPCL facilitates technical support on the selection of good milch animals, milch animal health monitoring and solutions for first aid and health issues through a digital platform in collaboration with Dwara Dairy Solutions Pvt Ltd at an affordable cost. Around 750 shareholders were linked in this e-dairy solution. KMPCL have established around 20 Rural Dairy Resource Centres/milk collection centres through which around 2,300 litres of milk is collected on a daily basis and sold to Dodla Dairy Pvt Ltd. The annual turnover of the company is ₹78.35 lakhs.

Reddiarchatram Sustainable Agriculture Producer Company Limited

Reddiarchatram Sustainable Agriculture Producer Company Limited (RESAPCOL), an FPO established in 2010 and has the membership of around 1,152 small and marginal farmers as its shareholders. RESAPCOL has engaged in providing input services, credit services, technical services, agro advisories, insurance services and marketing services to its shareholders. Under input services it has supplied good quality seeds of maize and cotton with an area of 460 hectares of maize and 75 hectares of cotton crops, bio-input sales of 18.75 tonnes. RESAPCOL has facilitated sales of organic inputs worth of ₹7.32 lakhs to cover around 468 hectares of land under organic cultivation to 735 farmers. It has facilitated the credit support worth of ₹67.50 lakhs from local commercial banks for on-farm and off-farm activities and made the output marketing of maize (475 tonnes) and value-added products worth of ₹9.53 lakhs.

401.3 SEMI-ARID AGROECOSYSTEMS: MAILAM REGION, VILLUPURAM DISTRICT, TAMIL NADU

Nallavur Farmer Producer Company Limited (NAFPCL) achieved commendable growth in the fiscal year 2024–2025, recording a turnover of ₹2.7 crore. With a strong focus on environmental sustainability, NAFPCL mobilised ₹1.25 lakh from Fairtrade NAPP to distribute 23,000 fruit-bearing and timber tree saplings to 581 members, an initiative promoting bund-based afforestation with long-term ecological and economic benefits. In addition to sustainability, NAFPCL prioritised financial inclusion by organising 35 Joint Liability Groups (JLGs) comprising 165 members, facilitating ₹89.5 lakhs in credit support through Tamil Nadu Grama Bank for agriculture and livestock-based enterprises. Collaboration with Krishi Vigyan Kendra (KVK) led to four training sessions on best practices in black gram, paddy, and groundnut cultivation, reaching 168 farmers. Furthermore, three plant clinics were conducted across two Gram Panchayats to provide timely crop advisory services. These efforts reflect NAFPCL's holistic approach to improving productivity, environmental resilience, and farmer livelihoods.

Value addition and quality input distribution played a pivotal role in enhancing profitability and productivity. The processing of 32 tonnes of black gram dal generated ₹4.16 lakhs through the company's value addition centre, while three tonnes of G7 groundnut seeds were distributed for multiplication, along with two tonnes of VBN 4 & 8 seeds to cover 100 hectares. Strategic procurement and marketing also contributed significantly, with 373 tonnes of groundnut worth ₹2.04 crore sold to Agro Crops Company at a 5% profit margin. The proactive procurement and branding of 25 tonnes of paddy and five tonnes of black gram seeds under the "Nallavur Seeds" label further ensures input readiness for the rabi season. To promote good governance, 52 Farmer Producer Groups were trained in maintaining books of accounts, and the successful completion of the Fairtrade audit underscores NAFPCL's transparency and eligibility for future funding. Overall, NAFPCL's integrated approach demonstrates its commitment to sustainable agriculture, financial empowerment, and institutional accountability.

401.4 A STUDY ON COMMUNITY SEED BANKS IN INDIA

DIVERSIFARM-India project aims to strengthen Farmer-Managed Seed Systems (FMSS) to improve food and nutrition security and enhance the livelihoods of small-scale farmers, especially through empowering Community Seed Banks. In its first year, the project successfully mapped 300 CSBs across India, more than twice the original target, by contacting over 125 organisations. A comprehensive database has been developed, laying the foundation for a GIS-based Community Seed Bank Atlas of India, to be launched in 2025–2026. This new typology, considering objectives, activities, seed distribution mechanisms, and priority crops, provides actionable insights for policy development and capacity building. The mapping revealed trends like commercialisation and professionalisation in some CSBs, while

others retained traditional, values-driven models.

To deepen the knowledge base, DIVERSIFARM-India conducted an extensive literature review and identified significant gaps in CSB research, with only 30 relevant studies found across 15 states. To address this, the project team hosted a two-day National Seminar in April 2025 in New Delhi, in collaboration with institutions such as PPV&FRA, WASSAN, and the Fridtj of Nansen Institute. This brought together 63 stakeholders including CSB practitioners, researchers, and policymakers. The project team presented its key findings, including the CSB typology and mapping results. Additionally, the team played a key role in the 9th Wayanad Community Seed Festival, leading a session on CSBs' roles in agrobiodiversity conservation and climate resilience. These outreach events fostered strong dialogue and policy-level recognition of the role CSBs play in advancing seed sovereignty and sustainable farming systems.

Community Seed Bank Initiative: Atlas and Web Portal

A Community Seed Bank Atlas and Web Portal has been developed to support seed sovereignty and agro-biodiversity across India as part of DIVERSIFARM project (details are provided in the Ecotechnology Programme). The portal serves as a comprehensive knowledge and data platform for stakeholders, including community practitioners, policymakers, researchers, and media professionals, to strengthen traditional seed systems. The portal includes a dynamic, map-based atlas that provides detailed information on existing CSBs across various agro-climatic zones in India. The atlas visualises parameters such as crop diversity, seed storage capacity, management models, climate vulnerability, and traditional knowledge systems. Built-in query and filtering options allow users to analyse and compare seed bank operations based on region, crop type, agroecological zone, or institutional structure. This enables more informed planning, replication, and resource allocation. A monitoring dashboard allows seed bank coordinators and supporting organisations to track seed exchange, germination status, seasonal trends, and community participation, ensuring transparent and data-driven management. This initiative not only strengthens grassroots conservation efforts but also enhances India's resilience to climate change by promoting seed diversity, local adaptation, and farmer-led innovation.

402. CLIMATE CHANGE AND AGRICULTURE

402.1 CLIMATE INFORMATION SERVICES

M. S. Swaminathan Research Foundation (MSSRF), in collaboration with the India Meteorological Department (IMD), Ministry of Earth Sciences (MoES), Government of India, has been implementing a Grant-in-Aid project titled "Gramin Krishi Mausam Sewa (GKMS)." The project aims to deliver location-specific, weather-based agro-advisories to assist farmers in making informed decisions and minimizing climate-related agricultural risks.

During the year 2024–2025, the Agro Meteorological Field Unit (AMFU) located at Kannivadi developed and disseminated 624 bilingual district-level Agro-Advisory Service (AAS) bulletins on a biweekly basis. These advisories provided critical agricultural guidance, including alerts on extreme weather events such as heavy rainfall and thunderstorms. Dissemination was carried out through multiple communication channels, reaching both male and female farmers across the districts of Dindigul, Madurai, Pudukkottai, Ramanathapuram, Sivagangai, and Theni in the Southern Agro-Climate Zone of Tamil Nadu. The bulletins were also made available through the official portals of the India

Meteorological Department (IMD).

In addition to district-level advisories, AMFU Kannivadi facilitated the preparation of 1,207 block-level Agro-Advisory Bulletins customised for the 14 revenue blocks within Dindigul district. These advisories were shared with farmers, Farmer Producer Organisations (FPOs), and local agricultural departments, further strengthening the outreach and effectiveness of weather-based agricultural planning. Between April 2024 and March 2025, a total of 580 Agromet advisories were delivered to 1,29,174 male and female farmers across six districts using the Government of India's mKisan web portal. This initiative significantly enhanced the reach and accessibility of crucial agro-meteorological information.

Leveraging Social Media for Agricultural Learning

AMFU Kannivadi effectively utilised WhatsApp as a dynamic platform for knowledge dissemination and interactive learning. Six district-level and fourteen block-level WhatsApp groups were managed to share timely agricultural and weather-related contents. Over the course of the year, 1,622 pieces of content including weather forecasts, agro-meteorological advisories, and livestock care information were shared across 32 dedicated WhatsApp groups, engaging 4,403 farmers (men and women).

Farmer Awareness and Capacity-Building Programmes

To promote the utilization of IMD's Agro Advisory services and encourage the adoption of mobile applications like "Meghdoot" and "Damini," 22 Farmer Awareness and Training Programmes were conducted in the Dindigul district. A total of 789 farmers (428 male and 361 female) were trained on various themes such as weather-based agricultural practices, climate risk management, pest and disease control in agriculture and horticulture, soil health, organic farming, integrated farming systems, and sustainable agriculture. These sessions were held across villages in Dindigul, Natham, Nilakkottai, Reddiyarchathram, Sanarpatti, and Oddanchathram blocks.

Student Engagement and Educational Outreach

During the reporting period, 20 students (16 male and 4 female) from institutions including TNAU Madurai, Gandhigram University Dindigul, and Kalasalingam University participated in educational visits to AMFU Kannivadi. As part of their NGO attachment programmes (RAWE/RHWE), students were introduced to the operational framework of AMFU, the medium-range weather observatory, and the broader efforts of MSSRF and GRIs in climate-resilient agricultural practices.

402.2 ENHANCING THE ADAPTIVE CAPACITY OF SMALL FARMERS

The project titled "Knowledge and Skill Enhancement on Establishing Biocontrol Units to Control Pest and Diseases in Cotton" has made significant strides in promoting eco-friendly and sustainable pest management practices in cotton cultivation. The primary objective was to reduce the use of chemical pesticides, enhance the use of biological agents, and strengthen the knowledge and skill base of partner staff and farmers across key cotton-growing regions in Maharashtra and Gujarat states. Seven awareness programmes; four for staff of partner organisations (BAIF, Cotton Connect, Sanjeevni, and Lupin Foundation) and three for cotton farmers were held in the districts of Patan (Gujarat), Dhule, and Khultabad (Maharashtra), benefiting 127 participants. Based on accessibility and field proximity, nine locations were selected and equipped to establish biocontrol production units. Further, 150 master trainers from partner institutions were trained through exposure visits to model biocontrol centres to serve as resource persons in their respective regions.

To support long-term adoption, the project developed tailored training modules and fact sheets covering Integrated Pest Management (IPM), Integrated Disease Management (IDM), and organic inputs. The biocontrol units have been operationalised with initial cultures of *Corcyra cephalonica* to produce *Trichogramma*, expanding from 10 to 40 baskets and targeting 150 baskets per unit. This growing local capacity will ensure the timely supply of biological agents to farmers. Moving forward, the project aims to scale up the application of biocontrol products in farmers' fields, provide regular advisories through trained staff and Farmer Producer Organisations (FPOs), and evaluate field-level outcomes to reinforce ecological sustainability and improve farmer livelihoods in cotton-growing regions.

Lifelong Learning for Farmers Programme

Under Phase IV of the Lifelong Learning for Farmers (L3F) Programme of COL-MSSRF, significant progress was achieved in linking small-scale farmers of Dindigul and Karur districts with credit-based learning. A total of 10,035 farmers (7,164 women, 2,835 men, and 36 persons with disabilities) accessed ₹4,014.27 lakhs in credit through 10 commercial banks, facilitated by partner NGOs and FPOs. MSSRF supported this with extensive knowledge dissemination, developing and broadcasting 585 voice messages on agriculture, dairy, climate, and FPO-related topics. Additionally, 327 voicemails on corporate literacy were sent to 24,850 smallholders, supporting informed financial decision-making. A mobile learning network was created linking 7,157 learners through programmes like KVK, Mahalir Thittam, and VKP, and these learners received 350 voice messages on enterprise development.

To strengthen digital learning, MSSRF produced 102 educational videos on agriculture and pest management, which were shared via YouTube, WhatsApp, and Facebook. 315 corporate literacy voice messages were sent to 10,000 FPO shareholders. A survey among 100 farmers assess-ed the impact of the monthly Seithisolai newsletter, reaching 4,000 readers with content on agriculture, livestock, climate, schemes, and success stories. Two MobiMOOC courses on e-NAM and coconut pest/disease management were launched with IIT Kanpur and COL, Canada support, reaching 1,500 farmers, of which 58% completed the course. Baseline and end-line surveys of 300 enrolled farmers indicated measurable gains in knowledge and skill levels, reinforcing the effectiveness of mobile-based learning in agricultural extension.

Climate Resilience project

The Resilience project, led by the MSSRF in collaboration with Odisha University of Agriculture and Technology (OUAT), Assam Agricultural University (AAU), Indian Council of Agricultural Research – National Rice Research Institute (ICAR-NRRI), International Water Management Institute (IWMI), and the Norwegian Institute of Bioeconomy Research (NIBIO), is funded by the Norwegian Embassy. The main objective of the Resilience project was to improve agricultural productivity, adaptive capacity, and the livelihoods of smallholders to climate and economic changes by building resilience and strengthening agri-product market value chains in the states of Odisha and Assam. The project ended in September 2024, and the next project, UPSCALE, began in October 2025.

Under the Resilience project, MSSRF established five physical VKCs and 15 virtual VKCs in coordination with partners and stakeholders in the states of Assam and Odisha. The VKCs have played a significant role in empowering rural farm women and men by providing demand-driven and value-added information/knowledge related to CSA, animal husbandry, health and nutrition, government services, market, and weather information using ICT and non-ICT tools. The project developed sustainable knowledge extension systems for smallholders and trained champion/lead farmers while engaging the private sector. In total, about 54,145 farmers (19,788 women and 34,357 men) were reached through various capacity-building and ICT programmes organised at VKCs. These programmes included, farmers helpline services, phone-in programmes, audio conferences, video conferences, video-based learning, farmers' WhatsApp groups, online plant clinic programmes, direct plant clinics, training and awareness programmes, audio advisories, and direct VKC users. The male and female participation in the VKC programmes was 63% and 37%, respectively.

The project carried out farmer-led climate-smart agriculture (CSA) technology validation through on-farm demonstrations and Farmer-To-Farmer (F2F) knowledge exchange in different agroecological zones/case study areas and worked to develop agri-product market value chain opportunities for smallholders on selected crops. Over the six-year project period, farmers' awareness of CSA interventions increased from 4.5% to 50%, farmers and other stakeholders trained on CSA interventions increased from 1% to 50%, and farmers practicing CSA interventions increased from 1% to 46% in the Assam and Odisha project areas.

Farmers' income has increased significantly: They normally received ₹11–12 per kg for grain production, but through seed production, they are now getting ₹24 per kg. Direct market linkages have been established, which assured farmers of procurement as well as fixed prices. Most importantly, the exclusion of middlemen or traders has enabled farmers to receive a higher price margin.

The intervention began through a systematic gendered needs assessment. The evaluation report revealed that about 70% to 80% of targeted women in the project areas have better knowledge and skills on CSA technologies and are actively engaged in agricultural marketing, production, and decision-making processes that reduces climate risks. About 62% of women have adopted CSA technologies such as climate-resilient varieties, seed treatments, planting methods, irrigation methods, and soil and plant health management practices. In overall, women's mobility, interaction with outsiders, participation in public meetings, involvement in marketing, linkages with institutions, recognition among relatives and friends, and negotiating skills have improved in the project areas.

Sustainability and Handover of Physical VKCs

Exit strategies and handover protocols were

developed in consultation with partners, management committee members, and other stakeholders. To ensure sustainability, the project formulated an exit strategy and handed over the VKCs. In Assam, the VKCs are being handed over to the relevant community-based organisations and KVKs.

The UPSCALE project is being implemented in both states. The key objective of the project is to increase sustainable productivity, farm income, and food and nutritional security in the highly climate-vulnerable states of Assam and Odisha, India. This will be achieved through upscaling innovative, evidence-based sustainable and climate-resilient rice and relevant agricultural technologies that will strengthen smallholders' capacity to adapt to climate change and enable transformative climate action. MSSRF's role in the project includes establishing 18 Virtual Village Knowledge Centres (VVKCs) and promoting capacity building and knowledge dissemination in coordination with partners and stakeholders. Gender integration and mainstreaming is also one of the key deliverables of MSSRF.

402.3 CLIMATE CHANGE AND WATER RESOURCES MANAGEMENT

The Indo-German Initiative on Water Security and Climate Adaptation (WASCA) is a bilateral cooperation project funded by the German Federal Ministry for Economic Cooperation and Development (GIZ), in collaboration with the Ministry of Rural Development (MoRD) and the Ministry of Jal Shakti (MoJS), Government of India. Implemented by GIZ, the project was operational across 15 agroclimatic zones in 17 states of India, aiming to strengthen water resource management through an integrated and climate-resilient planning approach at national, state, district, and Gram Panchayat levels. MSSRF served as the technical partner for five states Andhra Pradesh, Kerala, Tamil Nadu, Telangana, and the Andaman & Nicobar Islands, supporting the implementation of the project in two districts per state. Through collaborative planning, capacity development, and use of geospatial technologies, the initiative has contributed significantly to climate-resilient natural resource management and sustainable rural livelihoods. The WASCA project was successfully completed in March 2025, achieving its objectives in enhancing decentralised planning and water security interventions across the targeted regions.

The core objective of WASCA is to strengthen water resource management in rural areas by ensuring sustainable water security and enhancing resilience to climate change. The GIS-based plans were prepared, which involved developing 1,066 Gram Panchayat (GP) water budgets using both primary and secondary data in the Composite Water Resource Management (CWRM) tool and validated with GP-level consultation. District teams were supported in identifying key water challenges, and coordination was facilitated with government officials, project directors, and funding agencies to implement Climate Resilient Measures. Support was also provided for executing GP plans,

GIS-based planning, and state-level software and GIS portal upgrades.

Capacity development activities focused on training MGNREGA functionaries in the use of the CWRM planning, implementation, and monitoring tools, with a strong emphasis on GIS technologies. This included hands-on training sessions at district, block, subdivision, and GP levels. Training was also provided in nursery development, horticulture techniques, greywater management, soak pit enhancement, and compost pit-based waste management. A convergence model for CWRM planning was established with support from the state government and implemented in collaboration with departments and agencies such as Social Forestry, Groundwater Department, KINFRA, Agriculture Department, Forest Department, Land Use Board, Haritha Keralam, CRD Kasaragod, and the Green Tamil Nadu Mission.

In Andhra Pradesh and Telangana, the ridge-to-valley approach served as a foundational principle for planning and implementing watershed-based interventions. Leveraging this approach, GIS-based planning was initiated for 2,069 Gram Panchayats; 1,223 in Andhra Pradesh (577 in Ananthapuramu and 646 in Anakapalli) and 846 in Telangana (280 in Narayanpet and 566 in Vikarabad) and submitted to the respective district authorities for further integration and implementation in close partnership with the respective District Water Management Agencies. These plans aimed to integrate topographic, hydrological, and land use information to guide the effective design and prioritisation of MGNREGS works, ensuring both sustainability and convergence with broader climate-resilient water resource strategies.

To strengthen institutional capacity for water resource planning, the WASCA project organised a series of capacity-building trainings on Gram Panchayat GIS plan preparation for officials at district, mandal, and GP levels. A total of six training sessions were conducted, four in Andhra Pradesh and two in Telangana, benefiting 992 participants (805 male and 187 female) in Andhra Pradesh and 778 participants (636 male and 142 female) in Telangana. These trainings empowered Engineering Consultants (ECs) and Technical Assistants (TAs) with the knowledge and tools necessary for effective planning and implementation. The project also facilitated the preparation and validation of GIS plans, water budget and Composite Water Resource Management (CWRM) models in 30 pilot GPs in Telangana, in collaboration with district officials and local communities. To enhance the verification process, a mobile application GP-GIS Plan Verification Application (GGPA), was developed and piloted at the ground level in coordination with the districts in Andhra Pradesh. This is an Android-based mobile application developed and implemented in Andhra Pradesh to ground truth GIS-based plans using GP-specific KML inputs. The app enables field engineers and staff to verify plans on-site in consultation with the local community. Verified data is logged into a Google Sheet, and upon approval, directly uploaded to the MGNREGA portal for technical and administrative sanctioning by the respective authorities, showcasing the GGPA app's strong potential for upscaling to other states across the country.

