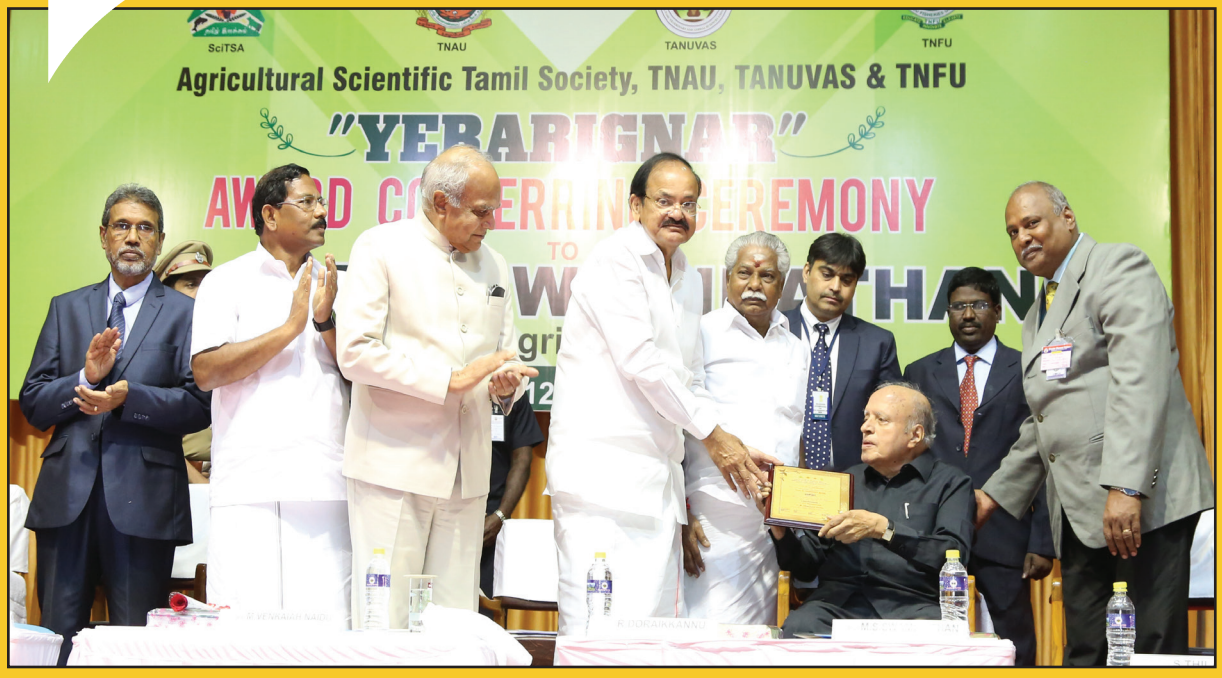
MSSRF

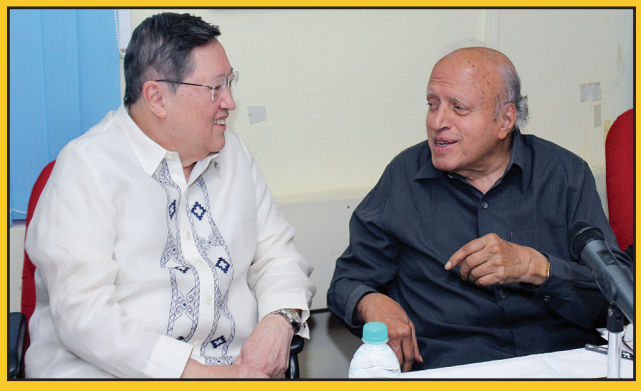
Science for Sustainable Development

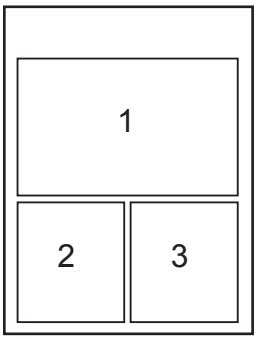
M. S. SWAMINATHAN RESEARCH FOUNDATION

2017-2018
TWENTY-EIGHTH ANNUAL REPORT

CENTRE FOR RESEARCH ON SUSTAINABLE AGRICULTURAL AND RURAL DEVELOPMENT, CHENNAI

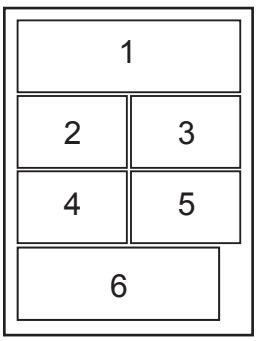






Front Cover

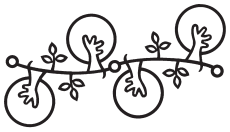
1. Hon'ble Vice President of India Shri. M. Venkaiah Naidu conferring Yerarignar Award to Prof. M.S. Swaminathan
2. Mr. Carlos Garcia Dominguez III, Secretary, Department of Finance, Republic of the Philippines interacting with Prof. M.S. Swaminathan during his visit to MSSRF, Chennai
3. Prof. M.S. Swaminathan interacting with Hon'ble Deputy Chief Minister of Tamil Nadu Thiru. O. Panneerselvam



Back Cover

1. Hon'ble Chief Minister of Kerala Shri. Pinarayi Vijayan inaugurated the Rural Innovators' Meet 2018 at MSSRF, Wayanad
2. Screening of saline tolerant paddy varieties under lab conditions
3. Mr. Eisuke Shiozaki, Chairman and Managing Director, Mitsubishi Corporation India Pvt Ltd visited project villages in Krishna District in Andhra Pradesh
4. Visit of Project Monitoring Committee to the Rice Biopark, Myanmar
5. Fish processing unit at Fish For All Centre, Poompuhar
6. Dr. V. Selvam, Executive Director, MSSRF receiving the Biotechnology Social Development Award – 2017 awarded by the Department of Biotechnology, Government of India

Twenty-Eighth Annual Report
2017 - 2018



M. S. Swaminathan Research Foundation

Centre for Research on Sustainable Agricultural
and Rural Development
Chennai, India

M. S. Swaminathan Research Foundation

Centre for Research on Sustainable Agricultural and Rural Development

Third Cross Road, Institutional Area

Taramani, Chennai 600 113 India

Telephone : +91 (44) 22541229

+91 (44) 22541698

Fax : +91 (44) 22541319

Email : executivedirector@mssrf.res.in

Visit us at **http://www.mssrf.org**

Printed at : AMM Prints

Citation : Twenty-Eighth Annual Report: 2017-2018
M. S. Swaminathan Research Foundation, Chennai 600 113

Contents

Chairperson's Introduction

I am happy to present this Annual Report with details of the activities and achievement of MSSRF over the last year. MSSRF was awarded the Biotechnology Social Development Award-2017 by the Department of Biotechnology, Government of India, in recognition of our role in popularizing biotechnology for agricultural and rural development. Recognizing the role of MSSRF in the conservation of agrobiodiversity, the Kerala State Council for Science, Technology and Environment (KSCSTE) declared the Community Agrobiodiversity Centre of MSSRF at Wayanad as a Grant in Aid Institution. This will provide core support to the Centre, specifically for applied research on agrobiodiversity conservation and sustainable utilization for income generation and food and nutrition security of tribal and other under privileged communities of Kerala. On May 14, 2018, Shri Pinarayi Vijayan, Chief Minister of Kerala, made this announcement at the inaugural ceremony of the Rural Innovators Meet, 2018.

Our staff continue to gain recognition internationally. Dr. Gayatri Venkataraman, Principal Scientist, was invited to the Plant Physiology Laboratory, University of Tasmania, and the Hobart Division of Natural Sciences, University of Western Sydney, to explore possibilities of employing non-invasive techniques to study salinity tolerance in wild rice as part of the Indo-Australia Biotechnology Fund Project awarded to MSSRF. Ms. Kumkum Kumari was awarded the prestigious EMBO (European Molecular Biology Organization) short term fellowship to receive training in electrophysiological techniques for understanding the genetic mechanisms involved in salinity tolerance in the laboratory of Dr. Anne-AliénorVéry, Institute of Biological Sciences, Montpellier, France.

The Coastal Systems Research programme continued to demonstrate interventions that enhance the adaptive capacity of local communities to sea level rise arising from climate change. These interventions resulted in restoration of 215 ha of mangrove forest in Tamil Nadu and Andhra Pradesh, and conversion of 25 ha of intensive coastal aqua farms into extensive and sustainable integrated mangrove-and-fish farms. In coastal Karnataka, MSSRF has been involved in the revival of *Kagga* saline tolerant rice-prawn cultivation system involving the establishment of Kagga rice seed banks and extensive documentation of farming practices. The Fish for All Centre was able to provide training and skill development in capture and culture fisheries to over 2000 fisher women.

The Community Agrobiodiversity Centre (CAbC) worked in partnership with 519 Scheduled Tribe and Scheduled Caste families across eight Panchayats of Wayanad, Thrissur and Kannur districts of Kerala to integrate agrobiodiversity with food and nutrition security. CAbC joined hands with Meenangadi Panchayatand the Government of Kerala to develop an action plan to achieve a "Carbon Neutral" district. The programme was inaugurated by Dr T. M. Thomas Isaac, Minister of Finance, Government of Kerala. In the Kolli Hills of Tamil Nadu, our focus remained on conservation of millet diversity working through

the Kolli Hills Agri-bioresource Producer Company, comprising small and marginal farmers. MSSRF worked on capacity building for improved agronomic practices and procurement and marketing mechanisms. In Koraput district of Odisha, 435 millet-growing farmers, with over 500 acres, participated in adoption of improved practices in millet cultivation.

The Biotechnology programme established phenotypic and molecular characterization of salinity tolerant *Kagga* paddy varieties collected from coastal Karnataka and saline tolerant mechanism of 47 saline tolerant rice landraces collected from coastal regions of India. This research can lead to improved varieties suitable for saline conditions (coastal regions). Field trials on testing microbe mediated biofertilization and bioirrigation in mixed cropping systems of pulses and millets showed good results: grain weight increased by 25 per cent and yield by 20 per cent. We need to work on large-scale adoption of these practices.

During the year, the JRD Ecotechnology Centre engaged with over 10000 farmers – 65 per cent of whom were women -- in three different agro-ecosystems in order to promote technologies for sustainable agriculture and natural resource management. The focus this year was on technologies for augmenting ground water resources and promoting efficient water use including micro irrigation in the semi-arid regions of Tamil Nadu. ICT tools such as mobile phones and social mediawere used for self-directed learning among small farmers.

The evidence emerging from the Farming System for Nutrition (FSN) study in Koraput and Wardha, shows that the introduction of improved varieties and crops in the existing cropping systems, and improved agronomic practices and nutrition gardens, increased the cropping intensity and food production at the farm level. Increased food grain availability and diversity at the farm level accompanied by better nutrition awareness has led to improved household dietary diversity.

During 2017-18, the Food Security programme was also active in advocacy of the concept of Farming System for Nutrition (FSN) among stakeholders in the four States of Andhra Pradesh, Bihar, Maharashtra and Odisha. The focus was on policies to strengthen agriculture-nutrition linkages. We are happy to note that, in his budget speech, Shri Pradeep Maharathy, Minister for Agriculture, Government of Odisha, introduced the theme of Nutrition Sensitive Agriculture. The Government of Odisha also sanctioned three projects to improve food and nutrition security among tribal communities of Koraput district through developing better seed systems for millets, integrated farming systems and farming systems for nutrition.

A meeting convened jointly with NITI Aayog called for demonstration of location specific FSN models in KVKs across the country. In Maharashtra, ten Krishi Vigyan Kendras (KVKs) have initiated the process of setting up FSN demonstration models in their premises with the technical partnership of MSSRF.

The Information Education and Communication Programme continued to empower the rural community using ICT, with a cumulative coverage of over 200,000 stakeholders including 85000 virtual users. Two institutions, Sokoine University of Agriculture in Tanzania

and Agricultural and Livestock Research Organization in Kenya, were inspired to replicate the Village Knowledge Centre model in Africa with training from MSSRF. The user-friendly pan-India Fisher Friend Mobile Application (FFMA), now available in nine Indian languages and downloadable from the Google playstore, was piloted in West Bengal and Karnataka.

The Jamsetji Tata National Virtual Academy awarded 74 grassroots Fellowship to 33 women from nine States. This year the Youth Science Congress, organized in partnership with Career Point University, Himachal Pradesh and SRM University, was inaugurated by Shri M. Venkaiah Naidu, the Hon'ble Vice President of India.

The last year has also been unique in the extent of staff engagement in planning future strategies, fund raising and personnel development including new systems of performance evaluation. I am very grateful to the staff and scholars for their engagement with this process and commitment to the goals of the Foundation. The length of the Annual Report speaks for their hard work. I also want to thank the trustees and Founder who have been a source of support to me and the staff. Last but not least, I thank all our donors for their continued and generous investment in our activities.

Dr V. Selvam, Dr G.N. Hariharan and Dr V. R. Prabavathy coordinated the preparation of this Annual Report. Ms Suni Ann Sebastian edited the contents and AMM Prints printed it. I record my appreciation and gratitude to them.

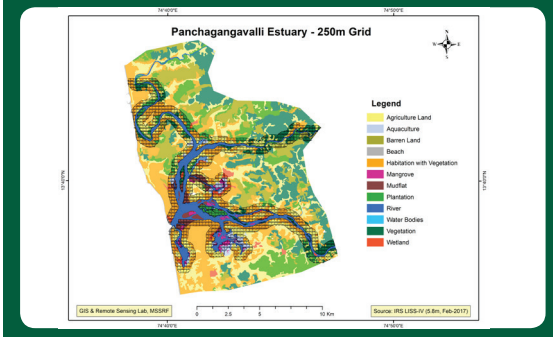
Madhura Swaminathan
Chairperson

Programme Area 100

COASTAL SYSTEMS RESEARCH

The major results achieved under the integrated coastal zone management include (i) coastal bioshield development, with restoration of mangroves in 115 ha. in Muthupettai; 90 ha. in Krishna delta, 10 ha. near the Sarsole region of Navi Mumbai and augmentation of the already established Tropical Dry Evergreen Forests (TDEF) plantations in Vedaranyam; (ii) biosaline agriculture focused on the promotion of Kagga rice cultivation in the Karnataka coast; and (iii) eco-restoration of Sambulam Lake – a lifeline water body for the rice cultivators of the Vedaranyam coast. The outputs and outcomes of the Fish for All Centre's activities includes training programmes organized in sustainable fisheries, community-based artificial reef programme, navigation aids to small-scale fishermen, demo units for integrated fish farming system and market value chain development focusing on regular employment opportunity and income generation for women. The study on the greenhouse gas fluxes in the mangrove ecosystem entered its third year and showed consistent data generation related to fluxes of carbon dioxide (CO2), methane (CH4) and H2O between the mangrove ecosystem and the atmosphere, as well as soil heat flux. The remote sensing team had developed a GIS-based Forewarning Model for Pest Management (GFPM) and prepared land use/land cover maps in a scale of 1:10000 for the entire Karnataka coast. The integrated rural development project in Machilipattinam resulted in the development of rural infrastructure such as roads, sanitary latrines and so on for the farmers. The Kuttanad Centre established a mobile water quality testing lab facility.


Mitsubishi Corporation
M.S. SWAMINATHAN RESEARCH FOUNDATION
Village Resource Centre : Ground Breaking Ceremony
Machilipatnam, Andhra Pradesh
A CSR initiative by Mitsubishi Corporation, Japan
MSSRF


Panchagangavalli Estuary - 250m Grid
Legend
Agriculture Land
Aquaculture
Barren Land
Beach
Habitation with Vegetation
Mangrove
Mudflat
Plantation
River
Water Bodies
Vegetation
Wetland
GIS & Remote Sensing Lab, MSSRF
Source: IRS LISS-IV (5.8m, Feb-2017)


KSDA
MSSRF
Reclamation of coastal saline soils of Karnataka
supported by
Department of Agriculture, Government of Karnataka
Operated by
M.S. Swaminathan Research Foundation, Chennai
University of Agricultural Sciences, Dharwad
Kagga paddy Demonstration plot
Manikatta
Area: 1.26 acre
Methods of Demonstration
* Broadcasting method
* Transplanting method
Date of broad casting: 24th June 2017
Date of transplanting: 13th July 2017

Sub Programme Area 101

Mangrove and Non-mangrove Coastal Bioshields

Veerankoil, Thanjavur District, Tamil Nadu: Restoration of 115 ha. of degraded mangroves in Pattuvanachi estuary (Lat 10°19'1.38"N Long 79°26'34.44"E) was initiated in T. Maravakadu Reserve Forest, Muthupettai, jointly with the Veerankoil Village Development Committee (VDC) and the Tamil Nadu Forest Department. Restoration work was preceded by participatory rural appraisal (PRA), preparation of micro plans with detailed work schedules, budget and physical assessment of the area for its suitability for planting (soil texture, topography, soil salinity, pore water salinity and pH and mangrove flora present close to the area). Digging of canals (main canals with 3.0 m top width, 1.0 m bottom width and a depth of 1 m; side canals with 2.0 m top width, 0.75 m bottom width and 0.75 m depth), the major task in the restoration project in the degraded area, resulted in regular tidal flow avoiding water stagnation. Nineteen main canals with a total length of 11500 meters and 1075 side canals with a total length of 32250 meters were excavated. About 437500 mature Avicennia spp. seeds collected from the Muthupet mangrove region were planted with an interval of 50 cm along the canals at a depth of 20 cm below ground level during November–December 2017. In addition, about 6000 Rhizophora apiculata and R. mucronata propagules collected from the Pichavaram mangrove area were also planted at 2 m interval along the sides of the natural creeks. The initial estimates showed that the survival percentage is more than 90 per cent during March 2018.

Krishna Mangrove Wetlands, Krishna District, Andhra Pradesh: Three main canals with a total length of about 2600 m and side canals with a total length of about 72000 m were dug in the selected degraded mangrove forest site (Lat 15°44'25.96"N Long 80°54'9.20"E) between July and August 2017. A total area of 90 ha. of work was covered for the reported period of time. Approximately 55000 *Avicennia marina* and *Avicennia officinalis* seedlings and an additional 80000 seeds of *Avicennia* spp. were planted along the canals between October and December 2017. Subsequently, an additional 110 ha. of canal digging work had been planned and the work was initiated in April 2018. Planting will be initiated from October 2018 onwards. An orientation programme on mangrove restoration for the local community was organized. It was attended by 64 members (29 women, 30 men and 5 project staff). The tidal flushing was found to reduce pore water salinity from 87 ppt (parts per thousand) during August 2017 to 54 in December 2017.

***Navi Mumbai, Thane District, Maharashtra*:** Mangrove restoration activity started in 5 ha. during the past year was continued and an additional area of 10 ha. of degraded mangroves near Sarsole, Navi Mumbai (Lat 19°15'1.37"N Long 72°49'51.80"E), was chosen for restoration with the participation of a local NGO Vanashakthi and the State

Forest Department. Nursery raised mangroves saplings, namely, *Rhizophora apiculata* and *Rhizophora mucronata* (about 2000 saplings) and *Avicennia* spp. (about 8000), were planted. In addition, about 12000 mature *Avicennia* spp. seeds were also planted. Natural seedlings of *Avicennia* spp. were found to establish more than six times.

Sub Programme Area 102

Biosaline Agriculture

The halophyte genetic garden in Vedaranyam, Nagapattinam district, Tamil Nadu, is being redesigned with the technical guidance of Botanical Services, Auroville, Puducherry. A shade house of about 140 sq.m is being established to maintain 29 halophytes species such as *Sesuvium* spp., *Suaeda* spp., *Salicornia brachiata* and so on collected from the Andhra Pradesh and Tamil Nadu coastal regions. This halophyte genetic garden will be the first of its kind in India.

The cultivation of saline tolerant plant species such as *Oryza coarctata*, *Paspalam vagenatum* and *Sesuvium portulacastrum* for the reclamation of saline soils is being implemented in collaboration with University of Agricultural Sciences, Dharwad (UASD), and Zonal Agricultural and Horticultural Research Station (ZAHRS), Brahmavar, Karnataka. Authenticated, quality planting materials for the above species have been raised and provided to partnering institutions. It was observed that all three species tolerate higher levels of salinity in the pot culture experiments. The results will be provided in next year's annual report.

During the reporting period 2017–18, the salient features of the Aghanashini estuary and cultivation of saline tolerant Kagga paddy in Ghazani lands (land which is below sea level and flooded with sea water during the summer season and freshwater during the monsoon season) in Karnataka were documented. The documented information includes (i) data on Ghazani land types and their characteristic features; (ii) key practices observed in the Kagga-prawn cultivation cycle; (iii) key traditional calendar dates for initiating Kagga cultivation; (iv) documentation of use of traditional tools such as special spades for Ghazani land preparation; (v) harvesting practices and implements; (v) information on special dishes prepared out of Kagga paddy and so on. Additional data from farmers groups, other stakeholders such as small and marginal traders associated with Kagga paddy, revenue records and past data on Kagga cultivation from Department of Agriculture, Government of Karnataka, are being collected.

Salinization of agricultural soils is a serious problem in coastal areas and it has greatly affected land productivity and led to abandoning of prime crop land. Hence, it is important to quantify the spatial distribution of salinity, map changing trends in space and time and also identify the key factors driving increased salinization. As a prelude to mapping soil salinity, a workshop was organized at the Zonal Agricultural and Horticultural Research Station (ZAHRS), Brahmavar, with the main

objective being to finalize the protocols and procedures for mapping coastal soil salinity in Panchagangavali and Aghanashini estuaries. Soil scientists from various agriculture universities in Karnataka and officials from three coastal districts of the Department of Agriculture, Government of Karnataka, participated in the meeting. The soil sampling grid map (250 m x 250 m) for Aghanashini and Panchagangavali estuary was prepared and overlaid with the land use/land cover maps.

Currently the mapping of surface and subsurface soil salinity is underway using an innovative electromagnetic induction meter (EM38) combined with assessment utilizing electrical conductivity meters and laboratory-based soil salinity analysis concurrently with remote sense maps and geographical information system (GIS). The results obtained in these surveys will be applied for developing salinity maps for the above estuarine regions, quantify extent of area and levels of salinity and track real-time spatial and temporal changes in salinity. Data on factors driving salinization (including land elevation, length of the dry season, tidal amplitudes etc.) are also being quantified in the study area. The phenotypic and molecular characterization of salinity tolerant Kagga paddy has been completed and is reported under Section 301.4 of PA 300.

With the objective of reviving interest in Kagga cultivation, a study tour for 15 Kagga cultivators from the Kumta region of Karnataka was organized in 2017. They visited areas under saline tolerant Pokkali rice cultivation in Ernakulam, Kerala, and observed as well as interacted with the Pokkali rice farmers. They were accompanied by senior officials from the Department of Agriculture, Government of Karnataka. This mutual interaction between farming communities of Karnataka and Kerala generated enormous interest in wanting to obtain more information about both the Kagga and Pokkali cultivation practices.

Sub Programme Area 103

Integrated Coastal Zone Management of the Vedaranyam Coast

During the reporting year, as part of the Integrated Coastal Zone Management (ICZM) activities, about 115 ha. of degraded mangroves were restored with the involvement of the Tamil Nadu Forest Department and the Veerankoil community. In addition, non-mangrove plantations have been established over an area of 61 acres, located in small patches, and these are being managed by the local community. Moreover, landscaping has been carried out in three zones near the Salt Satyagraha memorial pillar. About 916 saplings belonging to 40 species have been planted. Saline tolerant *Terminalia bellirica, Salvadora persica, Hibiscus tiliaceus, Thespesia populnea* and *Terminalia arjuna* were planted on a new mound created in the vicinity of the pillar. In the central area of the *Palmyra* grove, palm leaves were pruned, a walking track established and tropical dry evergreen forest (TDEF) species such as

Suregada angustifolia, Manilkara hexandra, Salacia chinensis, Garcinia spicata and *Eugenia bracteata* planted. In another zone, where a TDEF plantation was already present, gap filling with suitable species was carried out. A low-level labyrinth was created by preparing a series of concentric circular raised beds and *Sesuvium portulacastrum* planted in the elevated area. An interpretation centre is being built over an area of 1500 sq.ft near the Salt Satyagraha memorial pillar to attract tourists and it will cover themes such as the Vedaranyam Salt March, available coastal resources and details on the flora present for suitable display.

Village-level meetings were conducted in all 12 villages to monitor the revolving fund provided to the community. The Women Salt Worker's Federation formed in Vedaranyam had been strengthened by designating the roles and responsibilities of the office bearers. The federation membership has increased to 707, in which 238 members availed credit facility. Majority of the credit has been used to establish micro-enterprises and fulfill other needs such as education of the children, health care and so on.

Eco-restoration of the Sambulam Lake was completed during this reporting period with supervision by a joint working committee consisting of members MSSRF staff and communities from the Adhanur and Kadinalvayal panchayats. The district administration permitted desilting of the lake in June 2017. Invasive and weedy species such as *Prosopis juliflora*, *Ipomoea* sp. and *Lantana camara* that grew on the bunds were uprooted physically while neem and palmyra trees were retained. Desilting of the lake to a depth of 3 ft was done along the bunds and the desilted soil was used to strengthen the bunds. Bund height was increased to 9 ft and the breadth was increased between 10 and 20 ft. In addition, four mounds were created using the desilted soil. The mounds were 9 ft high and the areas of the mounds range from 10000 to 24000 sq.m. In the following monsoon season, in October 2017, the lake reached its full storage capacity. About 817 saplings belonging to 18 native species were planted along the strengthened bunds and in the four mounds to attract birds and also to reduce erosion. The water storage capacity of the lake has been enhanced and traditional systems of water tank management revived. This freshwater lake present in the coastal area acts as a reservoir to prevent saline water intrusion and also recharges nearly 200 dug wells effectively.

Sub Programme Area 104

Fish for All Research and Training Centre

The Fish for All Research and Training Centre aims to improve the socioeconomic conditions of coastal communities by adopting a collective and holistic approach in the fields of resource management, sustainable livelihood options and disaster preparedness and management. In order to achieve results, the centre focuses on four major areas. (i) Capture fisheries

resource enhancement and management; (ii) culture fisheries resource management; (iii) post-harvesting and livelihood promotion; and (iv) training and capacity-building. The major results achieved by the Fish for All Research and Training Centre are given below.

Capture Fisheries Resource Enhancement and Management

***Community-Based Artificial Reef Programme*:** Community-Based Artificial Reef Programme was initiated in the coastal waters around Karaikal to enhance fishery resources for small-scale fisher folk. This programme is being implemented with the active participation of the traditional fishing community of T.R. Pattinam village. A village-level marine council (VMC) was constituted, with representation from different resource user groups, for the management of the artificial reef. At the district level, an advisory committee was constituted with the involvement of the Indian Coast Guard, Fisheries Department, NABARD and district administration to provide necessary guidance and support for the effective management of the artificial reef programme.

Training and awareness programme regarding the artificial reef was held at the village and district level in which 497 fisher folk and fisheries stakeholders (M: 358; F: 134) were educated about the importance of the artificial reef, site selection process, construction of suitable reef modules, reef management and so on. Three artificial reef modules, two for commercially valuable fishes such as Grouper and Lobster and one for small fishes, were selected for fabrication. About 16 individual structures of each module totalling 48 with a total weight of 48 tonnes using cement reinforced with iron rods are being constructed. A sea floor survey was conducted in January 2018 to identify a suitable site for the deployment of the artificial reef. In the survey, the physical and chemical features of the sea surface, nutrients and availability of biological resources were analyzed and two suitable sites, located 7 km offshore from Karaikal fishing harbour, were selected for reef deployment.

***Navigational Aids for Small-Scale Fisher Folk*:** As part of the livelihood enhancement programme, 100 global positioning systems (GPS) were provided to small-scale fisher folk in Poompuhar village with 50 per cent of the GPS cost being borne by the community. The initial assessment study conducted among 20 per cent of fisher folk who received and used GPS revealed that the navigational aid along with potential fishing zone (PFZ) information from the centre helped them not only to increase their fishing efficiency in terms of reaching under explored fishing grounds easily but also reduced fishing time and consumption of diesel fuel. In addition, they also obtained an assured catch and better income.

***Promoting Sustainable Fishing Practices*:** In order to promote sustainable fishing practices, the centre has demonstrated and disseminated knowledge on the importance of square meshes, hook and lines, PFZs as well as information on the minimum legal size of fishes. In collaboration with NETFISH, the centre has conducted a series of training

programmes on marine resource conservation among fishermen, women, auctioneers and other stakeholders. In all, 106 classes were organized at different fish landing centres, covering 96 fishing villages across four coastal districts of Tamil Nadu. The trainees, 1353 men and 454 women, were educated about net mesh sizes, ecosystem conservation, government regulations and sustainability of fishery resources. Continuous demonstration and promotion of knowledge helped fisher folk to realize the importance of sustainable fishing practices and fish resource conservation methods. Now, fisher folk using bottom trawling in Poompuhar, Chinnamuttam and Mandapam regions show interest and willingness to use square meshes in the caudal end of trawl nets.

Culture Fisheries Resource Management and Enhancement

***Integrated Fish Farming System*:** A demonstration unit for an integrated fish farm was established in 84 cents of land at the Fish for All Centre. The farm layout was planned in consultation with the Tamil Nadu Fisheries Department and members of the local community. Important components such as field crops, horticultural crops, floriculture and vermicomposting have been integrated in the fish farm demonstration unit for better utilization of farm resources. Low input sustainable fish culture techniques were demonstrated in a 33 cent and 1500 indigenous fingerlings carps were introduced. A fish nursery unit was established in an area of 120 sq.m for the production of quality indigenous fish seeds. Salt and flood tolerant paddy variety Kattuyanam and other local crop varieties were also introduced in the Integrated Fish Farming System (IFFS) on a trial basis for large-scale promotion. The centre has facilitated members of the Kaveri Inland Fish Farmers' Association to avail a subsidy of Rs 3.5 lakhs for the new integrated fish farm development under the Blue Revolution, a Central Government scheme to create an enabling environment for integrated development of full potential of fisheries of the country. Training on concentrated feed preparation was given to the community in which seven farmers have started preparing concentrated fish feed on a regular basis. A community fish pond managed by self-help groups (SHGs) in Thenpathi village has started a second round of fish culture after fish pond renovation. The water testing laboratory trained 92 farmers on water sample collection methods through on-site practical demonstrations. In all, 77 water samples provided by 42 farmers from three villages were analyzed. Based on the results, the centre provided necessary inputs, including information on best management practices in shrimp and fish culture.

***Ornamental Fish Culture*:** A fresh water ornamental fish culture unit was established for fisherwomen and 1500 brood stock of Guppies and Molly varieties are being maintained. A two-day training programme was arranged for 30 fisherwomen on ornamental fish culture techniques, tank maintenance, water recycling, and disease and feed management. Linkages were established with ornamental fish traders for marketing the fish fingerlings.

The trained women are now actively involved in ornamental fish farm management, and they acted as local experts and are earning an additional monthly income of Rs 3000–4000. Since the unit is located in a coastal area, maintaining an optimal range of temperature was challenging for the women and this was addressed through proper technical training. Efforts were also taken to minimize disease outbreak. For better management of the ornamental fish farm, the centre provided regular training to the women on proper farm management practices, water exchange and feed management techniques which reduced the mortality rate of ornamental fishes in the farm.

Post-Harvesting Technology

***Literacy on FAO Code of Practice on Fish and Fishery Products Standards*:** To improve the standard of fish products, a series of training and demonstration programmes were conducted in association with the Fisheries Department (Tamil Nadu), Marine Products Exports Development Authority (MPEDA) and fishermen associations on fish quality management in the fish processing unit, at landing centers and at selected fishing harbors in the districts of Nagapattinam, Cuddalore, Ramanathapuram and Kanyakumari. More than 540 fishermen and 150 women from 24 villages underwent the training. Due to this continuous education, the fisher folk use a 1:1 ratio of ice for fish processing that helps to preserve fish quality. The training has helped to improve personal hygiene, in onboard fish handling and in maintaining hygiene in handling of ice and among fisher folk engaged in marine fishing.

***Signing of a Memorandum of Understanding with a Fish Marketing Agency*:** Fish for All Centre has signed a memorandum of understanding (MoU) with Fish Chain, a Bangalore-based marketing company, to create regular employment opportunities for fisherwomen. This company manufactures ready-to-cook and ready-to-eat fish products from economically low value fishes thereby increases the availability, accessibility and consumption of nutrient-rich fish to urban consumers at an affordable cost. Fish Chain is developing strategic partnerships with retailers in urban locations for marketing. About 40 fisherwomen who are members of the Winmeen Fish and Fish Producer Association have been trained by the Fish for All Centre engaged in fish processing for 10–15 days per month on a rotational basis. In addition, the fish processing and packaging sections were further improved. This section is equipped with necessary machineries and utensils to prepare marinated fish products. Quality of raw fish is properly analyzed by sensory evaluation methods to ensure the selection of quality fishes for further processing. Hazard Analysis and Critical Control Points (HACCP) standards have been maintained in all processes involved in preparing ready-to-cook fish. As indicated in Table 1.1, 12464 kg of low value fishes were processed for the production of a variety of ready-to-eat products and the participating women earned Rs 204000 as additional income over a period of three months.

Table 1.1: ***Different varieties of fish processed in fish processing unit***

S. no.	Name of the Fish Varieties	Total Weight (kg)	End Products (kg)
1	Sardines	3750	1914
2	Mackerels	2827	1900
3	Anchovies	1020.5	568.3
4	Shrimps	2298	1256
5	Dolphin fish	1263.9	824.1
6	Cat fish	259	84.6
7	Sail fish	578	301
8	Rabbit fish	456.6	229.4
9	Trevally	10.9	6
	Total	**12463.9**	**7083.7**

The centre has also developed several ways for recycling solid and liquid waste from the fish-processing units into usable products. Solid fish waste such as head, bones, intestines, scales and gills from the processing unit are collected regularly and recycled into feed for poultry, fish compost and fish amino acids. Nearly 1500 kg of fish waste were collected from the processing unit, of which around 1200 kg were dried for poultry feed and 200 kg converted into compost and fish amino acids. Fish compost was given to 20 farmers engaged in integrated fish farming to use as manure for horticultural crops on a trial basis. The farmers who applied the fish compost realized increase in yield in crops compared to control.

***Quality Dry Fish Production Using Tunnel Solar Dryers*:** Two tunnel solar dryers with a total drying capacity of 600 kg were established in the Fish for All Centre to help fisherwomen produce quality dry fish. The solar dryer offers distinct advantages: (i) it is faster drying vis-à-vis drying under the sun; (ii) it is more hygienic as it avoids exposure to dust and potential contamination by insect/flies or feeding by birds and animals; (iii) it retains nutrition and quality; and (iv) is easy to use. Nearly 4328 kg of fish including anchovies, ribbon fish, mackerels, silver bellies and lesser sardines were processed in the solar dryer. Due to better dry fish quality, the women were able to earn an additional income of Rs 50–100 per kilogram compared to open sun-dried fish. A research study was undertaken with two varieties of dry fishes by adding different flavors such as chilies, pepper and turmeric to retain its quality for longer period. Microbial growth tests suggest that sun-dried fish show increased growth of pathogenic microbes in contrast to fish dried in a solar dryer. There was, however, not much variation in biochemical parameters between open sun-dried fish and fish dried in solar dryers.

Training and Capacity Building

The Fish for All Centre is extending its services across the states of Tamil Nadu and Puducherry and has conducted a series of structured courses for fishermen, women, students and fish farmers, based on their livelihood needs and demands. Agencies including the State Fisheries Department, the Women Development Corporation, colleges and universities have also approached the Fish for All Training Centre for short-term training courses. A total of 69 such training sessions were organized on different subjects and training has been provided to 1272 men and 918 women (Table 1.2).

On the eve of the World Fisheries Day on 21 November 2017, a consultation on sustainable fishing with the theme 'Save the Ocean and Save the Nation' was held at the Fish for All Centre. More than 62 fisher folk and fisheries stakeholders participated in the consultation. The key suggestions such as monsoon fish ban, promotion of deep sea fishing technologies and resource enhancement programme such as artificial reef from the consultation were communicated to district- and state-level policymakers for necessary action. A stakeholders' consultation was held for planning strategies for the Fish for All Centre to move forward. Around 61 participants from fishing and farming communities, government departments, NGOs, academic institutions and CSR organizations participated and provided their valuable suggestions. These suggestions and the recommendations facilitated the centre to develop a five-year strategic plan.

The training centre also facilitated a Regional Workshop II on 'Capitalization of Experiences for Greater Impact in Rural Development' that was held at Puducherry in September 2017 in collaboration with the Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA), Netherlands, and the International Fund for Agricultural Development (IFAD). Twenty-seven development practitioners from seven South Asian countries participated in the workshop and benefited from MSSRF's experience and knowledge, and also provided visibility to the centre.

Table 1.2: ***Theme-based training programmes organized at Fish for All Centre***

S. no	Training Topics Participants	No. of Trainings	Male	Female	Total
1	Square mesh for responsible fishing	8	250	0	250
2	Onboard hygienic handling of fish resources	2	30	0	30
3	GPS troubleshooting techniques	24	560	0	560
4	Training on artificial reef building and its management	8	358	134	492
5	Integrated fish farming system	2	74	20	94
6	Ornamental fish culture	1	0	30	30
7	Quality dry fish production	22	0	660	660
	Total	69	1272	918	2190

Sub Programme Area 105

Remote Sensing and GIS

GIS-Based Forewarning Model for Pest Management

A centralized pest and disease forewarning system based on real-time, past and forecasted weather variables was initiated last year in Vedaranyam. A responsive WebGIS-based pest management system was developed and will be tested this year. This system contains maps of farming land up to field measured boundary (FMB) of more than 1000 farmers, covering (a total area of 35 sq.km) three villages, namely, Thennadar, Kathiripulam and Vanduvancherry. These GIS maps are integrated with the farmers' profiles, including name, phone number, survey number, crop type, soil types and so on. As mentioned in the previous year's report, all these three villages have automatic weather stations. The weather data collected from the three stations have been spatially interpolated, covering the entire Vedaranyam block (total area of the block is 630 sq.km). In addition, historical daily weather data (30 year data) has been obtained from the Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal. All these collated data is being processed jointly with the Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, and the Tamil Nadu Agricultural University (TNAU), Coimbatore, and a forewarning model is being developed with the support of scientists from the TNAU. The weather-based pest and disease forewarning information will be disseminated to the small and marginal farmers of Vedaranyam block through the android application and voice short message service (SMS). Development of the android application has been completed and is currently being tested among farmers.

In addition, about 500 farmers from the three project villages have been trained on pest and disease management practices for paddy, brinjal and jasmine. Eight village-level meetings have been organized to build the capacity of the farmers in the management of crop pest and disease practices. Experts from Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, are the resource persons. The soil awareness campaign and soil testing for the project villages were completed in 200 farmer fields. Physical and chemical properties of the soil such as color, pH, electrical conductivity (EC), calcium carbonate ($CaCO_3$), organic carbon (OC) and macro-nutrients such as nitrogen (N), phosphorus (P) and potassium (K) were analyzed. In addition, water samples from open wells were also collected and analyzed for pH, EC and anion and cation content. All soil analyses were carried out using the MSSRF mobile soil testing laboratory. After soil analysis, soil health cards were issued to the farmers with the recommendations of experts regarding suitability of crop species for cultivation and fertilizer application regimes.

Vulnerability Mapping of the Karnataka Coast to Sea Level Rise

Land use/land cover maps were prepared on a 1:10000 scale for the entire Karnataka coast

(380 km in length and 15 km in the landward region) using linear imaging self-scanner (LISS IV) satellite images. Hybrid classification technique was adopted to classify the satellite images using ERDAS software. Land use classes such as agricultural land, aquaculture, barren land, beach, built-up land, fallow land, habitation with vegetation, mangroves, mudflat, plantation, river, salt pan, vegetation, water bodies and wetlands were extracted from the satellite images. In addition, Cartosat satellite images and digital elevation model (DEM) data were procured from National Remote Sensing Center (NRSC), ISRO, to generate a DEM for the entire Karnataka coast up to a distance of 15 km landward. This will be used to study the vulnerability of the Karnataka coast to sea level rise using different Intergovernmental Panel on Climate Change (IPCC) scenarios and ERDAS and ArcGIS 3D software.

***Soil Mapping*:** As indicated in Table 1.3, soil salinity mapping of the agricultural lands located 500 meters on either side of the Panchagangavalli and Aghanashini estuaries are being prepared using GIS in association with the Zonal Agricultural and Horticultural Research Station (ZAHRS) and University of Agricultural Sciences (UAS), Dharwad.

The 250 m grid map was prepared and overlayed with the agriculture land use/land cover map prepared from LISS IV satellite images using ArcGIS software. The grid was used to identify the location of soil sampling points and the latitude and longitude of the survey spots were listed. Data on soil on EC and pH is being collected by two methods: (i) analysis of collected soil samples in the laboratory and (ii) *in situ* measurements of soil salinity by electromagnetic induction. Five hundred soil samples have been collected and coded for laboratory analysis which is being carried out by the Zonal Agriculture and Horticulture Research Station (ZAHRS) and University of Agriculture Sciences (UAS), Dharwad. Following data generation, results will be collated by MSSRF. Regarding salinity mapping by electrical induction, an electromagnetic induction instrument (EM 38 of Genomics, Canada) has been purchased and calibrated by soil experts at UAS and ZAHRS.