The project provided ongoing technical support for implementing key Climate Resilient Measures, including the construction of Loose Boulder Check Dams (LBCD) and staggered trenches in Telangana, and the restoration of mangrove wetlands in Andhra Pradesh. Significant outcomes of these CRM interventions include: 9.71 hectares of mangrove wetland restoration, 40.48 hectares of shelterbelt plantations, 359.78 hectares of tank cascade system rejuvenation, 208.72 hectares of silvipasture land development, 572.87 hectares of agricultural land reclaimed from sand dunes, and 106.03 hectares of greening of rocky hillocks. A major intervention was the Penna River rejuvenation over an area of 4,371.5 hectares, alongside the installation of 10 injection bore wells,

21.9 hectares of common land development, and reclamation of 2 hectares of salt-affected land.

WASCA – Geographic Information System in GP planning and Mobile App

The technical support was extended to the Ecotechnology programme in the preparation of GIS-based, GP-level scientific planning across Anakapalli and Anantapur districts in Andhra Pradesh, Villupuram and Dharmapuri districts in Tamil Nadu, Kasaragod and Palakkad districts in Kerala, and the South Andaman and Nicobar districts of Andaman & Nicobar Islands. 3,135 GIS-based GP development plans were prepared in alignment with the MoRD guidelines. Multiple thematic layers, namely land use and land cover, slope, soil type, soil erosion, drainage, and groundwater prospects, are overlayed and analysed to identify the potential sites for augmenting water resources through works on surface and groundwater conservation, drought-proofing, land development, and afforestation. Besides, a watershed-level mapping was undertaken in Anantapur and Anakapalli districts to support the rejuvenation and cascading of tanks. The mapping effort involved delineation of watershed boundaries and identification of hydrological features, including drainage lines, tank catchments, and flow accumulation zones. This watershed mapping facilitates strategic tank rejuvenation by identifying key hydrological features and flow patterns. It enhances water resource planning, improves groundwater recharge, and supports sustainable agriculture in the region.

As part of the work, a comprehensive vegetation cover assessment was conducted to understand the impacts of MGNREGS work in Anantapur and Anakapalli districts using Normalized Difference Vegetation Index (NDVI) based vegetation mapping and Sentinel-2 satellite imagery for the years 2009, 2015, and 2024. The NDVI-based vegetation assessment enabled the identification of green cover and land degradation.

Water Security for a Sustainable Future - Theni District, Tamil Nadu

The project called 'Managing Demand and Augmenting Water: Integrated Strategies for Sustainable Water Management' has been implemented in the Periyakulam block of Theni district, Tamil Nadu in December 2024. The main goal is to promote smart and sustainable use of water in both supply and demand activities such as harvesting water, storing and recharging the groundwater, and improving soil moisture. This has been carried out in five-gram panchayats covering 2,095 farmers directly and 7,845 farmers indirectly. This initiative involves both men and women farmers in Water User Groups, Farmers Association and Panchayat representatives. By the end of the year (November 2027) the initiative aims to save or collect 26.83 lakh cubic metres of water. It also built strong local water governance by supporting Water User Associations and Panchayats through regular meetings, water and soil monitoring using tools like sensors and observation wells.

To achieve sustainable water security, the project adopts an integrated approach encompassing both supply and demand-side interventions over a three-year period. On the supply side, it includes desilting of 6 tanks, construction of

50 mini percolation tanks (MPTs), development of 104 farm ponds, and establishment of 100 groundwater recharge structures. Additionally, soil moisture conservation will be promoted through tree plantations, with trenching across 250 hectares, and 18 soil and nutrient sensors will be deployed. On the demand side, water-saving technologies such as Alternate Wetting and Drying (AWD) have already been adopted by 200 farmers across 186 hectares, with a goal of reaching 500 hectares; Direct Seeded Rice (DSR) is practiced on 200 hectares, and micro-irrigation systems have been introduced over 30 hectares, benefiting 150 farmers through convergence with relevant schemes. Key indicators monitored include the number of focus group discussions (FGDs) and training programmes conducted, participation levels by gender, adoption rates of promoted technologies, changes in net agricultural income, and the extent of convergence achieved through integration of schemes, institutional linkages, and expenditure tracking. A 20% convergence target has been set by aligning with government schemes for micro-irrigation and other water-saving activities, supported by partnerships with technical institutions to aid in planning and implementation. This comprehensive initiative demonstrates how integrated water resource management, active stakeholder participation, and cross-sectoral collaboration can foster locally driven, sustainable water security.

Ecosystem-Based Restoration of Small Wetlands and Enhancement of Rural Livelihoods for Climate Resilience in Tamil Nadu

The "Ecosystem-Based Restoration of Small Wetlands and Enhancement of Rural Livelihoods for Climate Resilience in Tamil Nadu" project focuses on preparing Detailed Project Reports (DPRs) for the restoration of 25 small wetlands in the upper catchment of the Kazhiveli wetland in Villupuram district. The initiative emphasises ecological health and climate-resilient livelihoods for women farmers, aligning with both national priorities under the Amrit Dharohar scheme of the National Plan for Conservation of Aquatic Ecosystems (NPCA) and the Tamil Nadu Wetlands Mission. The project adopts agroecological principles and promotes the wise-use of wetlands through a multipronged approach that includes GIS-based profiling, climate vulnerability assessments and participatory planning with community institutions, NRLM, and MGNREGS.

Between January and March 2025, notable progress was achieved. Secondary data collection was completed for all 25 wetlands, capturing details on geography, demography, agriculture, and rural employment programmes. Rapid field assessments across all sites yielded critical ecological and socio-economic insights, while the draft DPR for Thamarai Kulam wetland was successfully finalised. A comprehensive literature review is underway to support planning and strategy development, and a tentative field visit plan has been created to guide stakeholder engagement and DPR preparation for the remaining wetlands. This groundwork establishes a strong platform for

inclusive, ecosystem-based planning and climate-resilient development in wetland-dependent rural communities.

Small Wetlands Assessment: Watershed Delineation and Catchment Analysis

As part of the small wetland restoration and management initiative, high-resolution elevation data from the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (30-metre spatial resolution) was processed using Global Mapper software. This data was used to delineate watershed boundaries for selected GPs in Vanur and Marakkanam blocks of Tamil Nadu, and identify specific catchment areas contributing to priority ponds within each GP were identified. The spatial extent of each catchment was calculated to understand the hydrological flow patterns, and a detailed catchment area map was developed by integrating multiple spatial layers including Gram Panchayat boundaries, delineated watersheds, and pond locations. In addition, land use and land cover classification was performed using satellite imagery from Google Earth to evaluate current landscape characteristics and assess anthropogenic impacts, supporting site–specific interventions for wetland rejuvenation, improved water retention, and biodiversity enhancement with plans including incorporating rainfall-runoff models and community consultations for prioritising nature-based solutions in wetland catchments.

403. VILLAGE RESOURCE CENTRES AND VILLAGE KNOWLEDGE CENTRES

The Village Resource Centres (VRCs) and Village Knowledge Centres (VKCs) provide need-based, local-specific, demand-driven information and knowledge (both dynamic and static), and organize training and awareness programmes. This agricultural cluster is operating 3 VRCs, 10 physical VKCs and 155 Virtual Village Knowledge Centres using digital tools such as video conferences, audio conferences, phone-in programmes, mobile-based audio advisories, WhatsApp, digital plant clinics, online plant clinics, farmers helpline services, video-based learning, and social media.

During this reporting period, 39,682 farmers, including 17,114 women, benefited from VRC and VKC programmes and acquired need-based advisories and skill development information. These initiatives led to the adoption of Good Agronomic Practices (GAP) and climate-smart agriculture technologies, helping to mitigate field risks and significantly improve farming practices, yields, and income among small holders. MSSRF conducted 178 ICT programmes and addressed 1,252 helpline queries, covering agriculture, animal husbandry, government schemes, and marketing. Creating and updating relevant content to suit local needs is a key factor in the programme. The information provided is time and location specific, demand-driven, and relevant to the day-to-day life and work of rural women and men. The VKCs developed 1,450 thematic content and documented 68 case studies. They also enrolled 837 farmers in the Velanmai Thagaval Sevai Maiyam, Disseminated 583 content through audio advisories. Further, 2,031 queries were addressed through WhatsApp groups, focusing on pest and disease management, fertiliser and nutrient deficiency, and input management.

The VKCs facilitated various online services for 2,701 users and generated ₹1,18,887, and established a strong network with the stakeholders. The feedback studies indicated that the ICT platform helped the reduce cost of cultivation by 62% per hectare, increased yield by 12.5%, and income by ₹8,750 to ₹11,250 per hectare. The Farmers Helpline services supported by VRCs and VKCs has been acknowledged as a successful

tool by the farmers as it assisted in receiving real-time knowledge to address crop-related problems, particularly in relation to pest, disease, and nutrition management.

Farm Field School

The Farm Field School in Pasupathikovil village plays a significant role in providing training and demonstrations to small and marginal farmers on Good Agricultural Practices (GAP). It promotes hands-on learning and farmer to farmer knowledge and skill exchange on topics such as increasing water use efficiency and reducing input usage for paddy and pulse cultivation.

During the reporting period, 21 training programmes were conducted, involving 769 farmers (299 men and 418 women). The sessions covered topics such as Kuruvai and Samba paddy cultivation, black gram production techniques, seed treatment, use of bio-inoculants, varietal selection, healthy seedling production through nursery management, border and trap crops for beneficial insects, weed control, and integrated nutrient management to maintain soil fertility through pulse cultivation. Through farmer-to-farmer learning, this knowledge and these practices reached over 2,500 farmers.

The Farm Field School also focused on improving water use efficiency in paddy and pulse farming by promoting techniques such as Alternate Wetting and Drying irrigation, installation of pani pipes etc. Field-based sessions were held in the morning, where participants learned to identify beneficial insects and methods to conserve them. They were also trained to assess the economic threshold levels of pests and apply natural pest management techniques. Feedback from farmers revealed that about 70% of those who regularly attended the Farm School achieved higher yields in Kuruvai paddy cultivation, recording an average of 6.4 to 7 metric tonnes per hectare from their previous yield of 5.5 to 6 metric tonnes. In black gram cultivation, trained farmers achieved an average yield of 1 metric tonne per hectare, compared to 0.8 metric tons by others.

Soil and Water Test

VRCs conducted soil and water testing for providing recommendations on input applications. This activity starts from demonstrating how to collect samples and continues through follow-up with farmers on applying inputs based on the test results. During the reporting period, 354 soil and 47 water samples were collected from 58 villages across five districts, and 264 farmers, including 53 women, received soil health cards with expert advisories through the mobile soil and water testing van. The soil test results showed, 82% adoption of soil health card advisories, and facilitated reclamation of 41 hectares of saline, 10 hectares of alkaline, and 6 hectares of calcareous soils, while improving crop yields. The initiatives led to an 18–22% yield increase in paddy, pulse, and gingelly crops.

Video-Based Learning

The M. S. Swaminathan Research Foundation, in collaboration with Access Agriculture, is conducting three types of interventions:

1. Developing need-based videos
2. Translating useful videos into local languages
3. Screening the videos in villages

These efforts aim to promote video-based learning (VBL) to enhance agricultural knowledge, technologies, and practices among farmers. VBL is being promoted in Tamil Nadu, Puducherry, Assam, and Odisha through VKCs and VVKCs. There has been a very positive response to VBL among farmers, particularly women, as the selection of videos is need-based and the screening timings are convenient for them. A total of 115 VBL programmes have been organised, reaching 1,815 farmers, including 940 women. Pre and post-evaluations revealed that 82% of farmers improved their knowledge. The feedback study indicated that 54.6% adopted the knowledge and

skills gained through VBL.

Plant Clinics

The plant clinic programme was started in 2012 in partnership with CABI in Tamil Nadu and Puducherry. It has now been extended to Assam, Odisha, and Madhya Pradesh. The Plant Clinics are an ICT-mediated advisory system conducted at regular intervals in villages to provide practical recommendations to the farming community. Trained plant doctors diagnose crop health issues using various diagnostic tools, such as Dino-Lite microscopes. This technology allows farmers to view pests and disease symptoms projected on screens, improving their understanding and empowering them to adopt effective management strategies. The recommendations provided by plant doctors are practical, locally available, culturally acceptable, economically affordable, and environmentally safe.

A Mobile Plant Clinic with advanced digital infrastructure, online plant clinics, plant health campaigns, and the promotion of the *Plantix* app for diagnosis and recommendations are important components of the plant clinic programme. Currently, 45 clinics are functioning across 225 villages. A total of 60 plant doctors, including 22 women, have been trained to conduct plant clinic sessions. During the reporting period, 327 sessions including 47 online were held, providing diagnostic and advisory services to 4,646 farmers (2,023 women) for 4,756 crop samples. Content development is one of the important components under the plant clinic programme, which developed 225 fact sheets, 110 Pest Management Decision Guides (PMDGs), and 2,650 photo sheets as reference materials for plant doctors and farmers.

The plant clinics have played a crucial role in enhancing farmers' knowledge of plant health and promoting behavioural changes. These include reduced use of toxic ("red-labelled") pesticides, greater adoption of biological inputs, and improved pest identification leading to more precise pesticide use. A feedback study revealed that 62% of farmers shifted from chemical to Integrated Pest Management (IPM) practices. The number of sprays was reduced from 10 to 4. Input costs were reduced by 45–55%, and 62% of farmers reported an income increase of ₹8,750 to ₹11,250/ ha.

Farmers expressed that they are empowered to take timely action in controlling pests, diseases, and nutrient deficiencies, which significantly reduced the damaging effects on crops. The use of recommended bio-inputs, which many farmers could prepare at home, helped reduce reliance on commercial agro-inputs and saved costs. This approach also led to a decrease in the number of pesticide sprays compared to conventional chemical pest control methods. As a result, farmers became less dependent on agro-input dealers. Furthermore, improved knowledge enabled farmers to better identify pests and their damaging stages, allowing them to make more informed decisions about the timing, quantity, and frequency of pest control measures.

Programme Summary

- Farmer producer collectives were facilitated to establish bio-input resource centres and ensure access to other productive resources for more than 15,000 farmers.
- 3,135 GP-based GIS water security plans were completed in partnership with the Department of Rural Development, aligning with the guidelines of MoRD and developed a digital mobile APP to verify the work identified at the ground level.
- A total of 150 farmers were trained as master trainers in eco-friendly pest management practices for cotton cultivation in Maharashtra and Gujarat and established decentralised bio-inputs production units.
- A total of 360 hectares of tank cascades were rejuvenated, and water-saving techniques such as Alternate Wetting and Drying were promoted on 186 hectares.
- Agro-advisories, combined with capacity building through information and communication technologies, led to increased yields and reduced costs, particularly in pest and disease management to over 40,000 farmers.
- MobiMOOC courses were launched to provide training in crop and livestock management and 3000 farmers (30% women) completed the course.
- Over 300 Community Seed Banks were mapped across the country and developed a CSB atlas and web portal at national level.


MORINGA MARVEL
Moringa
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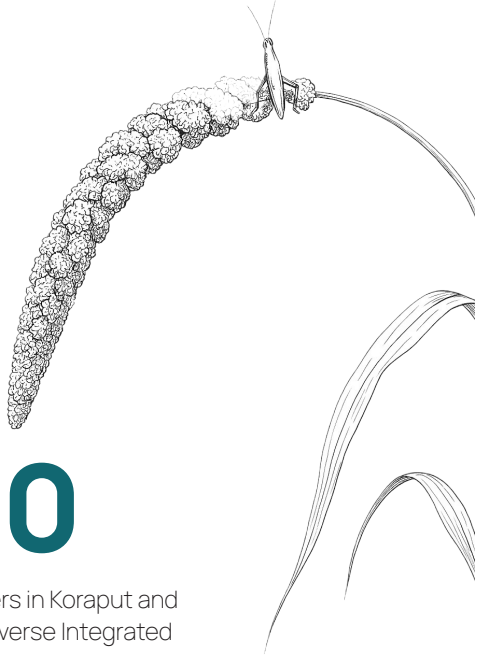
MORINGA MARVEL
Moringa
Atta/Chapathi

PA500

AGRICULTURE, NUTRITION AND HEALTH



1,20,000+

households and farmers directly reached in 2024–2025, spread across 12 districts in three states in nutrition and health interventions

2,483

families benefitted from training and outreach on crop diversification. 220 hectares of maize cultivation, undertaken by 220 farmers.

2,500

small and marginal farmers in Koraput and Nabarangpur adopted diverse Integrated Farming Systems models.

Enhancing food systems for better health

300 Villages were covered under community-led health resilience initiatives, directly benefiting a population of nearly

80,000 people

Seed production

74 tonnes of finger millet seed and 11.7 tonnes of niger seed were produced by 305 tribal farmers, enhancing farmer access to quality seeds, and 79 ha of green gram and 53 ha of groundnut were brought under foundation seed production, boosting yields and farmer incomes.

1,248

households (covering a population of about 6,240 people) benefitted from nutrition-sensitive agriculture interventions. 218 households, 39 Anganwadi Centres, and 7 residential schools were supported through institutional and community nutrition initiatives.

AGRICULTURE, NUTRITION AND HEALTH

In 2024–2025, the programme advanced Agriculture, Nutrition and Health (ANH) outcomes across tribal and smallholder farming communities in Odisha and Wayanad. Interventions promoted sustainable agriculture, crop diversification, improved millet and rice systems, and resilient seed and maize value chains. Integrated farming models and women-led mushroom enterprises supported livelihood enhancement. Nutrition-sensitive initiatives such as school and community gardens improved dietary diversity. Evaluations of Poshan Abhiyaan, food fortification, and group-based models for NCD management informed policy and practice. Community-based strategies integrated agrobiodiversity conservation, nutrition literacy, and rural development to foster resilience, inclusion, and well-being in under-resourced regions.

The Agriculture, Nutrition, and Health (ANH) interventions implemented in Odisha and Wayanad focus on strengthening food security, promoting sustainable agriculture, improving nutrition, and enhancing livelihoods among tribal and smallholder farmers. This section covers the progress and results of the health and nutrition studies carried out.

In Odisha, the TAbC (Tribal Agrobiodiversity Centre, Jeypore) has co-developed pilots and expansion to improve productivity, promote crop diversification and facilitate integration and intensification within a sustainable production framework. The efforts in improving the productivity of rice through suitable varieties and agronomic and farm mechanization practices; piloted the promotion of the Alternative Seed System Model (ASSM) in finger millet, groundnut, niger, and green gram for the certified seed production; maize intensification, mechanization, and facilitating market linkages; rice fallow management to grow legumes and oilseeds to improve land use and food security; and Integrated Farming System (IFS) models promoted aqua-based farming, vegetable gardens, poultry, and mushroom cultivation along with the main crop cultivation.

In Wayanad, Kerala, the CAbC implemented school nutrition gardens, linking agriculture and nutrition education, with students harvesting produce for midday meals; studied human-wildlife conflict highlighting the impact of invasive species and legal restrictions on indigenous food systems; piloted holistic rural development programmes

that support farm diversification, women's enterprises, water management, and education in Ernakulam, Idukki, and Wayanad, improving incomes, nutrition, and infrastructure; promoted Good Agricultural Practices (GAP) in turmeric and ginger; facilitated black pepper and turmeric value chains.

The nutrition and health programme, under section 503. highlights the learning from implementation of nutrition gardens at household and institutional levels, including Anganwadi Centres (AWC) and tribal residential schools, production of mushrooms by women SHGs and adoption of nutrition-sensitive agriculture by small farmers. At the systems level, the department evaluated the *Poshan Abhiyaan* across 112 aspirational districts to assess the effectiveness of large-scale food fortification programmes, a meta-analysis of Indian studies on iron-fortified foods; group-based models for managing diabetes and hypertension in public health settings; and promoted Community Champions to improve maternal and child health, sanitation, and nutrition.

501. TRIBAL AGROBIODIVERSITY CENTRE, JEYPORE

Agriculture, Nutrition and Health Interventions in Odisha highlights integrated interventions in agriculture, nutrition, and health across the tribal districts of Odisha. Key initiatives include demonstration of improved rice varieties, community-led seed systems for millets and pulses, maize value chain strengthening, crop diversification, and rice fallow intensification. Interventions in the areas of promotion of millets and Integrated Farming Systems (IFS) enhanced productivity, market linkages, and income diversification for tribal farmers, particularly women. Capacity-building, mechanisation, and value addition were promoted through Farmer Producer Companies and Self-Help Groups. These interventions collectively strengthened food security, livelihoods, and sustainable agricultural practices among smallholder farmers in Odisha.

501.1 DEMONSTRATION OF RICE VARIETIES FOR HIGHER PRODUCTIVITY

The lack of access to quality seeds and farm machinery, and inadequate knowledge of improved technologies and agricultural practices, constrain paddy cultivation among tribal farmers in Malkangiri, Koraput, and Rayagada districts. The challenges in access to knowledge, services, and technologies were addressed through demonstration and capacity building with these communities. The key interventions were: promoting quality seed production of five varieties (Bina-17, Mandakini, Sahabhagi, MTU-1153 and 1156), improved agronomic practices and farm mechansiation for weed management, spraying, and post-harvest processing. It was implemented in Kharif season 2024–2025 in partnership with the ICAR-Indian Institute of Rice Research (IIRR), Hyderabad, as part of the Tribal Sub Plan and Scheduled Caste Sub Plan programme in 80 hectares over 20 villages with the participation of 244 tribal farmers (39% women).

Seven skill-building training programmes were organised on improved agronomic practices: land preparation, seed treatment, nursery, line transplanting, intercultural operations, nutrient management, water management, integrated pest and disease management, harvest and post-harvest management technologies. Six farmers' field day events, three farmers' exposure visits and 30 Crop Cutting Experiments (CCE) were organised to

facilitate farmer-to-farmer knowledge exchange and networks. Four village-level paddy processing units were established to ensure the processing facility at the village level and reduce the drudgery of women.

The average productivity of the introduced five varieties were 26.9% higher than the conventional varieties adopted by the farmers: Bina-17 topped with 4.86 t/ha, followed by MTU-1156 (4.69 t/ha), MTU-1153 (4.57 t/ha), Sahabhagi dhan (4.57 t/ha) and Mandakini (4.01 t/ha). The average marketable surplus created per household was 22%. Additionally, the adoption of modern agricultural tools reduced physical labour by 58% across different operations and enhanced operational efficiency.

501.2 ALTERNATIVE SEED SYSTEM MODEL

The alternate seed system model aimed to enhance access to quality seeds of improved varieties and landraces of millets, pulses and oilseeds. This intervention also encouraged farmers to adopt improved practices, like System of Millet Intensification (SMI), Line Transplanting (LT), seed treatment through application of organic pesticide cum growth stimulant *(bijamrut)* and use of cycle wheel hoe to weed management. The System of Millet Intensification (SMI) involves transplanting younger seedlings (15–25 days old) with wider spacing (25 × 25 cm), allowing better root growth and tillering. It supports cycle weeding on both sides, improving weed control. In contrast, Line Transplanting (LT) uses older seedlings (20–35 days old) with narrower spacing (25 × 8 cm), resulting in higher plant density but limited root expansion.

The focus crops for seed production were finger millet, groundnut, niger and green gram. A community-led, alternative seed system model is being deployed to ensure the widespread adoption of improved seed varieties for higher productivity, increased household food security, livelihoods, income and sustainable management of natural resources.

The foundation and certified levels of seed production were undertaken for the following varieties of different crops: Finger millet- *Arjun* and *KMR-204*, Groundnut - KL-18-12 and Niger -Utkal Niger 150 during Kharif 2024–25. Seed production farmers were registered and monitored in different stages (in vegetative, seed setting and harvesting stages) by the Odisha State Seed Corporation Ltd (OSSCL). Genetic purity was confirmed as per the morphological characters of the varieties. A total of 305 farmers from 18 villages in Koraput and Boipariguda blocks were partners in the intervention, covering 122 hectares.

The 187 farmers produced the certified seeds of Arjun variety of finger millet in 48.8 hectares. This variety has recorded the highest yield of 2.45 t/ha. However, the average yield obtained was 1.92 t/ha. out of the total procurement of 74 tonnes, 35 tonnes were supplied to the OSSCL, while the remaining quantity was sold locally and to other agencies. Similarly, 68 farmers involved in Niger seed production programme covered 28 ha, recorded an average yield 0.32 t/ha, total 11.7 tonnes produced. A total of 247 farmers cultivated foundation seed of groundnut covering 53 hectares in rabi season. Similarly, green gram seed production programme was carried out in ten villages of four GPs under the Chikiti and Digapahandi blocks of Ganjam district covering 79 hectares. One and a half tonnes of green gram (Shikha variety) foundation seeds provided to 190 farmers for the seed production programme in Ganjam. The highest yield of 0.95 t/ha was recorded in the farmer's field whereas the average yield obtained was .0.57 t/ha. Production of 40-45 tonnes of quality seeds of green gram is expected in rabi 2025.

Capacity-building programme

Seed production of finger millet, niger and groundnut was undertaken in Koraput district. In Koraput district, 18 training programmes were organised on seed treatment, preparation, and application of enriched farmyard manure, integrated disease, pest and nutrient management, improved crop production technologies, in which 502 farmers and farm women participated. In Ganjam, 11 skill development training programmes were organised on seed treatment, integrated pest and disease management and improved crop production technologies in green gram seed production, covering 190 farmers. To institutionalise the interventions, a Farmers' Producer Company, Vikas Mahasangha Producer Company Ltd. was formed at the Boipariguda block of Koraput district. The FPC is involved in seed production, processing and marketing the labelled seeds to the OSSCL, private agencies and farmers.

This model increased the adoption and use of quality seeds and improved varieties 80% of the farmers. Besides, the model supports enhancing the awareness among farmers about quality seeds and better agronomic practices. Only the healthy and quality seeds were taken to OSSCL, while farmers used low-quality grains for household consumption and sold the remaining surplus in the local market. Women's involvement in processing and value addition activities in seeds promoted local entrepreneurship among tribal farmers. The FPC leaders trained over 350 farmers from other districts of Chhattisgarh and Odisha on this alternate seed production model.

501.3 MUKHYAMANTRI MAKA MISSION

The *Mukhyamantri Maka* Mission envisages end-to-end interventions in the maize value chain with a focus on increasing farmers' income through sustainable intensification of farming practices with reduction in cost of cultivation, post-harvest losses and facilitating direct market linkage with formal markets in Kundra block of Koraput district. The intervention also aimed to promote farm mechanisation and climate-resilient practices for the sustainability of production systems. Specific emphasis was given to increased participation of women in maize value chain and FPCs.

Over the years, there has been a gradual increase in maize production in Kundra block. During Kharif 2024, maize was cultivated in 180 hectares as mono crop and 40 hectares as intercrop with cowpea by 220 farmers. The farmers harvested an average yield of 4.0 t/ha under solo crop and 3.5 t/ha. under intercropping. The cultivation of sweet corn was extended to 6 hectares by a total of 21 farmers.

Twenty one training programmes were conducted reaching 2,483 farm families. It was done through the Training of Trainers (ToT) method, which focused on land preparation, mechanised sowing, seed treatment, intercropping, and pre-emergence weed management. The 30 selected lead farmers or FPC leaders were trained as trainers who

facilitated the ToT programmes in the block. The maize growing farmers were mobilised and organised into a FPC named Maa Patdei Mission Shakti Maize Producer Company, currently, it has 1,052 shareholders. The FPC procured 1200 tonnes of maize through 20 producer groups and established a market linkage with a private company.

501.4 CROP DIVERSIFICATION PROGRAMME UNDER MEGA LIFT IRRIGATION SCHEME

The Crop Diversification Programme has been piloted in the Mega Lift Irrigation regions of Kundra and Jeypore blocks in Koraput District. The intervention focused on the zones of upland and medium land paddy growing areas to non-paddy crops such as millet, maize, pulses, oilseeds, and vegetables during the kharif season, with 2,144 farmers covering 1,500 hectares. Seventeen capacity-building programmes were organised, focusing on crop planning, enriched farmyard manure preparation, and integrated pest and nutrient management. A total of 850 men and women farmers were trained along with awareness programmes through five road shows and one district-level food competition.

501. 5 RICE FALLOW MANAGEMENT

The Rice Fallow Management initiative has been expanded to Khordha, Nayagarh, Kandhamal, Malkangiri and Gajapati Districts of Odisha, covering an area of 49,500 hectares with legumes (green gram, black gram, field pea, grass pea and lentils) and oilseeds. Around 1,08,098 farmers effectively intensified the crop in the rice fallow fields in 2025. Field demonstrations and hands-on training were followed to build the capacity of 62,514 farmers (34,897 men and 27,617 women) on improved agronomic practices, including seed treatment, use of bio-inputs, and integrated disease and pest management. Almost 22,749 farmers (13,672 men and 9,077 women) participated in the farmers' field day and crop cutting experiments.

501.6 SPECIAL PROGRAMME FOR PROMOTION OF MILLETS THROUGH ODISHA MILLET MISSION

Odisha Millet Mission (OMM) currently known as Shri Anna Abhiyan (SAA) is a flagship programme of Government of Odisha to promote millets and accelerate maximum benefit to the small and marginal farmers with the objectives to increasing household consumption of millets, conservation and promotion of millet landraces through seed system, improving productivity of millets-based crop systems, facilitating the millet processing and markets and exports of milled-based products through FPOs. Under this SAA programme, MSSRF has tried to reach most of the millet cultivating farmers in Kundra block of Koraput district.

During Kharif 2024–2025, 1,590 farmers cultivated millets in 1,032 hectares, including finger millet (886 ha), little millet (122 ha), barnyard millet (10 ha), sorghum (10 ha) and pearl millet (4 ha) out of which 1,590 farmers covering 992.4 hectares received incentives of ₹49,58,347 from the government through Direct Benefit Transfer process. They followed the improved technologies like SMI, LT, line sowing and ridge and furrow method of cultivation. In rabi 2024–2025, finger millet was cultivated in 93.4 hectares, involving 152 farmers who received the incentive of Rs 6,24,600. Thirty one CCEs were conducted in the finger millet field of Kundra block in Kharif 2024–2025. It is observed that the average yield of

finger millet is 16.90 quintal/ha. The highest yield recorded 2.47 t/ha,and the lowest yield was 0.6 t/ha. Likewise, in rabi 2024–2025, six CCEs were conducted in finger millet fields. The average yield recorded was 1.70 t/ha, with the highest yield of 2.02 t/ha (Bada mandia).

Four farmers' field days were conducted in Kundra block with the Department of Agriculture. As part of capacity building of farmers, 15 training programmes were conducted, involving 540 farmers (343 men and 197 women) on good agronomic practices, SMI, LT and application of organic inputs, managing the seed banks and custom facility centres. Ten awareness campaigns were conducted among 3,160 farmers by organising harvest festivals, millet cooking competitions focusing on household consumption, food festivals, exhibitions, road shows through an awareness rath, highlighting nutritional value and importance of adding various millets in daily diet at village and block levels.

The Bamandei Farmer Producer Company (BFPC) procured finger millet through Millet Mandi and earned a revenue of ₹9.82 lakh. The BFPC facilitated registration of 2,419 households from 16 GPs of Kundra block in Millet Procurement Automation System App. Through this process, BFPC procured 1,320 tons of finger millet grains from 917 farmers with a turnover of ₹594 lakh.

Honour to Mrs. Raimati Ghiuria

Mrs. Raimati Ghiuria known as the Millet Queen received a prestigious honorary Doctorate in Science from Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, conferred by Her Excellency Smt. Draupadi Murmu. She also received many more state and national awards during the year, such as Amazing Indian Awards-2024, BRICS Trailblazer Award, Forbes We Serve India Award, etc.

501. 7 INTEGRATED FARMING SYSTEMS MODEL FOR INCOME ENHANCEMENT

During 2022–2024, the implementation of the Integrated Farming Systems (IFS) project was continued to enhance the livelihoods of small and marginal farmers through the integration of agricultural and allied activities. The project was initiated with support from Rastriya Krishi Vikas Yojana and has been implemented in selected GPs of Boipariguda Block in Koraput and Kosagumuda Block in Nabarangpur districts, targeting 2,500 small and marginal farmers. The primary focus is to promote diversified farming, increase resource use efficiency and strengthen rural income. The activities were structured around four major components: aqua-based systems, non-aqua-based farming, landless household support, and enterprises led by women SHGs.

Aqua-based Integrated Farming Systems:

161 households have adopted the integration of fish farming with agriculture with the pond size ranged from 3 to 85 cents, cumulatively covering 8.5 hectares. Training programmes were organised at the pre and post-stocking pond management and adoption of improved production practices such as lime (250 kg/ha), fish fingerlings (200 kg/ha), and fish feed in proportion to fish biomass. Apart from fish farming, duck rearing is also integrated for egg production (8–10 ducklings per household). Vegetable cultivation is integrated in the system on the pond dykes, and 70% of the participating households adopted this practice. Fruit-bearing trees, including banana, guava, lemon, pomegranate, custard apple, sapota, and coconut, were also planted on dyke areas. Vermicompost

pits were established by 54 households, with a capacity of 600 kg of compost. These integrated interventions facilitated income diversification and promoted efficient resource utilisation.

Non-Aqua-Based Integrated Farming Systems:

821 households have adopted non-aqua-based IFS. Training and capacity-building programmes were focused on improved crop production technologies in paddy, finger millet, and maize using quality inputs including certified seeds and bio-fertilizers. Finger millet cultivation was undertaken on 240 hectares using improved varieties such as KMR-204 and Chilika. Maize cultivation was undertaken on 64 hectares. Additionally, trainings were organised on integrated pest and nutrient management practices and nutrition gardening. 189 households adopted vermicomposting and 285 households cultivated vegetables. Fruit saplings were also planted along farm boundaries and near homesteads. To foster knowledge sharing and peer learning, 20 farmer field days were conducted at the cluster level, showcasing best practices in the cultivation of finger millet, maize, and paddy.

Support for Landless Households

To provide livelihood opportunities for landless families, technical and input support was extended to 327 households for the backyard poultry units. The unit size is 20 birds per household. Exposure visits to successful poultry units were organised to promote learning and adoption of better management practices.

Women-Led Enterprises

Promoting entrepreneurship and empowering women farmers is an important objective of the project. A total of 40 women SHGs were supported in oyster mushroom cultivation. Eleven training programmes were organised, and 200 women were trained in mushroom cultivation. 15 SHGs were equipped with a millet pulveriser, which helped reduce drudgery in processing and facilitated value addition to the primary produce.

502. COMMUNITY AGROBIODIVERSITY CENTRE, WAYANAD

502.1 SCHOOL NUTRITION GARDEN PROGRAMME

The School Nutrition Garden programme, locally known as *"Kuttikarshakakootam: Student Farmer Group"*, was piloted in ten selected schools across the Wayanad district. It focused on introducing agriculture, nutrition education, and environmental awareness into the school curriculum, thereby fostering local action to combat malnutrition. 890 students (boys and girls) received hands-on training in soil health, nutrition, and climate-smart agriculture along with strengthening nutrition gardens. Of these, 600 students adopted the learning in their home gardens. From the gardens of the school, 1,292 kg of vegetables and fruits were harvested and utilised in their midday meal

programmes, contributing to improved dietary diversity among schoolchildren.

502.2 STUDY ON HUMAN-WILD LIFE CONFLICTS

The main purpose of the initiative is to assess the impact of human-wildlife conflict on indigenous food systems in Wayanad district. Specifically, it studied the socio-ecological dynamics between wildlife incursions and traditional food practices among indigenous communities. The preliminary findings of the study indicate that, since the post-1970s, an array of state-led interventions in forest and land management have significantly contributed to escalating human-wildlife conflict and have profoundly disrupted the indigenous food systems in Wayanad District, Kerala.

Furthermore, the introduction and large-scale planting of invasive species such as *Senna spectabilis* during the 1980s, under the pretext of forest beautification, led to the suppression of native biodiversity. This ecological shift curtailed the availability of forest-based food resources traditionally accessed by indigenous communities, thereby further eroding their customary food practices and knowledge systems.

The enactment of the Wildlife Protection Act of 1972 played a pivotal role in this transformation. By legally prohibiting traditional hunting practices, which constituted a central element of indigenous subsistence strategies, the Act undermined a key component of the indigenous food system, that is, hunted meat.

The number of wildlife species involved in crop raiding has also increased over time, with incidents expanding beyond peripheral farmlands to include homesteads, which are areas central to the indigenous food basket. This shift represents not only a spatial intensification of human-wildlife interactions but also a direct threat to household-level food and nutrition security.

Ultimately, the rise in human-wildlife conflict and the transformation of indigenous food systems appear to be mutually reinforcing processes. As traditional food sources become less accessible or more vulnerable, reliance on cultivated crops intensifies, thereby increasing the likelihood of wildlife encounters and crop damage, further exacerbating both ecological and sociocultural disruptions.

502.3 HOLISTIC RURAL DEVELOPMENT PROGRAMMES

The Holistic Rural Development Programme, supported by HDFC Bank Parivartan, is working with 2,100 farm households to improve household income, promote sustainable farming practices, and enhance access to essential services for marginal farmers and tribal communities in Ernakulam, Idukki, and Wayanad districts of Kerala.

Promoting the diversification and integration of the farming system is one of the strategies for improving income. Key interventions were goat rearing with 210 households, backyard poultry units for 36 women, and apiary with 150 farmers. As part of promoting sustainable farming practices, disease free 51,000 banana saplings and 26,000 kg of bio-fertiliser were distributed among 510 farmers and 455 farmers were supported in sustainable cultivation of ginger and turmeric. Approximately 100 soil health cards were distributed following detailed testing, enabling informed nutrient management as part of sustainable farming practices. To promote local value chain and entrepreneurship, two farmers' outlets and ten community enterprises were established among 100 farmers (predominantly women) which include local resource-based seafood catering and bamboo crafts. The farmers' access to water harvesting and saving technologies

was strengthened. 365 drip and sprinkler irrigation systems, renovation of a common pond with increased storage area, which benefits 75 farmers and supported well recharge structures for 85 households in Ernakulum site. Twelve capacity-building programmes were conducted that trained 445 farmers and local panchayat leaders in sustainable agriculture practices, water-use efficiency, soil health, crop diversification, and risk adaptation strategies.

Furthermore, 21 schools and 70 Anganwadis were renovated, which directly benefited 5,934 students and over 900 pre-primary children. The Anganwadi's were upgraded with learning resources and toys and wall paintings in 30 villages.

Another integrated rural development initiative implemented with 664 households covering five villages in Kanthalloor Gram Panchayat of Idukki district in Kerala is supported by SBI Foundation. Key components of the intervention were enabling access to online services through digitally enabled gram seva centres, education, awareness on health and WaSH (Water, Sanitation and Hygiene), strengthening livelihood, women empowerment, youth development and environmental management.