Vulnerability Mapping of Coastal Maharashtra and Tamil Nadu to Climate Change

Vulnerability maps for all the coastal districts of Maharashtra and Tamil Nadu were prepared using ArcGIS software. Six choropleth maps

Table 1.3: ***Area of agricultural land selected for soil salinity mapping***

S. no.	Name of the Estuary	Breadth of the Buffer Zone on Either Side of the Estuary (m)	Length from the Mouth of the Sea (m)	Total Area (ha)
1	Panchagangavalli	500	16000	1600
2	Aghanashini	500	18000	1800
	Total			**3400**

have been prepared for the two states using the manual classification method. The maps have been used to develop an adaptation framework to provide practical strategies for protecting the food security and livelihood security of rural populations dependent on food crop production for fulfilling their needs. For more details refer to Programme Area 400 Ecotechnology

Nutrition Status Mapping for Andhra Pradesh, Bihar and Odisha

Nutrition status maps have been prepared for the states of Andhra Pradesh, Bihar and Odisha using ArcGIS software. Thematic maps were generated using the natural break classification method. Twenty-four maps were prepared from secondary data provided by the Food Security Programme team at MSSRF using the following parameters for the three states: underweight children, stunted children, children showing wasting, anemic children, anemic women, women with chronic energy deficiency (CED), safe drinking water and sanitation facilities. These maps were used to identify issues associated with nutrition across the focus districts for developing suitable policies.

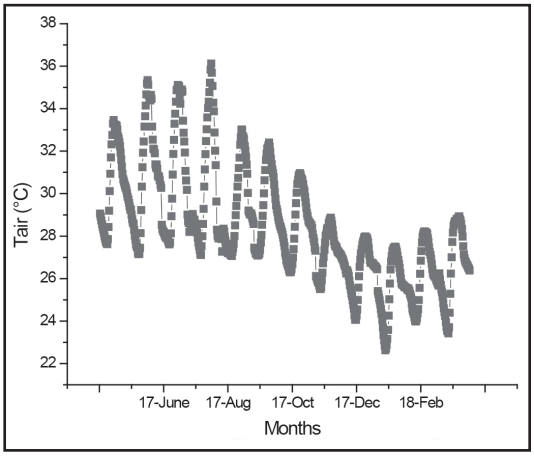
Sub Programme Area 106

Greenhouse Gas Fluxes in the Mangrove Ecosystem

In the Pichavaram mangroves, an Eddy covariance system was established on a 10 m tall tower in the midst of thick mangroves (Lat 11°25'36.61"N Long 11°25'36.61"N). The fluxes of carbon dioxide (CO_2), water vapor (H_2O) and methane (CH_4) were measured between the mangrove ecosystem and the atmosphere using closed path CO_2/H_2O and open path methane sensors at the top of the tower. In addition, data on meteorological parameters such as air and soil temperature, relative humidity, wind speed and direction, precipitation, solar radiation, photosynthetically active radiation (PAR) and line PAR below the forest canopy are also collected. In addition, soil heat flux, soil temperature and electrical conductivity measurements were recorded at two levels (2.5 and 5 cm).

Meteorological data collected from April 2017 to March 2018 indicate the climate was hot and humid for most part of the year. A monthly mean maximum temperature of 36.12°C occurred during July 2017 and a minimum temperature of 22.62°C occurred during the night hours of January 2018 (Figure 1.1a). The average relative humidity was 64.88 per cent for this time period while net total precipitation during the monsoon season (October–December 2017) was 2315 mm (Figure 1.1b). Net radiation peaked at midday and during May 2017 it stood at 822.17 watts per sq.m. The average daily wind speed was 2.48 m per second.

The maximum recorded CO_2 concentration using the Eddy covariance system ranged from 390.63 ppm (midday of September 2017) to 447.02 ppm (early morning of March 2018) (Figure 1.2a). Water vapour flux (computed as the sum of evaporation and



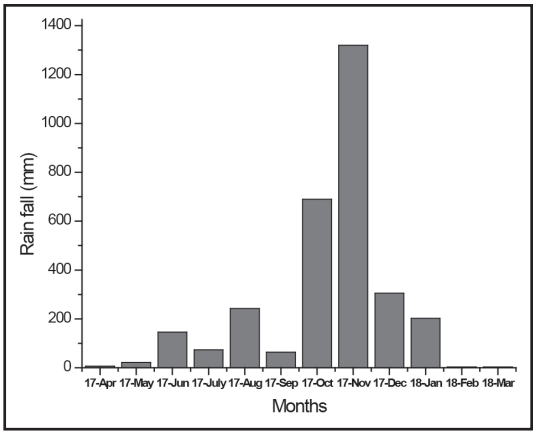
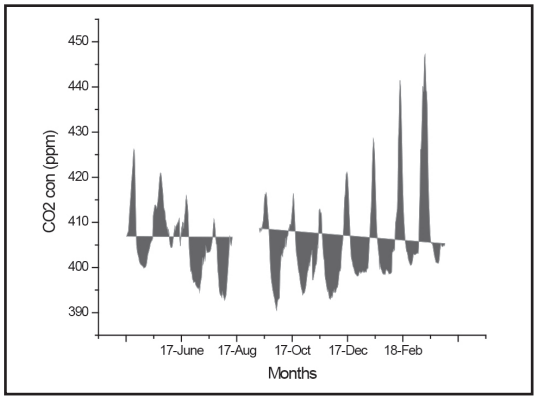


Figure 1.1: (a) Air temperature and (b) total rainfall at Pichavaram mangrove forest.

transpiration) in the Pichavaram ecosystem varied between a maximum of 3.89 mmol/$m^{2/}$ s^1 in February 2018 and a minimum of 2.31 mmol/m^2/s in November 2017 (Figure 1.2b). Eddy covariance–based daily gross primary production (GPP) values ranged between 3.71 gC/m^2/d (November 2017) and 7.86 gC/m^2/d (January 2018). Ecosystem respiration values ranged between 2.62 gC/m^2/d (July 2017) and 3.89 gC/m^2/d (April 2017). The daily net ecosystem production (NEP) was both positive and negative during the period April 2017–March 2018. Maximum NEPs were measured during the month of January 2018 (1.41 gC/m^2/d) and lowest NEPs during October 2017 (-0.02 gC/m^2/d). In the months of May, September and October the Pichavaram ecosystem acted as a source for CO_2 and during the rest of the observation period, it served as a carbon sink. Further long-term interannual measurements are required to arrive at a more definite conclusion with regard to the mangrove ecosystem serving as a source or sink for CO_2.



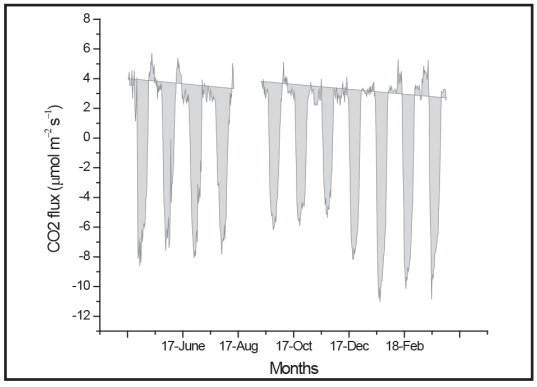


Figure 1.2: (a) Diurnal variations of atmospheric CO_2 concentrations and (b) CO_2 flux in Pichavaram mangrove forest canopy to atmosphere.

Air-water-CO_2 flux was monitored in and around the waters of the mangrove region of Pichavaram between April 2017 and March 2018. The average flux was 61.25 ± 11 mmol/m^2/d, mean flux in the freshwater zone was 39.12 ± 09 mmol/m^2/d and the mean flux value in the marine stations was 22.71 ± 4 mmol/m^2/d indicating that the water component of the mangroves acts as a source of carbon dioxide.

Sub Programme Area 107

Adaptation to Climate Change

A vital component of the response to climate change is enhancing the adaptive capacities of the local communities to rising sea levels. These activities are being implemented in three villages, namely, Sorlagondi, Nali and Basavanipalem. As part of this effort, about 90 ha. of degraded mangroves have been restored, details of which have been provided in Sub Programme Area 101. In addition, an Integrated Mangrove Fishery Farming System was established over an area of 15 ha. An exposure-cum-training programme was organized in Uppunda near Brahmavar, Karnataka, during June 2017. A team consisting of 8 members visited Karikambadi village (Uppunda taluk) where nearly 30 farmers culture fish (sea bass and *Lutjanus*) using cages in the backwaters with technical guidance from KVK Brahmavar. Nearly 2000 fish juveniles were stocked in each cage of dimension 20 ft x 12 ft x 7 ft and reared for nearly 20 months, during which time each fish attained a body weight of nearly 2–2.5 kg. About 1.0–1.5 tonnes of fish were harvested from each cage.

Sub Programme Area 108

Integrated Rural Development

108.1 Integrated Rural Development in Machilipatnam

On behalf of the village communities, MSSRF has contributed Rs 15 lakhs to the Government of Andhra Pradesh as part of a total fund of Rs 180 lakhs for paving concrete roads in the three coastal villages (Table 1.4).

Similarly, MSSRF has extended financial support for the construction of a retaining wall 80 m in height lining the community pond in Mangalapuram village with a total estimate of Rs 7.50 lakhs, with a contribution of Rs 3.50 lakhs by the community. Energy-efficient LED street lights were installed in the project villages – 60 lamps in Mangalapuram and 20 each in Sorlagondi and Nali.

Table 1.4: ***Details of concrete roads paved by the Government of Andhra Pradesh***

Village	Road Sanctioned (m)	Total Estimated Cost (in lakhs)	Project (in lakhs)	Community (in lakhs)	Government (MGNRES) (in lakhs)
Sorlagondi	1260	72.2	6	15.66	50.6
Nali	2240	123.0	4	8.3	110.7
Mangalapuram	470	27.0	5	3.5	18.5
Total	**3970**	**222.2**	**15**	**27.46**	**179.8**

Construction of Toilets at Households

MSSRF has provided partial financial support for the construction of household-level toilets in the three villages. The Government of Andhra Pradesh provided Rs 15000 for construction of each toilet under the Swachh Bharat Mission. A total of 682 toilets were constructed during this period in the three villages (Table 1.5).

During this year six medical camps were organized in the three project villages. Medical practitioners from Machilipatnam provided medical consultations, and medicines were provided free of cost. A total of 1072 members of the village community attended these medical camps (Table 1.6).

108.2 Integrated Rural Development in Kuttanad

The Community Water Knowledge Centre (CWKC) in Kuttanad, Kerala, continued the water literacy campaign and trainings in the area of water pollution, coastal biodiversity conservation and sustainable agricultural based livelihoods. During the reporting year 35 such meetings/sessions were conducted. World Water Day 2018 was observed in partnership with the Haritha Kerala Mission on 22 March simultaneously in three places: in Kuttanad with the support of the Regional Agricultural Station; in Wayanad at CABC campus; and in Kasaragod. One of the notable achievements of the centre was involvement as a knowledge partner to the Eraviperoor grama panchayath in their efforts to revive a 9 km long 'dead' river named Varattar.

Table 1.5: ***Details of toilets constructed***

S. no.	Village	No. of Toilets Constructed	2015–16	2016–17	2017–18
1	Mangalapuram	290	161	89	40
2	Nali	154	46	81	27
3	Sorlagondi	238	129	69	40
	Total	**682**	**336**	**239**	**107**

Table 1.6: ***Details of the medical camps organized***

Date	Type of Medical Camp	Men/Boys	Women/Girls	Total
28 April 2017	General	70	138	208
18 May 2017	Diabetes care	47	64	111
13 July 2017	General	130	170	300
14 September 2017	Eye camp	86	97	183
10 November 2017	School children	74	67	141
11February 2018	General	67	62	129
	Total	**474**	**598**	**1072**

A Mobile Water Testing Laboratory was established during the year considering the demand from the community members, who live in remote water areas of the Vembanad Lake. The Mobile Water Testing Laboratory analyzes water quality thrice a year (season-wise): pre-monsoon, monsoon and post-monsoon. This helps in identifying water problems in situ and the results are shared through necessary awareness classes and trainings. The Water Knowledge Centre has undertaken a student internship tie-up programme with MG University, Kottayam, which has resulted in two master's-level environment studies students doing their project dissertation work with the centre. Currently, one student from University of Wisconsin-Madison in United States is with the Centre studying the agrochemical-linked pollution of the lake area. The centre held several rounds of meetings with the officials of HDFC Bank's CSR-*Parivartan* programme, which is to be implemented in 10 villages in Kuttanad in partnership with MSSRF.

Programme Area 200

BIODIVERSITY

Tribal farmers in Kolli Hills produced 10.80 tonnes of millets, and this was marketed under the brand name Kolli Hills Natural Foods. As part of organic cultivation, tribal farmers produced 11.26 tonnes of vermicompost and 2.29 tonnes of bio-inputs for their own use. Kolli Hills Agri-Bioresource Producer Company Ltd, which consists of 55 per cent small farmers and 39 per cent marginal farmers, procured and marketed about 15.68 tonnes of primary produce such as pepper, mangoes, millets and bio-fertilizer from its members. About 2129 tribal farmers (M: 1233; F: 896) trained in various components of the project activities. Recognizing its contributions in the area of agrobiodiversity conservation, the Kerala State Council for Science, Technology and Environment (KSCSTE), under the Government of Kerala, awarded 'Grant in Aid' status to the Community Agrobiodiversity Centre in May 2018. Another achievement of the Centre is the launch of the second phase of development of the M.S. Swaminathan Botanical Garden (MSSBG) into an internationally renowned garden. The food security programme covered 519 families across eight panchayats in Wayanad, Thrissur and Kannur districts of Kerala. In Koraput, Odisha, 17 People's Biodiversity Registers (PBRs) were prepared for 17 gram panchayats of Boipariguda, Jeypore and Kundra blocks. A total of 36 Biodiversity Management Committees (BMCs) were established in 36 gram panchayats with 252 members, which included a 33 per cent representation of women. About 142 rice landraces, 23 millet landraces and 12 varieties of pulses were cultivated and conserved at MSSRF campus. A genetic garden was established to maintain a nutritionally rich crop, horticultural species and wild food plants. About 435 millet-growing farmers have been identified to take up activities to improve productivity over an area of 518.85 acres. The results showed that average grain yield increased from 16.87 to 30.57 quintals per hectare using improved agronomic practices.


FARMERS FIELD DAY
Crop cutting SMI field of Millet
Village
Gram Panchayt of Kasdra


M.S.SWAMINATHAN
RESEARCH FOUNDATION

Sub Programme Area 201

Community Conservation Programme in Kolli Hills

201.1 Integrated Tribal Development Programme

The major components of this programme are Wadi development (orchards covering horticulture, agriculture and silviculture crops in a one-acre model), soil conservation, water resource development, women empowerment, community health, and training and capacity building. Wadi is combination of horticulture, agriculture and silviculture that provides food, fodder crops and income. The project has so far covered 1000 tribal farm families from 40 settlements of Thiruppuli (321 farmers), Gundur (299 farmers), Alathur (190 farmers) and Gundani Nadu (190 farmers) panchayats of Kolli Hills.

***Orchard Maintenance and Monitoring*:** Orchard monitoring is an ongoing process, and during the reporting year, Wadi farmers were helped with organic manure, bio-insecticides, bio-fungicides, neem cake, basin weeding, shading, staking, mulching and irrigation of 1000 acres of land. All 1000 Wadi in 1000 acres were cultivated under organic conditions and farmers utilized only farmyard manure, bio-inputs and neem cake. About 600 tonnes of farmyard manure, 21.60 tonnes of bio-inputs and 8.15 tonnes of neem cake were used for this. Mortality assessment was carried out every month in a participatory mode and the survival rate estimated to be 91.82 per cent.

***Soil Conservation and Water Resource Development*:** Water resource development is a critical component of the Wadi, and so far 215 percolation ponds and 17 common wells have been established in the project locations for irrigation and as a source of drinking water for villagers. In addition, compartmental bunds or V-bunds and trenches were renovated and also constructed as soil conservation measures in all 1000 Wadi farms. Details of soil conservation work are indicated in Table 2.1.

Table 2.1: ***Details of V-bunds and trenches constructed in 2010–18***

Panchayat	Trenches (acre)	V-Bund (acre)
Thiruppuli	321.5	321.5
Gundur	298.5	298.5
Alathur	190.0	190.0
Gundani	190.0	190.0
Total	**1000**	**1000**

***Intercropping in Wadi Farms*:** Every year, Wadi farmers are encouraged to cultivate millet as an intercrop in and around Wadi fields. During kharif 2017, 114 farmers adopted millet intercropping and 10805 kg of millets were harvested. Families consumed about 85 per cent of the produce and the remaining was converted to value-added food and sold as Kolli Hills Natural Foods. Details of millet cultivation and yield are given in Table 2.2.

***Kitchen Garden and Nutrition Supply*:** During this year, several village-level camps were organized to create awareness on

Table 2.2: ***Details of millet intercropping and yield, kharif 2017***

Panchayat	No.of farmers	Acres	Yield (kg)	Consumed (kg)	Sold (kg)
Thiruppuli	36	14.50	3588	3088	500
Gundur	30	12.00	3300	2500	800
Alathur	39	19.25	3139	2839	300
Gundani	9	5.35	778	778	0
Total	**114**	**51.1**	**10805**	**9205**	**1600**

nutrition-related issues. In addition, high-yielding varieties of vegetable seeds, including tomato, brinjal, chilli, green leaves, lady's finger, ribbed gourd, bitter gourd, cucumber, bottle gourd and pumpkin, were sourced and distributed to all farmers. During the year, 855 tribal families harvested about 44200 kg of vegetables.

201.2 Millet Cultivation and Expansion

***Identification of Millet Farmers and Sources of Seeds*:** Tribal farmers from 14 panchayats of Kolli Hills were mobilized for millet-promoting activities through village-level meetings and programmes including a millet seed fair. A total of 250 millet-growing farmers were identified to take up activities in an area of 98.85 acres. Seeds of various local and high-yielding varieties of finger millet, little millet, Italian millet, common millet, sorghum and pearl millet were collected from seed keepers and custodian farmers in Kolli Hills and the surrounding area of Namakkal district. Recommended packages of practices for millet trials, such as supply of viable seeds, appropriate seed rate, locally suited high-yielding varieties, line and row planting, proper spacing, application of organic manure, proper thinning and weeding and so on, were promoted.

***Yield Enhancement Trial*:** Yield enhancement trials were taken up by promoting farmer-friendly improved agronomic practices. Two methods of cultivation were followed in the same field for comparative studies: method one involved row planting (monocrop and intercrop) with recommended packages of practices; method two involved broadcasting or farmers' practices (monocrop and mixed crop). During kharif 2017, 151 farmers participated in the demonstration. The results of the demonstration showed that average grain yield using the farmers' practices was 9.64 quintal per hectare whereas it was 12.17 quintal per hectare using improved agronomic practices. A 26.24 per cent increase in yield and 30.57 per cent additional income were reported from use of improved practices compared to farmers' practices (Table 2.3). Farmers cultivated millets by using farmyard manure, vermicompost and neem oil. They learned to handle simple agricultural tools such as furrow maker and cono weeder, along with training on production of vermicompost and bio-inputs.

Table 2.3: ***Details of average cost and returns on millet cultivation under improved and farmers' practices***

Input	Average Cost and Return (Rs per ha)	
	Improved Practice	Farmers' Practice
Seeds	501.77	748.78
Fertilizers	2470.94	1627.03
Plant protection	565.53	0
Irrigation	0	0
Ploughing	5518.47	3983.82
Human labour	16914.34	15233.84
Total cost	25971.05	21593.46
Gross return	39746.59	32143.67
Net return	13775.54	10550.21
Benefit: Cost (B:C) ratio	1.53	1.49

201.3 *Linking Agro-Biodiversity Value Chains, Climate Adaptation and Nutrition*

***Stakeholder Study on Millets in Madhya Pradesh*:** During this year, an assessment and detailed field study were conducted on the value chain for two minor millets, *Kodo* (*Paspalum scrobiculatum)* and *Kutki* (*Panicum sumatrense*), cultivated in the Mandla and Dindori districts of Madhya Pradesh as part of the International Fund for Agricultural Development project. The study involved various stakeholders such as millet farmers; elderly farmers having more experience in millet cultivation practices), children, traders, super markets, restaurants and consumers in rural and urban area. A total of 139 stakeholders were surveyed in Mandla, Dindori, Jabalpur and Bhopal. This study brought out the issues and potential options in millet cultivation, marketing and value addition.

***Vermicompost Production*:** A total of 87 tribal farmers were provided training on production, handling and application of vermicompost, and they produced about 11426 kg of vermicompost, which was used for their crops.

***Finger Millet Pulverisers*:** The finger millet pulverisers established in the previous years at Semputuvalvu, Navakkadu, Padasolai, Periyakovilur, Puliyampatti, Thiruppuli

Table 2.4: ***Details of millet processing, 2017–18***

Name of Millet Mill	Ragi Flour (kg)	Rice Flour (kg)	Wheat flour (kg)	Ragi Malt (Mixed Grains, kg)	Total (kg)
Semputuvalvu	115	12	327	–	454
Navakkadu	93	51	240	–	384
Padasolai	227	242	–	186	655
Periyakovilur	385	53	382	–	820
Puliyampatti	294	13	13	–	680
Thiruppuli Orpuram	251	–	415	–	666
Thuvarappallam	79	187	383	–	549
Vendalappadi	298	204	237	–	739
Sundakadu	187	–	180	–	405
Total	**1929**	**762**	**2177**	**186**	**5352**

Orpuram, Thuvarappallam, Vendalappadi and Sundakadu of Kolli Hills were monitored. These processing mills are managed by self-help groups (SHGs) and farmers' clubs and have helped in reducing drudgery involved in millet processing as well as creating opportunities for additional income. Details of millet mills and processing are given in Table 2.4.

***Village Knowledge Centres and Automatic Weather Stations*:** Village Knowledge Centres (VKCs) and Automatic Weather Stations are located in six places across Kolli Hills and managed by local SHGs and farmers' clubs. Strategies were worked out to help the VKCs and Village Resource Centres operate on their own with the involvement of local youth.

***Production and Marketing of Kolli Hills Natural Foods*:** Members of the Kolli Hills Agro-Biodiversity Conservers Federation (KHABCOFED) are producing and marketing value-added millet products under the brand 'Kolli Hills Natural Products' since 2001. Currently there are 11 value-added products such as ragi malt, little millet rice, Italian millet rice, little millet flour, Italian millet flour, little millet upma mix, little millet bajji mix, Italian millet payasam mix, Italian millet laddu, ragi murukku and ragi flour that are being produced and marketed across Tamil Nadu and other parts in India. During the reporting year, 11.83 tonnes of millet value-added products were sold and an overall gross income around Rs 11.00 lakhs earned.

201.4 Kolli Hills Agri-Bioresource Producer Company Limited

Farmers Producer Organization (FPO) is being nurtured with the brand name 'Kolli Hills Agri-Bioresource Producer Company Limited' (KHABPCol) at Kolli Hills since January 2016 with financial support from NABARD. The major objective of the FPO is to build capacity of the farmers' collectives to access financial and non-financial supports such as bank linkages, value-added products and marketing of primary products. The FPO comprises of small and marginal farm families of five village panchayats of Kolli Hills. So far, 583 tribal farm households have been registered as members. The details of memberships are given in Table 2.5.

KHABPCol consist of 54.72 per cent small farmers and 38.59 per cent marginal farmers with the remaining 6.52 per cent being large farmers. Each farmer has contributed Rs

Table 2.5: ***Membership of KHABPCol***

Panchayat	Villages	No. of FIGs	Male	Female	Total
Alathur Nadu	8	8	59	60	119
Gundani Nadu	8	7	61	43	104
Thiruppuli Nadu	9	8	142	8	150
Gundur Nadu	13	13	158	37	195
Vazhavandhi Nadu	1	1	14	1	15
Total	**39**	**37**	**434**	**149**	**583**

1000 as share capital and so far the FPO has collected Rs 583000. The Board of Directors (BoD) consists of one chairman, five directors and five executive members with equal participation of men and women. Major target crops are millets, fruits (jackfruit, mango, pineapple, orange, lime), cashew, pepper, coffee and pulses. The BoD and chief executive officer (CEO) of the FPO prepared a business plan and strategy for the next five years. During the past year, KHABPCol members procured about 15.68 tonnes of primary produce (420 kg of pepper, 11960 kg of mangoes, 1000 kg of millets, 2293 kg of bio-fertilizer and 2 kg of cloves) from member farmers and that was marketed with a total turnover of Rs 6.81 lakhs. A total of 23 orientation training programmes were conducted across 39 settlements covering the 583 farmers. The training sessions conducted focused on formation of FPO, farmers' mobilization, formation of farmers' interest groups and linking with banks and share capital collection. Fifteen training-cum-exposure visits were organized for BoD members and the CEO on formation of FPOs, roles and responsibilities of the CEO, farmers' mobilization, database management, share capital collection, equity grants and credit guarantee fund.

201.5 Training and Capacity-Building Programmes

The project team organized a number of on spot and outside training and capacity-building programmes through all projects that are being implemented in Kolli Hills. In total, 136 training programmes have been organized under tribal development programmes (orchard maintenance, soil conservation, water resource development, community health and women empowerment), farmers' producer company (organic method of cultivation, primary processing, marketing and financial linkages), millet promotion (improved agronomics cultivation, production of vermicompost and bio-inputs, value addition and marketing) and Village Resource and Knowledge Centre. A total of 2129 tribal farmers (M: 1233; F: 896) participated in these training programmes.

Sub Programme Area 202

Community Agrobiodiversity Centre, Wayanad

Recognizing its contributions in the area of agrobiodiversity conservation, the Kerala State Council for Science, Technology and Environment (KSCSTE), under the Government of Kerala, awarded 'Grant in Aid' status to the Community Agro biodiversity Centre (CAbC), Wayanad,in May 2018. Another achievement of the Centre is the launch of the second phase of development of M.S. Swaminathan Botanical Garden (MSSBG) into an internationally renowned garden, in collaboration with Denver Botanical Garden, United States. MSSBG receives over 12000 visitors every year, who study and research the botanical species available in the garden. Research and development activities in the CAbC encompasses three subthemes: livelihood and nutrition security;

education, communication and training; and finally conservation.

202.1 Food and Nutrition Security Initiatives

The target groups of this programme are tribal communities, scheduled castes, backward castes and smallholder farm families in Wayanad, Thrissur and Kannur districts of Kerala. The interventions covered 519 families across eight panchayats in three districts.

***Integrated Farm Development*:** During this year, farm development activities for livelihood enhancement were carried out among 251 tribal families in Cheeyambam tribal colony in Wayanad. Crops such as pepper, areca nut, mango, gooseberry and nutmeg were planted along with the existing crop, coffee, to encourage mixed farming. As part of promoting organic farming, 4852 kg of crushed neem cake were distributed and its application was promoted. Also, 218 compost pits were constructed and the availability of organic manure at household level was ensured. A total of 72 tribal families were facilitated with training and bank linkage to initiate cattle rearing during the reporting period. The construction of earthen bunds of volume 3975 cubic metres and rain pits of 1025 cubic metres was completed as part of soil and water management. Two ponds were renovated for irrigation and one well was renovated for ensuring the availability of drinking water since this region falls within a drought-prone area that is facing acute shortage of drinking water during harsh summers.

***Home Nutrition Garden to Combat Malnutrition*:** Home nutrition gardens, as models for ensuring nutrition at household level, were established in the homesteads of 110 families in Wayanad and Thrissur districts during the reporting period. These gardens consist of pulses, tubers, leafy greens and other preferred local vegetables that ensure both macro- and micronutrients to vulnerable families.

***Germplasm Collection and Maintenance at CAbC*:** Germplasm for pulses (1 species and 21 varieties of pulses, 5 species and 18 varieties of tubers, 3 species and 14 varieties of roots, 18 varieties of banana, 25 species and 15 varieties of leafy greens) are being maintained as ex situ conservation in the protected garden land of CAbC Agrobiodiversity Zone using organic agricultural practices. During this reporting period, 4 varieties of pulse, 1species and 4 varieties of tubers, and 5 varieties of banana were added to the existing germplasm collection.

***Community Conservation Plots*:** Community conservation plots for banana, pulses and leafy greens have been established and are being maintained in selected sites of Wayanad, Thrissur and Kannur districts. Fifteen varieties of banana, 21 varieties of pulses, 5 species and 35 varieties of leafy greens are being maintained in these conservation plots. A pulses seed village programme was initiated during the reporting period in seven sites in Wayanad and one site in Kannur district. This activity was carried out particularly to ensure

local availability of good quality seeds of pulsesand to promote pulse cultivation.

***Capacity Enhancement Programme*:** A total of 18 training sessions on nutrition gardening and management and 27 on health and nutrition issues of adolescent girls and women were organized. This was attended by 647persons including 478 women and 169 men.

***Promotion of Pepper and Ginger Cultivation in Selected Tribal Hamlets in Wayanad*:** Activities to promote pepper and ginger crop cultivation were carried out in five selected tribal hamlets in Wayanad with an objective to enhance their productivity. About 280 tribal households participated in the programme. Four women groups were formed and training was provided on nursery management. The groups were encouraged to establish decentralized nurseries of quality planting materials of pepper. They raised 13000 pepper vines, which were distributed among the selected farm households. A pepper nursery unit with 8 improved varieties and 12 traditional varieties was established at the centre to ensure availability of stock planting materials. Household-level multiplication of pepper vines was also attempted in10 units with a capacity to raise 3000 bags per unit.

***Production of Ginger Value-Added Products*:** Two selected women's groups comprising of five each were trained with necessary skills in ginger value addition and a unit was established for its commercial production. They marketed products such as ginger pickle, ginger squash, ginger chat, dry ginger and other products. Grama panchayaths also extended infrastructural support for women to initiate commercial production of ginger value-added products.

***Bio-inputs and Tissue Culture*:** During the reporting period, bio-input production units were established in three tribal villages, which produced and distributed 2.2 tonnes of bio-inputs and have reached 500 farmers. Microbial bio-inputs such as *Pseudomonas fluorescence, Trichoderma harzianum, T. viride, Beauveria bassiana* and *Lecanicillium lecanii*were used for the control of various pest and diseases affecting major agriculture crops in the district. Women were trained both theoretically and practically for the production as well as dissemination of bio-inputs. Tissue culture of banana *(Attunendran, Nadan nendran and Grand Nain*) was also initiated in the reporting period (Table 2.6).

Table 2.6: ***Bio-inputs and mushroom produced as part of the livelihood development***

S. no	Name of Inputs	Quantity Produced (kg)	Women Involved
1	Trichoderma spp.	2200	20
2	Pseudomonas spp.	360	20
3	Mushroom spawn	1950	1
4	Fresh mushrooms	216	5

***Effort to Strengthen Grassroots Institutions*:** The grassroots institution (GRI) programme of MSSRF in Wayanad is framed under the concept of building social structures for sustainable and collective management of natural resources such as land, water and biodiversity, giving thrust to conservation of agrobiodiversity.

***Wayanad Tribal Development Action Council and Seed Care*:** Under the Wayanad Tribal Development Action Council (WTDC), 15 activity groups covering 354 member families are engaged in group farming and agro-biodiversity conservation activities. These groups are conserving 7 varieties of *Dioscorea* and 11 varieties of other tubers and taros. Six groups are involved in conservation of 12 traditional rice varieties. Another 16 village-level groups are cultivating 38 native vegetable varieties. The WTDC and MSSRF jointly organized the Fourth Wayanad Community seed festival for three days in February 2018and exhibited a total of 182 varieties of 5 crop groups. About 1300 individuals visited the seed festival. As a part of the festival, a three-day national seminar on agrobiodiversity conservation was also conducted. A directory of 'Traditional farmers' was prepared with information on crops conserved by 256 farmers from Wayanad. SEEDCARE (grassroots institution of farmers) organized market fares to popularize consumption of diverse native food crops for bringing back agrobiodiversity in the food basket. As a part of this initiative, a 'Mango fest' was conducted to popularize native mango varieties (45 varieties) and a *Pathila Chanda* (market for leafy greens) was conducted to popularize the usage of seasonal leafy vegetables.

***Wayanad Agri Marketing Producer Company Limited*:** During the reporting period, the company marketed 400 kg of traditional rice, 'Thondi', and 1000 kg of scented rice, 'Gandhakasala', worth sales turnover of Rs 2 lakhs. As part of extension of its market reach, the Waynad Agri Marketing Producer Company Limited(WAMPCo) organized regular weekly 'nattu chanda' (safe-to-eat vegetable market). The company procured farm fresh vegetables, leafy greens, yams, taros, rice and various value-added products from local famers and facilitated weekly market.

202.2 Education, Communication and Training

The Community Training Centre provided demand-driven training to farmers, women and youths on various topics related to sustainable agriculture. A total of 2494 people benefitted from various training programmes (see Table 2.7). Training included classroom lectures,

Table 2.7: ***Details of training programmes conducted in 2017–18***

S.no	Name of the Programme	Men	Women	Total
1	Value addition of jackfruit	32	41	73
2	Pisciculture	43	19	62
3	Nursery techniques	69	31	100
4	Cultivation of pepper, ginger and mushroom	185	433	618
5	Jaladoodh – training on water conservation	597	951	1548
6	Pickle making		27	27
7	Modern farming methods	50	16	66
	Total	**976**	**1518**	**2494**

hands-on experience and interaction with expert farmers.

Twelve Indian Forest Service (IFS) probationers (2016–18 batch) from the Indira Gandhi National Forest Academy, Dehradun, underwent training on various aspects of conservation of biodiversity and agrobiodiversity at CAbC, Wayanad Campus, from 29 October to 3 November 2017 (M: 10; W: 2).

***Watershed Development*:** MSSRF has been serving as a resource supporting organization for implementing sustainable development plan for selected 30 watersheds in Wayanad. Monitoring and auditing of watershed activities are in progress.

***Weather Monitoring System and Child Climate Volunteers in Wayanad*:** Considering the need for micro-level weather monitoring systems to devise climate resilient practices and sensitizing children about climate change, MSSRF initiated an education programme with the support of Kerala State Council for Science, Technology and Environment (KSCSTE). Six schools from three different agro-climatic zones of Wayanad district were selected (two each from three agro climatic zones). Three Automated Weather Stations (AWS) were established in three schools which represents three agro-climatic zones of the district. The project intends to record and document daily weather data, create awareness among children on current climate change scenario in the local context and equip them to develop/think about local adaptation strategies. Each AWS has been installed with built-in sensors for measuring maximum and minimum temperature, rainfall, wind speed, wind direction andhumidity. A series of 32 awareness programmes, 2 exposure visits and 3 awareness camps were organized on topics such as climate change, impact of climate change on agriculture, importance of communicating weather information to the local farmers and so on.

***Every Child a Scientist Programme*:** A total of 26 children have been enrolled in the Every Child a Scientist (ECAS) programme in the year 2017–18. They were given regular classes on biodiversity and environment-related topics.

***Vacation Training Programme*:** The Ninth State Level Vacation Training Programme was organized between 12 and 26 May 2017 for students who have appeared for their tenth standard examination. A total of 28 students across Kerala attended the programme. They were given exposure to subjects such as biodiversity, climate change and biotechnology.

***Science Popularization Programme*:** A five-day science popularization programme, called 'Saasthra Sameeksha', was organized for students with the support of KSCSTE. A total of 238 students attended the programme. A vacation training course on biodiversity was organized for 38 students in CAbC between 17 April and 25 May2017, with Kerala State Biodiversity Board extending support for conducting this course.

***Technological Advancement for Rural Areas Innovation Cell*:** The Technological

Advancement for Rural Areas(TARA) Innovation cell has been established at the CAbC centre for promoting rural innovations in the area of agriculture and rural development. The Cell is intended to document and promote rural innovations in agriculture and traditional healthcare practices. A directory of 52 traditional healers has been prepared. An innovation meet for farmers and healers was also conducted at CAbC with 50 participants from the Malabar region. An exhibition of innovative farmers' inventions in agriculture was also conducted.

202.3 Biodiversity Conservation

Community Agrobiodiversity Centre's biodiversity conservation activities mainly centre around conservation of the rare, endemic and threatened (RET) plant species of Western Ghats, promotion of medicinal plants, conservation of genetic diversity of selected crops and development of the MSSBG.

***RET Plant Conservation*:** The collection, conservation and management of RET plant species of Western Ghats was the central theme of the biodiversity conservation programme during the year. Over 50,000 seed materials of 46 RET plant species were collected from various locations of Western Ghats and plants were raised in the nursery. Nearly 250 individuals of 112 plant species are being maintained at the MSSBG. The status and growth of RET species planted in MSSBG was assessed during the reporting period. The height and girth at breast height (GBH) were measured.

***Promotion of Medicinal Plants*:** *As a strategy for up-scaling the medicinal plants promotion program, a small-scale herbal production unit is being established in Wayanad district. A group consisting of 10 women* was formed (Navachaithanya Herbal Initiative) for running the herbal production unit producing herbal tooth powder, herbal shampoo and other semi-processed drugs. Four seminars were conducted at three locations in Wayanad on the cultivation, conservation, consumption and commerce aspects of medicinal plants, with 177 people participating. A two-day ethno-taxonomy workshop titled 'Oushadhajyothi 2017' had been organized at the centre for 52 selected traditional healers of Malabar region, with a view to enhance their plant identification skills and document and promote their innovative practices in traditional healing. Ethno-veterinary practices pertaining to mastitis had been started in collaboration with the Department of Pharmacology, Kerala Veterinary and Animal Sciences University. Phytochemical profiling of *Cipadessa baccifera, Hopea parviflora, Celastrus paniculatus* and *Ampelocissus indica* had been taken up with the support of CSIR-NIIST, Thiruvananthapuram.

***Promotion of Ginger*:** With the intention of tapping the potential of ginger-based products in local as well as regional markets of Malabar (North Kerala), one ginger production unit was set up at Pulpally, Wayanad, during the year 2017–18. The initiative focuses on disseminating proven technologies of value addition of ginger. A group named 'Ardrakam Women Organic Ginger Initiative' was formed with 10 members for running the unit and one

farmer group with 50 women members for production of organic ginger raw materials. Products manufactured include dry ginger powder, tea cuts, pickles, candy, paste and so on.

***M. S. Swaminathan Botanical Garden*:** The second phase of the MSSBG development was launched on 11 January 2018 along with a stakeholder meet. An advisory committee was constituted under the chairmanship of Dr K. K. Narayanan. A strategy plan has been prepared as a prerequisite for fund-raising. MSSBG was included in the district tourism map of DTPC for enhancing outreach.

***Floristic Exploration*:** Floristic exploration at four Ecologically Fragile Lands (EFLs) in Wayanad district, one at Mananthavady range and three at Meppadi Range, were conducted as per requisition of the Kerala Forest Department. The reports were submitted to the concerned range offices.

***Stream Rejuvenation Programme*:** During the reporting year CAbC initiated a year-long programme on World Environment Day 2017 to rejuvenate a partially deteriorated stream for a 10 km stretch between Vithukadu and Puthoorvayal. In the programme 'Aruvikkoru Punarjani' reeds and *Pandanus* were planted along a 2 km stretch on either side of the stream on 5 June 2017. The second phase of the programme was held at Manivayal stream on 9 June 2017 with the help of local institutions and individuals.

***Medicinal and Aromatic Rice Initiative*:** As part of the Medicinal and Aromatic Rice Initiative Programme, six new seed villages were established in Wayanad at Manikaini, Thariyodu, Kunjothumal, Kallanchira, Thanivayal and Erumadu. Each seed village consists of three to five farm families conserving more than two traditional paddy varieties. Eighteen seed storage boxes were also distributed in these new seed villages for safe storage. As a part of seed purification of traditional paddy varieties, panicle selection of six traditional paddy varieties were carried out in Puthurvayal (Veliyan, Adukkan), Athikolli (Thondi, Chenthadi) and Paramoola (Gandakasala, Chenellu) seed villages. During the 'Seed fest 2018' at CAbC, traditional paddy seeds (294.32 kg) which were collected from the farmers of the existing ten seed villages were distributed among 45 farmers across Kerala. Two training programs, one on 'seed purification' (52 participants) and another on 'Traditional Seed Conservation' (105 participants), were organized.

Sub Programme 203

Biju Patnaik Medicinal Plants Garden and Research Centre

203.1 Conservation of Biodiversity

***Ex situ Conservation of Ethno-medicinal Plants*:** A unique tribal botanical conservation garden with 387 plants species is being maintained within the campus of the Biju Patnaik Medicinal Plants Garden and Research Centre. During the year, 2500 medicinal plant seedlings belonging to14 species were raised in the nursery and distributed to 5 schools,

3 forest ranges, 2 NGOs and 42 traditional healers and individuals. Seeds were harvested from medicinal and other tree species grown in the garden and supplied to the Forest Department nursery (including three RET medicinal plants:*Mesua ferrea, Oroxylum indicum* and *Saraca asoca*).