To boost the gross enrolment rate in the region, scholarships were given to 21 students to continue education. Educational infrastructure in the schools was strengthened with the smart classrooms and science lab which are actively being utilised. Remedial classes are ongoing in the five project villages, and a computer lab with five computers were set up to train the children. An interschool sports event was conducted with the participation of 168 students.

Access to drinking water is ensured through the installation of water purifiers in four schools and five anganwadis, along with the renovation of an open well. Additionally, three toilets were renovated, and a solid waste management system was built and supported through the provision of a waste collection vehicle. In the health sector, two eye care camps were conducted, benefitting 411 participants, with 41 individuals receiving free surgery.

Farm mechanisation services were promoted by a common facility which had 33 pieces of equipment for use on a rental basis, and 664 hoes were distributed to farmers. Off-farm skill development activities were conducted. These included 75 participants for goat farming and 54 participants for mushroom production and food processing from which 65 farmers integrated goats into the farms. As a non-farm livelihood intervention, a Prerana Centre was established, offering tailoring training for women and last reporting period nine women were trained. To strengthen the on-farm livelihoods, access to quality planting materials was given priority: garlic bulbs for 236 farmers, ginger bulbs for 44 farmers, and vegetables seeds to 334 farmers were facilitated, and support for dolomite application to mitigate the problem soil to 106 farmers. For water conservation, two check dams were renovated and an SBI Jan Van and a mango and jackfruit park were established.

To support fitness and leadership development, two open gym fitness centres were established and sports equipment distributed to students for state level Kho-Kho championship. Rural infrastructure improvements included the renovation of five anganwadis, two community buildings, one footpath bridge and one school toilet. Solar electrification was implemented at 25 locations.

502.4 STRENGTHENING TURMERIC AND GINGER PRODUCTION

The Good Agricultural Practices (GAP) in turmeric and ginger were facilitated in Wayanad among tribal and non-tribal small holders. The GAP included a package of technologies and practices: land preparation, seed selection, raised bed planting techniques, water and nutrient

management, and integrated pest and disease control strategies. Field demonstrations, capacity building and access to inputs were the strategies adopted in the value chain development. A total of 54 turmeric demonstration plots were established, and regular training sessions on GAP were conducted. It is recorded that the GAP supported an increase in the productivity of turmeric yield by 24.45% (from 15.3 to 20.25 t/ha). Similarly, 45 ginger demonstration plots were established and 35 tribal farmers were trained on GAP which increased the ginger productivity by 40% (from 10.5 to 17.5 t/ha). Specifically, farmers were trained to use the bio-inputs (for the fungal diseases, which adversely impact crop growth and productivity) *Trichoderma* biocapsules, and crop-specific micronutrient mixes for turmeric and ginger. The use of these bio-inputs led to a reported 20-30% reduction in the use of chemical fertilisers, contributing to more sustainable farming practices.

502.5 BLACK PEPPER AND TURMERIC VALUE CHAIN DEVELOPMENT

The initiative aims to build the capacity of 50 farmers organised from four clusters in Wayanad district on GAP and value addition in black pepper and turmeric. The interventions focused on access to the use of quality planting materials, use of bio-inputs for disease management and micro-nutrient mix for balanced nutrition, and irrigation management in the production phase and promoting value-added products and establishment of storage spaces, processing units in the post-production phase. A total of 11 training programmes and two exposure visits were conducted, reaching 305 farmers, including 110 (36%) tribal farmers, from the four identified clusters.

Moreover, entrepreneurship is being promoted among farmers to reach the market with value-added products rather than selling the raw products. A common processing centre for pepper and turmeric was under development. Once operational, the facility would ensure standardised, high-quality processing and create opportunities for increased farmer income through value addition.

Forty pepper-growing farmers adopted a drip irrigation system covering 4 hectares, and quality planting materials were adopted by 190 farmers in pepper and 40 farmers in ginger. Thirty demonstration plots in different field locations were established to train the 50 farmers on the above-mentioned production technologies and practices. Five farmer–scientist interaction programmes were organised, benefitting 227 farmers, including 25% from tribal communities. These sessions served as vital platforms for knowledge exchange, allowing farmers to learn about advanced agricultural technologies and enabling scientists to understand the on-ground challenges faced by farmers.

503. NUTRITION AND HEALTH INITIATIVES

503.1 PROMOTION OF NUTRITION SECURITY AT INSTITUTIONAL LEVELS: TRIBAL RESIDENTIAL SCHOOLS, SHGS AND ANGANWADI CENTRES

The primary objectives of the interventions in Lamtaput and Dasmantapur blocks of Koraput district were to benchmark the status of household dietary diversity and food frequency and promote *Poshan Vatikas*/nutrition gardens at the household level, AWC and tribal residential schools to facilitate access to a balanced and healthy diet.

One of the key interventions is the establishment of nutrition gardens: 218 households, 39 AWCs, and 7 tribal residential schools have developed their own nutrition gardens. A SHG has successfully established a community-level nutrition garden linked to Integrated Child Development Services (ICDS) centres and schools, ensuring a sustainable supply of nutritious food for the Mid-Day Meal (MDM) programmes. 245 women from 23 women's SHGs were involved in mushroom cultivation at the household level. Mushroom cultivation has gained traction as a viable micro-enterprise, with women-led SHGs playing a crucial role in producing and marketing mushrooms locally. The economic benefits, coupled with the nutritional value of mushrooms, have motivated more community members to explore this alternative livelihood opportunity.

To strengthen the garden management, 50 Anganwadi Workers (AWW) and 10 school teachers were trained in the garden management. In addition, 356 members from AWW, Accredited Social Health Activist, SHG, Panchayat Raj Institutions, pregnant women, lactating mothers, and adolescent girls, and mothers of 7 month old to 5 year old children were trained through demonstrations on low-cost nutritious recipes. For the mushroom production, the *Poshan Sathis* and 23 SHG members were trained on different steps in mushroom production, including bed preparation, sowing spawns in the beds, maintaining the ambient temperature and humidity in the unit.

Table 11: Details of the nutrition garden and mushroom production units

Sl.	Items	Quality seeds/ seedlings	Inputs facilitated for garden management
1	Leafy vegetables (cabbage, cauliflower, pumpkin, raddish, bitter gourd)	14.44 kg	• 252 set (7 types of garden hand tools) procured for all target group • 250 units of shade nets for fencing • 504 of 50 ltr. drums for irrigation • 248 units of enriched Farm Yard Manure (FYM) and organic inputs
2	Other vegetables (lady finger, tomato, brinjal, cauliflower, pumpkin, bitter gourd)	15.01 kg	
3	Roots and tubers (carrot, raddish, beetroot)	11.4 kg	
4	Climbers (watermelon, cow pea, cucumber, pumpkin, bottle gourd, bitter gourd)	14.25 kg	
5	Spices (green chili)	570 gm.	
6	Fruits (raw & ripe) plants: lemon, moringa, papaya, banana, pomegranate, guava, sapota)	2,500 nos.	

7	Total beds raised Total mushroom Production	1,743 units 2,180 kg	• 45 units of straw cutter • 1,260 units of spawn • 40 number of 200 ltr. barrel

Table 12: Details of harvests and use from the nutrition gardens

Sl. No.	Vegetable Name	Yield (in Kg)	Consumed (in Kg)	Consumed by neighbors (in Kg)	Marketed (in Kg)	Amount (in Rs.)
1	Brinjal	3,343	2,372	370	601	13,970
2	Green chilli	2,112	673	355	1,084	1,06,380
3	Tomato	3,846	2,517	371	958	25,943
4	Cabbage	3,777	2,686	300	791	25,009
5	Cauliflower	2,941	2,406	276	259	7,723
6	Lady finger	3,052	2,333	282	437	15,109
7	Radish	4,249	2,837	546	866	17,578
8	Cucumber	1,931	1,362	269	300	11,866
9	Pumpkin	3,847	2,589	338	920	41,977
10	Cowpea	3,369	2,445	249	675	25,985
11	Bitter gourd	2,894	1,924	262	708	27,612
12	Carrot	2,031	1,479	329	223	16,580
13	Beetroot	1,304	759	174	371	21,492
				Total sale of vegetables		**3,57,224**
14	Mushroom	2,180	1,379	-	801	1,12,140

503.2 NUTRITION SECURITY AND DIETARY DIVERSITY AT HOUSEHOLD LEVELS: PROMOTION OF NUTRITION-SENSITIVE AGRICULTURE

The core objectives were to benchmark the status of household dietary diversity and food frequency in Lamtaput and Dasmantapur blocks of Koraput district and enhance the capacity of the tribal communities to cultivate, conserve, and consume nutritious foods to improve household-level dietary diversity and nutritional security. It was done by demonstrating the context-relevant technologies that reduce drudgery, improve farming skills, and help to diversify livelihood opportunities.

Table 13: Details of interventions to promote Nutrition-sensitive agriculture

Initiatives	Outreach
Households trained on improved methods of cultivation	1,248 households (population: 6240)
No. of small and marginal farmers trained across three seasons	875 farmers
Land covered	206.4 ha
No. of enriched FYM and organic inputs	248 Units
No. of farmers' groups formed	20 Nos.
Youth trained and skilled as *Poshan Sathis*	40 nos.
No. of custom hiring centres established in convergence with the village Panchayat	14 Nos.
No. of vermi-compost bed	100 units

As part of the interventions, a baseline study was done to understand the status and design the interventions. Moreover, a special study to understand the Water, Sanitation and Hygiene (WASH) conditions was done in two sample villages in 2 blocks. A model Gram Panchayat Development Plan was prepared in two GPs: one in Guneipada Gram Panchayat of Lamtaput block and another in Pindapadar GP of Dasmantpur block through participatory tools in convergence with PRI as per MoRD guidelines. Additionally, one district level and four block level convergence meetings were organised with all line departments of Koraput district and respective blocks of Dasmantpur and Lamtaput blocks. To create awareness, six special entitlement camps for women, children, and adolescent girls in six villages of both blocks were organised, in which 554 members participated.

Learning resources were also developed and shared with the relevant members. It includes nutrition literacy, enriched FYM and organic inputs preparation and use, nutrition-senstive agricultural practices and technologies, nutrition garden development, mushroom production and participatory tools for assessments.

503.3 ASSESSING THE IMPACT OF *POSHAN ABHIYAAN* IN ADDRESSING CHILD UNDERNUTRITION IN ASPIRATIONAL DISTRICTS ACROSS INDIA

The Prime Minister's Overarching Scheme for Holistic Nutrition (POSHAN) Abhiyaan, launched on March 8, 2018, is India's flagship mission to combat malnutrition among children, pregnant women, and lactating mothers. Implemented as Mission *Saksham Anganwadis* and Poshan 2, it adopts a convergence-based strategy, integrating eighteen ministries, using technology in the form of a digital tool, called the Poshan Tracker, for real-time growth monitoring and behavioural change initiatives for achieving *"Suposhit Bharat"*(Well-nourished India). The study was undertaken with support from the Ministry of Women and Child Development. (MoWCD).

The study employed a mixed-methods approach, combining quantitative and qualitative data. Quantitative data from 112 aspirational districts of the country were accessed from the Poshan Tracker for the period June 2022 to November 2024. It included enrolment rates of children in anganwadis under the ICDS, prevalence of underweight, stunting, Severe and Acute Malnutrition (SAM), Mild and Moderate Malnutrition (MAM), take home rations and hot cooked meals served in the anganwadis. Qualitative data was collected by selecting states with the maximum number of aspirational districts (Andhra Pradesh, Assam, Chhattisgarh, Jharkhand, Maharashtra, Rajasthan, and Telangana; 51 districts) from the six administrative regions.

Qualitative data was gathered in hybrid mode through extensive stakeholder engagement, including five consultations with senior state officials from key departments such as Women and Child Development, Health and Family Welfare, Drinking Water and Sanitation, and Panchayati Raj and Rural Development. Additionally, twelve focus group discussions were conducted with District Program Officers / District Social Welfare Officers across all selected states, along with some Child Development Project Officers. A total of 173 functionaries from different government departments at various hierarchical levels participated in the qualitative study. To further consolidate an understanding of the nuances of the results, a consultation was held with non-governmental organisations specialising in Maternal and Child Health and Nutrition. Data analysis has been completed. The study observations and the recommendations arising thereof will be compiled into a report that will be submitted to the MoWCD to enhance service delivery for reducing child undernutrition.

503.4 IMPACT OF IRON FORTIFIED FOODS IN ADDRESSING ANEMIA: A META-ANALYSIS OF INDIAN STUDIES

Anaemia is a major public health problem in India. To combat this, the Government of India provides iron and folic acid supplements to pregnant, lactating women and adolescent girls and double fortified salt with iron and iodine through government-run feeding programmes. The directive for providing iron fortified rice through the two large direct feeding programmes, ICDS and MDMs to reduce the prevalence of nutritional deficiency anaemia was issued in 2021, and approval for the supply of fortified rice through Public Distribution System (PDS) was issued in 2024. Supply of rice fortified (iron, folic acid and B12) through the PDS has been rolled out in eleven states, namely, Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu, Chhattisgarh, Uttar Pradesh, Odisha, Telangana, Madhya Pradesh, Uttarakhand, and Jharkhand. However, concerns

have been raised that this large-scale fortification has the potential for excessive iron intake within the population. To understand the implications and effectiveness, a meta-analysis of existing literature is being undertaken to assess the overall impact of iron-fortified foods in the ongoing fight against anaemia.

To implement this, the team followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines. The literature survey with a defined set of keywords was carried out using search engines [PubMed, Scopus, Dimension Publications, Google Scholar, Cochrane and Research Gate, National Institute of Nutrition, Food Services and Standards Authority of India (FSSAI) and St. John Institute of Nutrition]. All the collected literature related to fortification was uploaded into the Rayyan software for further screening based on a set of inclusion and exclusion criteria. Based on the above methodology, 1,229 studies have been shortlisted. Out of these, 935 studies based on exclusion criteria and 285 studies on duplicates were removed. Of these, 14 most relevant studies were finalised. These are being analysed for change in haemoglobin levels, ferritin and transferritin status and reduction in anaemia.

503.5 DESIGN PATHWAYS TO IMPROVE EFFICIENCIES THROUGH SHARED APPOINTMENTS

This study pilots and evaluates a novel model of follow-up care for patients with diabetes and hypertension through Shared Medical Appointments (SMAs) and a digitally assisted Case History Augmentation Tool (CHAT). The project aims to strengthen care coordination and delivery in Tamil Nadu's public health system by leveraging group consultations to improve patient engagement, peer support, and clinical outcomes. Anticipated outcomes include improvements in treatment adherence, health knowledge, and in-control rates for diabetes and hypertension, contributing to scalable, patient-centred and non-communicable disease care models in low-resource settings. The study is planned to be conducted in Chengalpattu, Thoothukudi, Villupuram and Cuddalore districts, Tamil Nadu, India.

503.6 SUSTAINABLE COMMUNITY LED INTERVENTION FOR TRIBAL HEALTH RESILIENCE

This study aims to improve health resilience among tribal communities in Dasmantapur and Lamtaput blocks of Koraput district, Odisha, through sustainable, community-led interventions. Despite the presence of government health services, access and utilization remain low due to infrastructural, cultural, and logistical barriers. The initiative trained local stakeholders: frontline workers, traditional healers, SHGs, and "Community Champions" to enhance nutrition, hygiene, and disease surveillance. By integrating local knowledge with public health systems, the project seeks to create a replicable model that addresses critical health challenges such as malnutrition, anaemia, maternal and child health, and infectious disease outbreaks.

In total 296 Community Champions were selected across both blocks and provided with training on maternal and child health, as well as WASH practices. They are currently tracking malnutrition status among 3,231 children. The study encompasses 300 villages, with a population of around 80,000.

The convergence training and orientation sessions have been completed in 22 Health and Wellness Centres (HWCs), including members of

the HWC teams and anganwadi workers. Forty two joint Village Health Sanitation and Nutrition Committee (VHSNC) meetings were conducted over the past year. Action plans were developed for each HWC by Community Champions and subsequently followed in the project.

Food demonstrations were started in January 2024 at selected villages' AWCs. Focus was on locally available, affordable, and nutritious foods such as ragi, sweet potato, green leafy vegetables, and pulses, as well as on using the chatua (health powder) provided by the centres. A total of 18 food demonstration events were held with support from Anganwadi staff, Community Champions, and VHSNC members.

503.7 THE IMPACT OF HEAT ON THE HEALTH OF WOMEN IN INDIA- A CROSS-SECTIONAL STUDY

This cross-sectional study examines the health impacts of extreme heat on women in India, focusing on physical, reproductive, and mental health outcomes. The research is being conducted in diverse urban and rural settings across seven states, targeting women aged 20 and above. Through structured interviews, focus group discussions and in-depth interviews with health care providers, the study aims to capture how heat exposure intersects with housing conditions, occupational risks, pre-existing health conditions, and access to healthcare. The findings will inform policy recommendations to enhance women-centric climate resilience and health adaptation strategies in India. Selected districts in the states of Andhra Pradesh, Karnataka, Kerala, Maharashtra, Rajasthan, Tamil Nadu, and Uttar Pradesh have been included in the study.

503.8 CAPACITY BUILDING

A collaborative exercise in digital nutrition literacy was undertaken jointly by the Programme Area of Health and Nutrition and Ecotechnology, through the specially created ECHO (Extension for Community Healthcare Outcomes) digital platform. The participants were men and women from Tamil Nadu, who are Fellows of the National Virtual Academy (NVA). There were twelve sessions of one hour each, held once in two weeks. In-house and external resource persons facilitated the sessions.

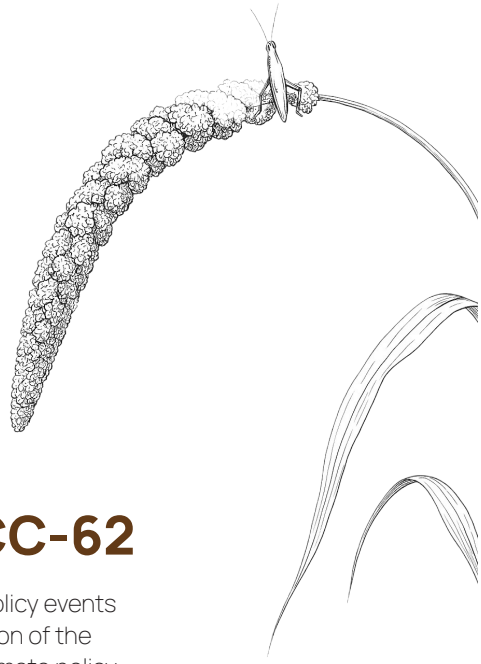
The first session explored the food habits and preferences of the participants, based on which a course outline was drawn. As the programme rolled out, topics suggested by the participants were also included. The sessions dealt with introduction to various food groups and nutrients, balanced diet and carbohydrate energy metabolism, role of millets in human nutrition, fat metabolism, obesity and its management, diet and its relationship to kidney health, gut health, cooking methods and their impact on nutrition, labelling and nutritive value of packaged foods and infant and young child feeding practices. The final session was a recap of all the key concepts introduced in the course. A literacy module integrating all key concepts was developed and distributed to the participants (For more information refer to the Capacity Building section).

Programme Summary

- Alternate Seed System Model has co-developed the processes and systems with the farmers and the Department of Agriculture to produce certified seeds to ensure access to quality seeds.
- Promoted demonstrations and capacity building for crop diversification, integrated farming systems and crop intensification through rice fallow management with over 60,000 hectares with 1.25 lakh farmers.
- School nutrition garden programme initiated in 10 selected schools in Wayanad for creating awareness about balanced diet and nutrition security
- The contemporary issue of human-wildlife conflicts in Wayanad is studied to propose locally suitable strategies.
- Holistic rural development initiative covered 2,100 farm households to improve farm income and promote sustainable farming practices in Ernakulam, Idukki, and Wayanad districts of Kerala.
- Clinical training was conducted for our staff in October 2024 to strengthen compliance with research ethics and standards.
- To promote nutrition security, multiple strategies have been promoted: Nutrition gardens were promoted at the household and institutional level among Anganwadi centres and residential schools; nutrition-sensitive agriculture with 875 small and marginal farmers trained in nutrition-sensitive farming over 206 hectares.
- 296 Community Champions trained in tribal Odisha for maternal-child health and WASH practices.
- A study on heat stress and women's health was completed in 7 states, focusing on physical, reproductive and mental health aspects.
- Digital nutrition literacy programme reached National Virtual Academy Fellows through 12 sessions on critical nutrition topics.

PA600

CLIMATE CHANGE



550

districts covered with crop carbon-footprint baselines (12 crops; ~92% of cropped area). Serves as a critical resource for policy making related to climate action in agriculture, including carbon trading.

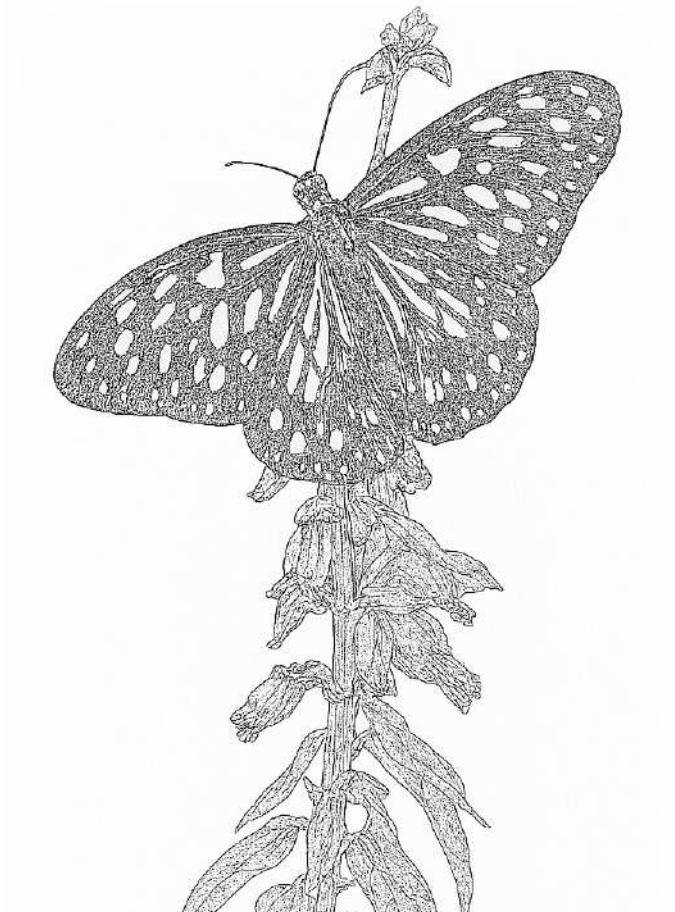
COP29 & IPCC-62

Engaged in 2 global Climate Policy events and supported in the integration of the equity framework in the GoI climate policy.

Tackling climate change with pragmatic solutions

Climate Equity Monitor (CEM)

Global-South equity tracker informing negotiations: ~2,000 active users across 78 countries, 30-day actives rising into the 300+ range; Positions CEM as a reliable Global-South evidence platform for fair-share carbon budgeting.



4 modules & 3 policy briefs

on land–energy transitions, informs equity-based land–energy policy for agri/livestock; provides evidence against regressive carbon taxes; flags biofuel trade-offs.

CLIMATE CHANGE

In 2024–2025, the programme advanced inclusive, equity-focused climate policy and science-based interventions through interdisciplinary research and engagement. Key highlights included evaluating regressive impacts of carbon pricing on Indian agriculture, estimating carbon footprints for major crops and milk at the district level, and modelling aridification effects on paddy cultivation using Artificial Intelligence (AI). MSSRF provided critical support to India's climate diplomacy at IPCC-62 and COP29, promoting a novel equity-driven global mitigation framework. Collaborations with ICAR, TERI, and GIZ strengthened land-use–energy policy linkages. The programme's integrated outputs aim to shape sustainable, just, and climate-resilient transitions for vulnerable communities and national policy systems.

The Climate Change programme undertakes cutting-edge policy and research work on various aspects of climate change. As a cross-cutting thematic focus within the foundation, the programme adopts a strong interdisciplinary and transdisciplinary approach to generate science-based, inclusive, actionable knowledge, working with communities at the frontline of climate change impact and the need for adaptation. It also works on policy outputs related to climate change to target and assist policy influencers and policymakers, both at national and global levels.

Thematic priorities include mainstreaming equity and climate justice in climate action and climate policy, analysing climate impacts on agriculture, advancing adaptation strategies, and supporting India's engagement in multilateral climate negotiations such as the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC). Through its integrated research and policy engagement, the programme contributes to shaping sustainable, just, and climate-resilient futures.

The LULC Modelling project, in partnership with The Energy and Resources Institute (TERI) and supported by *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ), aimed to integrate land-use and energy sectors in India's decarbonisation strategies, particularly focusing on agriculture and livestock. The study developed detailed baseline data on energy use in agriculture and livestock, analysed welfare and differentiated impacts of carbon pricing, and assessed the global distributional outcomes of mitigation scenarios in IPCC pathways, showing their negative impact on food security while increasing the risk of hunger. The study found that the impact of a carbon tax on

Indian agriculture will be unequivocally regressive. Adopting carbon pricing instruments in any form in the agriculture sector will be regressive for farmers, especially for the marginal and small farmers in India, as far as the relative cost burden is concerned. The last module evaluated the biofuel potential of agroforestry and livestock, emphasising trade-offs with energy, food, and fodder security. Policy recommendations call for balanced, equity-oriented strategies in land-energy transitions.

Another area of work on carbon footprint has been in collaboration with the Indian Council of Agricultural Research's National Innovations in Climate Resilient Agriculture (NICRA). The study's primary goal has been to estimate the carbon footprint, including both direct and indirect emissions, in the production of major field crops and milk production. The study covers 13 major crops across all the states of India and across land-holding categories of farmers at state and district levels. This initiative is the first of its kind in India, providing essential data on agricultural emissions disaggregated by regions and operational land-holding categories, based on official data sources. The study is indispensable in estimating and safeguarding future essential emissions from the agricultural sector for meeting India's food security requirements. The study offers granular (up to district level) insights into the carbon footprints of field crops in India and provides essential data for informed policymaking and climate action planning in the agriculture and livestock sector.

The MSSRF Climate Change Program Area has played a central role in supporting India's cli-mate policy development and strategy through its work under Global Environment Facility (GEF) funded projects and participation in international forums such as the 29th Conference of Parties (COP29) of the UNFCCC and the Sixty-second session of the IPCC (IPCC-62) for the Seventh Assessment Report (AR7) cycle. The team provided key support to the Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India, in terms of providing technical inputs, detailed policy briefs, along with research analysis and notes to intervene on significant issues in the climate science-policy nexus and issues related to equity and climate justice. A key contribution was the widely recognised equity assessment of IPCC scenarios jointly conducted by the MSSRF Climate Change Program Area and National Institute of Advanced Studies (NIAS). This lead to the development of an alternative global mitigation framework that integrates the principles of equity, climate justice and CBDR-RC (Common but Differentiated Responsibilities and Respective Capabilities). This novel framework aims to open new avenues of climate scenario planning and redefine how global climate pathways are designed, making it accessible, transparent, and equity-driven, with the potential to influence global climate policy.

601. LAND USE AND LAND COVER MODELLING STUDY

The project entitled "Land Use and Land Cover modelling IND01 Activity", was undertaken in collaboration with The Energy and Resources Institute (TERI). This multi-module research initiative aimed at integrating the land-use sector with the energy sector to assess its implications for India's decarbonisation trajectory, particularly in the agriculture and livestock sectors. In this context, the following two publications that reviewing the key arguments from the global experience have been published in the Economic and Political Weekly (EPW):

(i) Greenhouse Gas Mitigation and Carbon Markets in Indian Agriculture; and

(ii) The Changing Role of Agriculture in the Global Climate Policy Regime.

The project unfolded through four modules. The results and findings from each module are as follows:

1. Baseline estimation of energy and fossil fuel use

The first module developed detailed baseline data for energy and fossil fuel consumption in agriculture and livestock. The baseline data was prepared for various components such as 'number and hours of use of farm machinery', 'number of reported pump sets', 'projections for farm mechanisation in India', 'projected water demand in India', 'demand and supply projections of agricultural commodities' and 'baseline data for livestock'. This foundational work informed the subsequent analysis of mitigation potential in the sector.

2. Welfare and differentiated impact of carbon pricing

The second module focused on evaluating the welfare and differentiated impacts of carbon and biomass pricing on Indian agriculture. As a part of the project, a detailed literature review has been done critically evaluating the GHG mitigation and carbon pricing impacts on agriculture and its associated distributional impacts on farmers of different size classes. The quantitative data analysis using the translog cost function for India based on global experiences was done in order to assess the differentiated impacts of the carbon tax project module. The translog cost function allows economies of scale to vary with output level and thus holds significance for this study, where the heterogeneity among farmers with different farm sizes (and hence output) needs to be factored in to be able to better assess the distributional impact of carbon tax on different class sizes of farmers. From the findings of this study, it was clear that imposing a tax on carbon-intensive inputs like fertiliser and fuel would lead to inequitable impacts on Indian farmers. The cost of cultivation would increase, with the rise being proportionately higher for marginal and small farmers compared to large farmers. In other words, the impact of the carbon tax on Indian agriculture is going to be unequivocally regressive. The small and marginal farmers are one of the lowest income groups in India, so any increase in cost (by 5–10%) is going to adversely affect their well-being. In order to cut down on paid costs, they may have to increase the use of family labour. Moreover, the share of animal labour will increase, which can adversely impact the capital formation, mechanisation and productivity of Indian agriculture. Thus, impacting the food security of Indian farmers, especially subsistence, mostly marginal and small farmers.

3. Global distributional impact of climate mitigation scenarios

The third module examined the welfare and distributional impact globally in the scenarios of the Sixth Assessment Report of the IPCC. In scenarios assessed by the IPCC's Sixth Assessment Report (AR6), the Agriculture, Forestry, and Other Land Use (AFOLU) sector contributes 20 to 30% of total global mitigation by 2050. However, 80% of this mitigation burden is projected to fall on developing countries. In order to compensate for insufficient mitigation efforts of developed countries as well as the stringent constraint of the remaining carbon budget, Integrated Assessment Models (IAMs) often explicitly couple vegetation and land-use models with energy-economic frameworks to identify mitigation potential in the land or AFOLU sector. The study found that these stringent mitigation pathways perpetuated serious global inequalities in key development indicators, and these mitigation efforts led to increased food insecurity as well as resulting in increased populations at risk of hunger globally, with developing countries mainly bearing the brunt of these impacts. Such outcomes severely limit the policy relevance of the IAM-based modelled mitigation pathway for the developing world.

4. Agroforestry and livestock for biofuel production

The fourth module explored the role of agroforestry and livestock sectors in biofuel production through an extensive literature review. While the potential for biofuel expansion exists, the study stressed the need to manage critical trade-offs between energy security, food security, fodder security and sustainable land use. The continued reliance on food-based biofuels like ethanol, produced from a variety of feedstocks such as maize, sugarcane, molasses, sugarcane syrup, and damaged food grains like rice, creates direct competition with staple crops. This competition has the potential to escalate food prices and intensify land-use conflicts. To meet ambitious biofuel targets without undermining food security, availability and affordability, the focus must be on sustainable land-use planning, robust R&D for non-food biofuels, and infrastructure investments.

602. CARBON FOOTPRINT OF FIELD CROP PRODUCTION: A NATIONAL AND REGIONAL LIFE CYCLE ANALYSIS APPROACH

National Innovations in Climate Resilient Agriculture of the ICAR–Central Research Institute for Dryland Agriculture (CRIDA), aims to estimate the carbon footprint of Indian agriculture, including direct and indirect emissions. The project primarily focuses on estimating the carbon footprint of crop production of all major crops in the country, including operations within the farmgate and the input supply chain. The study is the first of its kind in India or in any developing country that would provide estimates of direct and indirect emissions from agriculture, disaggregated at the district level, climatic zones and operational land-holding categories, for major field crops. The emission sources covered for crop production includes (i) emissions from land management (based on IPCC system guidelines system boundaries) which includes direct and indirect nitrous oxide emissions, emissions from crop residue burning, emissions from urea application, and emissions from flooded paddy cultivation; (ii) emissions from fossil fuel/electricity use in irrigation pump sets; (iii) emissions from fossil fuel use in farm machinery; and (iv) emissions from the manufacturing of synthetic fertilizers. The crops included in the study are rice, wheat, maize (cereals); jowar, bajra (millets); sugarcane, cotton (commercial crops); chickpea, red gram (pulses); soybean, groundnut and rapeseed & mustard (oilseeds).

The district level carbon footprint estimates for the above 12 crops covered a total of 550 districts (according to 2016 –17 district classification) and 92% of the total cropped area of these crops across the country. Estimates at the size-group level covered 75% of the total cropped area of the crops under study. The results of the study indicate that land management and fossil fuel use in irrigation are the largest source of emissions for the study crops at over 38% each, followed by manufacturing of synthetic fertilizers at about 16% and fossil fuel use in machinery at

7%. Carbon footprint per hectare is the highest for sugarcane, which emits over 7.6t Co2eq/ha followed by paddy (4.3t CO2eq/ha), and wheat and cotton (both around 2.5t Co2eq/ha). Among all the sub-components within the emissions sources, the single largest contribution is methane from flooded paddy cultivation. The study shows an inverse relationship between crop yields and the carbon footprint per unit of production. Higher productivity can offset the carbon footprint per unit of cropped area and result in lower emission intensity per unit kilogram of production output. This clearly points to the significance of increasing productivity in reducing the emissions intensity of crop production output. The study also revealed that for most crops (including high emitting crops such as paddy, wheat, and sugarcane), there is a significant scale effect in the carbon footprint (CF), where there is a general trend of decreasing carbon footprint per hectare as the farm size increases, in line with general expectations of greater input use efficiency with scale. It indicates a potential influence of farm size and associated agricultural practices on soil-related emissions. Marginal farmers typically have the highest CF per hectare, and large farmers often have the lowest. The study highlights variability in emissions across different climate zones, particularly concerning managed soils and fertilizer use, suggesting that geographical and climatic factors play a significant role in determining agronomic practices that would determine agricultural emissions.

Regarding milk production, the results indicate that for cattle milk production at the national level, the average CF is 1.75 kg CO2eq per kg of kilogram milk produced. The contribution of different emission sources to the total CF includes enteric methane (88.8%), methane from manure management (10.7%), and nitrous oxide from manure management (0.4%). The study reveals a significantly higher CF for buffalo milk (3.42 kg CO2-eq/kg), compared to cattle milk, with buffalo systems showing consistently lower productivity and higher emissions across farmer categories.

Overall, this study is a significant contribution towards estimating the baseline carbon footprints of field crop production and milk production in India. It is expected to serve as a critical resource for policymaking related to climate action in agriculture, including carbon trading.

603. MODELLING THE IMPACT OF ARIDIFICATION ON CROP PRODUCTION: PADDY CULTIVATION IN THE CAUVERY DELTA, INDIA

This study is a project under Google's Artificial Intelligence (AI) for Social Good Programme, funded by the Google Research India Lab; it is specifically focused on the Cauvery Delta in Tamil Nadu. The primary aim is to leverage high-resolution satellite imagery, remote sensing data, and advanced machine learning (ML) techniques to analyse how aridification affects paddy cultivation in the region. By applying state-of-the-art deep learning models, particularly Convolutional Neural Networks (CNNs), the study classifies satellite images accurately to predict crop types, assess relevant biophysical and climatic parameters, and estimate crop production at finer spatio-temporal scales compared to traditional ground-based surveys.

The research emphasises generating quantitatively reliable predictions for several critical variables associated with paddy cultivation. These variables include creating accurate crop cover maps, identifying precise sowing and harvesting dates, estimating yields, and measuring evapotranspiration rates. Information from these predictions helps to better understand the potential impacts of aridification on paddy yields.

Achieving these objectives involves systematic experimentation with different satellite imagery and deep learning models to improve the accuracy and reliability of predictions. Significant progress was achieved in improving the prediction accuracy for tasks on identifying paddy crop plots and predicting sowing and harvesting periods for paddy in the Delta using various satellite images and deep learning models, including Unet-3D, Fusion ConvLSTM, and U-TAE. The Unet-3D model paired with Sentinel-1 data achieved 95.47% accuracy in crop identification. Sowing and harvesting dates were accurately predicted with the afore mentioned models.

In the recent quarter, the project's focus shifted towards expanding the capabilities of existing models and evaluating new modelling frameworks:

1. Conducted initial evaluations of the latest AI foundation models, exploring how they might enhance current ML methodologies used for estimating paddy crop cover. This step is crucial to understanding potential integration opportunities.
2. Actively pursued collaborations to further enhance model implementation and development. Efforts included submitting a joint proposal to Google Research with the ML team at IIIT, Delhi (Indraprastha Institute of Information Technology), aimed at developing ML benchmarks specifically for climate-related agricultural issues. Although this proposal was not accepted, continued discussions are identifying alternative collaboration opportunities to advance the project.
3. Presented current outcomes and future directions at the "AI for Agriculture and Natural Resource Management" event, held on 4th and 5th December 2024 at MSSRF in Chennai. This presentation provided an opportunity to highlight progress, discuss challenges, and explore broader collaboration avenues.

604. CLIMATE POLICY INTERVENTIONS

Under the various Global Environment Facility (GEF) funded projects, the Climate Change Program Area team at MSSRF has provided key support to the MoEFCC, Government of India, in terms of detailed policy briefs, along with research analysis and notes to intervene on significant issues in the climate science-policy nexus including key technical inputs provided at the agenda item of the Subsidiary Body for Scientific and Technological Advice (SBSTA) 60 and Subsidiary Body for Implementation (SBI) 60 sessions of the UNFCCC. The members of MSSRF's Climate Change Program Area have been part of the government of India's official delegation to the 29th Conference of Parties (COP29) of the UNFCCC held in Baku, Azerbaijan and also to the Sixty-second Session of the Intergovernmental Panel on Climate Change (IPCC-62), to support the Government of India for the Seventh Assessment Report (AR7) Cycle, coordinating for the draft outlines of the three Working Group contributions as

well as illustrating scientific understanding from developing countries' perspective of significant issues on climate change within the scope of the ongoing global climate discourse at various international forums of the UNFCCC. These key issues cover, *inter alia,* topics ranging from global mitigation and adaptation policies, policy aspects of climate science, climate policy in agriculture, Global Stocktake (GST), loss and damage, climate finance and issues related to equity and climate justice. Policy proposals by MSSRF's Climate Change Program on the operationalisation of international equity in climate policy based on the principle of fair access to global carbon budgets has now been incorporated as an integral part of the climate policy of the Government of India.