***Conservation of Plant Genetic Resources*:** A total of 142 rice landraces and 23 millet landraces (finger millet: 20;little millet: 2;foxtail millet: 1), 12 pulses varieties (black gram: 2; green gram: 3; *Dolichos*: 4; pigeon pea: 3) were cultivated and conserved at MSSRF campus. Farmers were invited to visit the conservation plots during the vegetative stage of growth as well as during crop maturity. A genetic garden was established to maintain nutritionally rich crop plants, horticultural species and wild food plants. Numerous demonstration plots showcasing the importance of the nutrition with different themes were established: Farming System for Nutrition, Annadata Nutritional Garden, Genetic Garden were established inside the campus to create awareness and capacity building of farming communities and visitors.

During the year, 208 kg of mushroom spawn and 96 litres of *Tricoderma viride* culture were produced and supplied to the farming communities and entrepreneurs. For promotion of these activities a residential training programme on mushroom production, mushroom spawn production and *Trichoderma* preparation was conducted involving 30 participants (M: 17; F: 13) from farming communities and entrepreneurs from Jeypore, Kundra and Boipariguda blocks of Koraput district.

***People's Biodiversity Register*:** A total of 17 People's Biodiversity Registers (PBRs) were prepared for 17gram panchayats of Boipariguda, Jeypore and Kundra blocks. Moreover, 36 Biodiversity Management Committees (BMCs) were established in 36 gram panchayats with 252 members, which had a 33percent representation of women. An agreement was signed with the Odisha Biodiversity Board (OBB) for the preparation of one new PBR. Documented records and information is available for 47 local rice varieties, 15 millet landraces, 16 tubers, 22 wild flowers, 27 wild fruits, 5 fumigating and chewing plants, 26 wild animals, 16 bird species,17 fish species and 21 insects species.

203.2 Foods and Nutrition Security through Millets

During the year with the support of Indian Institute of Millets Research (IIMR), the team has mobilized tribal farmers for promotion of millets in the Umuri block of Koraput district. Mobilization programmes including a millet seed fair, village-level meetings have been organized and 195 millet-growing farmers have been identified to take up activities over an area of 197.60 acres. The project team sourced various local and high-yielding varieties of finger millet such as Chilika, Subhra, Bhiarabi and GPU-66 and recommended packages of practices for millet trials, such as supply of viable seeds, appropriate seed rates, locally suited high-yielding varieties, line and row

Table 2.8: ***Comparative yield of local and high-yielding varieties***

Sorghum/Millet Used	Grain Yield (q per ha)	Fodder Yield (q per ha)	Cost of Cultivation (Rsper ha)	Gross Return (Rsper ha)	Net Return (Rsper ha)	B:C Ratio
Improved cultivar of finger millet						
Chilika	3057.5	2950	17500	67040	49540	3.83
Subhra	2027	1975	14562	44490	29928	3.05
Bhiarabi	2537	2347	14875	55434	40559	3.72
GPU-66	2847	2750	16220	62440	46220	3.84
Farmer's Practice	1687.5	1525	12525	36800	24275	2.93

planting, proper spacing, application of organic manure, proper thinning and weeding and so on, were promoted (Table 2.8).

***Yield Enhancement Trial*:** Yield comparisons were carried out between cultivation using farmers' methods and that using improved agronomic practices. The results showed that average grain yield using farmers' practices was 16.87 quintal per hectare whereas it was 30.57 quintal per hectare when using improved agronomic practices. There was an 81 per cent increase in yield using improved agronomic practices. The details of average costs and returns are indicated Table 2.9.

Table 2.9: ***Average cost and returns in cultivation (Rs per ha)***

Input	Improved Practice	Farmers' practice
Seeds	216	125
Fertilizers	4300	2400
Plant protection	500	–
Irrigations	–	–
Ploughing	6000	4000
Human labour	6484	6000
Total cost	17500	12525
Grain yield (q per ha)	3057.5	1687.5
Fodder yield (q per ha)	2950	1525
Gross return	67040	36800
Net return	49540	24275
Benefit: Cost (B:C) ratio	3.83	2.93

***Training on Integrated Nutrient and Pest Management*:** Training programmes were organized on nutrient and pest management and 28 farmers from three villages were trained on integrated pest management (IPM) while 35 farmers were trained on integrated nutrient management.

***Farmer's Field Day*:** A farmer's field day was organized during the pre-harvest stage of the crop. Farmers from three villages were invited to the millet plots. They observed various finger millet varieties both local and improved such as Chilika, GPU-66, GPU-67, Bati Mandia, Jam Mandia, Kakdi Mandia and Chilli Kangra Mandia. The farmers visited large-scale demonstration plots for finger millets with regard to line sowing, broadcasting, System of Millet Intensification (SMI) and line transplantation (LT).

***Distribution of Agriculture Implements*:** Rack weeders (5 units) and sickles (60 units)

were distributed among three villages of Umuri gram panchayat of Koraput block for day-to-day use in paddy fields for weed control and drudgery reduction among women.

***Odisha Millet Mission*:** During the year, a Special Programme for Promotion of Millets –'Reviving Millets in Farms and on Plates' – was launched in tribal areas of Odisha. The nutritious millets have been traditionally consumed as part of their diets and are part of crop systems in tribal areas of the state. Millets require less water and are more resilient to climate vulnerability. However, reduction in consumption of millets over the years has resulted in nutritional deficiencies and also use of unsustainable cropping systems that place an increasing demand on water. In order to address growing crop failures and nutritional issues, millets need to be revived. To revive millets, MSSRF has partnered with the Department of Agriculture and Farmer Empowerment, Odisha, as a facilitating agency to work in the Kundra block of Koraput district. This programme intends to revive millets in rain-fed farming systems and for household consumption. During the first year, the farming communities were mobilized to adopt improved agronomic practices and modern technologies such as SMI, LT, maintaining good spacing (15 cm x 15 cm) through a series of capacity-building workshops and exposures (Table 2.10; 2.11).

CBO – Community based Organization; CRP-Community Resource Person; IPM: Integrated pest management; SMI: System of millet intensification.

***Crop Cutting Experiment*:** Ten randomly selected finger millet samples were collected from field areas measuring (5 x 5) Sq.m in the

Table 2.10: ***Details of training conducted under Odisha Millet Mission***

Name of Training Module	No. of Programmes	Male	Female	Total Participants
Orientation training on promotion of millets	2	46	60	106
Training of trainers on SMI	1	44	10	54
IPM in millet	4	125	37	162
Farmers' field day	4	56	27	83
Awareness programme on millets	2	65	63	128
Farmers exposure visit in SMI finger millet field, Kundra	1	9	3	12
Training and orientation programme for CBO and community members on seed center management	2	15	20	35
Training to the CRP and progressive farmers on production and consumption of millets.	1	52	15	67
Training of NGO staff, CRP and progressive farmers on mobile application, documentation and data generation	2	22	2	24
Block-level planning meeting	1	19	2	21
Total		**453**	**239**	**692**

Table 2.11: ***Area under finger millet production and benefits received by the farmers****

Name of the GP	No. of Farmers in SMI	Area under SMI (ha)	No. of Farmers in LT	Area under LT (ha)	Total No. of Farmers (SMI+LT)	Total Area (SMI+LT) (ha)	Benefit Received by Farmers from Govt. in (Rs)		
							SMI	LT	Total
Banuaguda	85	46	28	17.9	113	63.9	230000	41000	271000
Lima	43	17.6	8	5.2	51	22.8	88000	13000	101000
Kundra	15	6.2	5	2.8	20	9	31000	7000	38000
Phupugaon	31	18.6	25	14.2	56	32.8	93000	35500	128500
Total	**174**	**88.4**	**66**	**40.1**	**240**	**128.5**	**442000**	**96500**	**538500**

* Following introduction of improved agronomic practices and new technologies including SMI and LT in Kundra block of Koraput district in the kharif season, 2017.

GP-Gram Panchayat: LT: Line transplantation; SMI: System of millet intensification.

presence of Government Agriculture officers both in SMI and LT fields. The highest dry grain weight among all the samples was recorded in the field of Sri Banu Santa of Beheraguda village (7.55 kg/25 sq.m). The estimated yield per hectare was 3.05 tonnes, which is considered a bumper yield for finger millet production in Odisha.

***Production of Quality Finger Millet Seeds in Rabi, 2018*:** Steps were taken towards quality finger millet seed production in four villages under three gram panchayats involving 17 farmers using improved agronomic practices and crop technologies such as SMI and LT. A total of 7.5 acres were covered used quality seed production. There is a plan to cover an additional 675 acres under finger millet, little millet and foxtail millet during kharif 2018.

203.3 Plant Clinics in Kundra and Boipariguda Blocks

MSSRF has launched two plant clinics, each covering a cluster of 10–15 hamlets in both Kundra and Boipariguda blocks with financial support from the Centre for Agriculture and Bioscience International (CABI) during July 2017. The Jeypore agricultural tract is known for subsistence farming and mainly has two agricultural seasons: kharif and rabi. Pests and diseases are major limiting factors in reducing yield in addition to erratic monsoon, flash floods, landslides, prolonged drought and variable soil fertility. In this scenario, bringing plant clinics to the farmer's doorstep will reduce crop loss. Progressive farmers are trained as 'plant doctors' to help farmers with disease diagnoses and management advice. During the year, six plant clinic sessions were conducted both in Boipariguda and Kundra, covering 135 farmers with 98 samples. The major diseases covered under this clinic include rice stem borer, brinjal shoot and fruit borer, citrus leaf miner, tomato spotted wilt virus and lady's finger vein clear mosaic. This advice has resulted in 25–30 per cent reductions in crop loss.

203.4 Grassroots Institutions

***Panchabati Grama Unnayan Samiti*:** The Panchabati Grama Unnayan Samiti (PGUS)

was formed and registered by MSSRF under the Society Registration Act – XXI of 1860 on 19 February 2003. It was formed after MSSRF received the Equator Initiative Award, and the plan was to utilize the award money mainly for agriculture and livelihood activities of tribal communities in the Koraput region. This Samiti covered 985 households of 16 villages benefitting 4500 people.

Under the guidance PGUS, 55 un-structured kitchen gardens were promoted in Pujariput and Bisoiput villages. About 97 paddy landraces and 21 millet varieties were conserved as part of this activity. In addition, to promote species diversity, 1500 species were planted in barren land in four villages.

***Vikash Maha Sangh*:** Vikash Maha Sangh (VIMAS) is a federation with 79 groups consisting of 978 members (both male and female) that are in operation in 11 villages. The main objective of VIMAS is to provide agro-input services, trainings and financial support for agriculture and allied activities. During the year, 5 quintals of quality groundnut seeds were procured from Odisha State Seed Corporation at subsidized rate and provided to 10 farmers in two villages. Fertilizers were procured in bulk from distributors, stored in a common place and distributed to the farming communities. A total of 383 quintals of diammonium phosphate (DAP), urea and muriate of potash (MoP) were procured from the Regulated Market Committee, Jeypore, and provided to 165 farmers across10 villages. A financial transaction of Rs 408184 was done by VIMAS during the year.

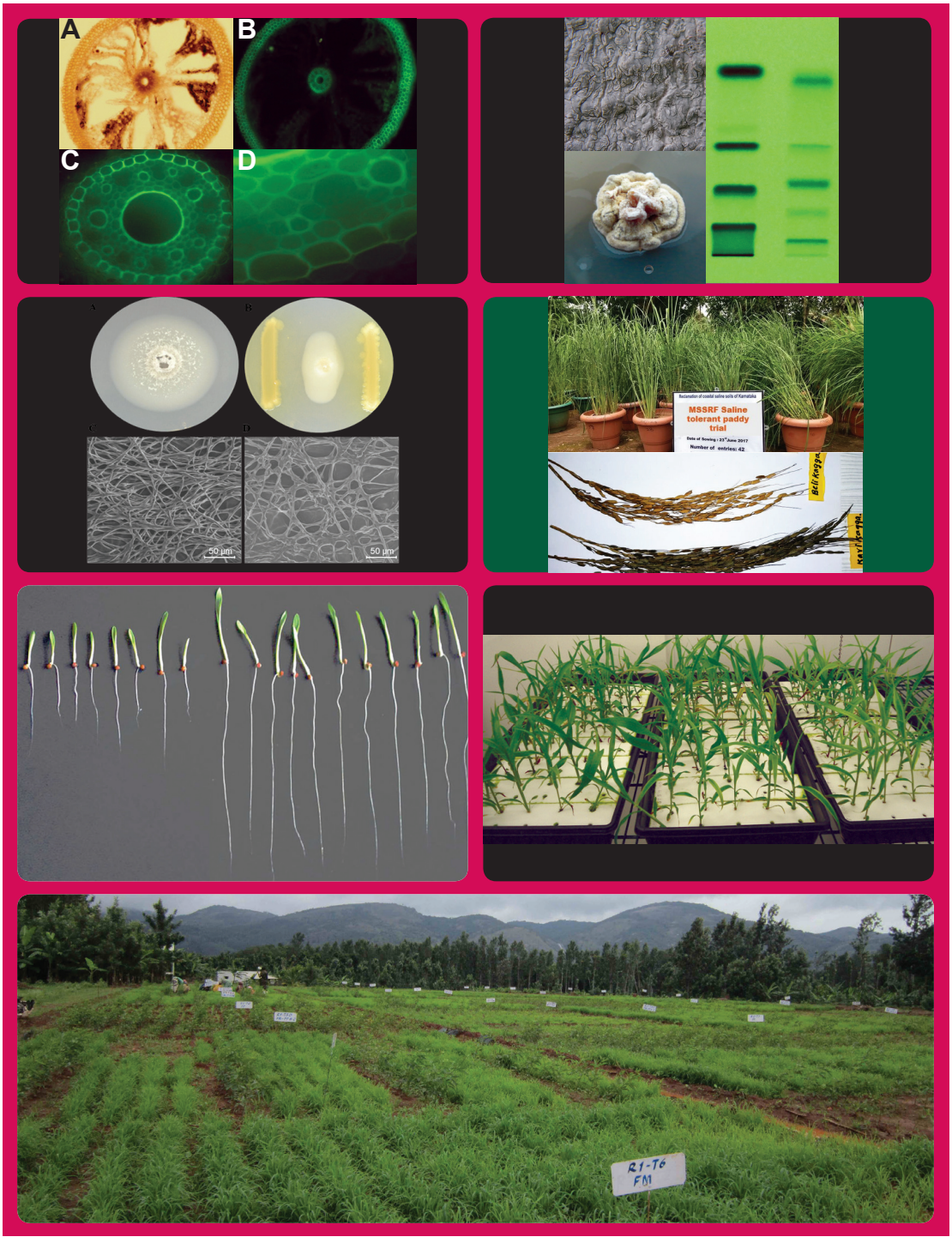
***Jagruti Maha Sangh*:** The apex federation, namely 'Jagruti Maha Sangh', which was formed under the Mahila Kisan Shasaktikaran Pariyojana in Kundra and Boipariguda blocks, and includes 4 cluster federations and 62 producer groups, was strengthened. Regular meetings were conducted to review their progress and to help them with the process of decision-making on group activities, procurement, processing and marketing of tamarind and other value products such as rice, millets and pulses, group functioning and management. A total of 92 SHGs and 12 Producer Groups were facilitated to avail Rs 16.3 lakhs from banks to invest in their agricultural practices and livelihoods.

***Income Generation Activities through the Producer Groups*:** A total of 1022 Mahila Kisans cultivated straw and oyster mushroom from which a net revenue of Rs 182000 was generated during the year 2017–18, excluding personal consumption. Eight producer groups were involved in preparation of value-added products such as rice, millets and pulses from which a net revenue of Rs 69000 was generated during the year 2017–18. Moreover, 206 Mahila Kisans cultivated vegetables on a large scale and availed a benefit of around Rs 15000 each in the year 2017–18.

Programme Area 300

BIOTECHNOLOGY

The Biotechnology Programme uses modern biotechnology tools to develop salinity stress tolerant and nutritionally rich rice varieties. Under the sub-theme Genetic Enhancement, special focus was given to isolating genes and understanding the molecular mechanisms of transporter genes that control Na+, K+ homoeostasis and their contribution to salinity stress tolerance in wild rice Oryza coarctata. The sub-theme Bioprospecting established lichen subcultures for the biosynthesis of secondary compounds. The group isolated a lead molecule against Mycobacterium tuberculosis. Under the sub-theme Microbial Diversity, a large number of bacterial and archaeal strains isolated from mangrove and crop plant rhizospheres were screened for their plant growth promoting properties. The potential strains were subjected to on-farm trials to assess their impact on crops.


A
B
C
D
MSSRF Saline tolerant paddy trial
50 µm
50 µm
R1-T6
FM

Sub Programme Area 301

Genetic Enhancement

The increasing salinization of agricultural land primarily due to anthropogenic causes as well as climate change contributes to reduced crop yield. Tolerance to salinity in plants is a complex trait that is governed by many genes and pathways. In-depth molecular analysis of mechanisms underlying salinity tolerance in halophytic model systems can be extended to crop plants to improve their salinity tolerance. Mangrove species and associates such as *Avicennia marina* and *Oryza coarctata* have been explored for their salinity tolerant mechanisms. Salt tolerant species differ from salt sensitive ones in the genetic pathways that control response to salinity or they show unique variations in gene sequence(s) that confer an advantage under salinity. Earlier studies focused on exploring *A. marina* as a model organism for understanding molecular mechanisms for salt stress tolerance and mining genes for engineering stress tolerance in rice. Currently *O. coarctata*, a halophytic wild rice, is being examined for salinity tolerance traits (gene networks, gene sequences) and compared with cultivated rice *Oryza sativa* (sensitive to salinity). This will help identify unique genes that enhance salinity tolerance of *O. coarctata*, which can be used to genetically enhance the salinity tolerance of cultivated rice *O. sativa*.

301.1 Salinity Tolerance Related Studies in Halophytic Wild Rice *Oryza coarctata*

***Salinity Stress Response in Wild Rice (O. coarctata) and Transcriptomics of Leaf and Root Tissues*:** The microhairs of leaves of *O. coarctata* act to reduce leaf Na^+ content and hence it is important to understand expression patterns of Na^+/K^+ transporters within these microhair structures. Total RNA was isolated from the isolated *O. coarctata* microhairs using the Nucleospin XS Kit. The RNA was quantified using Nanodrop. DNaseI treated (Nucleospin XS Kit) total RNA from microhair tissue was reverse transcribed using random hexamers and MMLV Reverse Transcriptase (Takara). PCR conditions were optimized for annealing temperature and primer concentration. RT-PCR amplification of *OcActin*, *OcALDP*, *OcNHX1*, *OcHKT1*.5 and *OcCLC1* cDNA fragments was confirmed by agarose gel electrophoresis.

Three month old *O. coarctata* plants were subjected to incremental salt stress [25 (E.C.: 0.91) $\rightarrow$ 50 (E.C.: 2.85) $\rightarrow$ 75 (E.C.: 4.13) $\rightarrow$ 100 (E.C.: 5.17) $\rightarrow$ 125 (E.C.: 6.62) mM NaCl] at three-day intervals for transcriptomic studies of leaf and root tissues. Samples were frozen for three controls and three salinity stressed biological triplicates. Simultaneously, leaf, root and rhizome tissues were harvested for elemental analysis ($Na^+/K^+/Cl^-$). Total RNA was isolated from root and leaf tissues. RNA was quantified by Nanodrop and RNA quality was assessed by RT-PCR using primers for *OcCLC1*, *OcCLC2*, *OcHKT1*.5 and *OcNHX1* genes. The RNA samples were then processed for transcriptomic analysis after RNA Integrity values were assessed by Agilent Bioanalyzer; 4 µg of total RNA from each sample was used

to prepare the RNA seq library using TruSeq RNA Sample Prep Kits (Illumina). Library quality (12 libraries; 3 control leaf; 3 salinity treated leaf; 3 control root; 3 salinity treated root) was assessed using Agilent Bioanalyzer. The libraries were sequenced using Illumina HiSeq 2500 platforms to obtain 2 x 100 bp paired end reads. An average of 50 million reads were generated per sample. The RNA seq raw data was processed to generate FASTQ files and final sequence. A standard bioinformatic protocol was followed for *de novo* transcriptome assembly and differential gene expression analysis. A total of 273472 unigenes and 520517 transcripts (isoforms) were obtained following assembly of the *O. coarctata de novo* transcriptome.

***Cloning of Full-Length Candidate Salt Tolerance Transporter Genes of O. coarctata*:** Adapter ligated cDNA libraries (six in all: leaf control, leaf treated, root control, root treated, rhizome control and rhizome treated) were constructed using small amounts of total RNA. Based on the *O. coarctata* transcriptome data-specific primers were designed to isolate full-length cDNAs for *OcCCC* and *OcSOS1* genes using the cDNA library prepared.

***Cloning of Candidate Salt Tolerant Genes for O. coarctata in Binary Vectors Using Appropriate Promoters for Gene Expression*:** The *Oc*HKT1.5 cDNA has been cloned in the *SmaI* and *EcoRI* sites of the binary vector *pCAMBIA0390* (*pCAMBIA0390: Nona Promoter: OcHKT1.5*) under the control of *O. sativa* landrace Nona Bokra *Os*HKT1;5 promoter (cloned in the *PstI* site). The pCAMBIA0390: Nona Promoter: *Oc*HKT1.5 construct has been co-transformed into *Agrobacterium* (EHA105) along with *pCAMBIA1301* as selection marker for rice transformation. *Agrobacterium*-mediated rice transformation has been performed with scutellum derived callus of IR64 indica rice variety.

O. coarctata Root Staining with CoroNa Green after Saline Treatment: Three-month-old *O. coarctata* plantlets were maintained in water for fresh root development. The plants were subjected to 100 mM NaCl for 3 days. Root sections were taken from 3 cm above the root tip. The sections were incubated for 2 h in dark in a solution containing 100 **µM CoroNa green. Images were taken** using Fluorescent microscopy. Green fluorescence indicative of Na^+ accumulation were observed in the outer epidermal and sclerenchymatous layers as well as in the endodermal region.

301.2 Genetic Diversity of Rice Land Races from Saline Coastal Regions of India

Genetic diversity and genetic structure were evaluated among 47 rice landraces obtained from geographically diverse coastal regions of India using genomic, genic and *saltol* QTL linked SSR markers. A total of 138 alleles were amplified with an average of 4.92 alleles per locus and a PIC value of 0.53 using genomic SSR markers. The genic SSR markers produced a total of 35 alleles with an average of 3.18 alleles per locus and a PIC value of 0.43. *Saltol* SSR markers altogether generated

45 alleles with an average of 5.62 alleles per locus and a PIC value of 0.59. Cluster analysis based on a Bayesian approach was carried out to infer the genetic structure among 47 landraces using 28 genomic SSR markers. STRUCTURE analysis revealed that five distinct groups (G1–G5) existed among the selected landraces. Clustering analysis based on Unweighted Pair Group Method with Arithmetic Mean (UPGMA) method separated all 47 landraces into five main groups, which was similar to the results obtained using STRUCTURE analysis. The clustering of genotypes observed using both methods (Hierarchical and Model based approaches) revealed a high level of similarity in the present study and appears to largely indicate the geographic origin of the rice landraces. A neighbor joining dendrogram was constructed based on the combined data obtained from the 11 genic SSR and 8 *Saltol* SSR markers. The dendrogram comprised of three major clusters into which the genotypes were grouped. Thus the present study revealed a significant molecular genetic diversity and established phylogenetic relationships among the selected rice landraces. This will aid in future association mapping and parental line selection for use in breeding for salinity tolerance.

The panel of 47 rice landraces is being evaluated for their relative salinity tolerance in a hydroponics system. Among these rice landraces, initially, salinity screening was done for 20 genotypes. Standard Evaluation Scores (SES) of visual salt injury at seedling stage was recorded after 10 and 16 days of salinity treatment. Among the 20 rice genotypes screened, 13 were tolerant, 4 were moderately tolerant, 1 was susceptible and 2 (salinity sensitive checks) were found to be highly susceptible. Significant differences were observed among rice landraces in their morpho-physiological parameters and biochemical parameters. A significant reduction in all morphological parameters such as shoot length, root length, shoot fresh weight and dry weight was noticed in saline treated plants when compared to control. Estimation of Na^+/K^+ revealed that landraces such as Hamilton, Orumundakan 1, 2 Mundon 1, 2 and Aduisen 1, 2 showed lower intake of Na^+ in shoot as well as in root. These landraces also exhibited low Na^+/K^+ ratio indicating their higher tolerance to salinity (Figure 3.1).

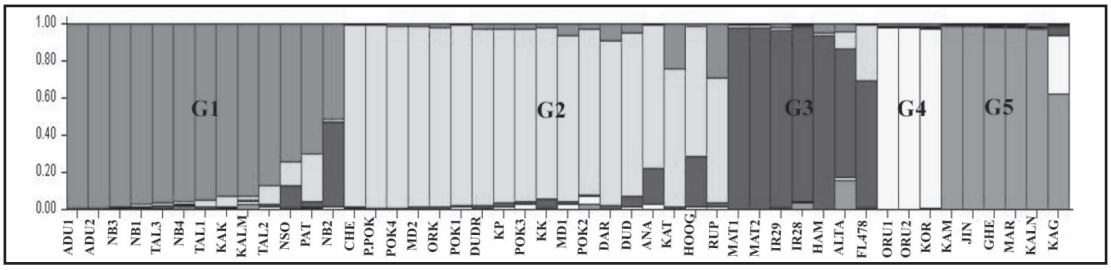


Figure 3.1: Population structure analysis of 47 rice landraces from saline coastal regions of India based on 28 genomic SSR markers and assignment of rice landraces to five subgroups (G1–G5) using software STRUCTURE 2.3. The clustering of genotypes largely indicates the geographic origin of the rice landraces.

301.3 *HKT1;5* Gene Diversity across *O. sativa* Landraces and Wild Rice Varieties

The *HKT1*;5 gene encodes a sodium transporter which is a major determinant of salinity tolerance in cultivated rice *O. sativa*. Molecular modeling of the three-dimensional structure of *Os*HKT1;5 protein suggests a $Leucine_{395}$ Valine change in its amino acid sequence could be responsible for conferring higher Na^+ transport rates in salt tolerant Nona Bokra. The genes conferring saline tolerance in rice, namely, *Os*HKT1*;5* and *HKT1,5*, were analyzed in 47 *O. sativa* landraces/varieties using CAPS marker (CAPS_OsHKT1;5V395). This marker targets the codon V395 in the exon 1 region of the *OsHKT1*;5 ORF. Forty-one rice landraces showed the presence of CAPS_OsHKT1;5V395 marker. Five varieties, Gheus, Kamini, Matla-1, Matla-2 and IR-29, showed the absence of this marker while Jingasal showed partial digestion indicating heterozygosity.

301.4 Phenotypic and Molecular Characterization of Salinity Tolerant Kagga Paddy

In the earlier report, the seedling level salinity tolerance of Kagga paddy was observed, and it was found that few plants survive even under 10 EC for upto 15 days of treatment. In the current year, the seeds of Kagga paddy were purified. Purity of the rice seed is important for uniformity of the crop and to achieve best yield and quality results. Traditional rice seed purification procedures involve at least three generations of self-pollination and selecting 1000 uniform panicles and evaluating the seeds collected from each panicle and planting seeds from one panicle in a single row to obtain uniform progeny for characterization.

Using this process, uniform seeds of Kagga were segregated and raised in pots for seed multiplication. University of Agricultural Sciences, Dharwad, was successful in generating adequate quantity of seeds from uniform panicles during this agricultural season (July–October 2017). The generated seeds were analyzed once again for their uniformity according to the IRRI protocol. During this year, the uniform seeds will be planted in progeny rows and evaluated for further purification and for back crossing.

301.5 Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR-Cas9)-Mediated Gene Editing in Rice

The RNA-guided endonuclease technology based on CRISPR-Cas9 is an extremely powerful tool for plant genetic engineering. CRISPR-Cas9 guide RNAs have been assembled in binary constructs for *Agrobacterium*-mediated transformation in rice, both targeting the first exon in *OsGORK* and *OsHKT1*.5 respectively. The presence of the cloned guide RNAs was confirmed by PCR, restriction analysis and sequencing. Both constructs, pRGEB31:*OsGORK* and pRGEB31:*OsHKT1*.5, are being transformed into *indica* rice cultivar IR64 by *Agrobacterium*-mediated transformation. At present, different batches of rice mature embryo calli are under selection.

301.6 Genome Editing of Cultivated Rice *miR393a* and *miR396c* Genes to Raise Saline Tolerant Rice for Further Analysis

In order to develop transgene-free saline tolerant rice varieties, CRISPR knockout constructs for *O. sativa* miRNA (miR393a and miR396c) genes (that are negative regulators during various stress conditions) have been assembled in binary vectors for rice transformation. A protocol for testing the binary constructs in rice protoplast system is being optimized. Simultaneously, *Agrobacterium (GV-44)*-mediated transformation of *indica* rice varieties IR64 and Pusa Basmati-1 is being carried out using standard transformation protocols.

301.7 RNA Transcriptome Profiling of Abiotic Stress Tolerance Plants

RNA transcriptome profiling allows the identification of genes that are responsive to a particular condition (stress arising due to drought, salt, pests etc.) or developmental stage in the tissue being analyzed. In the previous year's annual report, we reported creation of RNAseq libraries from leaf and root tissues of *Macrotyloma uniflorum*, *Chrysopogan zizanioides* and *Prosopis juliflora* seedlings subjected to salt and drought stress. The libraries were sequenced and raw reads were processed. Horse gram (*M. uniflorum* Lam.) is a grain legume largely cultivated by marginal farmers and is known for excellent nutritional and remedial properties and better adaptability to harsh environmental conditions. *Chrysopogon zizanioides* (vetiver) is a perennial grass with C4 photosynthetic pathway. This species is tolerant to water, salinity and submergence stress. *Prosopis juliflora* (Sw.) DC. (mesquite) is a leguminous tree species tolerant to drought and heavy metal stress. This year, we carried out detailed analysis of differentially expressing genes (DEGs) in leaf and root tissues of the aforementioned species under drought and salt stresses. Four DEG profiles were generated as part of the study (1. Drought responsive DEGs in leaf; 2. Salt responsive DEGs in leaf; 3. Drought responsive DEGs in root; 4. Salt responsive DEGs in root).

***Drought and Salt Stress Responses in M. uniflorum*:** The study revealed that 6911 unique genes were differentially expressing at least in one tissue or stress and those with a Gene Ontology (GO) annotation (4993) were further analyzed. Among these, 957 were found to be upregulated under either salt or drought stress in leaf or root tissue and 4086 were found to be downregulated. Overall, the number of DEGs was much greater in the roots (4752) than in the leaves demonstrating more transcriptomic changes in root tissue compared to leaf under stress. Drought stress resulted in more DEGs than salt stress. Of the total DEGs, 77.2 per cent were downregulated under drought stress in root tissue. The successfully annotated DEGs were classified into GO categories: molecular function (MF), biological process (BP) and cellular component (CC). The potential involvement of these DEGs in response to salt and drought stress in metabolic pathways was investigated using the KEGG annotation system. Similar

to the GO enrichment analysis, the KEGG enrichment analysis depicted common as well as tissue and stress specific patterns of over-representation.

Several DEGs in this study were identified as enzymes involved in the synthesis of raffinose family oligo-saccharides (RFOs), pointing towards the major role for RFOs such as galactinol and raffinose in tolerance to drought/ salt stress, possibly through osmoprotection and/or ROS scavenging. The upregulation of a few genes reported to result in ABA insensitivity points towards reduced abscisic acid sensitivity and increased water loss rate in *M. uniflorum* under the experimental conditions.

***Drought and Salt Stress Responses in C. zizanioides*:** It was found that 10025 unique genes were being differentially expressed in at least one tissue or stress and those with a GO annotation (3387) were further analyzed. Among these, 2447 were found to be upregulated under either salt or drought stress in leaf or root tissue and 940 were found to be downregulated. Overall, the number of DEGs was greater in the leaves (2154) than in the roots demonstrating more transcriptomic changes in leaf tissue compared to root under stress. Salt stress resulted in comparable number of DEGs in leaf and root tissues, while the difference in number of DEGs between the two tissues was more marked in the case of drought stress with root showing less number of drought responsive genes. The response to either stress manifested primarily as upregulation of gene expression in both leaf and root. One of the main commercial uses of *C. zizanioides* cultivation is extraction of the essential oil from roots. Several DEGs in our data were identified as enzymes involved in biosynthesis of essential oil components. The differential expression of these genes under drought and salt stress may affect the *C. zizanioides* essential oil composition. Similarly, several genes involved in the biosynthesis of benzylisoquinoline alkaloids including morphin were found to be differentially expressed in our data.

***Drought and Salt Stress Responses in P. juliflora*:** In this species 6874 genes were found to be differentially expressed at least in one tissue or stress and unique genes with a GO annotation (2932) were further analyzed. Among these, 1339 were found to be upregulated under either salt or drought stress in leaf or root tissue and 1596 were found to be downregulated. Assessing the global transcriptome changes under drought and salt stress resulted in the identification of several genes contributing to stress responses in this species. The study identified stress responsive genes commonly and differently regulated under stress and tissue conditions. A high percentage of genes commonly downregulated by drought and salt stress specifically in root tissue were coding for various ribosomal proteins. The study also indicated a possible role of 'centrins' in stress responses in this species.

Sub Programme Area 302

Bioprospecting

MSSRF in partnership with the National Institute for Research in Tuberculosis (NIRT), Chennai, further screened the identified molecules for their antibacterial (Methicillin-resistant *Staphylococcus aureus* (MRSA), Gram positive and Gram negative) and anti-tuberculosis properties.

302.1 Bioprospecting of Secondary Compounds

***Establishing Lichen Cultures Repositories*:** During this year, the subculturing of the mycobiont and whole thallus cultures of *Graphis caesiella*, *Diorygma junghuhnii*, *Platygramme caesiopruinosa* and *Graphis gracilescens* were carried out.

***Molecular Identity and Confirmation of Lichen Cultures*:** The molecular identities of *G. caesiella* and *P. caesiopruinosa* were established using conserved internal transcribed spacer (ITS) and mitochondrial small subunit (mrSSU) sequences. The mrSSU sequence data of *G. caesiella* and *P. caesiopruinosa* were submitted to National Center for Biotechnology Information (NCBI) with the Accession Nos MH120869 and MF773726, respectively.

***Isolation and Characterization of Secondary Compounds*:** During this year, the structural assignment of compound MSSRF/TE/02 isolated from the mycobiont culture of *Trypthelium eluteriae* was reinvestigated using 2D NMR experiments (^{1}H-^{1}H COSY, HSQC, HMBC and NOESY). Further, the specific rotation and electronic circular dichroism were carried out to determine the absolute configuration of MSSRF/TE/02 along with other isolates, that is, MSSRF/TE/03, MSSRF/TE/05 and MSSRF/TE/09. Results revealed that the MSSRF/TE/05 was identified as 2'R epimer and as the major compound (racemic mixture) and reported for the first time. The extract NNPL1.3, which showed significant activity against *Mycobacterium tuberculosis* H37Rv, was taken to chromatographic separation to identify the active principle present in it. This resulted in the isolation and purification of compound MSSRF/Usp/01. The purity of the MSSRF/Usp/01 was confirmed using HPTLC with suitable mobile phase conditions. The spectroscopic analysis is underway.

***Screening Compounds against Tuberculosis*:** During the past year, it was reported that lichen compounds MSSRF/TE/03 and MSSRF/TE/04 showed significant minimum inhibitory concentration (MIC) at 25 µg/ml against *Staphylococcus aureus*. During this year these compounds were screened against *Vibrio cholera, Salmonella typhi, S. typhimurium, Shigella dysenteriae* and *Klebsiella pneumonia*. The MIC levels were greater than 25 µg/ml for both the compounds against these pathogens.

302.2 Next Generation Sequencing on Selected Lichen Species to Explore the Lichen Inhabiting Fungal Community: Insights into Spatial and Temporal Shifts

A targeted next generation sequencing (NGS) based metagenomics approach provides detailed access to the diversity of the mycobiome within any substrate in distinct environments on earth. The natural lichen thallus hosts a large number of cryptic fungal species. The main objectives of this study were to assess the fungal taxonomic diversity in the natural thallus of *Dermatocarpon miniatum, Umbilicaria hirsute* and *U. pustulata* (summer, autumn and spring season collected samples) using NGS, and to investigate the functional diversity of the species detected. The study of lichen associated fungal communities in *D. miniatum, U. hirsuta* and *U. pustulata* (summer, autumn and spring season collected samples) revealed a total of 179299525 Illumina paired-end sequencing raw reads and converted into 104 OTUs (operational taxonomic units). A taxonomic assignment of OTUs was picked at 90 per cent sequence similarity and an E-value of 0.001. Only 87 out of 104 OTUs could be assigned to their fungal origin using the UNITE and GenBank® database. The remaining OTUs with a total of 79524 sequences had 'no blast hit'. The 87 OTUs included fungi species of Ascomycota (57 per cent), Basidiomycota (20 per cent), Chytridiomycota (1 per cent) and Unidentified (22 per cent). Among the Ascomycota the class of Dothidiomycetes was diverse with the quantity of 33 per cent. Based on overall OTU and taxonomic assignments the long-term spring season lichen samples represented more OTUs compared to long-term autumn and summer season lichen samples: Preliminary results highlight variation in lichen associated fungal community among three different host lichens seasonally at long-term intervals, that is, lichen inhabiting fungal community unique to each host lichen at different seasons. The functional diversity of these cryptic species is underway based on the types of key genes such as polyketide synthases (PKSs) present in them.

Sub Programme Area 303

Microbial Diversity

The microbial diversity investigation of agriculture and mangrove ecosystems resulted in the identification of potential rhizobacteria isolates for plant growth promotion and protection. This sub program focuses on understanding the microbe-mediated biofertilization and bioirrigation in mixed cropping system using pulses and millets in semiarid regions to enhance productivity with reduced use of mineral fertilizers. It also focuses on exploring the diversity of bacteria involved in assessing the *Dimethylsulfoniopropionate* (*DMSP*) bacterial community of the mangrove ecosystem which contributes to sulfur cycle

303.1 Microbial Community Profiling of the Mangrove Ecosystem

***The Dimethylsulfoniopropionate Bacteria Community of Mangrove Rhizosphere*:** Dimethylsulfoniopropionate is a major source of organic sulfur released by marine algae and plants and contributes to the global sulfur cycle. Microbial DMSP catabolism is responsible for liberating the most abundant biogenic sulfur gas, via two enzymatic pathways: demethylation and cleavage

produces methylmercaptopropionate (MMPA), dimethylsulfide (DS) and acrylate respectively. However, studies on the abundance, diversity and biogeography of DMSP degradation genes in mangrove ecosystem remain insufficient. To date, only seven DMSP lyase genes, *dddD*, *dddK*, *dddL*, *dddP*, *dddQ*, *dddY* and *dddW*, involved in the DMSP cleavage pathway have been identified from bacterial isolates. The only gene found to encode the first step in the DMSP demethylation pathway (*dmdA*) is known to be harboured by the *Roseobacter* clade and Gammproteobacteria. Hence, this study aimed to explore the diversity of DMSP lyase gene in mangrove bacterial isolates. The mangrove water and rhizosphere soil samples were collected from different locations of the mangrove ecosystem in Pichavaram, Tamil Nadu, and used for isolating DMSP catabolizing bacteria. The synthetic sea water amended with different substrates such as DMSP, Na-acrylate, DMSO, thiosulfate and methionine was inoculated with 4 per cent (v/v) mangrove water or 10 per cent (w/v) rhizosphere soil of *A. marina* and *Rhizophora mucronata* enriched for 2 weeks and serially diluted up to 10^{-4}, and plated in Minimal broth Davis, YTSS, and incubated at 28˚C for 15 days. A total of 620 bacteria isolates were isolated from six different samples.

303.2 Biofertilization and Bioirrigation for Sustainable Mixed Cropping of Pigeon Pea and Finger Millet

This year the experimental trial focused on understanding the finger millet (FM): pigeon pea (PP) plant density ratio to achieve effective microbe-mediated bioirrigation at Kuttikiraipatti village, Valapur Nadu, Kolli Hills. In each plot FM was grown in rows while polybag raised PP seedlings or directly sown PP seeds were planted in rows (8:2 and 4:1) or in mosaic (planting pattern). The experimental trial consists of 14 treatments as shown in Table 3.1:

The harvest data indicated that biofertilizer treatment showed more grain weight in FM by 25 per cent compared to no biofertilizer treatment. In case of PP, plots with biofertilizer and polybag raised seedling showed significant difference in grain dry weight compared to biofertilizer and direct sown treatment. Overall, this trial indicated that the polybag raised seedlings planted in rows and treated with biofertilizer showed enhanced yield by 20 per cent compared to the rest of the treatments (Figure 3.2).

Table 3.1: ***Treatment details and planting pattern***

PP planting pattern	Treatments	Row	Mosaic
Polybag raised seedlings	With biofertilizer	T1, T2, T3, T4	T5
	RDF without biofertilizer	T6, T7, T8, T9	T10
Direct sown	RDF with biofertilizer	T3 D	T5 D
	RDF without biofertilizer	T8 D	T10D

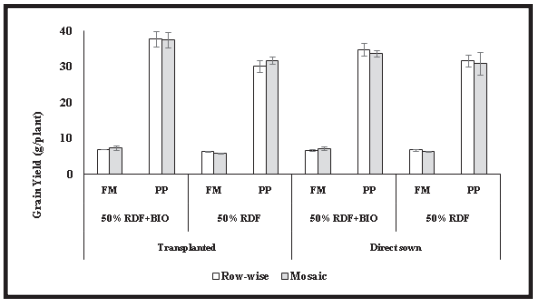


Figure 3.2: Effect of biofertilizer treatment on grain yield in transplanted and direct sown pigeon pea (PP) and finger millet (FM).

303.3 Microbes for Biotic Stress Attenuation

***Antifungal Effect of MSSRFD41 against Pyricularia grisea*:** In dual culture plates, strain MSSRFD41 showed significant inhibition of *P. grisea* TN508 mycelial growth, producing a 22.35 mm zone of inhibition. GC-MS of crude metabolite revealed the presence of 47 different metabolites including potential antifungal compounds 2,4-DAPG derivatives, octasiloxane, pyrrolo, 2,5-piperazinedione, 1,2-benzenedicarboxylic acid, hexadecanoic acid, octadecenoic acid, pyran, propenoic acid and dasycarpidan detected based on the retention time and comparison with NIST database. Scanning Electron Microscopy (SEM) analysis of fungal hyphae when co-cultured with strain MSSRFD41 showed damaged hyphae with rough surface and unusual bulges in the hyphal network while in control plates the hyphal network showed typical net structure with smooth surfaces lacking visible damage.

***Biopriming of Finger Millet Seeds*:** The FM seeds primed with MSSRFD41 showed increased germination (7.44 per cent), vigor index (21.58 per cent), shoot length (9.58 per cent) and root length (11.65 per cent) as compared to control unprimed seeds. Under greenhouse conditions, seedlings treated with strain MSSRFD41 showed increased shoot and root length with differences of 13–26 per cent not only among treatments but also at days after transplanting (DAT) compared to control seedlings. Maximum values for straw fresh weight (8.43 g), straw dry weight (3.53 g), root fresh weight (4.01 g) and root dry weight (2.58 g) were observed in samples of 100 DAT in treated seedlings, which was significantly higher than the values seen in control samples.

***Root Colonization Efficiency of MSSRFD41*:** This *Pseudomonas* sp. MSSRFD41 efficiently colonized the roots of FM plants in treated pots. The 20-day-old roots of treated millet seedlings grown in pots harbored cultivable bacterial population of 9.06 log CFU g^{-1} (King's B medium/KBA) compared to 9.00 log CFU g^{-1} in control. In *Pseudomonas* selective media (KBA+ sodium lauroyl sarcosine/SLT) the population of 4.82 log CFU g^{-1} was detected from treated samples which was slightly higher compared to control soil samples with 4.68 log CFU g^{-1}.

The presence of inoculated MSSRFD41 in the treated pots was confirmed using BOX-PCR profiles and Phospholipid Fatty Acid (PLFA) profiles. No significant differences in CFU of Gram-positive/Gram-negative bacteria, anaerobes, actinomycetes, fungi, eukaryotes, not assigned and total PLFA groups were observed in both control and

treated samples indicating that MSSRFD41 had no adverse impact on the native plant rhizosphere microbial diversity. This paper has been accepted for publication in *Frontiers in Microbiology* (doi:10.3389/fmicb.2018.01029).

303.4 Bioremediation of Distillery Effluent Contaminated Sites Using Bacterial Isolates

In continuation to screening for phenol degrading, heavy metal tolerant bacterial isolates from distillery effluent, *Glutamicibacter nicotianae* MSSRFPD35, was identified as a potential isolate. The Catechol dioxygenase gene involved in phenol degradation metabolic pathway was amplified using specific primers. Catechol 1,2dioxygenase gene was amplified using Primer 3 plus with AC1, 2O F ATCGAAGGCCCTTACTAC AC1,2O R AAGTACAGCTGGGCGGTGA and catechol 2,3dioxygenase was amplified using AC2, 3OFGAGAGCCTGCCTGTGAATAAAC2, 3ORCGCCAATTCTATCCATCATC, which yielded a product size of ~409bp and ~205bp, respectively. Further the phenol degrading enzymes 1,2dioxygenase and 2,3dioxygenase were quantified and confirmed that MSSRFPD 35 uses the *ortho* pathway for degrading the phenol. The identification of these genes will provide the basis for developing inocula for the rapid degradation of phenol and heavy metal contaminated soils.

Programme Area 400

ECOTECHNOLOGY

The center has continued its focus on technologies in sustainable agriculture and natural resource management with an institutional framework to ensure its sustainability. Strengthening Integrated Farming Systems approach at farm level with possible allied enterprises and crops to diversify the sources of income and reduce the risk in production of single crops. The center has been working with around 10400 farmers in fine-tuning the technologies and facilitating access to productive resources and services like input and output markets, credit and institutional linkages through Farmer Producer Organizations (FPO). Efforts have been focusing on improving the governance, financial and legal dimensions of the FPOs. Regular interactions among farmers at the group, cluster and federation level helps them to gain identity and leadership skills. Such intensive interactions help to bring transparency in functioning of the institutions at different levels and reduce the conflicts. Augmenting ground water resources at the supply side and promoting efficient water use technologies on demand side including micro irrigation has been facilitated to ensure access to small-scale irrigation for marginal and small farmers. The use of ICT tools like voice mails, social media, phone in programme, video-conferencing and websites in technology adoption and dissemination has facilitated learning and sharing among farmers. Such processes helped to move towards the framework of knowledge construction and self-directed learning.


SEED PRODUCTION IN
BLACKGRAM
VBN-4
VBN-3

Sub Programme Area 401

Coastal Regions

401.1 Puducherry state

***Puducherry Site*:** Sustainable livelihoods and natural resources management under the broader framework of Biovillages are the focus of the activities in the Puducherry site. The activities in the field have been institutionalized through two grassroots institutions: Innuyir Grama Sangam (IGS) and Pasumai Farmer Producer Company Limited (PAFPCOL). The IGS has been focusing on facilitating various services essential for sustainable livelihoods among its members in off-farm, non-farm sectors, whereas PAFPCOL is working on strengthening on-farm based livelihoods among farmers in the region.

***Innuyir Grama Sangam*:** The IGS has been functioning since 2000–2001 and currently it has 3100 members belonging to 62 hamlets. These members are organized into 286 self-help groups (SHGs). During the reporting period 274 new members joined the federation on seeing the services availed by other members in their villages.

During the reporting period IGS facilitated training and capacity building on different livelihood activities to 2050 members in collaboration with Veterinary College, Puducherry, Krishi Vigyan Kendra (KVK) and National Bank for Agriculture and Rural Development (NABARD), of which 859 members have taken up economic activities such as small-scale dairy, goatry, poultry, Japanese quill, floriculture, fodder cultivation, nursery for vegetable seedlings and so on. During this period, IGS has fine-tuned the production technologies for backyard poultry with an improved breed *Kadaknath* and Japanese quill rearing. IGS has established backward and forward linkages for these new activities by installing hatcheries for chick production, units for feed preparation and demonstration units for training. In addition, considering the prevalent malnutrition issues among women and children among the federation members, IGS organized awareness programmes and promoted 200 nutrition gardens in collaboration with primary health centres. With reference to natural resource management, IGS federation has been instrumental in organizing water awareness campaign with the support of NABARD in 21 villages. They took the lead in preparing resource maps focusing on water bodies and tree cover in the villages. In the process, they have identified the current issues affecting water bodies, available common land to increase the tree cover in the villages and 11 volunteers to take the initiative forward.

In 2013–14 MSSRF and IGS jointly prepared and started implementing a role change plan aimed at organizational sustainability to function independently. Since then considerable progress has been achieved in managerial, organizational, governance rotation and financial dimension sustainability. MSSRF's role is limited to creating new linkages and improving the systems and processes for monitoring the performances.

The total annual turnover of the IGS has increased by 34 per cent from the previous year, mainly due to increased linkages with formal financial institutions which are linked to the repayment performance (99 per cent) of the members as well as collective marketing. To increase the efficiency and transparency in the financial management systems the accounts of the groups are computerized using 'E-shakthi' portal with the help of NABARD. The members receive their account and financial status via their mobile phones each month, which strengthens the confidence and trust they have in the federation. To increase the market services, the federation has expanded its marketing strategies such as opening up of market outlets and linkages with bulk buyers in the urban space with the support of NABARD. The products such as pulses, groundnut, sesame, green leafy vegetables, country chick eggs and chicks, vermicompost, cattle feed including paddy straw, groundnut cake and so on are procured and aggregated at the village level and marketed through IGS. During the past year the business turnover of IGS stood at Rs.7.24 lakhs.

Considering the high population of single women, a socially and economically vulnerable section of the society, in the federation, IGS took a special step of collectivizing them as an exclusive subsidiary organization. A total of 84 single women groups with 1050 members spread over 34 villages in Puducherry are enrolled as members in this subsidiary organization. The main objective is to improve their access to economic opportunities and institutional linkages by harnessing their collective power. It was linked to National Forum for Single Women at the national level.

***Pasumai Farmer Producer Company Limited*:** PAFPCOL has been involved in promoting balanced cropping systems with the integration of legumes to maintain soil fertility and optimally use other natural resources. Legumes such as black gram and moth bean were promoted as a third crop in summer (February–May) following two crops of rice. In addition, small millets such as finger and foxtail millets were reintroduced to bring diversity in the cropping systems. The FPO also promoted the use of quality seeds, seed treatment with biofertilizers, maintaining optimum plant population per unit area and foliar spray of phosphorus at flowering stage as catalytic technologies to improve the productivity of legumes. Along with the technologies, this year it facilitated the use of 800 kg of seeds covering 40 ha, which has resulted in the productivity of black gram and moth bean being around 40 per cent higher than the state average productivity (Table 4.1).

Table 4.1: ***Details of area cultivated and productivity – moth bean and black gram***

Name of the village	Crop	Area of cultivation (ha)	Productivity (kg/ha)
Sorapet	Moth bean	9	1360
	Blackgram	5	1292
Vinayagampet	Moth bean	9	1266
	Blackgram	11	1243
Pillayarkuppam	Blackgram	8	1290

The company has 549 shareholders (F: 470; M: 79) organized into 31 groups in

Mannadipet commune. The main focus during this year was strengthening the leadership and governance systems of the organization. Five exposure visits were organized for the Board of Directors (BODs) to a nearby district to learn how they function and manage the institution. An orientation workshop about the legal aspects of the farmer producer company was organized with the technical support of a chartered accountant and company secretary. The annual turnover of the PAFPCOL during the reporting period was about Rs 7.00 lakhs. Despite continuous handholding with the management team of FPO by MSSRF, the conflicts at the members' level remain a challenge in promoting different services. Issues related to competency of the operating officer in handling the different services of the company for its growth, transparency in financial transactions and members' awareness and ownership of the contribution to the business of the company were seen as challenge areas for improvement while building the institution.

Sub Programme Area 402

Semi-arid Regions

402.1 Kannivadi

***Sustainable Agriculture Technologies*:** Promotion of sustainable agriculture practices especially in pest and disease management was given priority in the region based on the considerable area under vegetable cultivation. Use of biopesticides, biofungicides and plant growth promoting products along with non-pesticide methods were the main focus. So far nine microbe based bioinputs have been produced locally by women group members. During the reporting period attention was focused on upgrading the technology in the production process to meet market demands. In line with this, fine-tuning of production processes of liquid formulation in products such as *Trichoderma*, *Pseudomonas* and *Azospirillium* has been carried out which helped to reduce the production cost (18 per cent) and increase the shelf life of the products (upto 8 months). In addition, production of non-chemical products like *panchakavya*, *amirtha karaisal*, Effective Microorganisms (a consortia of beneficial microbes), plant extracts as pest repellent, viral control and control of weeds were promoted among 56 farmers both at farm scale (36) and commercial scale (20) as an allied enterprise. Capacity-building programmes and demonstrations were organized for 350 farmers on using insect traps and baits for different pests such as rhinoceros beetle in coconut, leaf minor in lablab, fruit flies in cucurbit vegetables and fruit species like guava and mango. In addition, the bioinputs production technology on *Pseudomonas* and *Arbuscular mycorrhizae* was replicated in Kolli Hills and biofertilizers such as *Azosprillum* and *Rhizobium* in Rice Biopark, Myanmar, by extending the technical support in production and designing marketing strategies.

***Promotion of Local Capacity in Plant Health Diagnosis*:** To reduce the dependence of farmers on agri-inputs dealers and agro-advisories, attempts were made this year to promote a cadre of 'plant doctors' to diagnosis

pests and diseases and suggest ecofriendly management practices. A total of 30 men and women farmers were selected and their capacity built in the areas of soil health, diagnostic methods for differentiation of nutrient deficiency, pests and disease infections. The capacity-building programme was organized by adopting mixed methods such as field-level observations, identification methods based on symptoms by comparing with the context, demonstrations and exposure to best practices and technologies through field visits. A total of 320 trainee days were organized for plant doctors. Of the 30 plant doctors, 20 have implemented the learning in their field and 3 have been trained as entrepreneurs in the production and marketing of organic and bioinputs, other than microbial inputs. The trained plant doctors in turn organized village-level plant diagnostics camps and so far 200 farmers have benefitted. The Plant Clinic reduced the use of chemical pesticides, improved the knowledge of farmers on soil and plant health and non-chemical inputs including biological inputs, and enabled the farmers to make informed decisions to improve productivity. This is evident from the increased sale of bioinputs (by 20 per cent during the past season) and non-pesticide based pest control measures in the input centre of the FPO as well as in the improved discussions on WhatsApp groups and Facebook about the use of biological inputs.

Grassroots Institutions

***Kulumai Producers Federation*:** Kulumai SHG Federation, registered under Trust Act in the year 2007, currently has a membership of 255 women and men SHGs (F: 250; M: 5) from 68 hamlets in the Reddiarchatram block of Dindigul district. The federation consists of 3600 members, of which 72 per cent are rural landless agricultural labourers and the rest are small and marginal farmers and other type of labourers. The federation has been facilitating collective action and access to productive resources through multiple services to strengthen the livelihoods of landless rural resource poor women and small and marginal women farmers. It also focuses on extending services in the areas of women's health and nutrition, sanitation and building awareness on women's legal rights.

***Sustainable livelihoods*:** Small-scale dairy farming and bioinputs production were fine-tuned as potential enterprise models for small holding and landless women farmers in the region. In the small-scale dairy farming model, the producers were collectivized into Kulumai Milk Producer Company Ltd (KMPCL) to achieve the scale of economy in accessing input and output services. It was started in January 2016 and currently has 920 shareholders with a share capital of Rs.9.20 lakhs. They were organized into groups at the local level as 132 Joint Liability Groups. The BODs meet once in a month to monitor the physical and financial performance and plan the activities for the coming month. The company is working in close collaboration with the Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) and Department of Animal Husbandry, Government of Tamil Nadu, in building the capacities of the shareholders

in feed management and improving the quality of milk and in disease management. In feed management, importance was given to promote low cost feeds such as azolla, balanced feeding through mix of micro nutrients and maintaining the ratio of green and dry fodder. Apart from this, the company has taken up a dealership for the concentrate feed with the feed mill and so far supplied 150 tonnes of good quality concentrate cattle feed at an affordable cost than the products available in the market. Through this initiative members have reduced their feed cost by 10–15 per cent.

KMPCL has established partnership with ABT Foods Pvt. Ltd. for milk procurement. It opened up 20 milk collection centres, which are managed by the women's group for collection from farmers at their doorsteps, testing the quality and uploading the milk to the company. During this period the average procurement by KMPCL was 3600 litres per day amounting to Rs. 97200 per day. The price fixed by the collection centre is based on the quality and on an average the members are realizing 26 per cent higher price per litre of milk. In case of credit access, the members were linked to banks to access the farm credit and during this year 252 members have availed credit to the tune of Rs 1.34 crores. At an outcome level the company has achieved an annual turnover of Rs 42.57 lakhs through various initiatives.

The model on bioinputs production units undertaken by women's groups have been producing bioinputs such as *Azospirillium*, Phosphobacteria, Potash mobilizing bacteria, *Arbuscular mychorhizae, Trichoderma viride, Pseudomonas fluorescens, Beauveria bassiana, Paeciliomyces lilacinus* and *Bacillus subtilis.* During this year they have produced 35 tonnes of bioinputs valued at Rs 25.00 lakhs (Table 4.2). It generated 2100 employment days through production and marketing. Capacity-building programmes were organized for 600 farmers on integrated crop management by application of organic and bioinputs in partnership with Department of Agriculture, Dindigul. Due to the consistent efforts of SHG

Table 4.2: ***Details of bioinputs production and marketing for 2017–18***

S.No	Bioinputs	Quantity produced and marketed (tonnes)	Sale value (in lakhs of Rs)
1	*Azospirillum*	5.2	2.00
2	Phosphobacteria	5.4	2.20
3	Potash mobilizing bacteria	4.5	1.80
4	*Arbuscular mychorhizae*	2.0	1.20
5	*Trichoderma viride*	5.1	4.20
6	*Pseudomonas fluorescens*	4.4	4.00
7	*Bacillus subtilis*	4.2	3.40
8	*Paeciliomyces lilacinus*	3.8	3.00
9	*Beauveria bassiana*	3.5	3.20
	Total	**38.1**	**25.00**

members and training, demonstrations and field-level approach, 3000 farmers (30 per cent women) have been regularly applying bioinputs for their crops in this region.

The role change process between MSSRF and Kulumai Federation continued with a focus on strengthening the governance at the organizational level. The federation concentrated on cluster development, which helped to ensure the active participation of the groups in the management of the federation. The operational issues relevant to planning for credit linkages, training for livelihood development and conflict resolution have been taken up at the cluster level which helps the executive committee work more on the strategic level of the federation.

As NABARD has recognized the federation as its implementing agency, during this year it sanctioned a project to promote sustainable livelihood under Area Development Programme at Reddiarchatram Block of Dindigul district. Under this project, the 320 members were trained in livelihood related activities and facilitated for credit support for an amount of Rs 1.35 crores to initiate or strengthen livelihoods such as dairy, goat rearing, small-scale vegetable or flower cultivation, agriculture and country chick rearing. In addition to this, under the community banking programme, Kulumai federation provided credit support to 216 members totaling an amount of Rs 54.00 lakhs.

***Reddiarchatram Sustainable Agriculture Producers' Company Ltd*:** The current shareholder strength of Reddiarchatram Sustainable Agriculture Producers' Company Ltd (RESAPCOL) is 1125 (M: 698; F: 427). It realized a turnover of Rs 9.75 lakhs, of which 65 per cent is from the sale of seeds and 35 per cent from the sale of bioinputs. Ten capacity-building programmes on financial literacy and dairy farming were organized for 350 men and women farmers. Of this 87 farmers (M: 35; F: 52) were linked and a total sum of Rs 39.15 lakhs mobilized.

The company has built its capacity in facilitating the farmer-to-farmer learning by adopting strategies such as mobile based voice mails, websites, video based learning and social media including Facebook and WhatsApp. During this year, it generated 467 contents on agriculture (294), animal husbandry (77) and corporate literacy on producer organization management (96) and disseminated to 591 farmers (M: 409; F: 182) shareholders through voicemails. In addition, 294 agriculture and veterinary based contents were shared with IFFCO Kishan Sanchar Limited for propagation via the IFFCO-Airtel network. With reference to web based learning, it is running a website (www.l3ftn.com) for the Life Long Learning Farmers in Tamil Nadu to provide locale specific weather and market information and also technical details for crop cultivation. About 26 video clips on agricultural practices and experiences of farmers were uploaded on YouTube. Moreover, 187 postings on modern agri-techniques and success stories of the farmers were uploaded on Facebook and liked by 87257 users, and around 24255 friends mutually shared these information. In addition, they were part of the team

involved in developing L3F pedia, a learning resource portal promoted by Commonwealth of Learning. During the year they converted the contents of 50 different agriculture and allied activities based contents as Open Educational Resources, which is freely accessible, openly licensed documents useful for learning, teaching and research purposes. RESAPCOL is now applied for the licensing for the common creative resources.

402.2 Pudukottai District

***Land and Water Management*:** This year 2016–17 saw the successful implementation of the water augmentation project supported by Hindustan Petroleum Corporation Limited (HPCL) and reviewed by the HPCL CSR team which appreciated the implementation process and outcomes of the interventions. It resulted in the approval of the next phase to support another 34 small holding farmers to renovate their open wells. In addition, the programme aims to construct the groundwater recharge structure to collect runoff water around all the open wells and emphasize the construction of toilets at the homes of benefitting farmers as part of the *Swachh Bharath Abhiyan*. The process of selection of beneficiary farmers and open wells, documentation and getting proper clearances from local bodies was completed. It is expected that this programme will increase the water holding capacity by 4200 sq meter, and support irrigation for 120 acres.

***Sustainable Farming Systems*:** The focus was on building integrated farms combining pulses, paddy, vegetables and other horticulture plantations along with small-scale dairy. The water augmentation works were kept as the base for the integrated farming model, which became the hope for the farmers in coping with the sixth consecutive year of drought in this region. To strengthen the promotion of integrated farming, a demonstration plot was established in a 0.5-acre plot within the farmer producer company field with paddy, pulses, vegetables, green fodder, dairy and poultry with country chicken. This integrated farm is emerging as a resource centre in the local area for seeds and other organic inputs. To supplement this, locally relevant contents on different technologies were developed based on the need and disseminated through 7371 voice mails to farmers. A total of 50 such farmers and farms were identified as the initial step in adopting multiple crops and horticulture planting and 36 farms covering 117.2 acres have stepped towards the integrated farming system model. A few key technological practices adopted in the integrated farms include a system of rice intensification in paddy, line sowing in pulses, seed treatment with biofertilizers, trap crops and use of organic inputs for all the crops.

Along with the promotion of integrated farm models, improved technological and organic cultivation practices were promoted among other farmers in 62 acres of paddy and 127 acres of pulses. Though the results were encouraging, the behaviour in adopting organic cultivation practices such as pest control mechanisms needs further facilitation. To ensure the constant red gram production, the perennial variety 'Richa 2000', which performed well in this region, was sourced and

distributed among 250 farmers. The farmers continued the small-scale vegetable cultivation under organic methods (10–20 cents), but due to water distress the level of adoption fell to 47 farmers when compared 136 farmers in the previous year. Though the farmers realized an average income of Rs 25,000 from the 10 cents in four months, water distress forced many to reduce the area under cultivation and discontinue cultivation.

Facilitation of access to farm machinery such as pulses seed drills, solar power sprayer, mechanical weeders, SRI transplanting machine and so on was continued at the village level through agriculture service centres (ASCs). Emphasis was laid on strengthening the institutional process in extending the services to all small farmers. The ASCs aimed to make the farm services available at the farmers' doorsteps, serving on technology transfer, providing farm implements and bioinputs, finally market information leading to fair price realization for the farm produces. During the reporting period, 436 small farmers accessed the centre and used the machinery.

***Grassroots Institution and Sustainable Livelihoods*:** MSSRF is facilitating the Farmer Producer Organization (FPO) named Illuppur Agriculture Producer Company Limited (IAPCL) consisting of 1000 shareholders (F: 773; M: 227). Participatory decision-making and implementation process, transparency and accountability are the key elements in the functioning of the IAPCL. Every activity was planned in the monthly board meeting. In addition, four special meetings were conducted to speed up the process of implementation. All the planned activities were executed through the 71 village-level farmer producer groups (FPGs), which also meet once every month. In total 616 such monthly meetings were conducted, which enabled the IAPCL to be more participatory and to take up true bottom-up decision-making process. Further, specific subcommittees – institution-building committee, water augmentation committee, input and credit committee and enterprises committee – were placed for monitoring each and every component of the implementation process.

To diversify the income of small holding farmers, IAPCL is supporting four social enterprises, namely, pulses, paddy, dairy and poultry, by extending input and output services that adopt the value chain approach. It is marketing its products – dal, rice, milk and chicken – under the brand name of 'Patikaadu'. The company is building facilities such as centres for processing of pulses and paddy, seeds and hatchery for poultry along with other bioinputs. During this year, 14 tonnes of different pulses were value added and marketed which helped broaden the market links. As a result of the progress this year, the Tamil Nadu Small Farmers Agri Business Consortium has approved a full-fledged dal processing facility worth Rs 33.00 lakhs, with a capacity of 4 tonnes per day. In addition, it has approved seed processing machinery and a godown with the capacity of 5 tonnes per day worth Rs 60.00 lakhs. These facilities are supporting the company in the process of upscaling the interventions in the region and

strengthening the role of farmers in the value chain processes.

In case of paddy, during the past year 231 tonnes of paddy were procured by the company by adopting fair trade practices such as correct weight and doorstep procurement, which provided a minimum of 5 per cent additional income to farmers. The company is aiming to develop a niche market by selling organic paddy and paddy variety with low glycemic index. To start with, 7 tonnes of organic paddy were procured and kept for processing, a gestation period of at least a year, to fetch a good price.

***Small-Scale Dairy*:** To diversify the income of farmers, the integration of small-scale diary in the farming systems was strengthened by interventions at input and output market level. At the input level, 7 animal health care camps, with the participation of 264 farmers, were organized to improve the health management practices. At the output market level, milk from 286 farmers was aggregated through 11 collection points and a total of 1.13 lakh litres of milk were procured and marketed collectively by FPO. The strategy continued to focus on local sales instead of bulk vendors which brought in an average higher price of Rs 31 per litre as compared to the vendor procurement price of Rs 25 per litre.

***Poultry*:** Poultry units rearing country chicken are now handled by 16 small holding farmers in place of the previous 9. They produced 1.04 tonnes of live chicken, which were procured and marketed. IAPCL is considering country chicken egg as a good product line to be taken up in the future along with live chicken. In the process of establishing mother hatchery units, it recently set up a unit with a capacity of producing 600 eggs and constructed a shed with the space of 400 sq feet.

IAPCL achieved Rs 99.69 lakhs of cumulative sales turnover through its enterprises – Rs 14.19 lakhs in pulses and bioinputs, Rs 50.08 lakhs in paddy, Rs 32.79 lakhs in milk and Rs 2.63 lakhs in poultry. Out of all the efforts, IAPCL gained Rs 5.37 lakhs of net profit in the financial year 2017–18. To support its critical cultivation expenses, MSSRF provided a loan of Rs 21.03 lakhs to IAPCL for its pulses and paddy crops operations.

Partnerships have been continued with Tamil Nadu Small Farmers Consortium (TNSFAC), Department of Agribusiness, Government of India, National Pulses Research Centre, Vamban, Kalanjiam Thozhilagam Limited, Pudukottai, Vijay Dairy and Foods, Pudukottai, 22 organic outlets across Tamil Nadu, 6 bulk processors and traders for technical and business supports. About 18 training sessions were conducted for the progressive farmers, FPG leaders and BODs of FPOs on various topics such as agriculture production techniques, FPO management, value addition and marketing and so on. In total 799 farmers (F: 468; M: 331) have benefited from these sessions. It also organized 4 exposure visits and sent farmers to Coimbatore, New Delhi, Aududurai and Dindigul to learn about various topics such as expos, dal mills and poultry units. A total of 48 lead farmers (F: 21; M: 27) benefited out of these visits. Moreover,

284 representatives belonging to 28 FPOs from various part of Tamil Nadu, Karnataka and Kerala witnessed the IAPCL activities at Illuppur for exposure to FPO activities. A residential training course for CEOs of FPOs on financial management of FPOs was conducted; it was very well received by the participants and FPOs and has good scope for development into a full-length training programme for CEOs of FPOs.

402.3 Villupuram District

***Augmentation and Efficient Use of Groundwater*:** Renovation of open wells linked with suitable ground water recharge units were promoted as a strategy to ensure access to small-scale irrigation among small holders. During the reporting period efforts have been taken to renovate 60 open wells, of which work has been started in 54. The farmers' organization adopted the revolving fund concept to implement the project. During this year, apart from recharging technology for augmentation, technologies such as drip, rain-gun and sprinkler methods were introduced to improve water use efficiency. An exposure visit was organized for leaders of the farmers' association to visit the farms which use the technology along with an interaction with service providers. It helped the farmers to take informed decisions to invest in the asset so that available water can be used efficiently and more area under cultivation can be ensured. So far, 25 farmers have taken steps to install the facility in the field for crops like vegetables and flowers which provide them with regular income.

Sustainable Farming System**:** Efforts have been on to improve the productivity and production of pulses. The use of quality seeds and suitable variety was adopted in 625 acres under black gram by 580 farmers. Foliar nutrients were introduced at the flowering stage as a key technology to increase productivity. In order to promote its adoption, participatory technology testing was carried out for both black gram and groundnut. The farmers evaluated this technology with different products in the market and the use of pulse wonder and groundnut rich was found to result in 15–20 per cent higher yield than the rest of the products including 2 per cent di ammonium phosphate (DAP), panchakavya and criyagen spray. As a result of the participatory evaluation, nearly 600 farmers adopted this technology in the second season. About 31 farmers have been involved in seed production of VBN 4 in black gram and moth bean seed, and during this year they produced 5 tonnes of black gram and 2 tonnes of moth bean. It was procured by the company and stored under safe conditions to be sold in the coming season.

***Grassroots Institution and Sustainable Livelihoods*:** Nallavur Farmer Producer Company Limited (NAFPCL) played a key role in facilitating input and output market services, access to credit support apart from extending necessary technological advisories (Table 4.3).

In addition, it facilitated linkage between women farmers and Department of Agriculture, Government of Tamil Nadu, through Farmers

Table 4.3: ***The services promoted by the NAFPCL and their benefits***

Services	Outputs	Benefits
Inputs: fertilizers and pesticides	5 tonnes of black gram VBN 4 seeds and 2tonnes of groundnut seeds produced by farmers	Ensuring use of quality seeds in the next season and seed production is established as an enterprise
Inputs: seeds	369 men and 48 women worth of Rs 5.37 lakhs	Increased the productivity of black gram and moth bean to 28 and 32 percent from farmers' practice
Financial services	Facilitated to provideKisan credit card to 258 farmers (M: 21; F: 237) who received the card and availed the credit worth of Rs 36.48 lakhs	The credit access supported to cultivate groundnut in 203 acres, black gram in 28 acres in kharifseason and black gram in 387 acres, moth bean in 46 acres and groundnut in 289 acres in rabiseason
Market services	The collective promoted bulk procurement by aggregating grains and attempted delayed market approach; apart from this they were engaged in value addition of groundnut into wooden pressed oil and split dal in blackgram	Marketed 11 tonnes of black gram and 2tonnes of paddy by ensuring market price, correct weighment and timely payment

Integrated Hand Book (FIHB) '*Vivasayigalin Orunginaintha Kaiyedu*' in women farmers' name for 200 members. The FIHB, valid for three years, is mandatory to get entitlements and technical assistance from the Department of Agriculture. It is introduced with an objective of promoting farm-specific crop plans based on soil test results and providing recommendations on crop-specific inputs as well as to appraise farmers on different schemes. This is the first time that women farmers without land title deed are accessing the government schemes through this card. The intervention has been started in Mailam block on improved farming practices in pulses under the demonstration module of the National Food Security Mission Scheme. During the past season, 200 farmer accessed inputs for pulses cultivation worth Rs 14.85 lakhs. Through these services the company achieved a business turnover of Rs 86.60 lakhs.

In order to strengthen the governance of the producer company, BODs meeting has been regularly conducted, and it has been observed that nearly 90 per cent of the members participated in the discussions. To regularize systems and procedure of the FPG 56 special meetings were organized for discussing various issues such as conceptual clarity on group functioning, ensuring regular recovery, linkage with various institutions and dovetailing

schemes from the government and other institutions. The general body (GB) meeting was organized in the month of September 2017 where 811 shareholders participated. The BODs were selected by the GB for two years and other resolutions were made in this meeting. Important decisions, such as changing the name of the FPO, increasing shareholders' and share amount, availing equity grant, expanding the business activities and value addition, were taken.

Recently, the company has been involved in the facilitation of greens cultivation in an organic method in partnership with *Nallakeerai* for the technical and marketing services. A total of 30 farmers have expressed their willingness to get involved in the production and have participated in the training as well as subsequent planning meetings. Therefore, the company is making an agreement with NAFPCL for extending technical and market buy back services. Under this scheme, farmers cultivate 42 different kinds of greens in 25 cents of land to get assured and continuous income throughout the year.

Programme Area 500

FOOD SECURITY

Policy advocacy on the concept of Farming System for Nutrition (FSN), among different stakeholders, across four states of India – Andhra Pradesh, Bihar, Odisha and Maharashtra – has been the major focus of the Food Security programme area during the reporting period. Twelve Krishi Vigyan Kendras (KVKs) from across Maharashtra and Gujarat participated in a workshop to set up FSN demonstration models in their premises with the technical partnership of MSSRF. Women farmers of Mahila Kisan Sashaktikaran Pariyojana in Maharashtra have been capacitated to manage their block level federations in a sustainable manner.


सामुहिक सुविधा
पालोती, ता. जि.वर्धा


Workshop on
FARMING SYSTEM FOR NUTRITION
A Pathway for Addressing Malnutrition in India
For District Level Officials, Bihar
at
BAMETI, Patna
16th – 18th November 2017
Organized by
M.S.Swaminathan Research Foundation, Chennai
Jointly with
Bihar Agricultural Management & Extension Training Institute (BAMETI), Patna, BIHAR

Sub Programme Area 501

Advocacy

Farming System for Nutrition: A Pathway for Addressing Malnutrition in India

MSSRF promotes the Farming System for Nutrition (FSN) as one of the approaches to tackle household food and nutrition insecurity in rural India. The concept of FSN is a sustainable framework of farming, based on nutrition-sensitive agriculture. FSN is a farmer-led strategy mainstreaming the nutrition dimension in agriculture, conceptualized by Professor M. S. Swaminathan. In the Indian context, where a significant section of the population is malnourished and dependent on agriculture, a pathway for addressing food and nutrition security by leveraging agriculture necessarily has great potential.

The objective of this advocacy project is to disseminate the FSN concept across different stakeholders and provide policy recommendations for strengthening agriculture-nutrition linkages in four selected states, namely, Andhra Pradesh, Bihar, Maharashtra and Odisha. The process adopted in advocating the concept of FSN were twofold: first, analysis of relevant secondary data and agriculture policies pertaining to the target states; and second, a series of consultations/ roundtable discussions/workshops/meetings held with different stakeholders (government officials, subject experts, farmers, civil society organizations, etc.) at different levels across the four states. The purpose of the policy analysis as also the stakeholder consultations were to identify the scope available for strengthening agriculture-nutrition linkages in the respective states.

***Consultations*:** As a first step efforts were taken to meet senior government officials (in the rank of Principal Secretary and above) from the departments of agriculture and allied sectors, across all the four states, to impress on them the need for promoting FSN approach in their state. In all the four states senior officials were extremely supportive and provided necessary facilitation for conducting FSN orientation workshops for district and state officials. In addition to the rapport established with government officials, meeting up with scientists who were engaged in developing or promoting nutrition-sensitive agricultural initiatives were taken up. Scientists from national research institutes and agricultural universities across all the four states were consulted on the scope for promoting FSN. Non-governmental organizations who are promoting various initiatives to strengthen agriculture-nutrition linkages were identified and discussions held with them as part of the consultation process.

***Orientation Workshops*:** Workshops were conducted to provide an orientation on the concept of FSN to government officials, NGO workers and scientists. Across the four target states, workshops with district-level officials – representing the departments of agriculture, animal husbandry, horticulture, fisheries, women and child development – were conducted. The orientation workshops

focused on discussing the concept of FSN; the need and scope for FSN through an analytical presentation of the status of nutrition and agriculture in the state; and through group discussions elicited the participants' views on the ongoing practices, constraints and support system required to practice FSN.

In Maharashtra and Bihar, higher officials presided over the workshop. Dr K. M. Nagargoje, IAS (Member Secretary, Maharashtra Council of Agricultural Education & Research), in Pune and Mr Sunil Kumar Singh, IAS (Agriculture Production Commissioner, Government of Bihar), in Patna presided over the workshop and addressed the participants.

Important discussion points that emerged during the consultations are listed below:

- The concept of FSN was well received by the district-level officials and they noted that they had opportunities within the existing system to incorporate the principle of FSN in various ways, particularly in schemes such as ATMA, RKVY and so on.
- Majority of the participants said they did not have much knowledge either about crop bio-fortification or about the bio-fortified varieties suitable for their states and that the consultation had helped them gain knowledge about these aspects. The knowledge gap or disconnect that is prevalent in the system between scientists and field-level functionaries came out sharply in the consultations.
- Participants also pointed out that unless differential pricing is adopted for bio-fortified crops, farmers will not have an incentive to grow them. This was particularly pointed out in the context of Quality Protein Maize.
- Constraints facing agriculture in general are also true for farming system for nutrition. For instance,
    - Participants pointed out the need to strengthen the extension system in order to create awareness among farmers on the FSN concept and provide support for adoption of FSN.
    - The support structure required to supply timely availability of quality inputs, say, seeds in the crop sector as also for livestock and fisheries development, were emphasized.
- Important state-level initiatives that focus on enhancing food and nutrition security through agricultural interventions were identified during the consultations and some of these initiatives are listed below:
    - Fodder scheme implemented in Anantapur district of Andhra Pradesh,
    - zero-budget natural farming in Andhra Pradesh,
    - generating advances in income and nutrition through orange flesh sweet potato (part of RKVY) in Odisha, and
    - school kitchen gardens promoted by Department of Education, Government of Bihar, in collaboration with agricultural university and UNICEF in Bihar.

These consultations were held across the four target states with the support of the National

Institute of Rural Development and Panchayati Raj (NIRD) with whom MSSRF had entered into a Memorandum of Understanding.

***Technical Guidance*:** Specific requests were received by MSSRF from Maharashtra Council of Agricultural Education and Research and ICAR-Agricultural Technology Application Research Institute, Pune, to provide technical guidance to implement FSN in Maharashtra. MSSRF conducted a one-day orientation workshop for scientists working in the Krishi Vigyan Kendras (KVKs) on the concept of FSN and its importance for the state of Maharashtra. As part of the orientation workshop, the scientists were facilitated to develop appropriate FSN designs that could be demonstrated in the KVK premises for wider reach of the FSN concept among farmers.

Agriculture-Nutrition Policy Landscape Analysis

A desk review of government policies (central and state) that foster nutrition-sensitive agriculture was undertaken for four states in India – Andhra Pradesh, Bihar, Maharashtra and Odisha. The focus was on analyzing the policies that enhance the availability of nutrition-rich foods in rural households and markets. The analysis framework recognized seven distinct domains of farming system for nutrition – four direct or core domains and three enabling or non-core domains. At its core, the approach calls for improving agricultural production diversity by incorporating an integrated farming system involving crops, livestock and aquaculture in the field or in the homestead. Other core domains that can directly improve the local availability of deficient nutrients include agricultural production, bio-fortification and agricultural value chains. Indirect or non-core domains that supplement the food related processes include nutrition-education, women's empowerment and natural resource management (Figure 5.1). The policy analysis focused on both the policy agenda setting and the policy adoption stages of the policymaking process.

The policy analysis brought out the scope available within the existing policy regime to mainstream nutrition in agricultural policies across the four states.

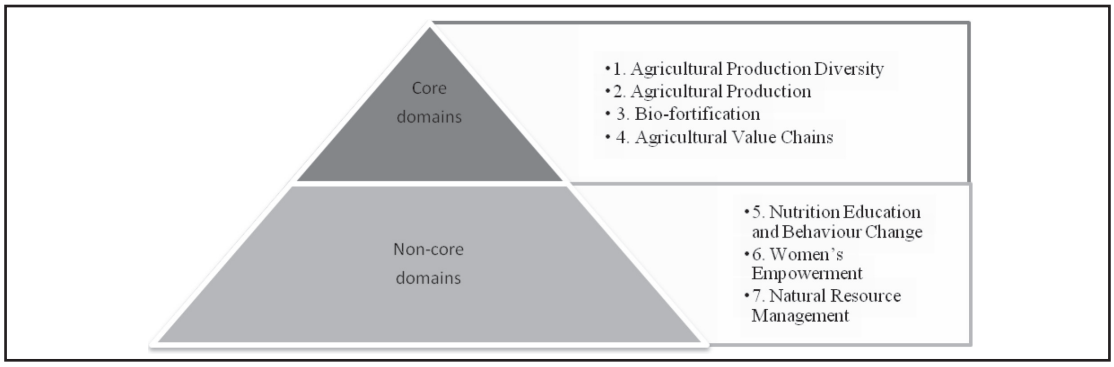


Figure 5.1: Domains of Farming System for Nutrition (FSN).