The landmark 2023 study on the equity assessment of IPCC scenarios, conducted by the MSSRF's Climate Change Program Area and the National Institute of Advanced Studies (NIAS), garnered widespread recognition within both the climate policy and scientific communities. This pioneering research laid the groundwork for independently developing Global Mitigation Pathways that explicitly incorporate principles of equity and climate justice - critical considerations in ensuring a fair share of the global carbon budget. Following up on this study, the MSSRF-NIAS team has undertaken a study to construct an alternative new framework for developing global climate scenarios. This approach seeks to integrate key dimensions of international climate policy, including the imperative to limit global warming, the pursuit of sustainable development goals, and the operationalisation of equity and Common But Differentiated Responsibilities and Respective Capabilities (CBDR-RC). The framework is designed to be both practical and accessible, employing straightforward methodologies rather than complex computational modelling. By removing the constraints of the complex computational framework, this approach opens new avenues for policymakers, researchers, and stakeholders from diverse backgrounds to engage with and contribute to scenario development. The proposed framework has the potential to redefine how global climate pathways are designed, ensuring that they are not only scientifically robust but also aligned with principles of equity and climate justice. This effort represents a significant step toward shaping a more inclusive and equitable climate scenario framework.


THE NEW INDIAN EXPRE

ON WORLD STATES OPINIONS CITIES BUSINESS SPORT GOOD NEWS MOVIES

Nation

Almost everyone in India vulnerable to climate change impacts: Dr Soumya Swaminathan at COP29

Swaminathan called for policies that integrate both health and climate objectives, stressing that this approach can drive development while building resilience against climate risks.

Dr. Soumya Swaminathan | Photo | Express

Programme Summary

- The pioneering study, in collaboration with NIAS, on the absence of climate equity, lack of food security, inequitable energy access and lack of growth in the global mitigation scenarios of the IPCC Sixth Assessment Report, has received widespread recognition within the global climate policy and climate science community. It has forced attention on equity in the work of the Seventh Assessment Cycle of the IPCC and has put it on the research agenda of even the climate policy institutions of the Global North.
- The foundation has been laid for an alternate framework that explicitly considers issues of equity and climate justice, poverty eradication and energy access in the Global South and the framework is being extended to explicitly include food and nutrition security.
- Played a key role in mainstreaming into national climate policy, and the climate discourse of the Global South, the critique of current IPCC mitigation scenarios from the perspective of climate equity and access to a fair share of the global carbon budget.
- Key technical advisory support provided to the MoEFCC, Government of India on policy issues, contextual assessment and strategy, in the run-up to and during COP 29 at Baku, Azerbaijan, including issues arising from the first Global Stocktake (GST) on the implementation of the Paris Agreement and the ongoing efforts on the global goal on adaptation.
- Technical advisory support to the MoEFCC, Gov of India on issues relating to the preparation of the Seventh Assessment Report (AR7) cycle of the IPCC, especially the chapter outlines of the reports, in the run-up to and at the Sixty-second Session of the IPCC (IPCC-62), held at Hangzhou, China.
- Key support provided to the MoEFCC in scientific and technical issues related to India's National Adaptation Plan currently under preparation.
- Key findings from the EU-GIZ funded 'Land Use and Land Cover Modelling Study' project include strong evidence that imposing a carbon tax on inputs such as fertiliser and fuel would lead to inequitable impacts on Indian farmers. The cost of cultivation would increase, with the rise being proportionately higher for marginal and small farmers compared to large farmers, with the overall impact of a carbon tax on Indian agriculture being unequivocally regressive.
- Findings of the NICRA-ICAR sponsored projected on the "Carbon footprint of field crop production: A national and regional LCA approach" have provided the first comprehensive district-level estimates of the carbon footprints of the production of 13 major field crops, along with the carbon footprint of milk production in India. The results highlight unambiguously an inverse scaling relationship between emissions intensity and farm size, as well as the need for increasing the productivity of small and marginal farmers to reduce emissions intensity.

CROSS-CUTTING THEMES

Gender Integration and Mainstreaming (GIM)

Revived the Gender Integration and Mainstreaming (GIM) group, deepened interdisciplinary research and supported project-level gender assessments.

Gender, Institution, Capacity Building and Policy studies

Strengthening Gender integration

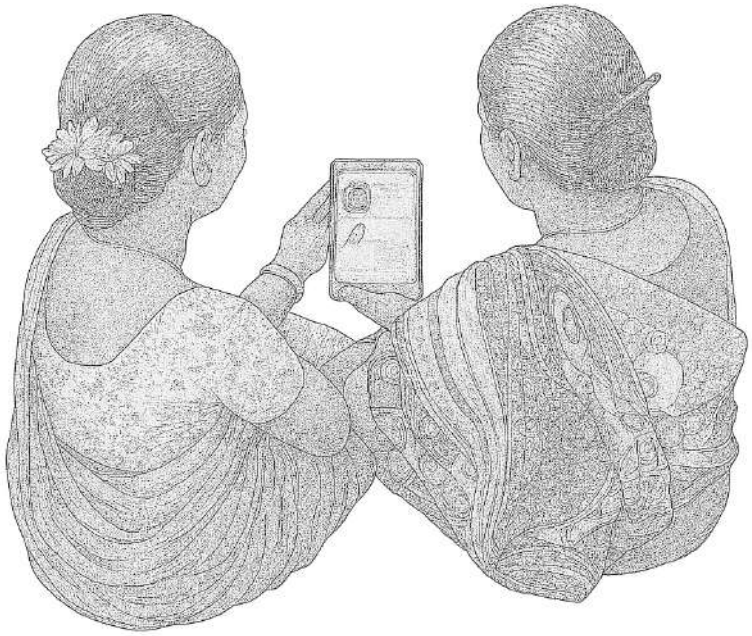
in project level: six flagship projects of different programme areas were supported with need-based capacity building in strengthening gender dimensions

Capacity-building

initiatives trained over 500 learners in nutrition among grassroots practitioners, farmers' governance among promoting organizations, and research skills among staff using the ECHO platform.

Revitalised 15 FPOs/FPCs

Institutional efforts revitalised 15 Farmer-Producer Companies through governance reforms, digital tools, branding support, and business planning.



CROSS-CUTTING THEMES

GENDER, INSTITUTION, CAPACITY BUILDING AND POLICY STUDIES

In 2024–2025, MSSRF advanced gender mainstreaming, institutional strengthening, and capacity building across its programmes. The Gender Integration and Mainstreaming (GIM) group deepened interdisciplinary research and supported project-level gender assessments. Studies highlighted how collective action enhances women's agency in fisheries and farming. Institutional efforts revitalised Farmer Producer Companies (FPCs) through governance reforms, digital tools, branding support, and business planning. Capacity-building initiatives trained over 500 participants in nutrition, governance, and research. Despite connectivity and logistical challenges, adaptive strategies improved outreach and learning. These integrated approaches fostered gender equity, community resilience, and sustainable development rooted in inclusive and locally anchored systems.

Gender, institution, capacity Building and Policy Studies have always been cross-functional and deeply interlinked with our programme areas towards the collective goal of sustainability.

Improving gender relations, while crucial for social justice, is also critical to achieving economic and environmental benefits. This past year, strengthening the integration of gender in project design and implementation phases, building the capacity of the team members and synthesising learnings with the team have been the main strategies adopted to ensure gender equality.

Recognising that collective bargaining is an important pathway for equitable and sustainable development of farmers and fishers, strengthening and enabling the transformation of community-based institutions like farmer producer companies, fisherwomen cooperatives and co-management committees and grassroot interventions are core to our work. Interventions towards strengthening governance and operations of farmer producer organisation. The following sub-sections provide a detailed overview of the actions facilitated at the institutional level to address the cross-cutting concerns:

Mainstreaming Gender

Gender is not just a standalone issue but a fundamental structure that shapes economy, society and policy. MSSRF recognises gender as a cross-cutting theme, and therefore seeks to intentionally integrate gender into all its development research and interventions. In the

past year, our effort has been to institutionalise and mainstream gender considerations at three levels - institutional, programmatic and project. To ensure that our work, both in its intentions and impact, is aligned towards the goal of gender and social justice, we employ an intersectional gender lens at all stages - from the point of ideation to its final evaluation. Our major achievements in the past year have been mentioned below.

Gender Integration and Mainstreaming Group at the Institutional Level

To maintain a strong emphasis on gender inclusivity, we identified "Gender Focal Points" in all the programmes and field offices who would be responsible for integrating gender perspectives in every project and intervention initiated under their programmes. These nodal persons work with the team at the programmatic and project levels to ensure that all the interventions are designed to address gender inequalities in the division of labour, resources, and power. For this, gender-disaggregated data is collected and tools are developed to capture the impact of our interventions on gender relations and to minimise the negative consequences on women or the local communities. This approach has been implemented in developing proposals as well as in all major projects that were initiated in the past year. At the institutional level, these nodal persons were brought together at the institutional level to form the Gender Integration and Mainstreaming (GIM) group. Presently, there are 18 members in the GIM group. In the past year, the focus has been to facilitate a horizontal learning platform led by the Gender Lead to build capacities of GIM members on their understanding on key issues that arise at the intersection of gender and rural development, research methodologies that are suitable to study the workings of gender, development monitoring and evaluation tools to measure the impact of our interventions on gender relations and especially on resource-poor women.

Interdisciplinary Gender Research

Across all programme areas, the gender focal point facilitated interdisciplinary research integrating intersectional gender analysis into the foundation's work on science and technology innovations in sustainable agriculture, fisheries, biodiversity management, and climate adaptation through collaborative research and programme implementation. To understand and address the root causes of gender and social inequalities, we also conduct mixed-methods social science research on how gender shapes important socio-economic dynamics, such as access to and control over knowledge, resources, technologies, and opportunities and how it impedes women's full participation in local development and governance of grassroots institutions.

One such research was undertaken in partnership with the Fish for All Centre to study how the collectivisation of women fish workers involved in post-harvest fisheries activities improved their working conditions and livelihoods. The study compared the experiences of two groups of fish workers in Mayiladuthurai district. The first was a group of women fish vendors who engage in individualised negotiations for work and the second was a group of workers who have been collectivised into a Fish Farmer Producer Organisation (FFPO) promoted by MSSRF, called Vetri Pavai FFPO and highlighted the differences in how both these groups relate to their work differently and the role of collectivisation in transforming women's work in the fisheries sector. The study found that despite sharing similar socio-economic and occupational backgrounds, differences between these groups yielded distinct outcomes in their fish-based occupation, business activities, agency and the social value they gained in their day-to-day fishing activities.

The findings demonstrated that Vetri Pavai FFPO, exhibited greater knowledge, skills, market exposure, income, and linkages in the fish business

than individual women vendors. The collective has bargained with the patriarchal norms more tactically and faced less stigma. Since, they have been able to develop a business model through product transformation activities as a collective, they identified themselves as entrepreneurs rather than fish vendors. The collective members faced lesser occupational health hazards and insecurities due to their access to enabling technologies and safer workplaces. This disparity highlights the importance of collective action and facilitation in empowering women in fisheries.

Another study on how commercialisation of millets is impacting the gender relations in Jeypore, Odisha was carried out. The study focused on how the changing political economy of millet production is creating gendered impacts in the millet value chain, decision-making at the household, farm and societal levels, and in food and nutrition security. These changes triggered both gains and losses to women (including other intersectional categories), and this study delves into gender and political economy transformations using a feminist political ecology framework in gender mainstreaming.

The GIM members also initiated five impact research studies in the last year:

- Gender Dynamics of the Biodiversity Conservation Initiatives of the Wayanad District Tribal Development Action Council
- The Impact of Micro-credit on Women Farmers - Is it Empowering or Disempowering?
- Impact of Pulses Cultivation in Rice Fallows on Gender Relations in Farming Households in Malkangiri District of Odisha
- Impact of Information and Communication Technologies (ICTs) on the Occupational Vulnerabilities of Women in Post-Harvest Fisheries in Mayiladuthurai district.
- Impact of Agroecological Practices on Women's Role in Agriculture: Evidence from Madhya Pradesh

Project-Level Integration

Planned efforts were made to ensure that gender considerations were incorporated at the initial stages when designing project proposals as well as in all existing projects. Efforts have been taken to conduct a gender needs assessment using surveys and focus group discussions with women farmers and relevant stakeholders before a project is implemented. Such assessments were conducted in the states of Odisha, Assam, Gujarat, and Maharashtra as a baseline for implementation projects that introduce new cultivation practices and climate-smart technologies in these regions.

Gender in Focus Dialogue Series

In the past year, we have been able to create a dynamic platform to foster meaningful conversations around gender and development, bringing together academics, practitioners, and community leaders to dialogue, share knowledge and diverse perspectives. The objective of the dialogue series is to reflect and dialogue on a range of issues that lie at the intersection of gender and development including, women's role in poverty reduction, livelihood transformations, natural resource management, and climate resilience. As part of this series, the following virtual talks were organised:

- "Rural Women and the Political Economy of Food Systems Transformation in India" by Dr. Madhura Swaminathan, Indian Statistical Institute - Bengaluru
- "Gendered Livelihoods and the Valuation of Women's Labour in Fisheries" by Prof. Holly Hapke, School of Social Science, University of California Irvine
- "Gendered Dimensions of Human-Wildlife Relations: Conflict, Conservation and Sustainable Use" by Dr. Meera Oommen, Associate Director and Founder Trustee of Dakshin Foundation
- "Accelerate Action Towards Gender Justice: Key to Climate Resilience and Food Security"

by Prof. Nitya Rao, Professor of Gender and Development, University of East Anglia

- "The World of Work: Recognising, Valuing and Measuring" by Dr. Sona Mitra, Director - Policy and Research, IWWAGE, Krea University

The Foundation also hosted a Women Farmers' session on International Rural Women's Day in October 2024, where eight women farmers from different parts of Tamil Nadu shared their experiences on how they gained access to productive resources, negotiated agency and brought transformations in agri-food systems.

Strengthening Grassroots Institutions

During the financial year 2024–2025, comprehensive and strategic efforts were undertaken to strengthen the institutional ecosystem of Farmer Producer Companies (FPCs) across Tamil Nadu, Puducherry, Odisha and Kerala field centres. The year's work focused on improving operational efficiency, building market and digital capacities, enhancing governance and compliance, and revitalizing underperforming FPCs. A key thrust was placed on creating visible, resilient, and self-sustaining Farmer Producer Organisations (FPOs).

The year commenced with a series of performance assessments of FPCs in locations such as Kannivadi, Kulumai, Pasumai, Innuyir, Mayiladuthurai, Poompuhar, two FPCs in Puducherry three FPCs in Odisha and one in Kerala. These visits employed a structured assessment format to evaluate institutional health, governance, market linkages, infrastructure usage, and member engagement. Findings from these diagnostics informed tailor-made action plans to bridge operational gaps, restructure financial processes, and introduce new market-oriented initiatives.

To enhance the digital capacity of FPCs, the Vyapaar App was introduced as a comprehensive solution for streamlining business operations. Designed specifically for small and medium agri-enterprises, the Vyapaar App enables FPCs to digitize their financial transactions, maintain accurate records, manage inventory efficiently, and oversee procurement and sales activities in real time. With its user-friendly interface and cloud-based access, the app allows FPCs to generate essential financial reports such as profit and loss statements, balance sheets, and stock registers with minimal effort. The integration of Vyapaar has helped 10 FPCs transition from manual record-keeping to a more transparent and accountable digital system, improving financial discipline, operational visibility, and timely decision-making. The Vyapaar app has now also been introduced to FPCs in Odisha to strengthen their digital and financial management capabilities.

A major priority this year was strengthening the marketing, branding, packaging, and product visibility of FPCs. A coordinated effort was made to design and print attractive promotional flyers and product brochures for more than 15 FPCs, with multilingual content and QR codes for digital access. A dedicated product display space was created at the Chennai office, showcasing over 60 curated products—ranging from millets and pulses to fish pickles and moringa powder—providing a professional platform for visiting stakeholders, buyers, and government officials to engage with FPC offerings.

In addition, packaging support was provided to enhance shelf appeal and compliance. Efforts were made to design updated labels with nutritional facts, manufacturing details, and branding elements. Consultations were held with branding experts to refine product identity and prepare FPCs for bulk retail and institutional sales. We also explored subsidy schemes under Pradhan Mantri Formalization of Micro Food Processing Enterprises and the Agricultural and Processed Food Products Export Development Authority to support packaging and export readiness.

To boost access to wider markets, the Foundation pursued strategic collaborations with platforms such as Open Network for Digital Commerce and public and private partners. These collaborations opened up business-to-business (B2B) and direct-to-consumer (D2C) opportunities. Select FPCs were introduced to bulk buyers and urban consumer networks. Further, training on pricing strategy, margin planning, and customer packaging preferences was provided to Board of Directors and Chief Executive Officers to enable informed decision-making. A focused effort was made to prepare business plans for fish-based FPCs such as Mayiladuthurai Kaveri FFPC, Vetri Paavai FFPC, and Bharathidasan Fish FFPC. These plans detailed their value proposition, operational costs, revenue forecasts, and market strategies, serving both as internal guides and as tools to attract funding or equity support.

Capacity building remained at the core of institutional strengthening. Multiple workshops and trainings were conducted, including a two-day program for CEOs and accountants of FPCs, focusing on financial management, procurement, GST compliance, and digital payments. A larger, cross-regional iECHO capacity-building series engaged over 150 participants from 50+ FPOs across 10 districts, covering modules on governance, leadership, statutory compliances, and market-readiness. Assessment tools were developed to measure knowledge gains and guide post-training support. To improve compliance and sustainability, audits were facilitated for FPCs with long-pending statutory filings. Auditors were changed for five FPCs, financial documentation was regularized, and formats were developed to standardize reporting.

One of the flagship institutional efforts was the revitalisation of Illuppur FPC, a dormant FPC with significant infrastructure but limited activity. A step-by-step turnaround roadmap was developed and implemented, and new business plans were initiated for milk and poultry aggregation. The pulses mill and seed processing units were revived, and collaborations with FPO supporting organisations helped to strengthen internal systems, credit linkages, and team recruitment. Illuppur FPC is now on a clear recovery path, with renewed operations, improved financial tracking, and expanded leadership involvement.

The institutional strengthening efforts this year have not only addressed operational gaps but also laid the foundation for scalable growth, digital integration, improved branding, and market readiness. Through multipronged support in governance, compliance, digital skilling, product marketing, and capacity building, FPCs under our umbrella are now better positioned to serve their farmer-members, attract new markets, and function as viable rural enterprises.

Capacity Building

The capacity building strategy is designed to enhance the skills and knowledge of individuals, institutions, and systems in all programme areas with a strong emphasis on gender inclusion and sustainability. The strategy operates on three foundational pillars: training people, strengthening institutions, and improving systems.

In partnership with ECHO India (Enhancing Well Being of Communities), MSSRF has successfully rolled out digital training programmes to build the capacities of grassroots leaders, FPOs, and researchers. These initiatives utilise the ECHO tele-mentoring model, which promotes hub-and-spoke knowledge sharing,` case-based learning, and continuous engagement. The programmes have significantly improved expertise in nutrition literacy, FPO governance, and research methodology, directly supporting MSSRF's mission of inclusive and sustainable rural development.

One of the key initiatives, the Nutrition Literacy Training Programme, trained 60 National Virtual Academy (NVA) fellows in Tamil Nadu and Puducherry (24 male and 36 female). Through interactive virtual sessions, participants learned

about balanced diets, local nutrient-rich foods, and healthy eating habits. Post-training assessments revealed that 98% of participants adopted healthier dietary practices, demonstrating the program's success in driving behavioural change. Additionally, NVA fellows became nutrition ambassadors, conducting local awareness sessions to amplify impact. A user-friendly learning module on nutrition literacy has been developed.

Another ongoing programme empowering FPOs with leadership, governance and social capital, has engaged 150 members from 50 FPOs across Tamil Nadu. The training covers legal compliance, financial management, market linkages, and business planning. So far, 8 out of 12 sessions have been completed, with participants reporting improved governance structures and stronger peer-learning networks.

To enhance the research capabilities of the in-house team, we facilitate training sessions on research methodology and statistical tools; 45 staff members have joined across Chennai, Odisha, Wayanad, and Poompuhar sites so far. The program focuses on research design, data collection, statistical analysis, and ethical practices. With six out of 20 sessions completed, participants have gained greater confidence in framing research questions and designing methodologies.

Table 14: Details of the participants (2024–2025)

Programme	Participants	Period	Coverage Area
Nutrition literacy	60	Mar 2024 - Oct 2024	Tamil Nadu, Puducherry
FPO leadership & governance	150	Nov 2024 - May 2025	Tamil Nadu (50 FPOs)
Research methodology	45	Feb 2025 - Dec 2025	Chennai, Odisha, Wayanad, Poompuhar
Every Child a Scientist	250	Jan 2025 - Mar 2025	4 centers (Chennai, Poompuhar, Kolli Hills, Pichavaram)
Total	505		

Despite the programme's successes in empowering rural communities and strengthening institutional capacities, several challenges emerged, including digital connectivity barriers, scheduling conflicts due to participants' livelihood commitments, and technical complexities in platform navigation. To overcome these hurdles, MSSRF adopted adaptive strategies such as utilising Village Resource Centers (VRCs) as access points, optimising session timings based on participant availability, and developing simplified, multilingual training materials. These interventions yielded valuable insights about the critical role of local infrastructure support, the effectiveness of grassroots champions in driving engagement, and the necessity of sustained follow-up mechanisms to ensure lasting impact. Participant feedback revealed that while 64% found the sessions highly engaging and informative, 36% recommended enhancements in interactivity and the inclusion of more localized case studies. Building on these learnings, MSSRF plans to implement peer discussion forums, distribute printed learning aids, and integrate region-specific examples to further improve programme effectiveness. As the initiative moves forward, continuous refinement of digital accessibility and community engagement approaches will remain central to scaling the programme's impact and advancing sustainable development across rural India.

THE M.S. SWAMINATHAN FELLOWSHIP

THE M S SWAMINATHAN FELLOWSHIP

The M.S. Swaminathan Fellowship (MSSRF) seeks to bring together young, talented postgraduate students in the fields of agriculture, ecology, economics, marine biology, nutrition and social sciences to do impactful research over 24 months that serve the needs of the communities that MSSRF works with, as well as the larger population in the country resulting in science and society interactions tailored towards addressing the Sustainable Development Goals.

Ms Angel Abraham

Six candidates have been awarded the fellowship, with each selected fellow being mentored by a Senior Scientist from MSSRF. The M.S. Swaminathan Fellowship covers topics like biodiversity conservation, addressing soil salinity, building tolerance to abiotic stress, reducing methane emission in paddy fields, addressing nutrition deficiency through the development of value-added products from edible seaweeds and nutri-rich green leafy vegetables.

Given below are the details of the individual research projects under the Fellowship:

1. Assessment of carbon stock in arboretum and coffee agro-eco systems: A case study

This research by Ms. Angel Abraham aims at understanding the carbon stock assessment in the tree biomass, dead wood, leaf litter and soil. Comparing the carbon stock of MSSRF's arboretum spread over 0.4 hectares, including Rare, Endangered and Threatened (RET) species from the Western Ghats with trees from a nearby coffee plantation spread over 16 hectares in Wayanad, Kerala. As an outcome, the data generated will help understand the long-term impacts on conservation of the RET species, as well as the impacts of climate change on the RET species in comparison to a commercially cultivated crop.

Year one of the fellowship activities included identification of trees in the arboretum and coffee plantation and marking geo-coordinates and taking girth per breast height measurement. Leaf

litter has been collected from 10 different plots, each from a coffee plantation and an arboretum, for assessing carbon stock assessment data entry, data cleaning for the coffee plantation have also been completed.

2. Exploration of rice microbiome and methylotrophs for mitigation of methane emissions in four rice varieties

This project by Ms. Ezhil Dhanasekaran focuses on exploring the bacterialcommunity around rhizosphere soil and the phyllosphere region of traditional rice varieties and cultivars through culturable and metagenomic approaches to understand their plant growth-promoting traits and abiotic stress tolerance. It also works on isolation of Methanotrophs and Methylotrophs which play a crucial role in methane mitigation by converting methane into less potent carbon dioxide from the rhizosphere soil, root, and leaf, as well as to screen for methane and methanol degradation genes. It also works for plant growth-promoting traits and drought-tolerance (abiotic stress), to assess the drought-tolerance. The outcome of the study would result in improved rice yield even under drought stress (through PGPR bio inoculant) and reduced methane emission in the fields.

Ms Ezhil Dhanasekaran

Review of literature, collection of samples, isolation of rice microbiome and methylotrophs through culture enrichment have been completed, along with screening bacteria for salinity tolerance and drought tolerance, are some of the key activities completed as part of year one.

3. Examining the influence of *Oryza glaberrima* SUVH7, BAG4, MYB106 complex on HKT1;5 expression during salinity stress

Salinity tolerance in rice is controlled by the sodium transporter, OsHKT1;5, which is expressed itself in an increased manner in the roots under conditions of salinity, resulting in better yields. This research being conducted by Ms. Gopika Jawahar focuses on understanding the expression of sodium transporter, OsHKT1;5,

Ms Gopika Jawahar

during salinity stress due to the influence of *O. glaberrima* RRSUVH7, BAG4, MYB106 genomic/protein complex. It also seeks to build a prototype to examine the same in many *O.glaberrima* genotypes and look for variation in HKT1;5 expression. The

research outcome seeks to develop new saline-tolerant varieties of *O. glaberrima*, creating more options for farmers cultivating rice in saline areas or vulnerable to the same in the future.

Key activities in year 1 include literature review, some key activities completed include gene isolation from five rice varieties and their HKT1;5 gene sequencing, salinity treatment, sample collection at 2h, 6h, 12h 24h, 48h from stress and cryopreservation for molecular analysis, testing of qPCR primers for target genes amplification, measurement of soil electrical conductivity and pH and quantification of HKT1;5 expression in FL 478 and IR 28 under control condition.

4. Conservation of Native Hymenopteran pollinator biodiversity and sustainable management of pollination services in agroecosystems linking the entomo-palynological approach and citizen science: A study by Ms. Indhu

The Hymenoptera is a diverse group of insects, including bees, wasps, with economic importance for their essential role in the pollination of a great variety of crops. This research focuses on the role of weed ecology in agricultural fields and its potential impact on pollination dynamics, on bee foraging behaviour and crops. The outcomes from this research would lead to improved cropping practices with a balanced crop-weed interface, resulting in better crop yields through ecologically sustainable pollination services.

Ms Indhu

During the first year, activities included finalisation of the study design, selection of sites (3-5 agro-ecosystems), baseline survey, collection, and identification of weed species in and around crops, documenting crop phenology, weed flora and flowering patterns, pilot observation of pollinator activities and set up observation plots.

5. Exploring the potential of seaweed by innovating value-added products for the sustainable development of *Sargassum wightii*

An edible seaweed rich in carbohydrates, minerals, proteins, essential amino acids, antioxidants with low glycaemic index, *Sargassum wightii* is usually found in the Mandapam region, Rameswaram in Tamil Nadu. This fellowship project by Mr. Prakash Saravanan seeks to create value-added products such as nutri biscuits and

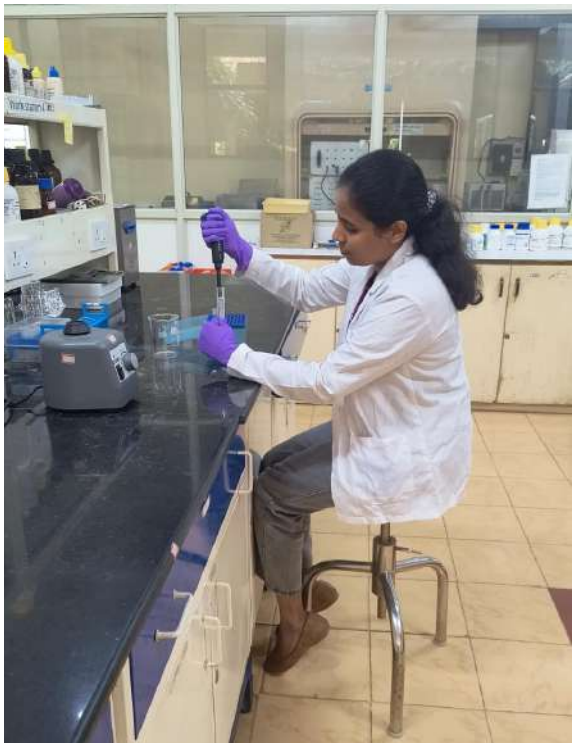
Mr Prakash Saravanan

nutribars using this nutrient-rich seaweed, along with millets. They grow in low rainfall and are highly rich in nutrients. The outcome seeks to bring nutritional improvement through innovative food products made of raw materials that are safe, easily accessible, affordable and strengthen the livelihoods of seaweed and millet producing farmers.

During the first year, activities included profiling of the seaweed, followed by trials with finger and pearl millet to test for texture, colour, aroma, and feasibility of inclusion of seaweed in millet combinations.

6. Exploring the nutritional richness of Wayanad's wild greens

A value addition approach for mainstreaming wild green leafy vegetables (GLVs) in Wayanad holds immense nutritional potential but remains untapped and underutilised. Nutrients like iron, vitamin A, and essential micronutrients found in them provide an accessible solution to malnutrition. The Fellowship project by Ms Praise Alex focuses on the development of value-added products from four nutri-rich underutilised GLVs used by Wayanad's tribal communities. In terms of its outcome, it seeks to develop a Nutri powder made from the four nutri-rich GLV vegetables to be used as nutritional supplement, thereby creating an option to address malnutrition with respect to specific nutrients like protein, iron, and promoting antioxidant activity.



Ms Praise Alex

During the first year of the study, sample collection and nutrition profiling, assessing the bioavailability of nutrients, as well as understanding the anti-nutritional properties of the GLVs have been completed.

COMMUNICATION AND OUTREACH

COMMUNICATION AND OUTREACH

With the strategic plan as our guiding compass, the communications team is poised to build a robust communications and messaging platform to showcase and amplify the immense breadth and interdisciplinary work of the organisation.

The rebranding strategy for MSSRF includes the new website and logo, structured around four thematic platforms. These are: Shakti (Agri-Food Systems), Satva (Climate and Health), Samudra (Coastal Resources and Marine Ecosystems), and Surya (Biodiversity and Empowering Indigenous Communities). These platforms showcase MSSRF's research and interdisciplinary approach in improving lives and livelihoods, with a sustainability-centric approach. A new donor portal has also been created to garner institutional support from our online community.

Looking ahead, more digital stories are planned to expand MSSRF's visibility in regional media networks and use various cutting-edge tools and metrics to gauge impact. This is to ensure that science and relevant research continue to inform, inspire, and impact the most marginalised.

Media Resource Centre

The Media Resource Centre (MRC) at MSSRF plays a pivotal role in bridging the gap between scientific research and public understanding. Its mission is to ensure that MSSRF's evidence-based insights reach diverse audiences in the public domain: policymakers, researchers, journalists, and communities in formats that are clear, accessible, and relevant. This work is vital, as informed communication fosters public trust, supports policy advocacy, and enables science to drive real-world change.

In 2024–25, the MRC expanded MSSRF's visibility through sustained engagement with

English and regional-language media, issuing multilingual press releases and securing coverage across print, broadcast, and digital platforms.

Mina Swaminathan Media Fellowship

Established in 2020–21, the Mina Swaminathan Media Fellowship was created to strengthen gender-sensitive journalism in regional languages. It honours the legacy of the late Mrs Mina Swaminathan, who championed a gender-sensitive approach to development. The fellowship supports young journalists who spotlight under-represented voices and social issues, helping shape inclusive narratives in the public domain. In 2024, three fellows were selected for their outstanding contributions to developmental journalism. Ms Indu Gunasekar, Tamil Nadu, Mr Shafeeq Thamarassery, Kerala and Ms Shatarupa Samantaraya, Odisha.

By supporting these voices, MSSRF is fostering a media landscape that is more inclusive, equitable, and responsive to grassroots realities.

Social Media Outreach: Expanding Digital Engagement

In the last year, MSSRF has continued to leverage our social media to amplify our outreach and deepen public engagement. These platforms served as powerful tools to communicate science, share community stories, and amplify initiatives for M.S. Swaminathan's centenary (MSS100). Facebook and Instagram helped connect with grassroots audiences through visually engaging content, while LinkedIn emerged as a key channel for professional outreach, generating over 690,000 impressions and engaging nearly 14,000 followers. Twitter facilitated dynamic interaction, with over 1,60,000 impressions and more than 8,000 engagements, reflecting strong public engagement with MSSRF's research and developmental work.

This digital presence was instrumental in promoting MSS100 events such as the #PhotoWithProf campaign, the Koraput National Consultation, and *Noorumeni Nandhi*. Through compelling storytelling and evidence-based insights, MSSRF used social media not just to inform but to inspire action, bridging the gap between research and real-world impact.

MSS100 Events Across India: Honouring a Legacy, Inspiring Action

- ***#PhotoWithProf Campaign***

This short-term but highly impactful initiative invited individuals – staff, colleagues, mentees, and other close affiliates – to share their own curated personal memories with Prof. M.S. Swaminathan, celebrating his legacy of compassion and visionary leadership and honoring his tireless championing of the most marginalised.

- ***Noorumeni Nandhi – Water Stewardship Initiatives***

As part of the centenary celebrations to mark the legacy of Dr. M.S. Swaminathan, the *Noormeni Nandhi* event was held on January 23, 2025, in Alappuzha, Kerala, spotlighting transformative efforts in water conservation and sustainable agriculture led by MSSRF in the Kuttanad region. MSSRF's initiatives, ranging from rainwater harvesting to community water literacy programmes, have addressed rural agrarian distress, contributed to the conservation of heritage farming systems, and empowered local communities to manage their water resources sustainably. These efforts are especially significant in Kuttanad, a region known for its unique below-sea-level farming practices and vulnerability to climate change.

During the event, the GIAHS certificate was formally handed over to Shri P. Prasad, Minister of Agriculture, Government of Kerala. In his address, the minister reflected on the importance of achieving Sustainable Development Goal 2: Zero Hunger, which calls for ending hunger,

improving nutrition, and promoting sustainable agriculture by 2030. He connected this global vision with Dr. Swaminathan's concept of the Evergreen Revolution, emphasizing the need for food sustainability rooted in ecological balance and community resilience.

- ***MSS Centenary Lecture Series***

Launched in October 2024, this series features global thought leaders discussing urgent challenges in agriculture, climate, and biodiversity. Highlights in the last year include Prof Ronnie Coffman, Dr Rajeev K. Varshney, Dr Himanshu Pathak, Prof V.K. Ramachandran, Prof Kamal Bawa, Dr Geoffrey Hawtin, Dr. Ismahane Elouafi, Dr. Pamela McElwee and Dr. Cynthia Rosenzweig.

Cumulatively, these events honour the rich and vibrant legacy of Prof. Swaminathan, while contextualising MSSRF's mission to build a more sustainable, inclusive, and climate resilient future.

Lectures, Workshops and Events

- **WomenConnect Challenge Round 2 Result Sharing Workshop**

The workshop on ICT Innovations in Post-Harvest Fisheries: Bridging the Gender Digital Divide and Building Socio-Economic Resilience of Fisherwomen in Coastal Districts of Tamil Nadu and Puducherry Union Territory was held on 6 March 2025 at MSSRF, Chennai. This programme was supported by Reliance Foundation and the United States Agency for International Development, and as part of WomenConnect Challenge, India Programme, has achieved significant breakthroughs in addressing technological hurdles faced by fisherwomen in Tamil Nadu and Puducherry. The workshop brought together government officials, fisheries experts, and digital inclusion advocates to reflect on the project's impact and chart future strategies. In a keynote address, Dr. Soumya Swaminathan, Chairperson (MSSRF), emphasised the transformative potential of technology when aligned with community needs, echoing Dr. M.S. Swaminathan's belief in the power of women to quickly adopt innovative technologies.

- **Wayanad Community Seed Festival**

Wayanad Community Seed Fest 2024–2025 was organised at CAbC, Wayanad, with a display of rich agrobiodiversity through 73 stall exhibitions, and more than 5000 participants. It was held from 30 January to 1 February, 2025. The three major objectives were: honouring the legacy of Professor M. S. Swaminathan toward advocating farmers' rights, role of community seed banks in food & nutrition security in the light of climate change and strategic role of Cooperatives in addressing agricultural challenges. The Seed Fest 2025 brought together men and women farmers, conservers, researchers, policymakers, private sector actors and government officials. This served as a platform for knowledge and material sharing and exchange, networking and showcased farmers' commitment in in-situ conservation of valuable crop genetic resources.

- **National Consultation: Building Climate Resilient, Sustainable and Inclusive Seed Systems for Food and Nutrition Security**

Held during 27–28 February 2025, at the TAbC, Koraput, the National Consultation on Building Climate Resilient, Sustainable and Inclusive Seed Systems for Food and Nutrition Security was organised by M.S. Swaminathan Research Foundation (MSSRF), the Government of Odisha, and Food and Agriculture Organisation (FAO). The main theme of this consultation was to address the urgent need for robust seed systems that can withstand climate variability while ensuring food and nutritional security, especially in biodiversity-rich tribal regions like Koraput, recognised globally as a GIAHS site. The consultation focused on integrating formal and informal seed systems, operationalising farmers' rights, and promoting agro-biodiversity through community-led approaches. The consultation brought together policymakers, researchers, community leaders, and international experts to develop actionable strategies for seed system resilience. It fostered collaboration across sectors, generated policy recommendations, and emphasized the role of women and youth in seed conservation. The outcomes are expected to inform national and regional frameworks, strengthen farmer-led conservation efforts, and serve as a scalable model for other biodiversity-rich regions. This initiative also forms part of the MSS100 celebrations, honouring Professor M.S. Swaminathan's legacy and underscoring MSSRF's 30-year commitment to sustainable development in Odisha.

- **Tuber Festival at CAbC, Wayanad**

The recent Tuber Fest in Wayanad on 23 April 2025 showcased the remarkable climate resilience and nutritional potential of tubers. Engaging a close-knit group of 100 participants. The event featured a colourful display of indigenous tubers, coupled with engaging sessions that raised awareness about their nutritional value, sustainable diets and role in climate-resilient agriculture. Through insightful discussions and interactive culinary demonstrations, the event recommended the addition of tubers into daily diets while highlighting their role in fostering ecological balance and community resilience.

- **Quantification and Monitoring of Blue Carbon Ecosystems along the Tamil Nadu Coast**

Hosted a consultation on 16 June 2025 to launch an exciting new project in partnership with Microsoft, India, 'Quantification and Monitoring of Blue Carbon Ecosystems along the Tamil Nadu Coast'. This pioneering initiative will combine drone-based multispectral remote sensing, LIDAR, and GeoAI to quantify carbon stocks in mangroves, seagrass beds, and tidal marshes – critical ecosystems for climate mitigation and coastal resilience. Ms. Supriya Sahu, IAS, Additional Chief Secretary for Environment, Climate Change & Forests, Tamil Nadu gave a heart-warming special address on environmental conservation. This consultation would lay the groundwork for blue carbon assessment across Indian coastal states, supporting national climate commitments and conservation policy.