Major Outputs

The following were the major outputs during the reporting period:

- Four consultations were held to capacitate district-level officials working in agriculture, horticulture, animal husbandry and fishery on the concept of FSN and also to discuss the need and scope for FSN in each of the target states. Each consultation spanned over two to three days. A total of 272 officials attended the consultations and have been capacitated on the concept of FSN – 20 participants from 13 districts in Andhra Pradesh, 97 participants from 37 districts in Bihar, 43 participants from 19 districts in Odisha, and 102 participants from 31 districts in Maharashtra.
- Orientation workshops were held for 30 officials and agricultural extension scientists from the four agriculture universities and KVKs in Maharashtra in partnership with Maharashtra Council of Agricultural Education & Research. In partnership with ICAR-Agricultural Technology Application Research Institute, Pune, technical guidance was provided to 10 KVKs in Maharashtra and 2 in Gujarat for setting up FSN demonstration models in their premises to promote the FSN approach among farmers. Twenty-five scientists participated in the technical orientation session on FSN.
- State-level Policy Advocacy meetings have been conducted for the states of Odisha and Andhra Pradesh. The meeting for

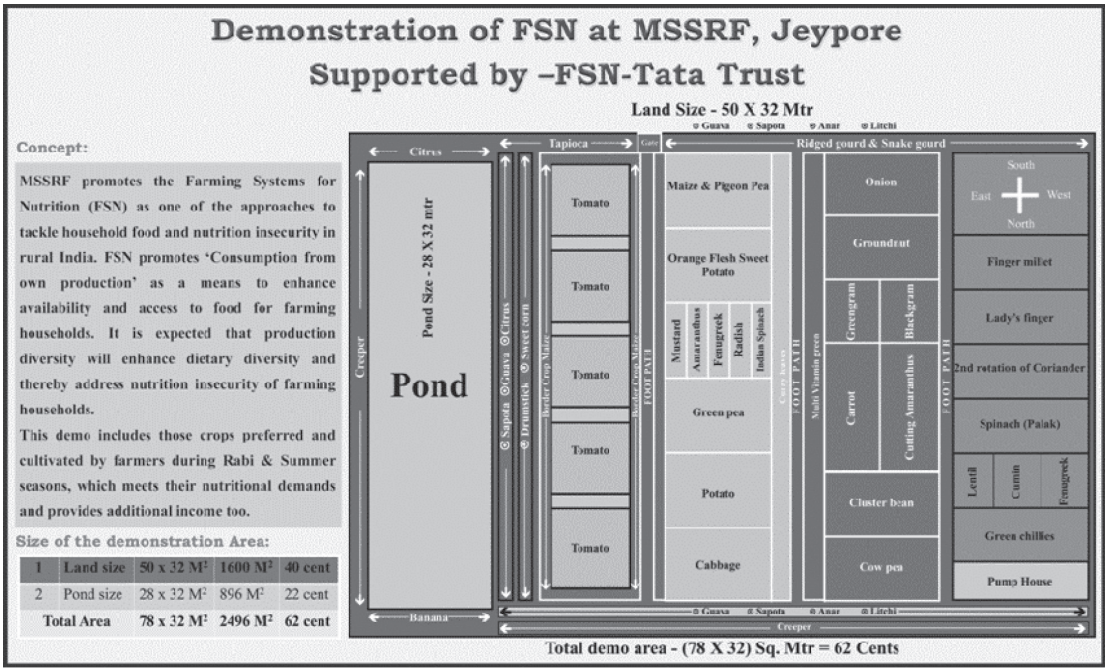


Figure 5.2: Layout of FSN demo plot on campus of MSSRF Regional Centre, Jeypore.

Odisha was held under the chairmanship of Mr R Balakrishnan, IAS (Development Commissioner cum Additional Chief Secretary, Planning & Convergence Department, Government of Odisha), and the meeting in Andhra Pradesh was chaired by Mr B. Rajasekhar (Special Chief Secretary, Agriculture and Cooperation, Government of Andhra Pradesh).

- The second meeting of the Technical Advisory Committee of the project was held in January 2018.
- FSN was the theme of a consultation organized in August around the Foundation Day and resulted in the Chennai Action Plan for a Nutrition Revolution.
- A demo plot exhibiting the FSN design (Figure 5.2) was developed in the MSSRF campus at Koraput, Odisha, during rabi 2017. Till May 2018, 113 farmers from different villages have come on exposure visits to the demo plot and received training on the FSN concept.

Sub Programme Area 502

Community-Based Interventions

502.1 Maharashtra

Mahila Kisan Sashaktikaran Pariyojana

The Mahila Kisan Sashaktikaran Pariyojana (MKSP) in Maharashtra was brought to a formal closure in November 2017, with the end of the project term. The main focus of the MKSP, during the reporting period, was to undertake measures to strengthen the sustainability of the programme. In the implementation process of MKSP some strategies have been in-built to address sustainability. Some of the strategies are: (a) Presence of women farmers' groups at the village level; (b) identification and deployment of community resource persons (CRPs) in each village; (c) setting up of management committees for Common Facility Centres (CFCs) or farm implements hiring centres; and (d) formation of federations of women farmers' groups at the block level comprising of all such groups. Some of the major activities undertaken in line with the above during the year were:

- The 215 women farmers' groups, comprising of 3265 women farmers across the 60 villages, were provided refresher training on effective management of groups as well as on bookkeeping and fund management.
- During the project period, 100 highly motivated and progressive women farmers were identified as CRPs and trained intensively to become trainers. They interact with women farmers in their villages on a regular basis, clarify doubts and provide necessary training and facilitation for adoption of good agricultural practices and other measures that enhance the availability of food grains, vegetables and fruits at the household level. During April–November 2017, several motivational sessions were held with the CRPs focusing on the inspirational role they can continue to play among fellow farmers.

- Refresher training sessions on organizational management were held for all the members of the management committees of the 13 CFCs that were promoted across 13 villages during the project term.
- The office bearers of the three block-level federations continued to receive systematic trainings on various aspects of institutional management including general management, credit, bookkeeping and conflict resolution.

Major Results

Women farmers trained under MKSP, by their own reckoning, now feel much more self-confident and empowered than prior to their participation in the programme. They are experiencing the strength and energy that comes from being a part of a larger group, which makes them demand and discuss issues with officials on an equal footing. With enhanced self-confidence, self-esteem and self-worth, women farmers have started attaching great importance to addressing issues they confront on a day-to-day basis. To cite some instances:

- Federations have been taking up local issues and submitting memorandums to appropriate offices. For instance, memorandums were given on a wide range of issues, such as requesting for a change of timing of Gram Sabha that is suitable for women to participate; on the non-functioning of public health centres; representation for rebuilding damaged bridges; regarding construction of toilets in villages; request for bus services to remote villages.
- Each federation is managing a revolving fund (to the tune of Rs 3 lakhs) and loans have been extended to members for the following purposes: (a) cultivation expenses; (b) production and sale of bio-inputs for agriculture; (c) leasing in of land for cultivation; and (d) medical emergencies for those categorized as the 'poorest of the poor'.
- Women farmers actively participate in Gram Sabhas and raise pertinent village specific socioeconomic issues related to drinking water, toilets, bus transportation, brewing of liquor, domestic violence, employment under MGNREGS and Aadhaar card.
- Women farmers' groups across 27 villages have been taking the initiative to stop the production of illicit liquor as well as sale of any liquor in their villages. Though the success rate of all the efforts taken by the groups is very limited, the entire process is indicative of their ability to take up and fight for a larger, social issue.
- Challenging domestic violence against women is also being done by the women farmers.
- In the local body election conducted in March 2014, 3 women farmers were elected as Sarpanchs, while 25 member were elected as members of Gram Panchayats.
- Maharashtra State Rural Livelihood Mission (MSRLM) has identified 28 women farmers

as resource persons to train farmers across different parts of Vidarbha.

The results of the sustainable agricultural practices in which the women farmers were trained are very encouraging. A baseline survey was conducted in the year 2012 for a sample of 220 women farmers to assess the levels of awareness and adoption of selected agricultural practices in any of the three years before the survey. A comparison of adoption of these agricultural practices by women farmers during the three-year base period of 2009–11 and during 2016–17 indicates significant increase in adoption of many of the recommended practices:

- Sowing across the slope adopted by only 5 per cent of the women farmers in the base period has increased to 72 per cent
- Soil test was undertaken by 32 per cent and it has increased to 71 per cent
- Seed treatment practice has increased from 5 per cent to 68 per cent
- Bio-fertilizer application has increased from 25 per cent to 54 per cent
- Bio-pesticide and botanical extract use has increased from 29 per cent to 58 per cent

Moreover, 60 women farmers across the 60 villages have set up seed banks in their homes, essentially to conserve indigenous seed varieties of bajra, sorghum, maize and vegetables.

Two key interventions that aimed at enhancing household food security were promotion of a mixed cropping system (with additional varieties of pulses, oils seeds, minor millets and vegetables in the conventional cotton/ soyabean and pigeon pea cropping system) and of nutrition gardens of fruits and vegetables.

- Nearly three-fourths of the women farmers who received training in mixed cropping system, that is, 2144 farmers, reported adoption of this practice; this has ensured production and household availability of pulses such as green gram, black gram, cow pea, lentil and sesame in addition to the pigeon pea that is conventionally grown.
- Of 3265 women farmer households, 2017 (about 62 per cent) have nutrition gardens, ensuring access to pesticide-free, fresh vegetables and fruits for consumption. In addition, 76 community nutrition gardens (CNGs) were developed in 52 villages. The CNGs also contributed to the mid-day meals in the schools whenever there was a surplus over and above the household requirements of CNG members.

502.2 Odisha

Community Grain Bank

Community grain banks (CGBs) have been set up at various time points during 2002–10 across different hamlets in the Koraput district of Odisha. An important development during the reporting period was the withdrawal of support by MSSRF in the management of CGBs. Each of the 17 CGBs that were functioning during this period was managed by a committee of village representatives. Members of the CGB

management committees were provided refresher training on bookkeeping and other aspects of grain bank management during the reporting period. The 17 CGBs catered to a total of 664 households, in 2017–18, and nearly 50 per cent of these households had taken grain loans during the year. The managing committees of all the CGBs are well capacitated to facilitate the continuous smooth functioning of the CGBs.

Sub Programme Area 503

Mahila Kisan Sashaktikaran Pariyojana – Koraput, Odisha

The overall goal of the MKSP is improving the socioeconomic status of Mahila Kisans by promoting sustainable agriculture practices, sustainable livelihood activities and converging villages with the entitlement schemes. The objective of the MKSP programme in the Koraput region is the empowerment of the women farmers by organizing them into groups and building their capacities for better livelihood, improvement in food and nutrition security and improvement in knowledge and skill for better status in the society. During the reporting year the following actions were taken up in the project

***Promotion of Kitchen Garden for Household Food and Nutritional Security*:** Structured Annadata model kitchen gardens and homestead gardens were promoted for household food and nutritional security. The Annadata model has a specific layout design of three different sizes such as 5, 10 and 20 cents, which were developed and implemented based on the availability of land and water resources. It includes leafy vegetables, tuber crops, pulses, cucurbits, fruits, crucifers, perennials and spices. About 1258 homestead kitchen gardens, including 258 units Annadata model nutritional gardens, were maintained by Mahila Kisans at the individual household level. About 852 Mahila Kisans processed and preserved different kinds of vegetable seeds for the next season and reduced seed dependency.

***Promotion of Sustainable Agriculture Practices for Crop Yield Enhancement and Crop Protection Measures*:** The sustainable agriculture practices concentrated more on botanicals preparation from available plant species and promotion of bio-fertilizer and organic manure for yield enhancement. The Mahila Kisans were trained in this aspect and disseminated this knowledge through village-level CRPs and Para Professionals. They were also trained on preparation and application of botanicals, enriched FYM and IPM practices. About 384 households of Mahila Kisans practiced sustainable agriculture practices in paddy, millets and vegetable cultivation in 242 acres of land. The input cost of cultivation has been reduced by 25–35 per cent.

***Training, Networking and Capacity-Building Programmes*:** The Mahila Kisans, CRPs and para professionals (PP) were trained on integrated pest management (IPM) and non-pesticides management (NPM). A total of 37 training programmes were conducted covering 502 Mahila Kisans, 42 CRPs and

12 PPs. Three exposure visits for 94 Mahila Kisans were organized on system of millet intensification (SMI), large-scale vegetable cultivation and mushroom cultivation.

***Documentation of Best Practices*:** A team from Ministry of Rural Development (MoRD) in collaboration with SRLM, Odisha, visited the project area and documented the best practices adopted for Annadata Model Nutritional Garden, which is published in 'Compendium of Agro Ecological Best Practices' by MoRD, Government of India (3.1.5, pp. 22–25), released by Hon'ble Prime Minister of India on 5 May 2018 at New Delhi during celebration of National Ajeevika Day (www.aajeevika.gov.in).

Income Generation Activities through the Producer Groups: About 1022 Mahila Kisans cultivated straw and oyster mushroom from which a net revenue of Rs 182000/- was generated excluding consumption during the year.

- Preparation of value-added products from rice, millets and pulses was carried out by 8 producer Groups, which generated a revenue of Rs 69000 in the year 2017–18.
- Large-scale vegetable cultivation was carried out by 206 Mahila Kisans and profits of around Rs 15000 reaped by each in the year.

***Convergence with State Government*:** A strong convergence with various line departments was established. During this year, about 462 cattle sheds, 12 dug wells, 375 household latrines, 63 farm ponds, 117 compost pits and 67 bore wells were established; moreover, 72 households availed horticultural plants (5 plants each), 128 households availed agricultural implements and 1640 households availed the benefit of free cattle vaccinations.

***Monitoring and Evaluation Mechanism*:** Surveys were conducted in the villages at regular interval as per the monitoring tools and mechanisms developed. The Mahila Kisan card given to each individual was updated and data collected for uploading in the MIS. An external review by MoRD through National Institute of Rural development, Hyderabad, was conducted during April 2018.

***Recognition to Mahila Kisans*:** Mrs Asmati Kaudia of Jantaguda village and Kamala Naik of Pialkani village of Boipariguda block were felicitated with NVA Fellowship Award during 2017. Besides this Mrs Raimati Ghiuria was felicitated by Tata Trust, Sukinda, and ICAR-IISW, Sunabeda, during the year.

Programme Area 600

INFORMATION, EDUCATION AND COMMUNICATION

The Information, Education and Communication programme has facilitated knowledge empowerment among the rural community. The intervention of pilot testing the concept of Village Knowledge Centre into the 50 public libraries (PLs) across India has seen advancement in its progress. Evidences from the PLs indicate that they are diversifying their interventions to make these libraries learning and knowledge centres. Village Knowledge Centres are gaining momentum towards its sustainability. The scientific information of Indian National Centre for Ocean Information Services (INCOIS) that are crucial for fisher folk has been auto-ported into the Fisher Friend Mobile Application to provide real-time information to the fishers. The agricultural interventions focusing on plant protection and soil health contributed well towards addressing the challenges faced by the farmers. New sets of ICT (Information Communication Technologies) applications were evolved to provide to demand-driven and need-based knowledge to the rural community. The Youth Science Congress drew the attention of the research and youth community to deliberate on creating a 'new' India. The Hindu Media Resource Centre (HMRC) provided a large number of media personnel with knowledge support services in the area of biodiversity and sustainable agriculture.


Audio Conference Programme
M.S.Swaminathan Research Foundation
Village Resource Centre
Pudukkottai


தொலைபேசி மூலம் ஆலோசனை


INELI Innovators link Global Goals with India's National Priorities
Indian Public Librarians link Global Goals with India's National Priorities


MSSRF
M.S.Swaminathan Research Foundation, Pudukkottai
Chennai

Information, Education and Communication

The programme has covered multi-stakeholders through its different sub programme areas as given in the following table.

Sub	Programme Area	Virtual	Men	Women	Total
601	National Virtual Academy	–	100157	59206	159363
602	Informatics Division	50302	–	–	50302
603	Youth in Development	–	227	291	518
604	Every Child A Scientist	–	54	21	75
605	The Hindu Resource Media	35183	–	–	35183
606	Library and Information Services	135	–	–	135
	Total	**85620**	**100438**	**59518**	**245576**

Sub Programme Area 601

Jamsetji Tata National Virtual Academy for Rural Prosperity

The programme continued reaching out to multiple stakeholders, including resource poor rural community, public library (PL) professionals and research institutions, this year. It covered over 1.59 lakh people during the year (Table 6.1).

Table 6.1: ***Overall reach of information, education and communication***

Intervention	Men	Women	Total
INELI and IPLM	41082	32080	73162
VRCs and VKCs	59075	27126	86201
Total	**100157**	**59206**	**159363**

601.1 National Virtual Academy

This year the Jamsetji Tata National Virtual Academy has selected 74 Fellows, including 41 men and 33 women, from 9 states, nominated across India by 28 partner organizations. In total there are 1874 grassroots academicians (M: 1173; F: 701) from 24 states and 2 union territories, in addition to 38 International Fellows (M: 30; F: 8) from 12 countries in the academy. The brief profile of the National Virtual Academy (NVA) Fellows has been documented in the form of directory, which was released during the convocation of NVA Fellows on 23 October 2017. The selected Fellows took part in the Participatory Knowledge Management workshop organized in October 2017 and cross-learned from each other's expertise.

601.2 Jamsetji Tata Training School

Online Capacity-Building: MSSRF spearheads the International Network of Emerging in Library Innovators (INELI India), an e-learning course specifically tailored to strengthen the abilities of PLs as innovators and leaders. This initiative has touched 43 library professionals across 19 states as INELI innovators to recognize and stimulate their passion to serve the community through PLs. The existing *moodle* platform enables Cohort 1

and Cohort 2 members to interact, collaborate and learn on the leadership modules besides facebook and WhatsApp. Some of the key results of the programme are:

- A total of 24 states with 43 librarians are participating in the online curriculum.
- Cohort 1 members have completed six modules whereas Cohort 2 members have completed three modules as of March 2018.
- INELI South Asia was launched in New Delhi in October 2017. INELI South Asia Cohort 3 was conceived with 8 participants from four countries, namely, Nepal, Sri Lanka, Afghanistan and Bangladesh.
- A Virtual Tour Video was developed for Boothalingam Library at MSSRF.

***Knowledge and Learning Centres*:** On the verge of facilitating experiential learning, the INELI innovators and library professionals have been brought into the Indian Public Library Movement (IPLM), as it provides ample opportunity to design and integrate the need-based knowledge services to different stakeholders through PLs. The Grameen Gyan Abhiyan, as a movement, has been advocating the mission of establishing 'Every Village a Knowledge Centre'. Both INELI and IPLM render such scope in the PLS given the existing scenario of technology evolution and dynamic knowledge needs.

The key results are:

- Public-private partnership for outreach and replication: The initiatives of agriculture intervention in PL services drew the attention of Vellalar College of Women, Erode, and they organized a symposium wherein INELI Innovators shared the diverse services being implemented in their respective libraries. This symposium included key local stakeholders from industries, who are major players having a stake in improving the health of the environment through their corporate social responsibility. With MSSRF as a knowledge partner, we believe that this concept will soon be initiated in support of farmers in other parts of Tamil Nadu.
- A series of training programmes on (i) monitoring and evaluation for 31 innovators (M: 26; F: 11), (ii) customer relationship, marketing and understanding self (including 11 women) and (iii) localizing UN Sustainable Development Goals (SDGs) and linking with national and state priorities and stories of change was organized.
- Thirteen INELI Innovators were recognized as master trainers, reviewers and co-facilitators during the training programmes.
- For the first time, Library Development Plan (LDP; an annual plan) was drafted for the library field across 39 libraries using participatory approach. A total of 149 services have been identified across 39 public libraries for the current year, across diverse thematic areas of education, employment, health, agriculture, microenterprises, gender equality and inclusion, civic services (schemes, online awareness programmes), fisheries, and networking and partnership.

A major outcome from these results was Innovators Services. The Innovators are delivering diverse services across various thematic areas such as education, health and nutrition, agriculture, culture and heritage, personality development, pro-nature, fisheries, micro-enterprises, women empowerment and civic services as given in Figure 6.1. Each of the services is linked with India's National and State Priorities.

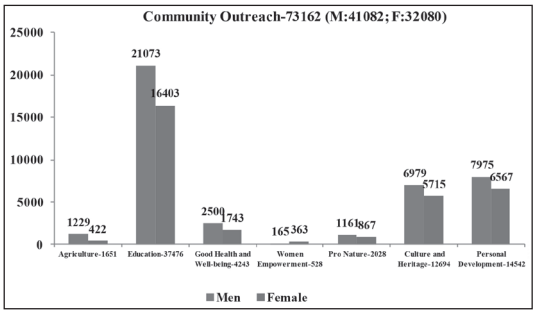


Figure 6.1: Community outreach through IPLM and INELI.

The results also helped in understanding the following:

- INELI and its synergetic approach with IPLM have helped in making the librarians empowered and provided them with innovative ideas in reaching out to the society and also in promoting the UN SDGs.
- The enhanced leadership capacity of librarians, improved soft and technical skills of the selected professionals and their associated library staff across 19 states in India are becoming very evident.
- INELI and IPLM initiatives have helped in the recognition of the librarians as potential innovators and change makers in the library field, which is evident through the awards and recognitions received by them.
- Throughout 31 libraries, librarians have organized outreach programmes for a wider group of citizens such as the early literacy for toddlers, children, adults, senior citizens, marginalized and differently abled.

601.3 Village Resource Centres and Village Knowledge Centres

The 5 Village Resource Centres (VRCs) and 24 Knowledge Centres (VKCs) provided need-based information and knowledge services to the rural community on farming, fishing, health and nutrition using Information Communication Technologies (ICTs). Both the Farmer Friend and Fisher Friend programmes span over Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Odisha, West Bengal and Karnataka. This year, the VRCs and VKCs have reached 86201 community members (Table 6.2):

Table 6.2: ***Reach of VRC and VKCs***

Themes	Male	Female	Total
Agriculture	19776	8996	28772
Fisheries	31250	0	31250
Animal husbandry	859	1211	2070
Health and education	4925	14594	19519
Government entitlements and civic services	2265	2325	4590
Total	**59075**	**27126**	**86201**

The VKCs for promoting climate adaptation among farming communities have inspired two institutions, namely, Sokoine University of Agriculture in Tanzania and Agricultural and Livestock research organization (KALRO) in

Kenya, to replicate it in their countries. A one-week training programme was organized for the two representatives of these counties to demonstrate the concept in their country.

***Sustainability of Village Knowledge Centres*:** Systematic efforts to ensure the sustainability of VKCs have resulted in handing over of 13 VKCs, promoting 4 VKCs as a model and bringing the remaining 7 VKCs to the state of winding down and conversion into a virtual mode.

601.4 Farmer Friend Programme

The Farmer Friend Programme includes a package of different knowledge services offered to the farmers to promote sustainable agriculture. Knowledge services on plant protection, soil health and good agricultural practices were provided to the farmers. The details of different activities under this programme are stated as below:

***Farm School*:** Farm schools facilitated the strengthening of the capacity of farmers through shared learning on farming practices across Tamil Nadu and Maharashtra. The following key results have been realized in the reporting period.

- A total of 393 farmers including 178 men and 215 women in Pasupathikoil Farm School have learned the advanced agronomic technologies and integrated pest and diseases control measures for paddy and black gram and also the ways and means of availing bank assistance. Also, the farm school has provided a platform for officials from the banking sector and development agencies to disseminate the salient features of their schemes and upcoming technologies.
- The foliar fertilization technology in paddy and pulses learned from Pasupathikoil Farm School gave an increased yield of 30 kg per acre in black gram and 125 kg per acre in paddy for 15 farmers.
- The Kisan Credit Card facility is being used by 29 farmers and 10 farmers received crop loan from Pandian Grama Bank in Pasupathikoil.

***Soil Health Management*:** The continued efforts of promoting soil health led to a collaboration with the Department of Agriculture, Government of Puducherry, to undertake testing of 2540 soil samples by creating awareness among farmers on the importance of soil health; soil samples in Tamil Nadu were also tested.

The following are the results realized through collaboration:

- In total, 830 soil and 294 irrigation water samples from 104 villages of 11 districts in Tamil Nadu and Puducherry were tested, of which 758 farmers (M: 582; F: 176) practiced the soil and water health card recommendations.
- Problem soil management cum reclamation measures were imparted to 144 farmers (M: 88; F: 56) from 18 villages of Pudukottai, Thanjavur and Nagapattinam of Tamil Nadu. Moreover, 150 acres of acidic,

saline and alkali and calcareous soils were replenished with recommended amendments and stabilized for sustainable farming in Tamil Nadu.

- Overall 310 farmers including 65 women in an area covering 425 acres have applied the soil health card recommendations and curtailed the cost of fertilizers in the range of Rs 400–500 per acre with an increase in net income of Rs 2000–2500 per acre.

***e-Plant Clinics*:** e-plant clinics in Tamil Nadu, Maharashtra, Puducherry and Odisha conducted this year enabled farmers to get appropriate recommendations to protect their plant health based on systematic diagnosis. The major results of this programme are:

- Conducted 415 plant clinic sessions in 120 villages diagnosing 6526 plant samples, in which 5037 men and 999 women farmers participated and received suitable advisories on pests and diseases, nutrient deficiencies and soil health.
- In all, 71 per cent of farmers approached the plant doctors for the issues of pests and diseases, 21 per cent for nutrient deficiencies and 8 per cent for other crop management issues.
- The cost towards plant protection inputs, fertilizers and labors has been reduced and now stands in the range of Rs 450–1200 per acre according to the crop.
- The shift to organic inputs from excessive dependence on inorganic inputs was noticed among 1050 farmers out of a total of 6036.
- The adoption percentage of plant clinic advisories stood 65 among users, and these farmers have approached input dealers to obtain the recommended inputs.
- The net income increase due to overall intervention of plant clinic varies from Rs 1500 to Rs 1800 for cereals, Rs 3000 to Rs 3500 for flower and vegetable crops, and Rs 4000 to Rs 4500 for cash crops, namely, sugarcane and banana.

***ICT-Based Agriculture Interventions*:** Agriculture focused knowledge services are provided to the farmers in the form of audio messages, helpline, expert and farmer interaction using audio conference and phone-in programmes and training programmes. Listed below are the key results at the output and outcome level:

- The ICT-enabled programmes, namely, phone-in programmes, audio-video conferences, webinars, audio advisories and helpline services have benefitted 28208 villagers, including 19358 men and 8850 women.
- The study shows that farmers prefer agro advisories through ICTs and their access to different technology choices include audio advisories (49.2 per cent), plant clinics (24.7 per cent), audio-video conferences (12.3 per cent), helpline services (8.8 per cent), phone-in programmes (4.8 per cent) and webinars (1.5 per cent).
- A total of 116 farmers from 35 villages received 870 need-based content on agriculture and animal husbandry from

WhatsApp, out of which 40 farmers practiced the advisories received from the experts.

- A total of 39050 farmers, including 8950 women, who received low-cost eco-friendly advisories for their crop issues have prevented 55 per cent of the crop yield loss.
- Among the farmers who received the voice messages, 65 per cent followed the recommendations, 75 per cent realized a reduced input cost of Rs 1050 per acre and increased income of between Rs 7500 and Rs 9500 per acre.
- A total of 550 farmers from Tamil Nadu, Puducherry, Maharashtra, Telangana and Andhra Pradesh followed the good agricultural practices in cereals, millets, vegetables and flower and cash crops and gained an additional income of Rs 27.50 lakhs.

601.5 Fisher Friend Programme

The Fisher Friend Programme caters to the dynamic knowledge needs of the fishing community by leveraging the required scientific information and early warning from the research institutions and local traders across seven states. It predominantly uses the mobile platform and application for facilitating knowledge exchange. The 24/7-helpline services provide access to fisher folk for validating their information needs. Combinations of communication strategies including Fisher Friend Mobile Application (FFMA) have been used to enable fisher folk to get the required information in time. Table 6.3 indicates the results:

Table 6.3: ***Overall reach of fisheries – tool wise***

S. no	ICT Tools	Number of Users
1	FFMA	12202
2	Audio advisory	16251
3	Helpline	1815
4	WhatsApp	576
5	VRC/VKC	156
6	Public address system	250
7	Notice board	105

***Fisher Friend Mobile Application Technology*:** The FFMA is not only the pioneering interventions of the Foundation, but also one of its flagship initiatives. The evolution of technology advancement has been interfaced into the FFMA while strengthening its design at every stage. Similarly, the key for its success is to take along the views of different stakeholders, specifically the fishing community, in sharpening its user interface. The partnership with Tata Consultancy Services (TCS) has supported the upgrade of the FFMA application and its user interface. The key highlights of the technical advancement done on FFMA are given in the section titled 'Informatics Division' of this report.

The consistent discussions with INCOIS facilitated the auto-porting of scientific information services such as wave height, wind speed, PFZ and TUNA advisories from its integrated dissemination system (IDS) into the FFMA. FFMA was pilot launched in West Bengal and Karnataka in partnership with Central Marine Fisheries Research Institute and Mangalore and Rural Educational Development Centre.

The key results accomplished during the reporting period are as follows:

- User-friendly pan-India FFMA in nine Indian languages has been made available in the Google Play store for public access.
- Overall 12202 new users accessed FFMA with a total screen view of 1525537.
- The Government of Kerala has constituted a high-level committee on ocean communication services and included FFMA as one of the major services to be taken forward across coastal Kerala.
- Across five states, 168 government and private partners contributed actively to the promotion of FFMA.
- Across seven states, 46591 fisher folk from 370 villages from 31 coastal districts received marine fishery advisories on a daily basis.
- The INCOIS-MSSRF 24/7 helpline facility, hosted in four languages, was accessed by 1815 fisher folk, and it addressed a total of 16182 queries.
- During the OCHI cyclones 1372 callers received timely advisories via the helpline. This led to three lost boats being traced and the lives of 9 fisher folk being saved due to timely facilitation via the helpline with coast guards and traditional village leaders of the fishing community.
- More than 60 per cent of the users who received PFZ advisories realized economic benefits ranging from Rs 10000 to Rs 50000.

601.6 Health Education

Multiple communication strategies, both ICT and non-ICT, have been used for creating awareness among community members across the working areas in Tamil Nadu and Puducherry aimed at promoting health and sanitation. The fortnightly tele-health education on different themes through 11 VRCs and VKCs in Tamil Nadu using a multipoint video conferencing in collaboration with Apollo hospital facilitated discussions between the rural community and doctors. The topics covered are intelligence, pregnancy, asthma, dengue, burns, alcoholism, women's health and empowerment, hypertension, recognizing the dangerous headache, skin conditions and a variety of general health conditions. The notable results are as follows:

- A total of 15962 community members (M: 4185; F: 11777) in 43 villages participated in the different programmes on improving health and sanitation.
- In all, 6186 students, including 3065 girls from 55 schools, participated in the campaign on health and sanitation, and personal hygiene.
- A model sanitary complex was promoted using a participatory approach by renovating two defunct women's sanitary complexes in Pudukottai district in coordination with DRDA and now 36 households are using it regularly.
- Nutri-gardens were established at 238 households in 42 villages in Pudukottai district.

- Overall 5500 school children, including 2400 girls, have been following personal hygiene practices. The study conducted by the State Planning Commission proved that 80 per cent of the households are using toilets regularly.
- The 164 nutri-gardens established in 35 villages constantly supply fresh vegetables worth Rs 400–750 per month for household consumption.
- A total of 5566 unused toilets in 34 villages have been brought to regular usage through effective behavioral change communication.
- Overall 7190 toilets have been newly constructed in 26 panchayats with the financial assistance of DRDA and brought into regular usage.

Sub Programme Area 602

Informatics Division

The informatics division has been supporting both programme and organizational functions and following are the key activities carried out:

Strengthening of FFMA

- FFMA has been upgraded in coordination with TCS from ADT bundle to the studio to make the application robust and scalable and three versions have now been released.
- Technical features to auto-port the scientific information of OSF, PFZ and TUNA data from INCOIS's integrated dissemination system (IDS) have been designed.
- New Firebase analytics to help track the application usages have been introduced in addition to Google analytics.
- A newly developed android mobile application 'Fisheries Helpline Manager' to enable the fisheries helpline to function efficiently has been introduced.

INELI-IPLM: Moodle 3.0 was upgraded and installed for pilot testing.

MSSRF website: The website was redesigned and launched with enhanced features.

LANSA website: Eight new features have been developed and added to the website. This website recorded 45,002 page views from 7,678 users from different countries during this period.

Survey Mobile application: A mobile application was developed and two versions released by including the feedbacks for conducting surveys.

Electronic Tools

- An improvised GSM-based PA system was designed for timely information delivery to end users covering 300 households.
- The electronic display board was synchronized with AWS and deployed in Vedaranyam sites, namely, Kahtaripulam, Thennadar and Vanduvancheri, to transmit information to approximately 5000 people. The display board fetches the data from the Automatic Weather Station via the internet and displays it on the screen

instantaneously as the information captured is dynamic in nature.

- Four electronic kits were designed for ECAS students to learn basic science.
- A GSM-based vegetable crop surveillance tool, which helps to detect pest and disease in vegetable crops, was developed.

Video production: The development of 18 videos for different projects was facilitated.

Sub Programme Area 603

Youth in Development

The Ninth Indian Youth Science Congress on 'Role of Young Scientists in Developing New India' was organized during 7–9 April 2018 at the Career Point University, Hamirpur, jointly with Career Point University Kota and SRM University, Chennai. The Congress covered a wide range of themes including technological innovations, climate change and carbon sinks, vision of youth for new India and nutrition. Mr M. Venkaiah Naidu, the Hon'ble Vice President of India, inaugurated the Youth Science Congress, which was attended by Mr Acharya Dev Vrat, Hon'ble Governor of Himachal Pradesh, Mr Jai Ram Thakur, Hon'ble Chief Minister of Himachal Pradesh, Mr J. P. Nadda, Hon'ble Union Minister of Health and Family Welfare, Government of India, Prof. Prem Kumar Dhumal, Hon'ble former Chief Minister of Himachal Pradesh, Mr Anurag Thakur and other dignitaries.

There were 60 invited talks, 1 plenary/public lecture, 45 oral and 151 poster presentations held during the Congress. More than 1000 delegates, including 600 students and 300 researchers, attended the Congress from different states. Prizes were awarded to the winners of essay competition, oral presentation, poster presentation, science models and cultural programme. The first Professor M S Swaminathan Youth Science Award 2018 was presented to Mr B. Kishore, a postgraduate student from Srimad Andavan Arts and Science College, Tamil Nadu. Professor M S Swaminathan Lifetime Achievement Award 2018 was presented to Prof. P. L. Gautam, Vice Chancellor, Career Point University, Himachal Pradesh, for his outstanding contributions in the field of agriculture sciences and technology.

Sub Programme Area 604

Every Child A Scientist

This programme was initiated to build the scientific temperament of students from underprivileged schools. The two-week programme has a combination of lectures, quiz, documentary films and exposure visits and so on in science, health, biotechnology, nutrition and related fields. During the reporting year, the Every Child A Scientist (ECAS) was upgraded with new resource material and equipment, for example, sensors-based analysis of the environmental parameters such as temperature, humidity, pressure, light, rainfall, and so on were monitored. In addition, ultrasonic sensor-based analysis of heartbeat and pulse rate to understand the heart functions was taught to the students.

During the academic year, approximately 75 students (girls: 54; boys: 21) benefited from this programme. It teaches students to enjoy science by adopting the learning-by-doing method.

Sub Programme Area 605

The Hindu Media Resource Centre, MSSRF

Regular updates and sharing of information is facilitated by *The Hindu* Media Resource Centre (THMRC) through the website, social media platforms, e-newsletter and print newsletter. The Foundation website reached 178168 page views during the year. The website also served as a contact point for enquiries from media, students, development practitioners, farmers, academics, international agencies and members of the public. During the reporting period, MSSRF achieved total impressions of 303900 or an average of around 25300 reads every month on Twitter. The MSSRF handle @mssrf helped disseminate information about the Foundation and other general information to the public. The number of followers for the Foundation's Twitter @mssrf handle as of March 2018 was around 2700.

On facebook, the Foundation had a reach of over 20500 people every month during this year, with regular posts, campaigns and event updates shared. A total of 1039 people 'like' the MSSRF page and receive updates on a regular basis. Prof. M. S. Swaminathan, who is on Twitter, has been consistently engaging on this platform with over 2902000 impressions during the year and 241833 impressions each month for his messages. He had 25701 new followers on Twitter over the year. MSSRF's e-newsletter called 'e-Synergy' reached 1685 internal and external stakeholders including media persons, scientific, academic and student communities. There were 12 e-newsletters sent out during the year, in addition to invitations. The MSSRF print newsletter 'Synergy' continued its successful run with three issues being brought out. In addition to news clippings, social media updates and publications, a total of 165 event and content updates in both English and Tamil were posted on the website during the year. MSSRF's flicker page is also regularly updated with the latest photos from our programmes, and our YouTube channel is also kept up-to-date with videos from prominent events and it also has a new video about the Foundation featuring Prof. M. S. Swaminathan.

Media Outreach: MSSRF has been featured in 424 news stories, in mainstream English, Tamil and Hindi newspapers and web editions. A total of 39 press releases, which includes English and Tamil press releases, were issued to journalists for events, updates and statements on behalf of the Foundation. Interviews and media coverage were facilitated for various occasions. There were over 40 requests from media persons for interviews, stories, quotations and information. Senior staff also participated in live discussion on water management and eradication of malnutrition in Tamil.

Advocacy Partnership: A knowledge partnership for nutrition alliance in Tamil Nadu

for advocacy and networking stakeholders in the state was initiated in partnership with UNICEF in 2017. The first phase of this year-long programme will come to an end during 2018, and it has helped to create a knowledge-sharing network, initiate and manage a portal of resources and advocate for strengthening nutrition initiatives among various stakeholders in the state.

Capacity Building: A media workshop was organized for journalists across Kerala, Karnataka and Tamil Nadu in Wayanad, Kerala, to create awareness and to sensitize the media about biodiversity-related issues and to bring it into the mainstream.

Lectures and Seminars: THMRC provided support and coordination for Foundation events and across Programme Areas for enhanced public and media outreach and impact on these themes. The seminars include topics on nutrition, Corbett Tiger Reserve and celebrating mathematician Srinivasan Ramanujan's life and career on his birth anniversary in December.

Sub Programme Area 606

Library and Information Services

M S Swaminathan Research foundation has a well-organized and reputed library. It serves and fulfills the needs of the scientists of this Foundation and research workers and scholars from other research and educational institutions. This year, the library has been air conditioned using solar power.

The library has 18718 books of which 127 were added during this year. In addition, it holds 575 CDs, 120 journals and 4535 bound volumes of journals. Adding more current, important scientific and technical books further enriched the existing collection of books. Besides, the library has a precious collection of technical reports, and annual reports from various institutions. Current Awareness Services (CAS), Review of Literature Services, Document Delivery Services, Publication and Distribution Services and Reprographic Services are some of the facilities given to users.

The web-based MSSRF Open Access Archives (OAA) has been initiated for the benefit of the global research community, and India Stat, EPWRF, JSTOR, SAGE and Informatics social science journals have been successfully renewed this year. The library provides assistance through CABI full text to research students working in the areas of biotechnology, agricultural sciences and life sciences. During the past year 135 students from various universities at the national and international levels have benefitted from this service.

Programme Area 700

CROSS-CUTTING THEMES

To reiterate and strengthen the mandate of the foundation, gender, grass-roots institutions and climate change have been adopted as cross cutting themes across all the programme areas. Foundation has been continuing its efforts in strengthening gender perspectives by building the capacities of the team members in proposal development and implementation phases. The interdisciplinary projects implemented during the reporting period has been focusing on gender issues with energy, climate change and biofertilizer technology. The role change process on Empowerment of Single Women at Wardha field site was initiated and necessary capacity building programmes were organized to function as self-reliant institution managed by the members. Also as the grassroots organizations are key to carry forward the technological interventions which are tested by the foundation, strengthening the organizational and management dimensions of the grassroots institutions has given due importance across its field centres.


நல்லாவூர் விவசாய உற்பத்தியாளர் கம்பெனி லிமிடெட்
NALLAVUR FARMER PRODUCER COMPANY LTD
ஆண்டு பொதுக்குழு கூட்டம்
ANNUAL GENERAL BODY MEETING


Incorporation status
Profile of Company
Commodities identified

Sub Programme 701

Gender

701.1 Gender Mainstreaming and Integration

As a part of the gender mainstreaming process, the Gender Institutionalization and Mainstreaming (GIM) team members met and discussed their current engagement in gender-related activities in respective programmes and projects and prepared an annual plan of action. During this meeting, gender concepts, key gender issues, gender sensitiveness, challenges in addressing gender issues, approaches to be followed to address gender issues and scope for publication based on the cases where projects address gender needs were discussed. Moreover, case studies based on the work carried out under the FSN-TATA project, the LANSA project, Fish for All centre, gender-related activities undertaken at Wayanad Centre and MSSRF-OCPF initiative of pulses promotion project were discussed. The key highlights of the discussion and the factors that need to be brought into focus are summarized below:

- Need for understanding research and developmental issues through the gender lens
- Critical analysis required from the gender and inequality perspectives on the field-based interventions
- Women empowerment interventions are needed to reduce gender inequality
- Essential to analyse the impact of the interventions related to gender relations
- Gender perspective need not only refer to men-women dynamics, but caste, market forces and occupation as well
- Gender analysis could include internal conflicts and patronage at the community and market levels

The GIM team identified the following potential publication during the year.