- **Bhoothalingam Library**

The Bhoothalingam Library was established in 1994 at MSSRF as a public resource centre supporting research and education in science and sustainable development. It offers access to over 21,000 books, journals, theses, and reports, along with 4,500 archived periodicals. Through its Online Public Access Catalogue and British Council Library membership, users can explore a wide range of physical and digital resources. The library provides research support through current awareness updates and selective dissemination of information. It also contributes to ECAS programme by hosting a dedicated digital gateway

with curated materials for students between grades six to ten, encouraging scientific learning in government schools. The library offers individuals access to physical or digital information, in line with educational and research needs.

- ## MSSRF Newsletter

In May 2025, MSSRF's in-house newsletter was re-branded and communicated to more than 2500 subscribers (online community) in India and worldwide. We intend to continue growing and diversifying this base through targeted outreach and digital campaigns. From long narratives and data-heavy reports to pithy write-ups and short digital stories on our research, this digital transformation is committed to showing how MSSRF's legacy is not just critical but can reach even wider audiences by greater accessibility and connecting the dots of our work from theory (lab) to praxis (land).

- ## Campus Visits by School and College Students

To spark interest in MSSRF's work across diverse programme areas such as Biotechnology, Ecotechnology, and Coastal Resources and Fisheries, the foundation offers immersive campus visits for students. In 2024–25, over 800 students from schools and colleges across India participated in these educational tours. During the visit, a short film presenting MSSRF's vision and mission is screened. This is followed by guided explorations of the Prof. M. S. Swaminathan Gallery, research laboratories, the Touch and Smell Garden, and the Nutri-Rich Garden, each designed to provide hands-on insights into MSSRF's journey in science, sustainability, and biodiversity.

SCIENCE EDUCATION

SCIENCE EDUCATION
EVERY CHILD A SCIENTIST

Every Child A Scientist (ECAS) programme, implemented in 4 centres viz., Chennai, Pudukkottai, Poompuhar and Kolli Hills, aims to nurture scientific thinking and promote joyful experiential learning among students in government schools.

The 15-day session per batch follows a structured, student-centric model that incorporates digital tools-based learning and teaching, focusing on a broad range of topics in biology. Students are exposed to various subjects in Biology, including Agriculture, Health and Nutrition, Earth and Atmospheric Sciences. It includes practical sessions, day-to-day real-life applications, lab-based experiments, model-making, pre-assessment, post-assessment tests, and feedback. It also incorporates life skill education to support holistic development. This approach fosters conceptual clarity, critical thinking, and hands-on scientific inquiry among students studying in classes 6–8, thus providing exposure to scientific topics beyond the regular school curriculum. Consequently, the ECAS initiative has successfully fostered curiosity, critical thinking, and environmental awareness among young students.

Hands-on Sessions

To complement theoretical learning, experiential sessions are being conducted to expose students to practical scientific concepts and techniques. During these interactive sessions, students foster curiosity and deepen their understanding of various concepts by creating models and conducting hands-on experiments. They prepare models on a wide range of concepts, including health and hygiene, the mosquito life cycle, atomic structure, tropism, soil science, plant and animal cells, DNA, the Universe, evolution, environmental issues, composting, and climate change etc. Students also carry out practicals on food sample testing, observing bacteria under a microscope, calculating Body Mass Index, Measuring Human body

temperature, determining the pH of different soils and substances, and conducting chemical reactions, among other activities. Conducting basic laboratory experiments in biology, physics, and chemistry promotes a "learning by doing" approach, allowing students to apply theoretical knowledge in real-world scenarios.

Special Lecture Series

Eight special lectures by experts from different fields addressing the students on diverse topics were organised. The students from all four centres connected online to attend the special lecture series. Besides, an important session on child safety and protection was conducted by an expert from the Department of Social Welfare, Mayiladuthurai. The session covered topics such as the Child Helpline Number (1,098) and education on good touch and bad touch to promote body safety awareness.

Field Visits

Nutri-Garden Visit

Awareness sessions on the importance of nutrition were organised, and students visited the nutri-garden within the premises and learnt about the nutrient content of the different fruits, vegetables, greens, etc. Students of each batch underwent this exposure on nutrition.

Fish For All Centre Visit (FFA)

Students were taken on a field visit to the FFA Centre to gain practical insights into fish processing techniques and preparation of value-added products. They observed the use of solar dryers for fish preservation and explored the microbiology lab to understand quality testing.

Fish Landing Centre Visit

Students visited the Poompuhar Harbour Fish Landing Centre to observe fishing crafts, gear, boat mechanisms, and fuel usage, linking scientific concepts to marine industry practices.

Library Session/Computer Literacy

To learn how to find and borrow books at a library, instil the habit of reading, as well as to develop a lifelong interest in reading, students were taken to the Bhoothalingam library. Hands-on training for students on basics of computer usage, internet browsing and using software such as Microsoft Office, PPT, etc. were also taught.

Exposure Visit to Hi-Tech Laboratories

The students were exposed to advanced scientific tools and techniques used in biotechnology, such as microscopes, extraction and observation of DNA, isolation of bacteria, DNA models, Polymerase chain reaction, and exposure to instruments like laminar flow and Gel Doc. This exposure created a lot of interest in the aforementioned subjects.

Table 15: Number of students benefited in the academic year 2024-2025

ECAS Centre	No of Batches @	Boys	Girls	Total
Chennai	7	207	192	399
Poompuhar	6	146	147	293
Pudukkottai	7	95	115	210
Kolli Hills	3	30	30	60
Total		**478**	**484**	**962**

PUBLICATIONS

BOOKS/MONOGRAPHS/MANUALS/PRINT & ONLINE

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M.S. Swaminathan Research Foundation. 2025. *Empowering fisherwomen through ICT: Bridging digital gaps in post-harvest fisheries.* MSSRF/CS/02/202.

M.S. Swaminathan Research Foundation. 2025. *Hindsight & Forethought 30-Year Journey of MSSRF in Odisha.* MSSRF/OP/12/2025

M.S. Swaminathan Research Foundation. 2025. *15 years Fish for All Research and Training Centre: Building resilience and transforming livelihoods of small-scale fishers.* MSSRF/OP/13/2025

M.S. Swaminathan Research Foundation. 2025. *National Consultation Building Climate Resilient, Sustainable and Inclusive Seed Systems for Food and Nutrition Security.* MSSRF/PR/85/2025

Seenivasan, R., Arokiamary, A., Muthulakshmi, P., Manikandan, T. and Rengalakshmi, R. 2025. *MobiMOOC course book on pest and disease management in Coconut.* MSSRF/TM/2025/06

THESIS

Nagarajan, R. 2024. *Quantification of blue carbon stock in mangroves using machine learning techniques by integrating optical and SAR remote sensing with the field data for REDD+*. Thesis submitted to the University of Madras, Chennai, in partial fulfilment of requirement for the degree of Doctor of Philosophy.

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AWARDS AND RECOGNITION

Ezhil, D. 2024. 1st Prize in Oral Presentation. 9th Asian PGPR India Chapter, National Conference on "The Beneficial Microbes as Integrated Approach for Sustainable Agriculture: Opportunities & Challenges", Bharathiar University, Tamil Nadu.

Lenka, K. C. 2025. Eastern India Regional Wildlife Conservation Award (Runner-up). International Lions Club, News18, and Forbes India, Guwahati, Assam.

Lenka, K. C. 2025. Odisha Banyaprani Mitra Award 2025. Evergreen Forum, Rabindra Mandap, Bhubaneswar.

Parida, P. K. 2025. Prameya Pratignya Samman 2025. Summa Real Media (News7 and Prameya Odia).

Prabavathy, V. R. 2025. Best Women Scientist Award. International Conference on "Advances in Plant Health Improvement for Sustainable Agriculture (APHSA)", Microbiologist Society of India, TNAU, Killikulam.

Prabavathy, V. R. 2025. Career Achievement Award. 9th Asian PGPR India Chapter, National Conference on "The Beneficial Microbes as Integrated Approach for Sustainable Agriculture: Opportunities & Challenges", Bharathiar University, Tamil Nadu.

Prabavathy, V. R. 2025. Dr. S. N. Banerji Award. National Conference on "Utilization of Microbiome for Sustainable Plant Health and Livelihood", Ramakrishna Institute of Culture, Golpark, Kolkata. Mycological Society of India, Kolkata.

Ramasubramanian, R. 2025. Nominated Member, Technical Committee, Andhra Pradesh State Wetland Authority (Conservation and Management). Constituted by Environment, Forests, Science & Technology (Sec.II) Department, Government of Andhra Pradesh. G.O.Rt.No.68, Dated 23 May 2025.

Rengalakshmi R. Member of the Subject Expert Committee on Environment, Climate and Sustainable Development (ECSD) under Women in Science and Engineering (WISE)- Societal Challenges with Opportunities (SCOPE) Fellowship program of WISE-KIRAN Division (Period - three years 2024-2027).

Rengalakshmi R. Member of a Tamil Nadu State committee of MRNREGS – planning, implementation and monitoring – 2024-2026

Rengalakshmi. R. Technical committee member of the Himalayan Agroecology Initiative, and to develop common roadmaps for sustainable food systems led by Alliance Biodiversity and CIAT 2025-26

Rengalakshmi. R. Technical Expert Committee for exploring and Permissible works under Mahatma Gandhi NREGS – Ministry of Rural Development, GoI.

Salim, P. M. 2024. Green Warrior Award. Green Ahalia International Foundation, Palakkad.

Velvizhi, S. 2024. Member, Advisory Committee for Capacity Building on Sustainable Capture and Culture Fisheries & Exports, Marine Products Export Development Authority (MPEDA), Government of India, Cochin.

Velvizhi, S. 2025. External Expert, Internal Quality Assurance Cell (IQAC), Tamil Nadu Jeyalalitha Fisheries University, Nagapattinam.

Velvizhi, S. 2025. Member, Advisory Committee on Capacity Building for Sustainable Capture and Culture Fisheries & Exports, NETIFISH, MPEDA, Government of India.

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Dr Rohan Arthur, Marine Biologist, Nature Conservation Foundation	Dr R Rengalakshmi, Executive Director: Area Operations MSSRF
Dr S Velvizhi, (Member Secretary) Area Director – Coastal Resources and Fisheries MSSRF	

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Dr B Sesikeran, Former Director, National Institute of Nutrition, ICMR	Dr C George Thomas, Chairman, Kerala State Biodiversity Board
Dr Harisankar Sreedharan Nair, Former MD and CEO, Punjab and Sind Bank Independent Professional Director, Board of Directors of KSCB, Kerala State Cooperative Bank (Kerala Bank)	Dr D Girija, Former Registrar & ICAR Emeritus Professor Kerala Agricultural University College of Agriculture, KAU
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Dr Niraj Joshi, (Member Secretary), Director, MSSRF CAbC	

BIOPARK ADVISORY TEAM

Dr Vijay Dhasmana, Rewilder, Eco- Restoration Practitioner	Dr Ruchi Pant, Head Climate Adaptation, NRM and Biodiversity, UNDP
Ms Suprabha Seshan, Head , Gurukula Botanical Sanctuary	Mr Sammilan Shetty, Conservationist
Dr Ethan Freid, Leon Levy Native Plant Preserve, The Bahamas	Dr Pranay Lal, Conservationist and Natural History Writer
Dr Duruvu Narasimhan,	Dr Aparna Watve, IUCN SSC Red List Authority Coordinator
Mr Yash Veer Bhatnagar, Scientist Country Representative, IUCN	

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Mr Srinivas Raman, Executive Director - Strategy & Operations
Dr G N Hariharan, Executive Director - R&D and Govt. Affairs*

COASTAL RESOURCES AND FISHERIES

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Mr G Vishnuram, Scientist
Ms S Punitha, Scientist *
Dr M Utchimahali, Scientist
Ms Shreya Vinodh, Intern *
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Mr S Yogeswaran, Associate

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Ms S Akila, Technical Assistant
Ms R Kalaibharathi, Technical Assistant *
Ms J Kaviarasi, Technical Assistant *
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Mr K Abdul Salam, Development Assistant
Mr J Arockia Kevikumar, Development Assistant
Ms S Kanmani Raji, Technical Assistant

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Mr B Ramar Muniswaran, Technical Assistant *
Mr A James Laboshan, Driver

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Mr Shaik Imran Hussain Choudhary, Scientist *
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Mr Pratap Chandra Jena, Development Assistant
Mr Ranjit Kumar Dalai, Development Assistant
Mr Satyabrata Patra, Development Assistant
Ms Banasri Pattnaik, Development Assistant
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Mr Antarjyami Bisoi, Development Assistant
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Ms Priyadarshini Rath, Development Assistant *
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Ms Sujata Jena, Project Assistant
Ms Pujarani Panda, Project Assistant
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Mr Manasa Kumar Mahanandia, Development Assistant *
Ms Puspa Khara-Development Assistant *
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Mr Akash Nag, Young Professional *

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Mr Rabindra Behera, Development Assistant
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Mr Nandakishora Gouda, Development Assistant
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Mr Manas Ranjan Mishra, Development Assistant
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Mr Santosh Kumar Mahakund, Development Assistant *

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Mr Abhinash Kumar Munda, Development Assistant *
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Mr Jaya Digal, Development Assistant *
Mr Sekhar Kumar Digal, Development Assistant *

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Mr Bikram Martha-Development Assistant *
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Mr Pratyush Kumar Chottaray-Development Assistant *
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Mr Narayan Mahapatra, Development Assistant
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Mr A Annadurai, Development Assistant
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BIOTECHNOLOGY

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Dr Sivan Kalyani Velu, Senior Scientist
Dr Rebecca Mathew, Women Scientist Wo — A *
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Ms D Balasundari, Project Associate
Mr R A Sudhan, Project Associate
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Ms Gopika Jawahar, M S Swaminathan Fellow

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Mr Mariadasan - Community Resource Person *

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Narayanpet
Mr Sridhar Bendi, Associate Scientist

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Puri, Odisha
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Ms Etha Madhuri-Associate Scientist

Thiruvanthapuram
Ms K Remya, State Coordinator *

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Mr A Jeevanandham, Associate Scientist

Thiruvaiyaru
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AGRICULTURE, NUTRITION AND HEALTH

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Mr V Pranav, Project Coordinator
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Mr Sandeep Mahato, Consultant
Mr Charu Chandra Devshali, Consultant*
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Ms Sadaf Afreen Mondal, Research Assistant

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Dr Anamika Ajay, Principal Scientist - Gender

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Ms N A Anbuvahini, Lead Training Coordinator
Mr C T Chidambaram, Coordinator - Livelihoods *
Ms Costanza Conti, Lead-Policy Research
Ms A Uma, Assistant manager

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Dr N Parasuraman, Principal Archivist & Knowledge Manager
Ms Afrah Umapathy, Manager — Digital Communications
Ms Shriya Naidu, Manager — Science Communications
Mr Lakshmi Kanth Bharathi, Senior Executive, Digital Communications
Mr Subhranshu Bhusan Sahoo — Librarian *
Mr Gurrala Srinivas — Librarian
Mr Kumar Arpit — Media Associate

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Ms T S Akshaya, Research Assistant *
Ms Deepa Agnes Monisha, Secretary

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Mr S Om Vigneshkumar, Head — HR Operations & Compliance
Ms S Madhumitha, HR Associate *

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Col M V Shashidhar, Head — Administration *
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Ms S Geetha, Deputy Manager, Administration
Mr G Suresh Kumar, Deputy Manager, Administration & Facilities
Mr T Krishnamoorthy, Executive, Administration
Mr P Muthukumar, Electrician
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Mr E Thiruvengadam, Electrician
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Mr K A Sankaran, Assistant Manager
Ms R Jayashree, Assistant Manager
Mr P Raghuraman, Assistant Manager
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Ms R Selvarani, Executive
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Mr Sukumar Renganathan, Lead
Ms K K Liji, Manager

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Food & Agriculture Organisation of the United Nations, Italy
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Directorate of Agriculture and Food Production, Govt. of Odisha, Bhubaneswar
ICAR – Indian Institute of Rice Research, Hyderabad
HDFC PARIVARTAN, Mumbai

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Kerala State Council for Science Technology And Education, Thiruvananthapuram
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SBI Foundation, Mumbai
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Department of Science & Technology, Govt of India, New Delhi
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Indo French Centre for the Promotion of Advanced Research, New Delhi
Larsen & Tourbo Ltd, Chennai
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The State Planning Commission, Govt of Tamil Nadu, Chennai

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Norwegian Institute of Bioeconomy Research, Norway
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National
CABI, New Delhi
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GIZ, New Delhi
National Bank for Agriculture and Rural Development, Chennai
TATA Consumer Products Ltd, Bangalore
Indian Meteorological Department, Ministry of Earth Sciences, Govt. of India, New Delhi
Department of Biotechnology, Ministry of Science & Technology, New Delhi

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ITC Limited, Bengaluru
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United Nations Children's Fund, Chennai
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GIZ, India
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TATA Consultancy Services Ltd, Mumbai

FINANCIAL STATEMENT 2024-2025

M S SWAMINATHAN RESEARCH FOUNDATION

No.6, Third Cross Road, Taramani Institutional Area, Taramani, Chennai - 600 113

BALANCE SHEET AS AT 31ST MARCH 2025

Figures in Rs.Lakhs

LIABILITES	Sch. No.	2024-25 Rs.	2023-24 Rs.	ASSETS	Sch. No.	2024-25 Rs.	2023-24 Rs.
OWN FUNDS				**OWN ASSETS**			
CORPUS FUNDS	1	168.06	168.06	FIXED ASSETS	5	389.33	402.11
ENDOWMENT FUNDS	2	4,985.73	4,985.73	INVESTMENTS	6	6,848.52	6,597.39
RESERVE FUNDS & OTHER FUNDS	3	4,351.58	3,772.95	CURRENT ASSETS			
RESTRICTED FUNDS - OBLIGATIONS	4	2,659.97	1,276.02	CASH & BANK BALANCES	7	5,023.12	3,036.45
CURRENT LIABILITIES	11	781.65	179.95	ADVANCES	8	355.80	208.46
				OTHER ASSETS	9	20.63	16.65
				RESTRICTED FUND-RECEIVABLES	10	309.60	121.66
Total		**12,947.00**	**10,382.72**	**Total**		**12,947.00**	**10,382.72**

Audited Statements

Previous year figures are regrouped wherever necessary

M S SWAMINATHAN RESEARCH FOUNDATION

No.6, Third Cross Road, Taramani Institutional Area, Taramani, Chennai - 600 113

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2025

Figures in Rs.Lakhs

EXPENDITURE	Sch. No.	2024-25 Rs.	2023-24 Rs.	INCOME	Sch. No.	2024-25 Rs.	2023-24 Rs.
SALARIES	16	1,571.98	1,122.08	INTEREST INCOME	12	571.82	498.03
ENDOWMENT EXPENSES	17	63.34	179.43	DONATIONS	13	513.04	276.78
				CONTRIBUTION RECEIPTS CORE ACTIVITIES*	14	38.21	32.23
MEETINGS & OTHER RELATED EXPENSES	18	83.81	147.41	PROJECT GRANT	4&10	6,457.03	3,647.95
DEPRECIATION ON FIXED ASSETS	5	31.67	31.60	OTHER INCOME	15		
OTHER ADMINISTRATIVE EXPENSES	19	5,509.92	3,001.08	RENTAL RECEIPTS		26.37	28.57
LESS: OVERHEADS RECOVERY	19	-277.90	-128.57	MISCELLANEOUS RECEIPTS		145.53	75.97
NON RECURRING EXPENSE		190.65	120.07				
EXCESS OF INCOME OVER EXPENDITURE		578.53	86.43				
TRANSFERRED TO GENERAL FUND							
Total		**7,752**	**4,560**			**7,752**	**4,560**

Audited Statements

* Expenditures stated above includes the expenses incurred for the core activities Previous year figures are regrouped wherever necessary

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