- Role of women's federations in empowering women fish folk in Pumbhukar region
- Gender Implications of Farming System for Nutrition approaches – a case from Jeypore
- Key gender outcome of *Mahila Kissan Sasakthikaran Pariyojnana* programme in the Vidarbha region – narratives and critical analysis
- Role of Farmer Producer Organizations (FPOs) in helping women's agency
- Empowering position of women in dairy value chain
- Voice of women salt workers – gender constraints, challenges and remedial measures
- Post-harvest processing, value chain development specific to millet-based enterprises – gender analysis
- Gender impact on agroforestry development
- Gender impact of homestead farming among Kuruma tribes

- The biotechnologist's view on gender inclusion in lab to land-based programmes

701.2 Interdisciplinary Research Initiatives

Activities are focused on changing the role of the foundation in single women farmers' empowerment programme wherein the federation is taking the lead in facilitating development initiatives. The BIOFI project on bio-fertilizers and intercropping system was completed last year and the results are being consolidated into research articles.

***Empowerment of Farm Widows and Other Single Women Farmers in the Vidarbha Region*:** The activities during the reporting period were focused on consolidating the learnings and strengthening the federation to function independently. Towards this aim, at the village level, the members were organized into 65 Joint Liability Groups based on the kind of productive activities and linked to banks; following this, at the panchayat level, the groups were federated into 5 clusters in Wardha and Deoli blocks and these clusters were linked at the apex level as a federation. Of the total 860 members 85 per cent are widows, 11 per cent are abandoned, 2 per cent divorced and 2 per cent separated. Training and capacity-building programmes were organized for the group leaders and federation leaders on their roles and responsibilities and adhering to the by-laws of the federation. The members were also trained on augmenting social capital and building human and financial capital in partnership with institutions such as banks, Department of Rural Development, Department of Social Welfare, Department of Agriculture and NABARD. Only 20 per cent of the members are engaged in on-farm activities, 44 per cent are involved in off-farm activities such as goatry, poultry and calf rearing and 36 per cent in non-farm income-generating activities such as petty shops, tailoring, small-scale trade within the village and so on.

With reference to financial capital, though the groups are linked to banks, accessing loans is difficult and hence they started internal credit among themselves using their savings. Apart from this the federation is extending services related to entitlements and aggregation of inputs and grading and marketing of their products. During the reporting period the federation addressed issues related to old age and widow pension (34), ration card (12) and land (4) and provided counselling to women (15). A total of 120 members were trained on backyard poultry farming activity in Wardha and started the activity with the support of Krishi Vigyan Kendra. Similarly another 50 members were trained on goat rearing with a focus on deworming, feed management and water management during seasons of water scarcity. All the trained members initiated their respective activities and the federation is extending further technical support in collaboration with KVK and veterinary department. The federation is linked with National Forum for Single Women at the national level. Two of them were elected as executive committee (EC) members in the National Forum and shared the progress, issues, challenges as

well as new initiatives in various on-farm and off-farm livelihood measures at the grassroots level. The federation EC members and staff participated in the annual general body meeting of the National Forum and EC meeting and workshop. Last year they attended two workshops held at New Delhi and Ranchi, Jharkhand, and shared their issues and challenges, intervention and progress.

***The Gender Factor in Political Economy of Energy Sector Dynamics*:** With reference to research work, data collection was completed at the micro, meso and macro levels. The data sets were cleaned and analysis initiated based on the research questions. At the micro level quantitative data collection was completed in all the field sites along with qualitative data through focus group discussion and individual interviews. At the meso level discussions were carried out in state-level departments and with officials and collected data and structures associated with the policymaking and implementing processes. At the macro level, discussions were held with concerned institutions and policymaking bodies on key issues related to gender and energy.

Under the Programme Cooperation, our team collaborated with the South African team RA 2 which is focusing on women-managed enterprises. The fieldwork and policy consultation workshop in South Africa was completed and the report prepared. In the dissemination category, at the macro level, a national-level stakeholders' workshop was organized with the support of NITI Aayog, New Delhi. It covered two important themes – clean energy services for cooking as well as productive work (agriculture) for women. In this context, the team provided inputs to strengthen gender dimensions of draft national energy policy based on evidences and field-level cases.

The key expected output of the project is publications. Out of the four committed articles, three were submitted and two got published. In addition, the country-level studies of South Africa and India were published as working papers which were then shared on the website as well as through an institutional newsletter. Also, based on South Africa country study a draft paper was written in collaboration with the RA 2 group which is in the stage of finalization. This paper will be jointly presented in the forthcoming 10th Biennial Gender, Work and Organization conference 2018 in Sydney, Australia, by Macquarie University, from 13 to 16 June 2018. Also, recently the team committed for another paper on 'Addressing Gender Concerns in the Energy and Land Nexus: An Analysis of Feminization of Agriculture in India and Nepal' to the journal *Gender, Technology and Development*, which is due in June 2018.

The team participated in the LCEDN–ENERGIA consultation and subsequently in evolving the Community of Practice on Gender and Energy Network in India (GENI) in partnership with other research areas working in India (TERI and IRAde) and DFID. As part of GENI, a workshop was organized on Women and Energy: Transitions to a Low-Carbon Economy in Agriculture and Natural

Resource Sectors in April 2018. The main objectives were to build gender and energy expertise through research and practices and develop a shared understanding of gender-responsive analysis of practice and policy; and to establish and strengthen a network of government, corporate, civil society organizations, researchers and practitioners in the field of gender and energy as GENI. A total of 32 experts from different energy sectors, working in the interface of technology, gender and sustainability, participated.

Sub Programme Area 702

Grassroots Institutions

As part of strengthening the grassroots institutions, technical support was given to build the capacity of the leaders in managing the financial and governance systems. The books of accounts were verified and the internal auditing process for SEED Care, WTDAC, completed. In the case of RESAPCOL and IGS, support was extended to finalize the balance sheet for external audit. The EC members/board of directors in institutions based in Puducherry, Mailam and Wayanad participated in the capacity-building process. In addition, support was extended towards legal registrations for the MKSP project in Koraput and for organizing the general body meetings in all the GRIs.

***Farmer Producer Organizations and Collective Action*:** Technical support has been extended in building the three FPOs based at Mailam, Kolli Hills and Puducherry. The main areas focused on in the reporting period were business plan preparation, strengthening governance and ensuring transparency in management. As part of the capacity-building process, a two-day programme was organized on statutory compliances for FPO with the technical support of a company secretary and charted accountant. Another important focus was a role change process; as the support of NABARD to the FPOs is slated to end in December 2018, the board of directors and group leaders were consulted to evolve strategies and plan for the transition. This step is crucial in whole institution-building processes, as all three FPOs are in the initial stages of developing the business component through which they have to earn the revenue for financial sustainability.

Sub Programme Area 703

Climate Change

There are three important areas in which activities were carried out under this theme: assessment of the climate change impact and vulnerability on food security and livelihoods and evolving an adaptation framework, communication of climate information and building the capacity of women farmers in using climate information and adaptation technologies. The details of the progress made in each of the sub-themes are given below:

***Climate Change Impacts, Vulnerability and Adaptation: Food Security and Livelihood*:** Assessing the impacts of climate change, vulnerability and adaptation is one of the

key components of the India's Third National Communication (TNC) launched by the Ministry of Environment, Forest and Climate Change. As part of this, MSSRF has been assigned with the responsibility of preparing inputs for the TNC on the topic 'Climate Change Impacts, Vulnerability and Adaptation: Food Security and Livelihood'. The study aims to develop a framework for assessing the impacts of climate change on food security and livelihoods for the period 2030, 2050 and 2080 at the pan-India level, then research the vulnerability of food production and livelihoods of farmers, analyze the policy gaps and advocate the potential adaptation strategies for two states, namely, Tamil Nadu and Maharashtra.

The future climate projections for rainfall and temperature at the state level were derived for three future scenarios – 2030s, 2060s and 2080s – under four Representative Concentration Pathways conditions: 2.6, 4.5, 6.0 and 8.5. Then to understand the current variability of climate across the states, district-level rainfall and maximum and minimum temperature data were used. Following this, the impact of current and projected climate variability and change on crop productivity was assessed using DSSAT, a dynamic crop simulation model which is at the state level for the two selected primary crops which are crucial to ensure food security. Using the output of the crop simulation model, the estimation of future food security scenarios for different states is under process. Simultaneously, vulnerability analyses for the livelihoods have been carried out for the two selected states both at the state and district levels. For the assessment of vulnerability of livelihoods, the study uses socioeconomic, demographic, agricultural and natural resources and relies on secondary data sources. The data has been arranged into the subcomponents of vulnerability such as exposure, sensitivity and adaptive capacity. Exposure components have indicators reflecting climate variability and exposure of population and area. The sensitivity component has indicators reflecting system, human, ecological and economic sensitivity. Adaptive capacity has indicators reflecting different dimensions of adaptive capacity – economic, socio-demographic, infrastructure, resource and livelihood strategy capacity. Three different methods, namely, integrated vulnerability index (IVI), livelihood vulnerability index (LVI) and LVI-IPCC, are tried to study the vulnerability of livelihoods.

In addition, the policies and programmes of the food and livelihood sectors of the two states have been collected and initiated for the policy gap analysis from the adaptation perspective. The policies and programmes are largely designed at the state level with slight variations for rain-fed and irrigation production systems. With these data, it is planned to develop a decentralized adaptation framework based on the diverse vulnerability status within the states to build resilience across different agro-ecosystems.

***Climate Information Services*:** Developing and disseminating the integrated agro-advisories for the medium range weather

forecast for the farmers and other users in the south zone of Tamil Nadu is the main objective of the initiative. The agro-advisories help the farmers take informed decisions in relevant agricultural operations by reducing risk and increasing productivity. During 2017–18 around 1248 (Tamil: 624; English: 624) weather forecast and weather-based agro-advisory (AAS) bulletins were developed in the regional language (Tamil) as well as in English by MSSRF and issued to the six adjacent southern districts (Dindigul, Madurai, Pudukkottai, Ramanathapuram, Sivagangai and Theni) of Tamil Nadu. A total of 6118357 Agromet advisory SMSs were sent to men and women farmers of six neighboring districts every Tuesday and Friday through the mKisan Portal.

A reliable network has been formed with civil society organizations in Dindigul and Theni districts to receive weather forecast and Agromet advisory bulletins from MSSRF and disseminate to a further 6000 farmers in the southern districts of Tamil Nadu. Around 832 audio advisory contents on weather forecast, agriculture, horticulture, soil water conservation and livestock care were developed and disseminated to the women and men farmers of the districts in south agro-climatic zone. Using the social media as learning tool, a separate social media 'Whatsapp' group named as 'Weather and Agriculture' has been operationalized in the regional language since 2016. Around 250 farmers and agriculture experts were added to this group. Information such as weather forecast (bi-weekly), agro-meteorological advisories and livestock care were shared and discussed in this group. Apart from this, audio and videoconferences were also carried out in Kannivadi region. In total 646 farmers (M: 424; W: 222) were organized and trained on various themes, such as agriculture, livestock and health, through these programme.

***Enhancing Women Farmers' Adaptive Capacity to Address the Challenges of Climate Change*:** Climate information services and agro-advisories are important tools in building the adaptive capacity of smallholding farmers. However, its uptake is slow due to the lack of awareness and scientific capacity among user groups as well as gap in providing need-based information to farmers. Given this, an attempt has been made to build the capacity at local and organizational levels to engender climate information services of IMD. At the local level, to develop scientific capacity to understand, practice and disseminate the climate information and advisories to women farmers, an attempt has been made to build a cadre of 30 climate risk managers (CRMs) at the local level from six neighbouring districts, namely, Dindigul, Madurai, Pudukkottai, Ramanathapuram, Sivagangai and Theni districts of the south agro-climate zone. At the organizational level, 14 FPOs and 7 agro-field meteorological units (AMFU) in Tamil Nadu were identified for developing and disseminating women farmer–friendly agro-advisories. The curriculum preparation for all three sections of the stakeholders has been started and an initial orientation meeting with 30 CRMs, 14 FPOs and 7 AMFUs has been completed during the reporting period.

Sub Programme Area 704

Institutional Initiatives

Social Science Unit

***Data Management*:** During the reporting period, the database relating to MSSRF's community-based interventions, with reference to March 2016, was completed and updated in a web portal and made available for internal access. The database consists of a consolidated picture of the Foundation's community-based interventions pertaining to geographical location, thematic focus and socioeconomic characteristics of individuals who participated in the interventions. The dataset reveals that different interventions cover 447 revenue villages (across 710 hamlets), spread over 33 districts of 8 states – Andhra Pradesh, Karnataka, Kerala, Maharashtra, Odisha, Puducherry, Tamil Nadu and Telangana. A total of 88405 persons were touched by MSSRF's interventions in March 2016 of which 52 per cent were women. In accordance with MSSRF's approach of promoting grassroots institutions for collective action, the interventions were carried out with the support of 581 Self-Help Groups, 334 Farmers' Groups and 12 Village Development Councils. In addition, 5986 persons have been identified as 'community resource persons' and have received intensive training in different areas and are in turn training fellow villagers. Farming and farm-related interventions have been undertaken by MSSRF across all the 8 states while fishing-related interventions are ongoing in 4 – Andhra Pradesh, Kerala, Tamil Nadu and Puducherry. Detailed profiles of 32 districts and 113 revenue villages where MSSRF is operating have been prepared and uploaded to the web portal.

Education Support Programme

One of the first initiatives of MSSRF in the Vidarbha region was to provide support to suicide-affected families by ensuring that children whose parents had committed suicide continue their education at least up to class 12. In the initial year 2006–2007, the programme covered 45 boys and 33 girls in Wardha district and expanded to include another 48 children – 29 boys and 19 girls – from Yavatmal district in 2008–2009. During the reporting period 2017–18, 21 children – 11 girls and 10 boys – across 16 villages spread over Wardha and Yavatmal districts were covered. All the 21 children covered in this programme were given continuous counselling, motivation and guidance by the staff at MSSRF.

Programme Area 800

SPECIAL PROJECTS

The LANSA research consortium programme entered its final year. The focus of work during the year was on consolidation of emerging research evidence and advocacy with policy makers. Endline survey was undertaken under the Farming System for Nutrition (FSN) study in Koraput and Wardha districts and the data analyzed showed improvement in dietary diversity.


District Level Consultation
on
"Farming System for Nutrition"
सामुहिक बीज बैंक, हेटी
Community Seed Bank, Heti
DR. AVINASH KISHORE
PRABHU

Sub Programme Area 801

Leveraging Agriculture for Nutrition in South Asia

A number of papers were published based on completed research studies. The research and research uptake (RU) teams continued to work closely during the year to present the research to policymakers and policy influencers. Village men and women in the Farming System for Nutrition (FSN) study villages started emerging as spokespersons, sharing their experience of leveraging agriculture for nutrition at different forums. LANSA partnered with the Agriculture Nutrition and Health (ANH) Academy at their annual conference in Kathmandu in July 2017 and organized a plenary session on the theme of 'Women in Agriculture and Nutrition'.

Research

Ongoing research culminated in the publication of six papers in peer-reviewed journals and eight LANSA Working Papers during the year. Two papers based on pro-nutrition agri-food value chain research in India appeared in a special issue of the IDS Bulletin based on LANSA research on the theme of 'Markets for Nutrition', published in February 2018. The focus of one paper is on the scope of private business value chains for nutrition and the second examines the food distribution value chain under the Integrated Child Development Services. Five posters based on research on enabling environment for agriculture nutrition linkage, millets in the public distribution system, situational analysis of pulses, agri-food value chains and FSN were presented at the ANH Academy Conference in Kathmandu in July 2017.

Farming System for Nutrition

The FSN study underway since 2013 in seven villages in Koraput district, Odisha, and five villages in Wardha district, Maharashtra, had commenced with a baseline survey to identify the existing disconnect between agriculture and nutrition linkages. Following discussion with farm-households and stakeholders, FSN interventions focusing on increasing the area and productivity of nutrient-dense crops, namely, millets, pulses, fruits and vegetables, were initiated. A number of on-farm experiments were conducted in 2013–15 under collective responsibility of farmers and researchers. Going forward from the formative study phase to the feasibility stage, core interventions were identified in 2016 to increase area and number of farmers practicing nutrition-sensitive agriculture. The crop-based interventions tested for feasibility under the study focused on crop diversification along with varietal substitution of nutrient rich crops, that is, finger millet and maize, and pulses (green gram, black gram, pigeon pea) in Koraput and sorghum, wheat and pulses (green gram, pigeon pea and bengal gram) in Wardha along with nutrition gardens of fruits and vegetables in the backyard or field. Poultry in Wardha for the landless and marginal farmers and fishery in Koraput and nutrition awareness are the supporting interventions. Data was collected as per requirement

and the economics of each intervention analyzed and shared with farmers for them to understand the difference and benefit over the existing practices being followed by them. This facilitated better understanding and acceptance of recommended interventions.

The year 2017 saw the upscaling of core FSN interventions both within the initial set of villages and across neighbouring villages in the two study locations, without any external input support. To assess the impact of FSN interventions, a representative sample of 190 households was selected at each study site for endline survey. This included household demographic profile and socioeconomic characteristics, agriculture, animal husbandry and nutrition garden, anthropometric measurements and food consumption frequency based on 30-day recall; diet survey based on 24-hour recall was administered on a sub-sample of 150 households having children less than 5 years age, as done during the baseline.

The total sample in each case included at least 30 households who had not participated in the interventions, for purposes of comparative analysis. The number of such households was 32 in Wardha and 35 in Koraput; that is, in the sample of 190 households, 158 households in Wardha and 155 households in Koraput had been covered under one or more intervention. The data analysis is in progress. In order to examine whether on-farm production diversity was leading to improved household diet diversity, the food consumption frequency pattern (for the period of May–August) was compared with the baseline collected for the same period in 2014 for the same set of 158 and 155 households in Wardha and Koraput respectively. Details of activities taken up during the year and a few emerging findings of the endline survey are described below.

Koraput

***Crop Interventions*:** Paddy is the main crop in Koraput; interventions were promoted both in low-elevation and medium-elevation land paddy ecosystems to increase the cropping intensity by introducing improved varieties of nutrient-dense rice fallow crops such as green gram, black gram and finger millet, by creating access to irrigation or relay cropping. In uplands, finger millet, maize-pigeon pea intercropping and orange fleshed sweet potato (OFSP) were promoted instead of leaving the land fallow or shifting towards perennial tree cropping. The uptake of FSN interventions expanded beyond the core group of 7 villages to 18 more villages in Koraput, reaching out to more households. Table 8.1 gives the details of uptake of crop interventions in the core study villages and beyond in 2017.

In kharif 2017, 305 farmers from 22 villages, including 167 from 6 of the core study villages, cultivated finger millet (variety GPU-67) in 44 ha. The average yield was 2268 kg/ha, which was 52 per cent higher than the yield of local varieties at 1489 kg/ha. Similarly, maize and pigeon pea intercropping in 1:1 ratio was done in 14 ha by 242 farmers from across the 22 villages. Average production of maize green cob was 4336 kg/ha, Pigeon pea green pod was 658 kg/ha and mature pod was 356 kg/

ha. OFSP was cultivated by 60 farmers in 11 villages covering an area of 2.6 ha with an average yield of 5.8 ton per hectare. As rice is the primary staple in the study area, a high zinc fortified rice variety [DRR Dhan 45 (IET 23832)] was undertaken in a 21 ha area, involving 238 farmers across 7 villages. The variety had an average yield of 7.7 ton per hectare which was 15–20 times higher than that of farmers' varieties. Paddy being the staple crop, zinc-fortified paddy seeds were made available to farmers and its cultivation reduced some area under maize pigeon pea and OFSP in 2017–18. The households having no suitable area for growing finger millet in kharif were encouraged to go for the short-duration variety Bhairabi in rice fallows, wherever irrigation facility was available. In rabi 2017, finger millet (variety Bhairabi) was cultivated by 62 farmers in 10 ha in 3 villages. However, the number of farmers and area under finger millet was lower in rabi, as compared to the previous year, due to some problems in availability of water for irrigation. Green gram variety SML 668 was cultivated by 173 farmers in 44 ha and black gram variety TK 94-2 was grown by 33 farmers in 4 ha.

***Nutrition Garden*:** Out of 658 households in seven core villages, 578 were having nutrition gardens of fruits and seasonal vegetables using their own seeds saved from the previous cropping season. Besides 145 farmers having irrigation facility, cultivated vegetables in rice fallow across 34 ha during the rabi season. There were also nutrition gardens in two schools and two ICDS centres, with the produce going into the midday meal.

Table 8.1: ***Number of farmers and area under FSN crop interventions in 2017***

Crop	FSN Intervention Villages (7 Villages)		Extension/Non-intervention Villages			Total	
	No. of Farmers[a]	Area (ha)	No. of Villages	No. of Farmers	Area (ha)	No. of Farmers	Area (ha)
Kharif							
Rice[b]	238 (7 villages)	21	0	0	0	238	21
Finger millet	167 (6 villages)	23	16	138	21	305	44
Maize + pigeon pea	108 (6 villages)	6.5	16	134	7.5	242	14
OFSP	36 (7 villages)	1.6	5	24	1.0	60	2.6
Rabi							
Finger millet	62 (5 villages)	10	0	0	0	62	10
Green gram	122 (6 villages)	29	7	51	15	173	44
Black gram	33 (5 villages)	4	0	0	0	33	4

[a] There is double/multiple counting of farmers. Farmers cultivating different crops are not mutually exclusive.

[b] Zinc-fortified paddy was introduced in kharif 2017.

***Fishery*:** Fish farming activities covered 196 farmers managing 73 ponds in 16 villages. The first round of harvest has been completed and the second round is underway.

***Endline Survey*:** The food consumption pattern in terms of quantity, diversity and frequency of consumption of the 155 intervention households in the sample of 190 was compared with baseline data of the same parameters for the same households. The key findings are highlighted below.

- Number of households growing nutrient-rich foods (finger millet, pigeon pea, green gram, black gram, OFSP) and the average intake of such foods entirely from home production was higher in comparison with the baseline (Figures 8.1 and 8.2). Thirty-four households were cultivating and consuming OFSP.
- There was an increased frequency of consumption of the foods listed above (daily or twice/thrice a week) versus once in a week or fortnight in baseline.
- There was a 14 per cent increase in average intake per day of finger millet from 70 g/CU/day in baseline to 80 g/CU/day.
- Pulse consumption (pigeon pea, green gram, black gram) became diversified, both as whole and dal. There was also a 63 per cent increase in average intake per day from 28 g/CU/day in baseline to 45 g/CU/day.
- Both diversity and average intake of all the three groups of vegetables (green leafy, other vegetables and roots and tubers) was higher. In case of fish intake, 10 of households were consuming daily versus none in baseline.

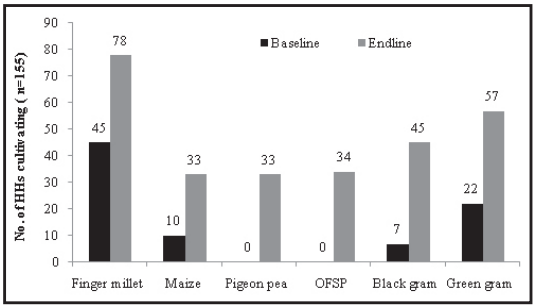


Figure 8.1: Number of households growing nutrient-dense food crops: Comparison of baseline (2014) with endline (2017).

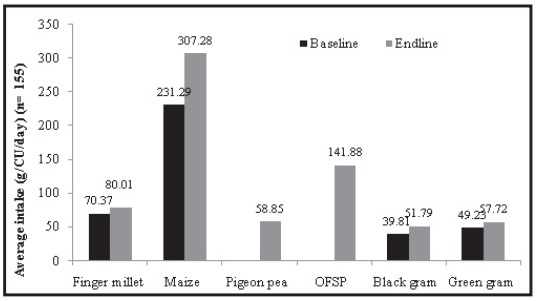


Figure 8.2: Average intake of nutrient-rich foods sourced entirely from own production (period: May–August): Comparison of baseline (2014) with endline (2017).

Wardha

***Crop Interventions*:** In Wardha, where cotton and soybean often with intercrop of pigeon pea are the main crops during the kharif season, both sole cropping and intercropping of pulses other than just pigeon pea, for example, green gram and black gram, as well as cultivation of sorghum were encouraged. Improved variety of pigeon pea was also introduced and thrust

was given to cultivating sorghum at least for home consumption. Besides, suitable varieties of bengal gram and wheat were promoted to improve productivity and to bring more area under cultivation during the rabi season. The uptake of FSN interventions expanded beyond the core group of 5 villages to 16 more villages in Wardha, reaching out to more households. Table 8.2 gives the details of uptake of crop interventions in 2017.

In kharif 2017, red gram varieties PKV-Tara and Durga were grown by 128 farmers covering an area of 29 ha including sole cropping by 21 farmers. The results indicated that the average yields of Durga and PKV-Tara were 1947 and 1500 kg/ha, 57 and 21 per cent higher yield than regular farmers' varieties (1237 kg/ha), respectively. Compared to the previous year, area under pigeon pea in 2017–18 was lower as farmers who wanted to take a rabi crop opted for short duration pulse crops (green gram and black gram) instead of pigeon pea, which is a long duration crop.

Green gram variety Naval was grown by 122 farmers in 8 ha, including 70 farmers having sole cropping with an average seed yield of 515 kg/ha, 40 per cent higher than local varieties (368 kg/ha). Even though black gram is normally not cultivated as a sole/intercrop in the area, this kharif, 87 farmers cultivated it as sole crop in 8 ha and the average seed yield was 658 kg/ha. Similarly, 165 farmers cultivated sorghum (hybrid CSH-14) in 72 ha either sole or in combination with green gram or pigeon pea with an average grain yield of 2.2 tonnes per hectare. In rabi 2017, the micronutrient-dense improved varieties of wheat, namely, AKAW-4210 and NIAW-

Table 8.2: ***Number of farmers and area under FSN crop interventions***

Crop	FSN Villages (7 Villages)		Extension Villages (16 Villages)		Total	
	No. of Farmers[a]	Area (ha)	No. of Farmers	Area (ha)	No. of Farmers	Area (ha)
Kharif						
Pigeon pea	117	68.6	11	3.6	128	72.2
Green gram	115	17.8	7	1.6	122	19.4
Sorghum	145	179.5	20	11.9	165	191.4
Black gram[b]	76	15.6	11	3.9	87	19.5
Rabi						
Wheat	13	5			13	5
Bengal gram	13	8			13	8
Linseed[b]	9	3			9	3

[a] There is double/multiple counting of farmers. Farmers cultivating different crops are not mutually exclusive.

[b] Black gram and linseed were newly introduced in kharif and rabi 2017, respectively.

1415 (both rich in iron and zinc), were grown by 13 farmers in 5 ha using their own seeds saved from the previous year. Similarly, the wilt-resistant chickpea variety JAKI 9218 was cultivated by 13 farmers in 8 ha in the five core study villages. However, compared to previous year, farmers growing wheat and bengal gram varieties promoted under the study were reduced as some private seed agencies in the area were promoting their varieties for on-farm trial with 100 per cent input cost provision. Following an exposure visit to linseed fields in neighbouring villages in February 2017, 9 farmers cultivated linseed (variety TKV NL 260) in 3 ha during the rabi season.

***Nutrition Garden*:** It was found that 219 households had nutrition gardens of fruits and seasonal vegetables; in addition, there were community nutrition gardens managed by groups of women in four villages and similar gardens in four schools. Community seed banks were established in all the five study villages in Wardha in early 2017 to ensure availability of vegetable seeds for the next season, and these are being managed by groups of women in each village.

***Poultry*:** A second batch of backyard poultry was facilitated for 25 households in early 2018.

***Endline Survey*:** Out of 190 households, 158 were participating in FSN interventions and their food consumption pattern in terms of quantity, diversity and frequency was compared with the baseline in 2014 for the same households. Key findings are described below.

- Number of households growing nutrient-rich foods (pigeon pea, green gram, black gram, sorghum, wheat and bengal gram) and average intake of such foods entirely from home production has increased in endline as compared to baseline (Figures 8.3 and 8.4).
- There is an increased frequency of consumption of the foods listed above (daily or twice/thrice a week) versus once a week in baseline.
- Sorghum consumption sourced entirely from own production increased from 6 per cent of households at baseline to 30 per cent households at endline.
- Diversified pulse consumption (pigeon pea, green gram, black gram and bengal gram), both as whole and dal, was seen. Average quantity of per day intake increased 1.5–2 times.
- There was an increase in the percentage of households cultivating and consuming newly introduced vegetables/plant species: drumstick (47 per cent), curry leaves (30 per cent), beetroot (53 per cent), and OFSP (41 per cent).
- Both diversity and average intake of all the three groups of vegetables (green leafy, other vegetables and roots and tubers) were increased.
- In terms of egg consumption, 10 per cent of households were found to be having eggs twice/thrice a week versus 1 per cent in baseline.

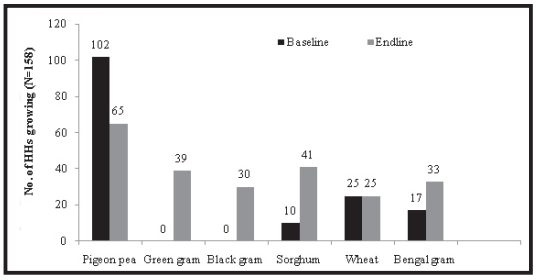


Figure 8.3: Number of households growing nutrient-dense food crops: comparison of baseline (2014) with endline (2017).

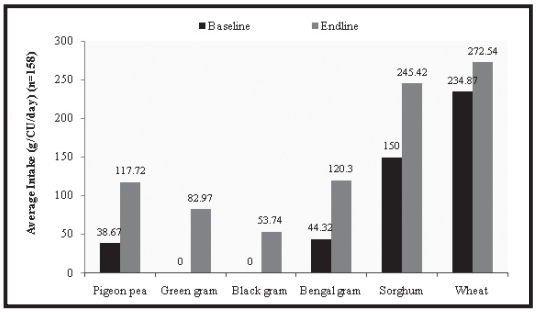


Figure 8.4: Average intake of nutrient-rich foods sourced entirely from home production, (period: May–August): comparison of baseline (2014) with endline (2017).

Capacity-Building Programmes at Both Study Locations

***Koraput*:** An exposure visit of 1 female and 38 male farmers from nine villages was organized to 'System of Millet Intensification (SMI)' demonstration fields in November 2017. The main objective of the exposure visit was to create awareness among the farmers on millet cultivation practices under SMI and its benefits. The farmers were impressed to see the demonstration field and about 20 have expressed their intention to adopt the technology in the upcoming kharif season in 2018.

Five staff members visited two ICAR (Indian Council of Agriculture Research) institutes in Bhubaneswar, namely, ICAR-Central Institute for Women in Agriculture (CIWA) and the regional centre of Central Tuber Crop Research Institute (CTCRI) in November 2017. The visit gave them an opportunity to update their knowledge on technologies for women in agriculture with regard to crop and horticulture production, livestock and fisheries, drudgery-reducing women-friendly farm tools and equipments and knowledge of tuber processing and value-added products from tubers.

***Wardha*:** Training on Community Seed Bank was organized at Borgaon Gondi village on 11 November 2017 to provide technical knowledge on management of seed (safe harvest and storage) and Community Seed Bank. Two women farmers from the Community Seed Bank established under the Mahila Kisan Sashaktikaran Pariyojana in Paloti village were invited as resource persons and 28 women farmers from the five core FSN study villages participated in the training programme.

A team of about 40 men and women farmers from the study villages and staff members went on an exposure visit to the M S Swaminathan Farm School in Takarkheda in Arvi taluka in December 2017. The visit included knowledge sharing on organic farming, information on model nutrition garden and vermicompost unit and understanding the operation of bio-gas plant.

***Nutrition Awareness Activities at Both the Study Locations*:** As a part of impact assessment of the nutrition awareness initiatives, internal and external evaluation was conducted at both the study locations in late 2017. The internal evaluation was conducted with the help of seven checklists for different categories of stakeholders. The staff members in Wardha and Koraput were oriented on the checklists and the evaluation was done in early 2018. External evaluation was entrusted to a consultant. Following the recommendation of refresher courses for community resource person (CRPs) at both the study sites in the evaluation report and also in order to further strengthen the knowledge of CRPs on nutrition, refresher courses were arranged in discussion with the CRPs. They identified some areas in which they wanted to be trained and it was around these that the objectives of the refresher course were framed. In Wardha, the programme was conducted on 16 February 2018; a total of 30 members (M: 13; F: 17) including CRPs, Sarpanch, ASHA, members of FSN community nutrition garden and community seed bank, farmers, PRI members, Anganwadi workers, SHG members and village volunteers from five FSN study villages attended the programme. Mrs Avanti Naidu, Assistant Professor in the Department of PG Studies and Research in Home Science, JBAS College for Women, Chennai, was the resource person for the programme. In Koraput, the workshop held on 8 March 2018 had 26 members of the community (M: 15; F: 11), including CRPs, ward members and village volunteers, participating. Ms Trupti Mahapatra, Anganwadi supervisor, Jeypore, was a resource person. Materials in local language on balanced diet, entitlement cards, FSN leaflets and write-ups on different topics were distributed to the CRPs so that they could use them as tools for spreading nutritional messages.

A food chart on balanced diet in the form of wall hanging in Marathi and Odia was designed and distributed to all households in all FSN study villages, schools and government institutions.

***Feasibility of FSN*:** The evidence emerging from the comparison of the endline survey with the baseline indicates feasibility of the FSN approach. The interventions clearly demonstrated that with the introduction of improved varieties and crops in the existing cropping systems, and improved agronomic practices and nutrition gardens, the cropping intensity and food production at the farm level increased at the field level in both the study areas. The introduction of short duration crops and improved varieties also helped to diversify the household food production basket covering cereals, pulses and vegetables. The increased food grain availability and diversity at farm level has led to improved household dietary diversity as evidenced in increased number of food groups in the diet, consumption of all three groups of vegetables, increased frequency of consumption and increased average intake of the food consumed.

***Sustainability Measures*:** For the sustainability of the programme, linkages for convergence have been created between the village community and technology stakeholders and

government departments. In terms of inputs, especially of seeds, several measures such as distribution of and familiarization with triple-layered polythene bag for safe seed storage, community seed banks for nutrition garden cropsand linking farmers with seed suppliers for field crops in Wardha, and village seed banks of field crops in Koraput were taken. To encourage the consumption of millets and pulses, five community-level pulse processing units (one for pigeon pea, one for green gram and black gram and three for millets) were installed in Koraput. These are being managed by farmers' groups and have been strategically located to cater to a cluster of villages. Resolutions have been passed regarding their operation and management. Display boards having information on FSN interventions and names of village volunteers were installed in all the core study villages in both locations. Pictorial messages on nutrition sensitive agriculture and importance of different foods were also drawn on the walls at strategic places, for example, ICDS Centre and adjacent to a shop, in the study villages in Wardha, for continued awareness. The management of Farmer Knowledge Centres (FKC) in two villages, four community nutrition gardens, school nutrition gardens, three community seed banks and one genetic garden (GG) in Wardha were formally handed over for operation with the respective Gram Panchayats overseeing the operations, following meetings with village members, PRI members and school management committee members. Resolutions to this effect were duly passed by the respective Gram Panchayats. In Koraput, approval has been recently received for extending the work to more villages with support under the Rashtriya Krishi Vikas Yojana (RKVY).

***Advocacy*:** The insights from the FSN study are being shared and discussed at several scientific forums as well as at block-, district-, state- and national-level consultation meetings. The work was shared at the Regional Consultation on FSN at MSSRF in August; MSSRF was invited to conduct a session on FSN at a workshop on nutrition sensitive agriculture conducted by the Indian Agriculture Research Institute in September 2017. The Director General of the Maharashtra Council of Agriculture Education Research (MCAER) visited the FSN study villages in October 2017 and interacted with the members of the community and staff; following that, in December 2017, MCAER convened a workshop of the four agriculture universities and Krishi Vigyan Kendras (KVKs) in Maharashtra and invited MSSRF to elucidate the FSN approach (see SPA 501 for more details). A high-level multi-sectoral one-day roundtable on 'Leveraging Agriculture for Nutrition' was jointly hosted by NITI Aayog and MSSRF in Delhi on 30 January 2018 to discuss the nutritional dimension in agricultural policies and programme in India (see section on Workshops and Conferences for more details). A state-level consultation on sharing research evidence from the FSN study in Odisha with government officials and researchers was held in collaboration with the office of the Development Commissioner, Planning and Convergence Department, Government of Odisha, in Bhubaneswar on

20 March 2018 (see section on Workshops and Conferences for more information). In Wardha, a district-level workshop on 'Leveraging Agriculture for Nutrition through Nutrition Gardens' was organized under the aegis of the Wardha District Council (Zilla Parishad), Wardha, on 23 May 2017 to share and discuss the experience and insights on promotion of nutrition gardens and generating nutrition awareness as part of the FSN study. The evidence from the study was shared with the District Collector, CEO, Zilla Parishad and other officials at the Collector's office in Wardha on 12 March 2018; a stakeholder consultation with civil society organizations was also convened the same day. In Koraput, the District Collector chaired a meeting at the MSSRF Regional Centre in Jeypore on 23 March 2018, where the study was presented to officials from different departments. The base created by this study is providing support for the FSN advocacy initiative reported under SPA 501.

Most importantly, farm men and women from the study villages are sharing their experience under FSN with other farmers and at different stakeholder platforms. Their understanding, ownership and acceptance are crucial for sustenance and upscaling of the approach.

Research Uptake

From the outset of the research programme, the research uptake (RU) strategy under LANSA has focused on bridging the science-to-policy and the science-to-practice interfaces. MSSRF has been leading the Consortium on RU and country activities in India, keeping with the following objectives as designed since inception:

1. Stakeholders and policymakers are engaged with LANSA research, from the outset.
2. High-quality research communication is tailored to the needs of stakeholders.
3. Consortium members have increased RU capacity.
4. Stakeholders are better able to understand and use evidence.

Below are some RU highlights under each of the above for the year 2017–18:

***1. Engagement with Stakeholders and Policymakers*:** The RU team continued to engage with stakeholders identified at baseline and expanded the stakeholder base. Every form of engagement by researchers and the RU team is recorded in a stakeholder engagement log managed and maintained by the RU team since 2013. The information is structured to enable the RU team to monitor LANSA output and research products presented at conferences, research evidence showcased at meetings, workshops, seminars and so on. The data is logged for every country and for global-level stakeholder engagement as well, and allows the RU team to plan for follow-up action. Agriculture-nutrition stakeholders continuously engaged with research evidence through events either hosted by LANSA or where LANSA was invited to present research work, such as knowledge-sharing consultations, stakeholder roundtables, online discussions, face-to-face

meetings, conferences, seminars and so on. Stakeholders ranged from policy decision-makers to policy influencers including women. Researchers were invited to present research evidence and share insights at regional events organized by SAFANSI in Kathmandu in September 2017 and FAO Regional Office for the Asia-Pacific in Bangkok in November 2017. LANSA partnered with the ANH Academy at their annual conference in Kathmandu in July and organized a plenary session on women in agriculture and nutrition where gendered insights from work done under the FSN study were shared.

***2. High-Quality Research Communication*:** All MSSRF agriculture-nutrition stakeholders receive the LANSA India e-newsletter. RU has also continued to produce thematic and customized high-quality communication products for target stakeholders in the country. A total of 12 Policy and Research Briefs have been produced from the research undertaken, and cross-posted on Eldis, Open Docs and the MSSRF website for wider reach. Downloads are monitored and recorded for consolidation as part of annual reporting. The RU team applied strategic approaches to assess the quality and usefulness of LANSA products that were produced from the research evidence generated. The exercise involved stakeholders who have the potential to influence policy in India, and those who have expertise in agriculture and nutrition at various levels.

***3. Increased Research Uptake Capacity among Researchers*:** LANSA's RU manager facilitated a workshop on RU for senior staff members in August 2017 in Chennai as part of the organization's plan to streamline RU at the institutional level. LANSA's experience with RU is helping to mould the strategy document and also plan for the future communications agenda of MSSRF. The half-day workshop oriented senior staff members on the concept of RU and strategies and RU activities adopted by the LANSA in India. LANSA research products, challenges and lessons learned were also reflected upon. Twenty-three staff members participated in a half-day training on social media tools, specifically blog and twitter writing, conducted by the LANSA RU manager on 11 August 2017. At the end of the training, 95 per cent participants reported that the training was useful to communicate their research work more widely, and that they would like to have additional skills support for effective research communication.

***4. Stakeholders Are Better Able to Understand and Use Evidence*:** Engagement in 2017–18 was more strategic, and specific policymakers and policy influencers were identified to take-up LANSA-MSSRF evidence. These identified 'champions' for LANSA work have been spokespersons at influential forums not just in India, but in South Asia region and globally as well. MSSRF-led RU team facilitated two lightning sessions in partnership with Innovative Methods and Metrics for Agriculture and Nutrition Action (IMMANA) on 'Research Uptake – What Is It, Why Bother, and Are You Good At It?' during the ANH Academy Week in July 2017. The session offered an opportunity for researchers at various levels as well as RU and communication persons to engage with

questions around RU. The LANSA Research Uptake Self-Assessment Tool (RUSAT) was much appreciated by participants. A pre- and post-assessment was done to understand how participants felt about the trainings. There were 46 participants, and after the training 75 per cent were convinced that it is possible to perform RU and 99 per cent said they would like to know about how to engage in effective RU.

Some Highlights of Research Uptake Activities for the Year Include:

- @LANSAresearch receives 11,911 new profile visits
- 10 blog posts on LANSA website by researchers
- 12 policy/research briefs on research evidence generated
- 32 meetings with decision-makers at district/state/national level
- 18 presentations at national or international conferences
- 4 media briefings/press releases
- 14 news articles published
- 4 short films from FSN study for LANSA website

Coordination

The LANSA Consortium Steering Group and Annual Partners' meeting were held in July 2017, back to back with the ANH Academy Week in Kathmandu. With LANSA entering its final year, proposed synthesis activities and budgetary requirements were finalized during the year and work on consolidation of the research undertaken has commenced.

Sub Programme Area 802

International Projects

Rice Bio-Park

Infrastructural facilities for the conversion of Rice Bio-mass into market driven products have been created at the Rice Bio-Park for helping the small land holding families engaged in rice farming to generate more jobs and income. Nine master trainers deputed by the Department of Agricultural Research, Myanmar have been trained in India at Chennai, Kattupakkam, Puducherry, Thanjavur, Dindigul area, Erode and Mysore. They have been trained in various activities like preparation of complete feed block using urea treated rice straw, making handmade paper/board using rice straw and its value added products, bio-fertilizer production using black ash from rice husk as carrier, vermi-compost production from rice biomass and preparation of rice based products like popped rice, flaked rice, puffed rice and their value added products which would form the main work of the Rice Bio-Park.

Two rice mill Engineers of the Department of Agricultural Research, Myanmar were trained by the technicians of M/s Perfect Equipments during the erection and commissioning of the two tonne Ultra Modern Rice Mill installed at the Rice Bio-Park for 15 days as per the terms

and conditions of the supply order issued to the supplier of the rice mill components. Dr Selvamukilan imparted onsite training to the technicians of Rice Bio-Park on making paper utilizing rice straw as one of the ingredients. He also trained them in operating different devices/tools involved in the production of paper. Four days training was imparted to RBP staff on basic operation and application of protein analyzer Gerhardt by U Soe Aung (AMTT. Co. Ltd., Lab Manager). He imparted training on preparation of chemical reagents, digestion, titration and calculation of protein content in cereals and legumes.

Rice farmers from different States of Myanmar as selected by the Directorate of the Department of Agriculture were imparted training on all the aspects of utilizing the entire biomass of rice and also on better agricultural practices for growing rice. Totally 10 trainings with three days duration each were conducted at the Rice Bio-Park. Till the end of March 2018, 325 farmers have been trained. The training consists of Lectures, Power point presentations and demonstrations. The farmers desired to implement some of the processes in their village sites for generating more job and income. A Report on handing over of Rice Bio-Park to Myanmar Authorities has been prepared and submitted to the Ministry of External Affairs, Government of India. It is planned to organize visit of the Project Monitoring Committee to the Rice Biopark and during which the date of handover of the Rice Biopark to the Government of Myanmar will also be decided.

Workshops and Conferences

Tamil Nadu Nutrition Alliance, Chennai, 18 May 2017

An initiative for better nutrition to bring together different stakeholders across Tamil Nadu for nutrition was launched on May 18, 2017. The 'Tamil Nadu Nutrition Alliance', is being facilitated by MSSRF in partnership with UNICEF and aims to bring synergy of nutrition efforts across Tamil Nadu in partnership with the Government of Tamil Nadu. The logo of the alliance, signifying a healthy food basket and an emerging network was formally launched by Prof. M.S. Swaminathan and Dr. Darez Ahamed, IAS, Mission Director, Tamil Nadu National Health Mission. Mr. Job Zachariah, Chief of Office, UNICEF Tamil Nadu and Kerala spoke of how nutrition cannot be seen in isolation but required convergence. Terming the alliance, a timely need, Prof. M.S. Swaminathan, Founder MSSRF, said this could create a major change in the nutrition scenario in the state. Representatives from the State Planning Commission, Department of Social Welfare ICDS and Health, research institutions, NGOs, nutritionists and Community Based Organizations participated in the meeting. During the day-long discussions, participants provided their suggestions and inputs for taking the alliance ahead.

M.S. Swaminathan: The Quest for a World without Hunger Book released by the Prime Minister Shri. Narendra Modi, New Delhi, 19 May 2017

The Prime Minister, Shri Narendra Modi, released a two-part book series on the eminent agricultural scientist Dr. M.S. Swaminathan titled - M.S. Swaminathan: The Quest for a world without hunger. Several Union Ministers and other dignitaries were present on the occasion. Praising the dedication and commitment of Prof Swaminathan, the Prime Minister described him as a "Kisan Vaigyanik" – Farmers' Scientist; rather than just a "Krishi Vaigyanik" – Agricultural Scientist. The Prime Minister said that Prof. Swaminathan's specialty is that his work has been grounded in practical reality. Prof Swaminathan thanked the Prime Minister for his kind words, and appreciated his vision. He emphasized the importance of synergy between technology and public policy.

Saasthra Sammeksha 2017, Wayanad, 26-27 and 29-31 May 2017

A five-day environment camp was conducted on May 26th, 27th, 29th 30th & 31st 2017. The program was organized in order to promote science education among school going students and attended by approximately 238 students.. The program was supported by the Kerala State Council for Science, Technology and Environment (KSCSTE), Government of Kerala.

Indo Myanmar Rice partnership, Visit of Scientist to MSSRF, Chennai, 12 July 2017

MSSRF under the guidance of Prof Swaminathan and with support from the Government of India established a Rice BioPark in Yezin, Nay Pyi Taw, Myanmar in

2013, for the preparation and marketing of value added products from the rice biomass consisting of straw, bran, husk and grain. A team of nine senior scientists from Myanmar visited MSSRF and met with Prof Swaminathan, Founder MSSRF and Dr V Selvam, the Executive Director, MSSRF. The team was in India for a fortnight and visited MSSRF sites in Puducherry for training on making value-added products from rice biomass.

Fish for All Research and Training Centre, Stakeholder consultation, Poompuhar, 11 July 2017

A stakeholder consultation was organized in Fish for All Research and Training Centre, Poombuhar during 11th July 2017 to identify actions needed to address the present and emerging challenges in sustainable livelihood development of fishing communities and to solicit stakeholders' contributions for the way forward. 62 key stakeholders from the community, Government departments, and Research institutions, Universities, NGO's and CBO had participated in the meeting. Needs and issues related to marine fisheries, post harvesting, inland aquaculture were discussed through panel discussions with community members and government officials. The following key points emerged from stakeholders for promoting sustainable fisheries. (i) Promote artificial reef for improving the biodiversity of near shore marine environment across Tamil Nadu and Puducherry coast; (ii) Government and Research Institutions like MSSRF focus more on promoting Hook and line fisheries among fishers through awareness creation, structured training and demonstration; (iii) Concrete and constant efforts needed from Government side to reduce trawling operation and promote alternative sustainable fishing solutions; (iv) Conduct 2-3 trails engaging fishers with and without square mesh to promote square mesh operation and to realize its benefits; (v) The present ban period is not much effective; so it needs further study to understand its effectiveness; and it was also suggested promoting monsoon fish ban which is very effective; (vi) Need long term action plan for Government to minimize coastal pollution, especially throwing plastics into marine environment; (vii) Regulate Engine Horse Power and need a strict monitoring mechanism for its implementation and execution; (viii) TUNA advisory services are more useful; need such species specific services for other commercially important fish species and (ix) Organize periodical district level fisher folks interaction meetings and develop an action plan involving fishing community and government to promote sustainable fisheries. Some of the important recommendations from the stakeholders' consultation meeting have been incorporated in the Five Year Strategic plan of Fish for All Centre.

District Level Consultation on Workshop on Farming System for Nutrition, Pune, 24-27 July 2017

The consultation was organized by the MSSRF in collaboration with NIRD&PR, Hyderabad and YashwantraoChavan Academy of Development Administration (YASHADA),

Pune. The consultation was inaugurated by Dr. Siddayya, Associate Professor, National Institute of Rural Development and Panchayati Raj (NIRD&PR) on the 24th July, 2017. On the 25th and 26th of July, the consultation was presided by Mr. Anand Pusavale, Associate Professor of YASHADA while on the 27th July, Dr. K. M. Nagargoje, IAS (Member Secretary, Maharashtra Council of Agricultural Education & Research) provided a keynote address. A total of 102 participants-district officials, representing the departments of agriculture, horticulture and animal husbandry and scientists from Mahatma PhuleKrishiVidyapeeth (MPKV), Rahuri attended the consultation.

INELI Peer Review workshop: INELI mentors and Cohort 1 innovators, Goa, 23-28 July 2017

This workshop aimed at reviewing and refining the existing contents to meet the needs of the public librarians. The two modules on Community Needs Assessment & Understanding Self were strengthened with leading examples from the field involving 2 mentors, 4 innovators, 3 MSSRF INELI staff during this exercise.

Regional Consultation on Farming System for Nutrition, Chennai, 7-9 August 2017

Setting the tone for a new agenda on nutrition in the country, Prof M S Swaminathan, Founder MSSRF called for a 'nutrition revolution' in India. Speaking at the concluding session of the 3-day conference on Farming System for Nutrition, organized by MSSRF in Chennai, Prof Swaminathan said there needs to be a Common Minimum Programme among stakeholders so that 'Zero Hunger' could be achieved. The role of farming and of integrating various aspects into farming practices was shared by speakers from across the world during this three-day consultation organized by MSSRF with the support of Tata Trusts. Some of the speakers during the conference included: 2016 World Food Prize laureate Dr Andrade, the IFAD Country Director, Dr Omar, Director General of ICAR, Dr Mohapatra, Director Tata Trusts, Dr Sankar, Director ICRISAT, Dr Whitbread, Ms. Kalaivani, progressive farmer from Thanjavur and others. Shri Krishna Byre Gowda, Honourable Minister for Agriculture, Government of Karnataka delivered keynote address in the inaugural session. The 'Chennai Action Plan for a Nutrition Revolution' that was discussed at the consultation was shared with stakeholders and policy makers to strengthen nutrition sensitive agriculture in the country.

Workshop on "Strengthening Local Self-Governments to integrate Biodiversity conservation in the local development plans through Participatory Community Action", Wayanad, 18-19 August 2017

The result sharing and closing workshop of the one year activities as part of this project was conducted during 18th and 19th of August 2017. A total number of 75 individuals including Panchayath representatives, BMC members, environmental activists and scientists participated in the workshop. The objectives of this workshop were to share the

results of the one year activities and to plan future activities in biodiversity conservation of Wayanad.

Regional Samvaad programme (Tribal Youth Programme in partnership with Tata Steel rural development society, Jamshedpur), Wayanad, 26-27 August 2017

TATA steel in collaboration with M.S.Swaminathan Research Foundation organized Regional SAMVAAD (South India)-2017, a two day tribal conclave at CAbC. The conclave discussed the emerging issues among tribal youths and emphasized the need of building capacity of tribal leaders to motivate the community and mainstream their needs and demands. Over 200 tribal youth from South India participated.

District Level Consultation on Farming System for Nutrition: A Pathway for Addressing Malnutrition, Odisha, IMAGE, Bhubaneshwar, 28-29 August 2017

The consultation was organized by the MSSRF in collaboration with Institute on Management for Agricultural Extension (IMAGE), Bhubaneshwar and Nationl Institute of Rural Development and Panchayat Raj, Hyderabad. The consultation had representations a total of 43 participants from 19 districts over the two days. District officials, representing the departments of agriculture, horticulture and animal husbandry and officials serving in the respective state departments at Bhubaneshwar participated.

Piloting and Upscaling of PAN India Fisher Friend Mobile Application in Karnataka, Mangalore, 5 September 2017

MSSRF has developed a PAN India Fisher Friend Mobile Application in 9 languages in partnership with Qualcomm to cover the entire coastal states of India. The Kannada version of the FFMA was launched on 5th Sep '17 in two locations - Malpe and Mangalore fishing harbors in partnership with ICAR – CMFRI as piloting for refinement and up scaling the application among the fisher folk in Dakshina Kannada and Udupi districts. Scientist In-charge, Regional Centre, CMFRI, Mangalore, Deputy Director of Fisheries, Malpe and Fishermen Associations leaders participated in the launch event; they spoke about the importance of the FFMA for small scale fisheries development. Mobile handsets loaded with FFMA application were distributed to 10 fishermen master trainers from Malpe and Mangalore areas for piloting the application. At the end of the programme, the characteristic features of the FFMA were explained; also how the features could be downloaded from Google play store and its registration process was demonstrated. Around 100 fisherfolk from Maple and Mangalore fishing harbor had participated in the confluence. The application is regularly updated and till date 1079 fishermen are using this facility. Feedback received from fishers indicates that the application is very useful in times of distress and also has greatly shortened the time required to get to the fishing grounds indicated by the PFZ advisories.

District Level Consultation on Farming System for Nutrition: A Pathway for Addressing Malnutrition in Andhra Pradesh, Extension Training Centre (ETC), Srikalahasti, 7 September 2017

A one-day consultation was held at the Extension Training Centre (ETC), Sri Kalahasti to disseminate the concept of Farming System for Nutrition among district officials representing the departments of agriculture, animal husbandry, horticulture and fisheries. The consultation had representatives from 13 districts with a total of 29 participants, including 8 faculty members from ETC. The consultation was inaugurated by Dr. Radhika, Associate Professor, NIRD & PR in the presence of Ms. Prasanthi, Acting Principal, ETC.

Workshop on Soil Salinity Mapping and Management, Brahmavar, 8 September2017

MSSRF organised a workshop on "Soil Salinity Mapping and Management" at Zonal Agricultural and Horticultural Research Station (ZAHRS), Brahmavar on 8thSeptember 2017. The main objective of the workshop is to finalize the protocols and procedures for coastal soil salinity mapping in Panchagangavali and Aghanashini Estuaries. Soil Scientists from University of Agricultural and Horticultural Sciences, Shivamogga, University of Agricultural Sciences Dharwad, University of Agricultural Sciences Bengaluru, University of Agricultural Sciences Raichur, KrishiVigyan Kendra, Brahmavar, M.S. Swaminathan Research Foundation and officials of Department of Agriculture, Government of Karnataka from three coastal districts participated in the meeting.

Workshop on Knowledge Management for Nutrition, Puducherry, 26-27 September 2017

The Tamil Nadu Nutrition Alliance gathered for a two-day workshop on 'Knowledge Management for Nutrition' at Puducherry on September 26 & 27, 2017. The participants shared knowledge of their work related to nutrition and were in consensus about promoting traditional crops and foods for nutrition and about the involvement of community in spreading the message of nutrition. Dr FarhatSaiyed, UNICEF outlined the objectives of the Alliance requesting each of the stakeholders present to contribute to the network to take it forward. Head HMRC, MSSRF highlighted how the Tamil Nadu Nutrition alliance knowledge platform could be used to share tools and resources for nutrition in Tamil Nadu. The meeting also included field visits to Vazhudavoor, to study the dairy collectives of women and a visit to Poraiyur for an interaction with adolescent girls on nutrition and related issues.

INELI South Asia Kick-start meeting, New Delhi, 5 October 2017

A kick off meeting to begin INELI South Asia was organized involving the INELI chair, INELI South Asia Steering Committee members, Mentors, representatives from IPLM, IFLA and Global Libraries programme. This purpose of the meeting was to envision the inception

and future of INELI South Asia. The meeting highlighted the role of UN-SDGs, its relevance in community development and services demonstrated through public libraries and the need for strengthening network for building a strong community of practice in South Asian countries.

Peer Review Workshop on INELI Online learning platform, Chennai, 6-7 October 2017

Ms. June Grace, Consultant of Bill and Melinda Gates Foundation who facilitated the Global INELI was invited to discuss on strengthening the INELI India online course and to understand the relevance of content, and the process that supports the online facilitation and its process. Together 8 Innovators were invited to be part of this discussion along with the MSSRF team to capture the issues, for accelerating their online learning environment integrating all concerned stakeholders.

Seminar on Achieving the Goal of Malnutrition Free India and Inauguration of Genetic Garden of Biofortified Crops, Chennai, 16 October 2017

Speaking on the occasion of the World Food Day programme organized by MSSRF, Dr V Saroja Honourable Minister for Social Welfare and Nutritious Noon Meal Programme, Tamil Nadu said, "The World Bank has lauded Tamil Nadu for its efforts to address malnutrition. However, in spite of excellent PDS and schemes like fortified salt, food-based initiatives to address malnutrition is essential and efforts to include millets in the PDS at the earliest". The minister said she would also discuss revision of 'Malnutrition Free Tamil Nadu' policy with inter-sectoral convergence. With Prof M S Swaminathan's guidance, Tamil Nadu was the first state to put together such a document in 2003 facilitated by MSSRF.The Minister also inaugurated a 'Genetic Garden of Biofortified Crops' at MSSRF that aims to provide planting material and awareness on plants based nutritive property such as Vitamin A-rich plants, iron-rich plants etc. Mr. Job Zachariah, Chief, UNICEF Office for Tamil Nadu and Kerala, Dr G S Toteja, Senior Deputy Director General, Indian Council of Medical Research Government of India, Mr R Jegannathan, Proprietor Nallakeerai were some of the other speakers on the occasion.

Jamsetji Tata National Virtual Academy (NVA) 11th convocation of National Virtual Academy, Chennai, 22-23 October 2017

The 11th convocation was organized through which 74 Fellows, including 41 Men and 33 women from 9 states across India were inducted into the academy. The brief profile of the NVA Fellows in the form of a Directory was released as a 9th volume during the convocation on 23rd October 2017. A Participatory Knowledge Management Workshop was organized prior to the convocation to bring together the Fellows to orient the role of Fellows. Besides, the workshop played a significant role in the exchange of information, experiences and expertise sharing for cross learning among fellows and to enhance their self-esteem.

Pilot Launch of Fisher friend Mobile Application in West Bengal, Digha, 26 October 2017

MSSRF in partnership with Rural Eco Development Centre (RED), an NGO working for the welfare of fishermen community in Digha launched the Bangla version of the FFMA for piloting and refinement of the application with the participation of fishing communities in West Bengal. The launch programme was conducted in Digha, West Bengal on 26th October 2017. Dr. S. Balakrishnan, Scientist & In-Charge, Zoological Survey of India (ZSI), Govt. of India, Dr. Subho Ghosh, In-Charge, Digha Science Centre, Govt. of India and Shri. Pranab Kar, Chairman, Digha Fisherman and Fish Traders Association participated and spoke about the importance of marine communication for fishermen and the role of Fisher Friend Mobile Application. Ten key fishermen from Purba Medinipur and South 24 Pargana district were identified as master fishermen trainers and mobile handsets loaded with FFMA application were distributed for providing feedback to strengthen the FFMA in order to make it more user friendly. Around 150 fishermen participated in the event. Presently, the FFMA is promoted mainly in Digha-Shankarpur region of Purba Medinipur and a few pockets of South 24 Pargana District, such as Kakdwip and Frasergunje. About 742 fishers are currently using FFMA in West Bengal and they have given good feedback around the application. Most of them appreciated International Border Line alert between India and Sri Lanka and requested to make it operational between India-Bangladesh at the earliest possible.

Action Plan for Carbon Neutral Wayanad,Wayanad, 1 November 2017

A consultation to devise strategies and action plan for combating climate change and to promote carbon neutral development process for “Carbon Neutral Wayanad” was held in MSSRF n Wayand on 29th October, 2017. It was inaugurated by Dr. T. M. Thomas Issac, Minister of Finance, Government of Kerala at the MSSRF Community Agrobiodiversity Centre (CAbC), Wayanad, Kerala. Experts from different R&D institutes, Panchayath Raj Members and farmer representatives shared their views and opinions. MSSRF ensured technical support in implementing Carbon Neutral activities in Wayanad. There was a panel discussion on developing market value chain for Wayanad shade coffee -problems and prospects. DrIssac said carbon neutrality in Wayanad was made possible by the scientific intervention and implementation of methodologies including afforestation of indigenous tree species that proved to be helpful in carbon sequestration.

National Consultation on Political Economy of Gender and Energy, New Delhi, 1 November 2017

MSSRF in collaboration with NITI Aayog and ENERGIA organized a one day consultation on ‘Political Economy of Gender and Energy’ at New Delhi on November 1, 2017 with the active participation of policy makers,

academicians and civil society organizations. The main purpose of the consultation was to share preliminary findings of a study on the topic and learn from experts and practitioner to deepen and widen knowledge and also in providing assistance to policy making on Gender, Energy and Agriculture. The discussions were organized in two technical sessions: Clean cooking energy and women's access and use of energy based machinery in agriculture. Shri. Rajnath Ram, Joint Adviser, NITI Aayog detailed the provisions in the Draft National Energy Policy aimed at achieving the Government's commitment to achieve 100% electrification by 2022 and fuel switching in cooking from unclean solid fuel to clean sources like LPG, PNG and electricity. Also, he expressed that considering the 300 sunny days in the country, promotion of solar energy assumes greater priority and by 2022 the nation is aiming to have renewable energy mix in order to meet the NDC target of 40% energy use should be from non-fossil fuel based sources. Dr. Mridul Eapen, Member, Kerala State Planning Board delved on the inter-linkage of women's empowerment and energy use and described Kerala's non-conformity to this central argument, as reflected by the higher level of LPG use despite a low work participation rate for women in the state. She attributed this to conservative measures of work participation.

Prof. M. S. Swaminathan, Founder Chairman, MSSRF, emphasized the need for engendering programmes and plans right at the designing and planning stages. He highlighted the lack of gender inclusiveness in the implementation of several national programmes like *kisan* credit cards and reiterated the need to have gender dis-aggregated data both in the field of energy access and use and in agriculture. He stressed the importance of having an integrated energy supply system with adequate energy mix, especially renewable energy to achieve sustainable energy security at village level. He stressed the need to have more research on women friendly agriculture machinery in order to increase the adoption rate. He emphasized the need to adopt strategies to strengthen the professionalization and empowerment of women farmers with new skills and knowledge that leads them to gain agency and access to clean energy. He stressed that without women, sustainable development is not possible.

The consultation stressed on the need for treating LPG use for cooking as the 'new-normal' rather than a prestige good. The need for engendering the 'Draft National Energy Policy' was highlighted and the need for inclusion of energy-based machinery for women's work in agriculture. Making HAP as a public health issue was widely commended by the panelists and discussants. Participatory implementation and machinery development for women, bundling of subsidies and progammes aimed at women's increased uptake of clean energy, delinking the definition of farmer from ownership of land, promotion of women's collective to influence change in social norms, and encouraging women's participation in the energy value chains were highlighted as key action strategies to encourage adoption of clean energy by women for productive and household work.

Workshop on Climate Change for students and teachers, Wayanad, 24 November 2017

One day workshop on climate change was organized for students and teachers. The workshop dealt with various aspects of climate change and its impacts on agriculture and human wellbeing. Researchers working in the areas of climate change interacted with students and teachers.

District Level Consultation on Farming System for Nutrition: A Pathway for Addressing Malnutrition in Bihar, Bihar Agriculture Management and Extension Training Institute (BAMETI), Patna, 16-18 November 2017

The consultation was inaugurated by Shri Sunil Kumar Singh, IAS, Agriculture Production Commissioner, Govt of Bihar in the presence of Dr Ganesh Ram, Director, BAMETI. Approximately 97 officials representing the departments of agriculture, gardening, animal farming and fisheries representing 37 (out of 38) districts participated in the consultation whose primary aim was to propagate the concept of Farming System for Nutrition and discuss the need and scope of nutrition sensitive agriculture in Bihar.

Workshop on Biodiversity and Media, 30 November -1 December 2017

A strategy is needed to conserve biodiversity in Wayanad and to make it a model conservation district, said Prof M S Swaminathan, Founder MSSRF at a media workshop on biodiversity held between November 31 and December 1, 2017. Speaking on video from Kottakkal, Kerala, Prof Swaminathan emphasized on the need to dialogue with media to bring greater discussion on this subject. Expressing concern that genetic erosion is happening to our mega diversity, he reiterated that every gene and species were precious. Wayanad is considered a biodiversity hotspot in the country. The workshop was organized by MSSRF in partnership with the National Biodiversity Authority (NBA). India's Biological Diversity Act, 2002, has been put in place to offer a theoretical account for sustainable utilization of resources and equitable benefit sharing. Mr Gopikrishna Warrier, Contributing Editor Mongabay, shared how the media had been consciously and unconsciously covering biodiversity. A study of media coverage on environmental issues completed by MSSRF, showed that although the concern related to biodiversity was present in the media, the term itself was rarely used. The workshop also included field visits that resulted in rich stories from the participants.

Chairman, Mitsubishi Corporation visits to project villages, Andhra Pradesh, 5 December 2017

On 5th December, 2017 Mr. Eisuke Shiozaki, Chairman and Managing Director, Mitsubishi Corporation India Pvt. Ltd visited project villages in Krishna District in Andhra Pradesh where a Mitsubishi supported project on Integrated Rural Development for Improved Water, Sanitation and Livelihood

is being implemented. He also participated in the foundation stone laying ceremony for the Village Resource Centre (VRC) at Machilipatnam. Mitsubishi Corporation Japan is supporting the construction of the VRC. The proposed VRC will provide need based knowledge and information to the fishing and farming communities living in the coastal areas of Krishna district for livelihood enhancement and disaster management. About 170 villagers from Sorlagondi, Nali and Mangalapuram villages participated in the function. Mr. Shiozaki, Chairman and Managing Director, Mitsubishi Corporation India Pvt. Ltd., informed that they are implementing socio-economic and skill development programmes through their Corporate Social Responsibility (CSR) in India from 2002. He emphasized the need of knowledge and skills for societal development for which the proposed VRC will help to fulfil the needs of the rural community.. Shri K. Narayana Rao, commended the work on participatory mangrove conservation and management in Andhra Pradesh. He thanked MSSRF and Mitsubishi Corporation for implementing developmental works in three villages of his constituency and assured all help from the state government.

Millennium Lecture: Building shared value – Mitsubishi and MSSRF partner for development, Chennai, 6 December 2017

Some years ago in a remote village in Koraput district in Odisha, a group of women gathered to pray in front of something that was going to make a big difference to their lives. It was the first street light that the village was getting. For a village yet to get electrical connectivity, this was a moving and life changing experience. These lamps and the reverence of the people were made possible by the first partnership that M S Swaminathan Research Foundation and Mitsubishi Corporation entered into nearly a decade ago. It was in continuation of this partnership that Mr Eisuke Shiozaki, Chairman and Managing Director Mitsubishi Corporation India Ltd. launched a series of development programmes in rural Andhra Pradesh.Mitsubishi Corporation has so far engaged in a series of initiatives in partnership with MSSRF in Odisha, and also along the eastern coastal regions. The lecture was part of the Millennium Lecture series of MSSRF where eminent personalities share their work and vision for sustainable development.

Traditional food *Mela* cum diversity *Mela*, Kolli Hills, December, 2017

Millet based traditional food mela/festival cum millet variety mela conducted at the central part of Kolli Hills (Thenurpatti patti of Gundur Nadu Panchayat) during 17 November and 9 December 2017 to create awareness, exchange of knowledge among the farmers and to expand the area of production. There are two food cum seed mela conducted during month of November and December,during the post harvesting season. About 100 tribal farmers actively participated in these events of that more than 60 % of them are women and resident of Gundur Nadu, Thiruppuli Nadu, Alathur Nadu, Gundani Nadu, Edappuli Nadu, Bail Nadu, Perakkarai Nadu and Chithur Nadu. In case of food mela, women farmers brought

more than 50 different traditional recipes exhibited such as koozh, kazhi, rice, uppma, kitchedi, kachayam, payasam, vegetable rice, briyani, Murukku and so on. In case of seed mela, farmers exhibited nearly 18 local varieties of five millets (Finger millet, Little millet, Italian millet, Proso millet and Kodo millet). These programmes are conducted as part of IIMR-TSP and Bioversity supported project. Key participants are scientists from IIMR, Bioversity International, DDM NABARD, Panchayat members and tribal farmers.

Localizing UNSDGs with India's National Priorities in Indian Public Libraries and "Facilitating and Strengthening Community Services and Capturing Positive Stories, Pondicherry, Pune, Kolkata and Chennai, January 2018 - April 2018

The 4 days intensive workshop was organized aiming at improving the public librarians' understanding on providing need based services for their communities in alignment with the National and State priorities, which are conceived, based on the UN-SDGs, 2030. The plan covered the review of data collection instrument, need for building evidence of change, a method of capturing key stories of change, readiness of the annual library development plan with specific focus on community based innovative services. In all, 37 Public librarians from 14 countries participated in this breeding; they brought greater understanding to take forward UN-SDGs and link India's National Priorities with their several public libraries.

Meeting of the Technical Advisory Committee of the project, 'Farming System for Nutrition: A Pathway for addressing malnutrition in India', Chennai, 8 January 2018

The second meeting of the Technical Advisory Committee was chaired by Prof. M.S. Swaminathan and attended by six of the consultative committee members. The meeting began with welcome remarks by Dr. V. Selvam, the Executive Director, MSSRF, followed by a presentation on the progress of the project activities by Dr. R. Rukmani. Following the deliberations by the members, Prof. M.S. Swaminathan provided the concluding observations.

Launching of M. S. Swaminathan Botanical Garden (MSSBG), Wayanad, 11 January 2018

The new phase of M. S Swaminathan Research Foundation- Community Agrobiodiversity Centre, at Puthurvayal, Kalpetta, Wayanad, a Botanical Garden that project the Global standard has been efficaciously launched by Shri. M.I Shanavas, MP on 11th January 2018. The garden has a specialty with various zones and Components for Science, Education and Recreation. The prodigious message from Professor Swaminathan highlighted on achieving the vision of 'Bio-happiness' integrating agriculture, nutrition and health, to resolve the increasing pressure on natural habitats in an era of climate change and on this important addition of the Botanical garden in pool of scientific capability in dealing with

emerging problems and new demands. Dr. Madhura Swaminathan, the Chairperson of MSSRF presided the launching programme. Dr. Sarada Krishnan, Director, Horticulture and the Center for Global Initiatives, Denver Botanic Gardens has designed the masterplan of the new phase of the garden.Dr. K. K. Narayanan the Chairman of MSSBG- Advisory Committee welcomed the distinguish leaders, honourable delegates and respectable gathering of the launching programme.

Kerala Science Congress – Celebrating 30 Years, Wayanad, 24 January 2018

The 30 year celebrations of the Kerala Science Congress were held at MSSRF's Community Agrobiodiversity Centre, Wayanad, in association with the Kerala Science Council for Science, Technology and Environment (KSCSTE). Three curtain raiser programs were held in Wayanad district at MSSRF St. Mary's College, Sultan Bathery, and Kerala Veterinary and Animal Science University (KVASU), Pookode.

Roundtable on Leveraging Agriculture for Nutrition, NITI Aayog, New Delhi, 30 January 2018

A one day roundtable discussion on 'Leveraging Agriculture for Nutrition' was organised with NITI Aayog in New Delhi. The event was chaired by Dr. Ramesh Chand, Member (Agriculture) an Dr. Vinod Paul, Member (Health & Nutrition) at NITI Aayog. There were about forty participants from different government ministries, NITI Aayog, research institutions, UN and donor agencies and MSSRF. Four presentations were made — one highlighting the evidence emerging from research under the LANSA consortium in India, a second elucidating the data sets on agriculture and nutrition that are available, the gaps and the challenges posed by issues like bioavailability and one each by the National Institute of Nutrition and the Indian Council of Agricultural Research highlighting the food consumption pattern and nutrition status of population as revealed by National Nutrition Monitoring Bureau (NNMB) surveys and research on developing biofortified varieties of different crops and improving productivity of naturally nutrient rich crops in order to address undernutrition, respectively. Shri Rakesh Srivastava, Secretary, Ministry of Women & Child Development who came in the afternoon session called for the need to bring agriculture and nutrition on a common platform and called upon NITI Aayog to take the lead in the matter. Location specific demonstration of Farming System for Nutrition Models through Krish Vigyan Kendras, a roadmap for the promotion of biofortified crops, nutrition, literacy in the community as a whole rather than just a mother-child centric approach, reviving NNMB and having state-level nutrition institutes and NITI Aayog as the nodal agency for convergence of Agriculture, Nutrition and Health were among the recommendations for action. The detailed minutes of the event are available at http://lansasouthasia.org/article/niti-aayog-and-lansa-seek-better-agriculture-nutrition-linkages-india

Water Literacy in 19 languages – A science communication initiative, Wayanad, 5 February 2018

Campaign modules on water literacy in 19 Indian languages are being planned as part of a joint initiative by MSSRF in partnership with the Environmental Resources Research Centre (ERRC), Trivandrum. This initiative is unique, since it is the first time that such a massive science communication campaign, focused on 'Sustainable Water Resource Management' is being planned on a mission mode for the Indian population in their native languages.

Wayanad Community Seed Fest-2018 and National Seminar on 'Community Seed Banks to Combat Climate Change, Wayanad, 23-25 February 2018

National Seminar was organized to deliberate on the importance of Community Seed Banks to strengthen the adaptive capacity of farmers. Traditional Crops and Seed varieties, having multiple traits, are on the verge of extinction. It is high time to collect unique gene pools and encourage farmers to multiply seeds of crops and varieties that are potential to adapt to climate change. Representatives of farmers and scientists shared their views and concern over declining crop diversity, and emphasis the need of setting up community seed banks, for developing climate resilient agriculture under the supervision of BMCs.

Leveraging Agriculture for Nutrition through Farming Systems Approach, 20 March 2018, Bhubaneshwar

The Development Commissioner cum Additional Chief Secretary, Govt of Odisha chaired the meeting at his office in the State Secretariat on 20 March 2018. There were about thirty participants comprising secretaries of key government departments, the Vice Chancellor of OUAT and researchers from ICAR and ICMR institutes and MSSRF. There were two presentations, one on an analysis of policies in Odisha from a nutrition lens and the other on the evidence from the Farming System for Nutrition approach demonstrated by MSSRF in Koraput district. The need to bring in a nutrition focus in policies and programmes of agriculture and allied sectors was recognised; referring to kitchen garden of fruits and vegetables as Nutrition Garden to highlight the nutrition focus and formulating a separate scheme for such gardens, location specific models of farming system for nutrition through KVKs, nutrition literacy across the board, building in this focus in the agriculture university curriculum and roadmap for promotion of biofortified crops were among the recommendations made. The detailed minutes of the event is available at http://lansasouthasia.org/content/mssrf-lansa-researchers-share-fsn-evidence-odisha-government

Gender and Energy: Energy linkages with Gender, Productivity and Inclusivity, MSSRF, Chennai, 26 April 2018.

One day workshop was organized with an objective of setting up and strengthening the Gender and Energy Network India (GENI), with support from Low Carbon Energy

Development Network and ENERGIA, on 26 April 2018 and to discuss Women and Energy: Transitions to a Low-carbon Economy in Agriculture. The inaugural address was presented by Professor M. S. Swaminathan, who highlighted the importance of considering gender within energy discussions, particularly those around agricultural energy. He emphasized the importance of considering human energy as well as other forms of energy, particularly given that so much of the manual work done in farming is done by women. There are key takeaway points from the workshop were; importance of involving energy users in conversations around gender and energy, energy access is important, but it needs to be supported by many other legislative, financial, educational and societal developments to ensure women can utilise and exploit energy access opportunities and to facilitate gender equality and women's empowerment, women have roles to play throughout the entire energy system and supply chain but needs access to new skills and associated resources, adopting gender inclusive policy, consideration for women's priorities aside from energy, increasing the value of women's labour and addressing the gendered norms in energy access.

Lecture Series on Community Food and Nutrition Security, Jeypore, September 2017 to March 2018

On 11 September 2017 Dr. Prakash Shetty, Professor, Public Health Nutrition, University of Southampton Medical School, UK, spoke on "Community Food and Nutrition Security" in MSSRF in Jeypore. The main objective of this lecture was to create awareness among the staff members on the importance of nutrition for normal growth, development and healthy life. About 23 staff members attended this lecture. On 24 Nov 2017 Dr. Basanta Ku Sahu, Indian Institute of Food Technology, New Delhi delivered a lecture on "Impact of Drought in Household food security in Odisha" at MSSRF, Jeypore. Staff members and other stakeholder participated in this lecture. The purpose of this lecture was to highlight the impact of drought on food security. He stressed in his lecture that drought, flash floods, soil erosion and other natural calamities cause food insecurity particularly among rural households. Lecture on Water and Food Security: National and Local Perspectives was delivered by Shri Kashinath at MSSRF, Jeypore on 1 March, 2018. About 45 participants attended (23 staff members and 21students of the American college, Madurai). The purpose of this lecture was to reflect the status of water and food security at local and national level. He tried in his lecture that water and food securities pose a 'wicked challenge'. A complex mix of hydrology, social, inter-sector, institutional, and agronomic issues – with a mix of vested interests that drive policy and determine outcomes in each country, particularly India.

State Level Policy Advocacy meeting on Need and Scope for Farming System for Nutrition in Odisha, Bhubaneshwar, 10 May 2018

The meeting was chaired by Shri. R. Balakrishnan I.A.S., Development

Commissioner cum Additional Chief Secretary, Planning & Convergence Dept., Govt of Odisha and attended by more than 40 senior government officers, scientists, social scientists; and representatives from civil society organisations. The objective of the meeting was to discuss the need for a farming systems approach in Odisha.

State Level Policy Advocacy on Advocacy meeting on Need and Scope for Farming System for Nutrition in Andhra Pradesh, Vijayawada, 21 May 2018

The meeting was convened by the M. S. Swaminathan Research Foundation (MSSRF) and conducted in collaboration with the Acharya N.G. Ranga Agricultural University (ANGRAU) to discuss the need for a farming systems approach in the state of Andhra Pradesh. The meeting was chaired by Shri. B. Rajasekhar, I.A.S., Special Chief Secretary, Agriculture & Cooperation, Govt. of Andhra Pradesh. Dr. N.V. Naidu, Director of Research, ANGRAU, co-chaired the meeting. The meeting was attended by 25 participants comprising of government officers and academicians.

Publications

Books / Monographs /Manuals /Electronic Material

Aliza Pradhan, A. V. Vijaya Bhaskar and Mahesh Maske. 2017. *Crop Based Demonstrations and Trials under Farming System for Nutrition Study in Wardha (2013-16)*. Research Report No. 42. Chennai: MSSRF. 35 pp.

Aliza Pradhan, A. K. Panda and A. V. Vijaya Bhaskar. 2017. *Crop Based Demonstrations and Trials under Farming System for Nutrition Study in Koraput (2013-16)*. Research Report No. 43. Chennai: MSSRF. 44 pp.

Anuradha, G., Aliza Pradhan, R. V. Bhavani, R. Gopinath and R. Rukmani. 2018. Farming System for Nutrition. Manual No. 82. Chennai: MSSRF. 20 pp.

Rajshekar, S. C. and S. Raju. 2017. *Introduction of Millets in PDS Lessons from Karnataka*. Research Report No. 41. Chennai: MSSRF. 52 pp.

Ratheesh Narayanan, M. K., M. K. Nandakumar, C. N. Sunil, V. Balakrishnan and K. A. Sujana. 2018. *Rare Endemic and Threatened Plants of Western Ghats.*New Delhi: Southern Book Star. 270 pp.

Rukmani, R., G. Anuradha, Kishore Jagatap and Prashant Deokar. 2017. Mahila Kisan Sashaktikaran Pariyojana: An Initiative towards Empowering Women Farmers. Monograph No. 47. Chennai: MSSRF. 66pp.

Theses

Ashok Kumar, M. 2017. *Identification and characterization of NAC transcription factor gene from Avicennia marina (Forsk) vierh. and its expression in yeast and tobacco*. Thesis submitted to the University of Madras, Chennai, in partial fulfilment of requirement for the degree of Doctor of Philosophy.

Manjula, M. 2018. *An Econometric Analysis of Household Cooking Energy Choice and Demand: The Case of Odisha and Tamil Nadu*. Thesis submitted to the University of Madras, Chennai, in partial fulfilment of requirement for the degree of Doctor of Philosophy. Degree Awarded.

Suji, S. 2017. *Characterization and evaluation of sodium transporter HKT1; 5 from wild rice Oryza coarctata (Roxb.) Tateoka (OcHKT1;5)*. Thesis submitted to the University of Madras, Chennai, in partial fulfilment of requirement for the degree ofDoctor of Philosophy.

Vidya, J. 2017.*Functional characterization of NHX1 antiporter gene from wild rice Porteresia coarctata (Roxb.) Tateoka (PCNHX1)*.Thesis submitted to the University of Madras, Chennai, in partial fulfilment of requirement for the degree ofDoctor of Philosophy.

Articles in Journals / Books

Aliza Pradhan, Mahesh Maske, Manoj Sayre and Mahesh Sadatpure.2016. “Assessment of physico-chemical parameters and nutrient availability in soils of Arvi and Karanja blocks of Wardha District, Maharashtra”. *Agropedology*. 26(2): 237-241.

Aliza Pradhan, Raju Sathanandhan, Akshaya Kumar Panda and Rupal Wagh. 2018. "Improving household diet diversity through promotion of nutrition gardens in India". *American Journal of Food Science and Nutrition.* 5(2): 43-51.

Aliza Pradhan and R. V. Bhavani. 2017. "Building climate resilient communities in India". *Transformation in Agriculture.* 160(8): 10.

Anil Kumar, N. 2017. "Wayanadan jaivavaividhyam". *Aranyam.* 38(3): 36-38.

Anil Kumar, N. and T. Raveendran. 2017. "Karshika mekhalayude shaktheekarnam: Chila nirdesangal". *Swathanthra Karshakan*. 8: 38-51.

Anil Kumar, N., A. Saleem Khan and V. Balakrishnan. 2018. "Coffee, climate and biodiversity: Understanding the carbon stocks of the shade coffee production system of India". In W. F. Leal (ed). *Handbook of Climate Change and Biodiversity.* Berlin: Springer. (In Press)

Anuradha,G.2017. "Impact of public distribution system on household food security: A case study of Tamil Nadu". Indian Journal of Social Research. 58(4): 439-455.

Balakrishnan, V. and T. Raveendran. 2018. "Nadan nellinte kalavarayil". *Kerala Karshakan*. 2: 19-24.

Balakrishnan, V., N. Anil Kumar and M. K. Ratheesh Narayanan. 2017. "Ethnic knowledge in classification and conservation: A case study of wild yam in Western Ghats". In Sabu Abdul Hameed, N. S. Pradeep and Shiburaj Sugathan (eds).*Bioresources and Bioprocess in Biotechnology:Status and Strategies for Exploration.* Vol.1. London: Springer. pp 303-330.

Bhavani, R. V. and Rohit Parasar. 2018. "Food distribution value chains under the integrated child development services". *IDS Bulletin.* 49(1): 73-89.

Breitkreuz, R., et al. 2017. "The Mahatma Gandhi National Rural Employment Guarantee Scheme: A policy solution to rural poverty in India*?*". *Development Policy Review.* 35(3): 397-417*.*

Dev Nathan, Manjula M., R. Rengalakshmi and Govind Kelkar. 2018. "Energy use and women's work in agriculture: Reducing green house gas emissions".*Economic and Political Weekly.* 53(17): 79-86.

George, S., Deepika Manoharan, Jie Li, Monica Britton and Ajay Parida. 2017. "Transcriptomic responses to drought and salt stress in desert tree *Prosopisjuliflora*".*Plant Gene*.12: 114-122.

George, S., Deepika Manoharan,Jie Li, Monica Britton and Ajay Parida. 2017. "Drought and salt stress in *Chrysopogon zizanioides* leads to common and specific transcriptomic responses and may affect essential oil composition and *benzylisoquinoline* alkaloids metabolism". *Current Plant Biology*.11(12): 12-22.

George, S., Deepika Manoharan,Jie Li, Monica Britton and Ajay Parida. 2018. "Drought and salt stress in *Macrotyloma uniflorum* leads

to common and specific transcriptomic responses and reveals importance of raffinose family oligosaccharides in stress tolerance". *Gene Reports*.10: 7-16.

Girigan Gopi and Manjula M. 2018. "Speciality rice biodiversity of Kerala: Need for incentivizing conservation in the era of changing climate". *Current Science*. 114(5): 997-1006.

Gopinath, R., R. Vimal and N. Amaravathi. 2017. "Cost-return analysis of floriculture: A case-study from Vedaranyam, Tamil Nadu". Indian Journal of Social Research. 58(4): 495-506.

Indira Devi, P., et al. 2017. "Payment for ecosystem services: Guaranteed farm income and sustainable agriculture.*Economic and Political Weekly.* 52(17): 12-14.

Kesavan, P. C. 2017 "Radiation protection policies and practice rest on a thinsheet of ice called linear, no-threshold hypothesis". *Radiation Protection and Environment.* 40(2): 51-59.

Kesavan, P. C. 2017. "Bt cotton and integrated pest management". *Current Science*. 113(11): 2057-2058.

Kesavan, P. C. 2017. "Linear, no threshold model in radiation protection and safety: standards thrive on 'assumptions' and not on science-based evidence". *Current Science*. 112(12): 2349-2350.

Kesavan, P. C. and M. S. Swaminathan. 2017. "A. T. Natarajan (1928–2017)". *Current Science*. 113(6): 1185-1187.

Kesavan, P. C. and M. S. Swaminathan. 2017. "Towards health for all: cost-effective and innovative treatment of diabetes shows the pathway". *Current Science*. 112(12): 2379-2385.

Kesavan, P. C. and M. S. Swaminathan. 2018. "Three decades of experience with genetically engineered crops: Way forward in the Indian context". *Science and Culture.* 84**(**3): 92-98.

King, E. D. Israel Oliver, Stefano Padulosi and Gennifer Meldrum. 2017. "Millets and markets-Need for networking and integration". *LEISA India*. 19(4). 18-21.

King, E. D. Israel Oliver and N. Kumar. 2017. "Role of agro forestry in strengthening adaptive capacity and improving livelihoods of Malayali Tribes in Eastern Ghats". In K. T. Parthiban, R.Jude Sudhakar and C. CinthiaFernandaz (eds). *Agroforestry Strategies for Climate Change Mitigation and Adaptation.* New Delhi: Jaya publishing house. pp 373-380.

King,E. D. Israel Oliver, Stefano Padulosi and Gennifer Meldrum. 2017. "Minor millets: Preliminary findings from an ongoing market study (IFAD-EU Grant 2000000978). " *IFAD News Letter.* 12(8): 13-14.

Kumari, K., Vidya Jegadeeson, S. Suji, Gayathri Venkataraman and Ajay Parida. 2017. "T-homoeolog specific plasma membrane protein 3 [Nt(t)PMP3-2] in polyploid Nicotiana tabacum shows conserved alternative splicing, derived from extant *Nicotiana tomentosiformis* parent". *Plant Physiol Biochem.* 119:338-345.

Manjula,M. and Girigan Gopi. 2017. "Universal access to clean cooking energy and the need

for an inclusive policy: Evidence from analysis of cooking fuel use in Odisha and Tamil Nadu". *DECISION*. 44(3): 193-207.

Manjula, M., R. Rengalakshmi and K. Thachinamurthy. 2017."Gender and policies in livestock production issues and opportunities". *Leisa India.* 19(3): 15-16.

Nithya, D. J. and R. V. Bhavani. 2017. "Dietary diversity and its relationship with nutritional status among adolescents and adults in rural India". *Journal of Biosocial Science.* 50(3): 397- 413.

Nithya, D. J. and R. V. Bhavani. 2018. "Factors which may limit the value of dietary diversity and its association with nutritional outcomes in preschool children in high burden districts of India". *Asia Pacific Journal of Clinical Nutrition*. 27(2): 413-420.

Nithya, D. J., S. Raju and Aliza Pradhan. 2018. "Effect of agricultural seasons on energy intake: Evidence from two agro-ecologically different rural Districts of India".*Food and Nutrition Sciences.* 9(5): 542-555.

Notaro, V., Stefano Padulosi, GeaGalluzzi and Israel Oliver King. 2017. "A policy analysis to promote conservation and use of small millet underutilized species in India". *International Journal of Agricultural Sustainability* 15(4): 393-405.

Novak Colwell, Julia M., Mark Axelrod, Shyam S. Salim andS. Velvizhi. 2017. "Gendered analysis of fisher folk's livelihood adaptation and coping responses in the face of a seasonal fishing ban in Tamil Nadu & Puducherry, India". *World Development*. 98: 325-337.

Parasar, Rohit and Bhavani R V. 2018. *"*Private business-driven value chains and nutrition: Insights from India". *IDS Bulletin.* 49(1): 21-38.

Parasuraman, N. 2017. "Attracting and retaining youth in agriculture". *Rural & Marketing*. 6 (4): 40-43.

Parida, Ajay and R. V. Bhavani. 2017. **"**Farm-fresh blueprint**"**In Virginius Xaxa and Rajiv Tikoo (eds).*Forest Lanterns: A Collection of Essays on Solutions for Nourishing India's Tribal Children*. Gurgaon: Penguin Random house. pp 13-18.

Parida, Prashant K., S. Malarvannan and K. C. Lenka. 2017. "Effect of good agricultural practices on the yield of two introduced rice varieties under rain-fed conditions in selective villages of Koraput, Odisha. *Tribal Studies:A Journal of COATS.*5(2): 32-37.

Pavithran, M.K. 2018. "Pradeshika vithubankukal bhakshya surakshakkulla karuthal sekarangal". *Karshakanatham*. 3: 32-37.

Ramasubramanian, R., V. Selvam, R. Nagarajan and N. Anil Kumar. 2018. Current status of Mangroves in the Gulf of Mannar Marine National Park. In K.Sivakumar (et al). *Integrated Management Plan of the Gulf of Mannar Marine National Park and Biosphere Reserve (2018-2027).* Ramanathapuram: Wildlife Institute of India. pp 159-177.

Rampal, Priya and Ranjula Bali Swain. 2018. "Food security, agriculture and female malnutrition in India". In Raghbendra Jha (ed). *Hunger and Malnutrition as major*

challenges of the 21st Century. Singapore: World Scientific Press. pp 1-23.

Ratheesh Narayanan, M. K., et al. 2017. "Sonerila janakiana sp. nov., a stoloniferous species of Melastomataceae from India". *Nordic Journal of Botany.* DOI: 10.1111/njb.01297.

Ratheesh Narayanan, M. K., N. Anil Kumar and Parameswaran Prajeesh. 2017. "Bioresources for food and nutrition security: The case of wild ediblesof Western Ghats". In Sabu Abdul Hameed, N. S. Pradeep and Shiburaj Sugathan (eds).*Bioresources and Bioprocess in Biotechnology:Status and Strategies for Exploration.* Vol.1. London: Springer. pp 73-98.

Rengalakshmi, R.,Manjula M., V.R. Prabavathy,S.Jegan and B.Selvamukilan. 2018. "Building bioeconomy in agriculture: Harnessing soil microbes in sustaining ecosystem services in agriculture**".** In Walter Leal Filho, Ismar Borges de Lima, Diana-Mihaela Pociovalisteanu and Paulo Brito (eds). *Towards a Sustainable Bioeconomy: Principles, Challenges and Perspectives.* London: Springer. pp 261-77.

Rengalakshmi, R., Manjula M. and M.Devaraj. 2018. "Making climate change communication gender sensitive: Lessons from Tamil Nadu". *Economic and Political Weekly.*53(17): 87-95.

Salim, Pichan M. 2017. "*Liparis sanamalabarica* (Orchidaceae): A new species from South Western Ghats, India", *Taiwania* 62(4): 345-348.

Sasikumar, P., et al. 2018. "Dihydro-β-agarofuran sesquiterpenoids from the seeds of *Celastrus paniculatus Willd*. and their α-glucosidase inhibitory activity". *Phytochemistry Letters.* (Accepted)

Sekar J., Raju K., Duraisamy P. and Ramalingam Vaiyapuri P. 2018. "Potential of finger millet indigenous Rhizobacterium *Pseudomonas* sp. MSSRFD41 in blast disease management—Growth promotion and compatibility with the resident Rhizomicrobiome. *Front. Microbiol*. 9:1029. DOI: 10.3389/fmicb.2018.01029

Shrikanth, S.K., S. George, M. Sankaramasubramanian and Ajay Parida. 2017. "Proteomic analysis of long term salt responsive proteins in the halophyte *Suaeda maritime*".*Plant Omics Journal*.10(4):197-204.

Suma, T. R. 2017. "Kunnummelae maramanu vayalile vellam (Wayanadinte anthareeksha jalam oru avarokanam)".*Sasthragathi.* 4: 40-43.

Sunil, C. N., M. K. Ratheesh Narayanan, V. V. Naveen Kumar, M. K. Nandakumar and V. Balakrishnan. 2017. "*Eriocaulon govindiana sp.nov*.(Eriocaulaceae), from southern Western Ghats, Kerala, India**".** *Taiwania.* 62(4): 387-391.

Swaminathan, M. S. 2017. "J. B. S. Haldane: An uncommon scientist". *Journal of Genetics.* 96(5): 731-732.

Swaminathan, M. S. and P. C. Kesavan. 2018. "Science for sustainable agriculture to achieve UN SDG Goal 2". *Current Science*. 114(8):1585-1586.

Swaminathan, M. S. 2018. "The zero hunger challenge". In V. K. Ramachandran and

Madhura Swaminathan (eds). *Telling the Truth, Taking Sides*. New Delhi: Tulika Books. pp 188-207.

Velvizhi, S. and A. Gopalakrishnan 2017. "Occupational health hazards among Irular tribal fisherwomen fishing in Pichavaram mangrove water. *Journal of Fisheries and Life Sciences*.2(1): 20-25.

Vijaya Bhaskar, A. V., D. J. Nithya, S. Raju and R. V. Bhavani. 2017. "Establishing integrated agriculture-nutrition programmes to diversify household food and diets in rural India". *Food Security*. 9: 981–999.

Web Published Articles/Videos

Gopinath, R. "Velan kadan thallupadi: Verum salugaya?". *The Hindu Tamil*. March 17, 2018.

Parasar, R. and R. V. Bhavani. 2018. "Effectiveness of the value chain of an agrifood product in reaching low income consumers: A business case study of Amulspray". LANSA Working Paper No. 25.Chennai:MSSRF. pp 20.

Parasar, R. and R. V. Bhavani. 2018. "Can business-driven fortified foods reach nutritionally vulnerable households? A case study of Tiger Biscuits". LANSA Working Paper No. 28. Chennai: MSSRF. pp 15.

Rampal, Priya. 2018. "An analysis of protein consumption in India through plant and animal sources".LANSA Working Paper No. 28. Chennai: MSSRF. pp 35.

Rampal, Priya. 2017. "Situational analysis of pulse production and consumption in India". LANSA Working Paper No. 28. Chennai: MSSRF. pp 46.

Rao, N. and S. Raju. 2017. "Gendered time, seasonality and nutrition: Insights from two Indian Districts". LANSA Working Paper No. 22.Chennai: MSSRF. pp 37.

Sujatha,R. and R. Gopinath. "Hype over pad man but India's menstrual owes continues". *The Hindu Centre for Politics and Public Policy*. May 12, 2018.

Papers Presented in Conferences/ Symposia/Workshop

Aliza Pradhan. "Leveraging agriculture for nutrition: Insights from a farming system for nutrition study". Advanced Faculty Training on Extension Strategies for Nutrition Sensitive Agriculture to Address Sustainable Development Goals. Division of Agricultural Extension, Indian Council of Agricultural Research (ICAR), New Delhi. 20 September 2017.

Anabel, Nancy J. "Information, education and communication - Technology as a Catalyst". Annual National Conference on Accelerating Technology for Development. Collective Action for Student's Concerns and Development (CASCADE), Chennai. 9 March 2018.

Anabel, Nancy J. and Priyanka Mohan. "Transforming public library as common hub". World Library and Information Congress – 83rd IFLA General Conference. *International Federation of Library Associations* and Institutions (IFLA), Wroclaw, Poland. 18-27 August 2017.

Anuradha, G. "MSSRF's experience of farming system for nutrition". 2nd National Consultation on Confronting Successive Droughts: Enhancing Resilience of Children and Women. National Institute of Disaster Management (NIDM), Ministry of Agriculture and Farmers Welfare, Andhra Pradesh State Disaster Management Agency (APSDMA) and UNICEF. Vijayawada. 8-9 June 2017.

Balaji, M., Max AurthorGill, Santosh Raj Benia and Ghasi Takri. "Finger millet cultivation in rabi season: A new approach towards food and nutrition security". 9th Indian Youth Science Congress (IYSC). Career Point University, Hamirpur. 7-9 April 2018.

Bhavani, R. V. "Food and nutrition security situation in India and the SDGs". International Conference on India & Global Economy: Issues and Challenges. Dwaraka Doss Goverdhan Doss Vaishnav College, Chennai. 5 March 2018.

Bhavani, R. V. "Healthy food for all: The SDG 2 Goal". Stakeholder Workshop on SustainableAgriculture and Doubling Farmers Income to Ensure Healthy Food for All. SDG 2 Roadmap Framework, New Delhi. 8 May 2018.

Bhavani, R. V. "Leveraging agriculture for nutrition in South Asia: A research programme consortium". Ministry of Agriculture and Farmer Welfare and Bill and Melinda Gates Foundation, NAAS, New Delhi. 6 June 2017.

Bhavani, R.V. "Training community members to be champions on nutrition sensitive agriculture in India". South Asia Food and Nutrition Security Initiative (SAFANSI) Roundtable on Government Action for Nutrition, Kathmandu. 7 September 2017.

Bhavani, R. V. and Aliza Pradhan. "A farming system for nutrition design for sustainable and healthy diets: The LANSA experience". Asia and the Pacific Symposium. FAO Regional office for Asia Pacific, Bangkok. 10-11 November 2017.

Bhavani, R. V. and Aliza Pradhan. "A farming systems approach to food & nutrition security". International Conference on Environmental Health & Sustainable Development. India Habitat Centre, New Delhi. 14 Nov 2017.

Deepa, J., R. Karthikeyan, R. Raja, R. Sivaprakash andV. Gayatri. "CRISPR/Cas9-based genome-editing approach for developing transgene-free salt tolerance rice varieties". Crop Genomics Present and Future. ICRISAT, Hyderabad. 6-8 December 2017.

Deepa,J., S. Gothandapani,R. Sivaprakash and V. Gayatri."Developing salt tolerant rice varieties using CRISPR/Cas9 based genome editing approach". 9th Indian Youth Science Congress (IYSC). Career Point University, Hamirpur. 7-9 April 2018.

George, S."Leaf temperature, yield and genotype specific patterns of gene expression in *Sorghum bicolor* under drought and salt stress".VI NGGIBCI International Conference on Crop Genomics: Present & Future. ICRISAT, Hyderabad. 6-8 December 2017.

George, S."Molecular responses to drought and salt stress in horse gram".International

Conference & Expo on Agriculture & Veterinary Sciences: Research and Technology.Professor Jayashankar Telangana State Agricultural University, Hyderabad. 23-25 October 2017.

George, S."Role of bioinformatics in agriculture". Workshop on application of bioinformatics tools in molecular taxonomic studies (Phase II).Lady Doak College, Madurai. 5-9 March 2018.

George, S."Transcriptomic responses to drought and salt stress in desert tree *Prosopis juliflora*".NextGen Genomics, Biology, Bioinformatics and Technologies (NGBT) Conference. SciGenom Research Foundation (SGRF), Bhubaneswar. 2-4 October 2017.

Girija, D.S. "Possible ways of integrating agriculture intervention in public libraries". National Seminar on Digital Initiatives to Empower the Librarians. Vellalar College for Women, Erode.2-3 March 2018.

Gopinath, R. "Social cost benefit analysis". Training Programme for Newly Recruited Research officers. Anna Institute of Management, Chennai. 12 April 2017.

Hariharan, G.N. "Ecology based solutions: For resource conservation and ecological sustainability". National Institute of Technology, Nagaland. 21 February 2018.

Jagannath Khillo, Naresh Patro and Jaganath Naik. "Adoption of system of millet intensification for food and nutritional security". 9th Indian Youth Science Congress(IYSC). Career Point University, Hamirpur. 8-9 May 2018.

Jaganth Naik, et al."Capacity strengthening of local community men and women to be champions of nutrition awareness messages". 9th Indian Youth Science Congress(IYSC). Career Point University, Hamirpur. 8-9 May 2018.

Joseph John and P. R. Sreeraj. "A Study on seasonal changes in selected physical chemical and biological parameters in soils of coffee gardens in Wayanad District". National Environment and Climate Change Congress. Directorate of Environment and Climate Change (DoECC) and Department of Environment, Government of Kerala, Thiruvananthapuram. 20-22March 2018.

Kelkar, Govind and R. Renglakshmi. "Gender and energy: Contesting energo-patriarchy and policy changes". The 5th International Conference on Developments in Renewable Energy and Technology. Kathmandu University, Dhulikhel, Nepal. 29-31 March 2018.

Khan, A.S. "COREDAR for Chennai: Lessons from New York city".Conference on Chennai as a Global City.The Raintree Hotel,Chennai. 9 November 2017.

Khan, A.S. "Impacts of climate change on the coastal zones:Tamil Nadu perspective". State Level Trainer's Training (ToT) on Climate Change and Disaster Mitigation. State Institute of Rural Development (SIRD), Chennai. 15 September 2017.

King, E. D. Israel Oliver, G. Meldrum, N.Lauridsen, S. Padulosi and D. Stoian. "Gender responsive 5 capital evaluation

of millet value development in Kolli Hills, Tamil Nadu, India". Tropentag Conference. University of Bonn, Germany. 20 September 2017.

King,E. D. Israel Oliver. "Reflections on gender and nutrition aspects of value chains in India (kodo - *Paspalum scrobiculatum*, kutki - *Panicum sumatrense* and other minor millets)". Workshop on Linking Agrobiodiversity Value Chains, Climate Adaptation and Nutrition: Empowering the Poor to Manage Risk. Bioversity International, Rome, Italy. 17-19 May 2017.

King, E. D. Israel Oliver. "Small millets and markets: Challenges and opportunities". National Policy Workshop on Mainstreaming Small Millets in our Diets. DHAN Foundation, New Delhi. 1 June 2017.

Kumar, N. "Dynamics and dimension of agricultural development in Tribal area: A Study in Kolli Hills of Tamil Nadu". National Seminar on Hill Economies and Prospects and Challenges. Rajiv Gandhi University, Itanagar, Arunachal Pradesh. 5-6 February 2018.

Kumari, K., V. Jegadeeson,S. Suji, V. Gaytri andA. Parida. "Alternative splicing of plasma membrane protein 3 [Nt(t)PMP3-2] in polyploid *Nicotiana tabacum* is derived from *Nicotiana tomentosiformis* parent". National Conference on Recent Trends in Genetics Engineering and Biotechnology. SRM University, Kattankulathur. 25-26 September 2017.

Lenka, K. C. "Drinking water facility in Koraput, Odisha: A case study of Kundra and Boipariguda". 9th Indian Youth Science Congress(IYSC). Career Point University, Hamirpur. 8-9 May 2018.

Manjula, M. "Ecosystems and farmer well-being: PES as a tool in ensuring farmer welfare". The IXth Biennial Conference. Indian Society for Ecological Economics, Kerala Institute of Local Administration, Thrissur, Kerala. 7-11November 2017.

Mishra, S. K., Max Aurthor Gill, Balaji Mohanty, Ghasi Takri, Santosh Raj Benia and Akshaya Kumar Panda. "Scale up of farming system for nutrition interventions in Koraput District of Odisha". 9th Indian Youth Science Congress (IYSC). Career Point University, Hamirpur. 7-9 April 2018.

Nagarajan, R., R. Rakesh, S. Punitha and R. Ramasubramanian. "Quantifying the above ground biomass of Krishna mangroves through remote sensing". Asian Conference on Remote Sensing, New Delhi. 23-27 October 2017.

Nagarajan, R., S. Punitha and V. Selvam. "Assessment of landuse / landcover dynamics and shoreline changes of Gulf of Mannar islands through remote sensing". Asian Conference on Remote Sensing, New Delhi. 23-27 October 2017.

Nithya, D. J. and S. Raju. "Seasonal variation in energy intake from different foods in two different agro climatic locations in rural India". Agriculture, Nutrition, Health Scientific Symposium and Academy Week conference. ANH Academy, Kathmandu, Nepal. 9-13 July 2017.

Panda, A.K., N. C. Patro, M. Balaji, S. Sushant, Ghasi Takri and D. J. Nithya. "Capacity strengthening of local community men and women to be champions of nutrition awareness messages". 9th Indian Youth Science Congress (IYSC). Career Point University, Hamirpur. 7-9 April 2018.

Parasar, R. and R. V. Bhavani. "Can business led pro-nutritional value chains enhance nutrient intake?". Agriculture, Nutrition, Health Scientific Symposium and Academy Week Conference. ANH Academy, Kathmandu, Nepal. 9-13 July 2017.

Parasuraman, N. "Technological empowerment for rural women". National Conference on Gender and Development. Rajiv Gandhi National Institute of Youth Development, Sriperumpudur. 8-9 March 2018.

Parida, Prashant K., S. Malarvannan, Ajit Kumar Sahu, Rajdeep Behera and E. D. Israel Oliver King. "Nutrition sensitive annadata kitchen garden model: Growth for health and wellbeing of tribal poor". Sustainable Agriculture, Food and Nutritional Security (SAFNS). School of Agriculture, Lovely Professional University, Jalandhar. 16-17 February 2018.

Patro, N.C., Jagannath Naik and Akshaya Kumar Panda. "Zinc fortified rice varieties for food and nutritional security of rice dominated tribal belts of Odisha". 9th Indian Youth Science Congress (IYSC). Career Point University, Hamirpur. 7-9 April 2018.

Prabavathy, V.R. "Towards sustainable agriculture: Harnessing organic farming and soil microbes to promote Agriculture Bioeconomy". National Conference on Biotechnological Advances Towards Sustainable Agriculture and Environment. Hindustan College of Arts and Science, Chennai. 17 August 2017.

Priyanka Mohan. "INELI successions and accomplishment". INELI Final Global Convening. Bill & Melinda Gates Foundation, Seattle, Washington, USA. 01 March 2018.

Priyanka Mohan. ''Changing dimensions of public libraries and library professionals". National Conference on NEXGENLIB. Anna Centenary Library, Chennai. 2-3 February 2018.

Rajkumar, R. "Repositioning the public libraries as knowledge and learning centres". National Seminar on Digital Initiatives to Empower the Librarians. Vellalar College for Women, Erode. 2-3 March 2018.

Rajkumar, R. "Repositioning the public libraries as village knowledge and learning centres". National Conference on Connecting Digital Divide through Academic and Public Libraries. Sri Sarada Niketan College of Science for Women, Karur. 1-2 December 2017.

Raju, S. "Consumption patterns of millets compared to rice and wheat in Karnataka State, India".Agriculture, Nutrition, Health Scientific Symposium and Academy Week Conference.ANH Academy, Kathmandu, Nepal. 9-13 July 2017.

Ramasubramanian, R. "Conservation and management of coastal resources as a potential adaptation strategy for sea level rise".

National Workshop on Project Formulation - Climate Change Mitigation and Adaptation. Bank for Agriculture and Rural Development (NABARD) and Bankers Institute of Rural Development (BIRD), Vijayawada. 18-22 December 2017.

Rampal, Priya. "Situational analysis of pulse production and consumption in India". Agriculture, Nutrition, Health Scientific Symposium and Academy Week Conference. ANH Academy, Kathmandu, Nepal. 9-13 July 2017.

Rengalakshmi, R. "Energy policy influencing factors in Tamil Nadu". International Conference on Women's Freedom from Unfreedoms: Influencing Factors and Challenges to the Effectiveness of Gender and Energy Policies. Centre for Rural Technology, Nepal.27 November 2017.

Samantray, P. C., Prashanta Kumar Parida and Ranjit Kumar Dalai. "Community grain bank- A sustainable model in tribal villages".9th Indian Youth Science Congress(IYSC). Career Point University, Hamirpur. 8-9 May 2018.

Sangeetha, R. "Research uptake under LANSA". International Conference on Research for Development (ICRD). University of Bern, Switzerland. 5-8 September 2017.

Selvam, V. "Joint Mangrove Management" Regional Consultation on Forest Landscape Restoration. Ministry of Environment, Forests and Climate Change, Indian Council of Forestry Research and Education (ICFRE), and the International Union for Conservation of Nature (IUCN), New Delhi 29-30, August, 2017

Selvam, V. "Sustainable Management of Mangrove Ecosystem in – Experience from India" Technical Workshop Mangrove Ecosystems for Climate Change Adaptation and Disaster Risk Reduction, International Union for Conservation of Nature (IUCN), Suva, Fiji 5-8 March, 2018

Shalini, P.,S. Suji, V. Gayatri and A. Parida."Isolation of a partial OcHKT1, 4 genomic sequence from halophytic wild rice *Oryza coarctata* by PCR based genome walking". National Conference on Recent Trends in Genetics Engineering and Biotechnology. SRM University, Kattankulathur. 25-26 September 2017.

Shalini, P., V. Gopikaa and V.Gayatri."Development of a cleavage amplified polymorphic sequences (CAPS) marker for the cultivated rice sodium transporter gene,*OsHKT1*;5 that results in codon modification and Analysis of saline tolerant Indian landraces for the presence of the CAPS marker". 9th Indian Youth Science Congress (IYSC). Career Point University, Hamirpur. 7-9 April 2018.

Sivan, V. V. and N. Anil Kumar. "Conserving the rare endemic and threatened (RET) plant species of Western Ghats, India - The M. S. Swaminathan Botanical Garden's approach". 6th Global Botanic Gardens Congress. Conservatory and Botanic Garden of the City of Geneva, Geneva, Switzerland. 25 June 2017.

Velvizhi, S. "Promoting an inclusive small scale fishery value chain for sustainable

development: A case study from MSSRF". National Conference on Indian Fisheries: Prospects and Challenges, Kumbakonam. 16 February 2018.

Vepa, S. S., Brinda Viswanathan, Rohit Parasar and R. V. Bhavani. "Child underweight, land productivity and public services: A district-level analysis for India". Agriculture, Nutrition, Health Scientific Symposium and Academy Week Conference. ANH Academy, Kathmandu, Nepal. 9-13 July 2017.

Participation in Training Programmes/ Workshops

Anabel,Nancy J.2nd CSI Conference: Transactions on ICT. IITM Research Park, Chennai. 3rd February 2018.

Anabel,Nancy J. and Priyanka Mohan. Global Libraries: International Network of Emerging Library Innovators (INELI) Networking and Learning Convening. Bill & Melinda Gates Foundation, Seattle, Washington, USA. 27February - 8 March 2018.

Anabel,Nancy J. and R. Rajkumar. Meeting on Policy Boot Camp and Policies for Integrating ICT Enabled Services and SDGs into Library Space. Indian Public Library Movement (IPLM), New Delhi. 23-25 January 2018.

Anabel, Nancy J. Conference on Precision Agriculture Technologies. Tamil Nadu Technology Development and Promotion Center, Chennai. 16March 2018.

Anabel,Nancy J. International Conference on the Role of ICT in Education and Development. Bharathidasan University and J.J. Engineering College, Trichy. 22January 2018.

Anabel,Nancy J., Priyanka Mohan, T. Aruna, R. Rajkumar, J. Rojarani, K. Siranjothi and R. Srinivasan. Indian Public Library Conference-2018.Indian Public Library Movement (IPLM), New Delhi. 2-6 October 2017.

Annadurai,A. Training on Credit Linkages for Grass Root Institutions. NABARD Financial Services (NABFIN), Krishnagiri.27January 2018.

Anuradha, G. Roundtable Discussion on Food and Nutrition Security with Reference to Karnataka. Department of Agriculture and Synergia Foundation, Bengaluru. 15September 2017.

Baskar, R. State Level Workshop on Millets. Hotel Taj Coromandel, Chennai. 6October 2017.

Baskar, R. Workshop on Protection of Plant Varieties and Farmers Right Act 2001. TANUVAS-KVK, Namakkal. 17March 2018.

Behera, R. Training on Data Entry on ENERGIA Survey App. Odisha Livelihood Mission (OLM), Bhubaneswar. 2-3 November 2017.

Bhavani, R. V, et al. Agriculture, Nutrition Scientific Symposium. Agriculture, Nutrition and Health (ANH) Academy and Feed the Future Innovation Lab for Nutrition, Kathmandu, Nepal. 9-13 July 2017.

Bhavani, R. V. Roundtable on Reimagining PDS: From Food to Nutrition Security.

National Institute of Nutrition (NIN) and Indian School of Business (ISB), Hyderabad. 16 February 2018.

Bhavani, R. V. Roundtable on Towards Budgeting for a Diversified Food System for Improved Nutritional Outcomes: Perspectives and Opportunities. National Institute of Public Finance and Policy (NIPFP) and Tata Cornell Institute (TCI), New Delhi. 20 February 2018.

Bhavani, R. V. Stakeholder Consultation on Food and Nutrition Security. World Food Programme (WFP), New Delhi. 28February 2018.

Chaudhury,S. S. Reflection Workshop on Special Program on Millets for Tribal Areas of Odisha. Department of Agriculture and Farmers Empowerment, Bhubaneswar. 10-11 August 2017.

Chinnathambi, S.Meeting on Kulumai Federation's Annual Day. Kannivadi, Dindigul. 6April 2017.

Chinnathambi, S. Training on Credit Linkages for Grass Root Institutions. NABARD Financial Services (NABFIN), Krishnagiri. 27 January 2018.

Chinnathambi, S. Workshop onMillet Festival. News 7 Channel, Thanjavur.25January 2018.

Chinnathambi, S. Workshop on Post-Harvest and Value Addition in Millets. DHAN Foundation. Madurai. 15-16 February 2018.

Deepa, J. Workshop on Transcriptome-Seq Data Analysis. Clovergen Incubation Center, Institute of Agri-Biotechnology, University of Agricultural Science, Dharwad. 29-30 June 2017.

Deepa, J. Workshop on Unix for Biologists. Crescent University, Chennai. 22-24 January 2018.

Devaraj, M. Training on Use of Extended Range Forecast in Development of CRM tools in Agriculture. Indian Institute of Technology, Bhubaneswar and University of Agriculture &Horticulture Sciences, Shimooga. 24–30 December 2017.

Dhanya, C. S. National Conference on Technological Empowerment of Women. Vigyan Bhawan, New Delhi. 8-9 March 2018.

Dhanya, C. S. National Symposium on Recent Trends in Research in Biotic Systems. North-Eastern Hill University,Shillong. 29-30 June 2017.

Dhanya, C. S. Regional Expert Consultation Meeting on Technology Sharing of Spice Crops in SAARC Region. SAARC Agriculture Centre (SAC), Dhaka, Bangladesh and Indian Institute of Spices Research, Calicut. 11-12 September 2017.

Dhareshwar, Kiran P.National Conference on Genetics and Cytogenetics. University of Agricultural Sciences, Dharwad. 1-2 February 2018.

Gayatri, V.National Conference on Technological Empowerment of Women. The National Academy of Sciences, India. Vigyan Bhavan, New Delhi. 8-9 March 2018.

Gayatri, V. Workshop on State level Biosafety Capacity Building. Tamil Nadu Agricultural

University (TNAU) and Biotech Consortium India Limited (BCIL), New Delhi. 23rdMarch 2018.

George, S. India International Science Festival, Chennai. 13-16 October 2017.

George, S. International Conference & Expo on Agriculture & Veterinary Sciences: Research and Technology.Professor Jayashankar Telangana State Agricultural University, Hyderabad. 23-25 October 2017.

George, S.National Conference on Technological Empowerment of Women. The National Academy of Sciences, India. Vigyan Bhavan, New Delhi. 8-9 March 2018.

Girigan Gopi. International Meeting on Local Economic Development–Towards local Agribusiness Cluster Development: Catalyzing Vibrant Rural Economics. Wageningen Centre for Development Innovation and South Africa's Agricultural Research Council. Sandton Hotel, Woodmead, Sandton, Gauteng, South Africa. 23October– 3 November 2017.

Gnanamoorthy, P. 22nd International Forestry and Environment Symposium. Department of Forestry and Environmental Science, University of Sri Jayewardenepura, Nugegoda, Sri Lanka. 10-11 November 2017.

Gnanamoorthy, P. Corporate Social Responsibility (CSR) Conference and Round Table Discussion on Synergy for Maximizing Social Impact. Madras Chamber of Commerce and Industry (MCCI), Karumuthu Centre, Chennai. 2 March 2018.

Gnanamoorthy,P. Training Programme on Project Formulation - Climate Change Adaptation and Mitigation. National Bank for Agriculture and Rural Development (NABARD) and Bankers Institute of Rural Development (BIRD), Vijayawada. 18-22 December 2017.

Gnanaprakasam, R. Meeting on Coffee Board Schemes. Coffee Board Department, Salem. 13 December 2017.

Gnanaprakasam, R. Training on Capacity Building of Farmer Producer Organization (FPO). National Bank for Agriculture and Rural Development (NABARD) and Centre for Indian Knowledge System (CIKS), Chennai. 11-13 October 2017.

Gnanaprakasam, R. Training on Credit Linkages for Grass Root Institutions. NABARD Financial Services (NABFIN), Krishnagiri. 27January 2018.

Gnanaprakasam, R. Training on Refresher Programme on NGO. National Bank for Agriculture and Rural Development (NABARD), Indian Overseas Bank (IOB) and Indian Bank. Namakkal. 21 February 2018.

Gnanaprakasam, R. Workshop on Protection of Plant Varieties and Farmers Right Act 2001. TANUVAS-KVK. Namakkal. 17 March 2018.

Gopinath, R. Policy Dialogue on towards a Diversified Food System: Emerging Opportunities in Odisha. Tata Cornell Institute of Agriculture and Nutrition (TCI-TARINA), Bhubaneshwar. 19 July 2017.

Hariharan, G.N.Expert Consultation to Deliberate on Integration of Agriculture and

Nutrition for Demonstrating Freedom from Hunger. Indian Council of Medical Research, National Institute of Medical Statistics, New Delhi. 21 November 2017.

Hariharan, G. N. National Symposium on Current Trends in Plant Sciences. Madras Christian College, Chennai. 23 February 2018.

Hariharan, G. N. State Bank of India - Youth for India Alumni Meeting.State Bank Learning Centre, Bengaluru. 17 March 2018.

Hariharan, G.N. Workshop on Developing Intervention Strategies to Address Problem of Undernutrition and Hidden Hunger. District Collectorate, Palghar, Maharashtra. 24-26 September 2017.

Hariharan, G. N. Workshop on Soil Salinity Mapping and Management.University of Agricultural and Horticultural Sciences, Shivamogga andZonal Agricultural and Horticultural Research Station, Brahmavar. 8 September 2017.

Jaganath Naik and Jagannath Khillo. Women's Convention on Agriculture, Food and Nutrition. AGRAGAMEE, Tribal Museum, Koraput. 10-12 December 2017.

Jagannath Khillo and Ranjit Dalai. Farm Innovators Day. Indian Institute of Soil and Water Conservation, Koraput. 28February 2018.

Janakiraman, A. Indian Public Library Conference-2018.Indian Public Library Movement (IPLM), New Delhi. 2-6 October 2017.

Janakiraman, A. National Digital Library of India and Art of Story Telling. Pratham Books, IIT Kharagpur and Indian Public Library Movement (IPLM),Chennai. 22-23 March 2018.

Janakiraman, A. Workshop on Mange for Change. Indian Public Library Movement (IPLM), Hotel Cignetta Repose, Guwahati. 24-27 April 2017.

Jena, P. C. Training on Mobile Application and Web Application. Watershed Support Services and Activities Network (WASSAN). Bhubaneswar. 22-23 February 2018.

Khan, A.S. Five Days Training Program on Writing Proposals: Climate Change Adaptation and Mitigation.National Bank for Agriculture and Rural Development (NABARD) and Bankers Institute of Rural Development (BIRD), Vijayawada. 18-22 December 2017.

King,E. D. Israel Oliver. FAD EU Project Steering Committee Meeting and Value Chain and Gender Workshop. Rome, Italy, 17-19, May 2017.

King, E. D. Israel Oliver. Reflection Workshop on Millets for Tribal areas of Odisha. Department of Agriculture and Farmers Empowerment and Watershed Support Services and Activities Network (WASSAN), Bhubaneswar, Odisha. 10-11 August 2017.

King, E. D. Israel Oliver. Seminar on Prevention of Sexual Harassment of Women at Workplace. Institute of Good Governance, New Delhi. 28-29 August 2017.

King, E. D. Israel Oliver. Workshop on Scaling up Small Millets Post-harvest and Nutritious FoodProducts, Madurai. 15-16 February 2018.

Koshy,Shely Mary. Institutional Capacity Building Workshop on Agriculture and Environment. *Institute of Management inGovernment*(IMG), Thiruvananthapuram. 6 October 2017.

Koshy, Shely Mary. Popularization Workshop. Center for Water Resource Development and Management, Calicut. 18 November 2017.

Koshy, Shely Mary. Varattayar Watershed Development Workshop. Institute for Watershed Development and Management, Kerala (IWDM-K), Chadayamangalam. 30 October 2017.

Kumar, N. National Seminar on Hill Economies and Prospects and Challenges. Rajiv Gandhi University, Itanagar, Arunachal Pradesh. 5-6 February 2018.

Kumar, N. State Level Workshop on Millets. Hotel Taj Coromandel, Chennai. 6October 2017.

Kumar, N. Workshop on Protection of Plant Varieties and Farmers Right Act 2001. CREED-Krishi Vigyan Kensdra. Cholamadevi, Ariyalur. 17 March 2018.

Kumar, N. Meeting on Vendor Survey of Millet Machines. Tamil Nadu Rural Transformation Project, Ooty.7April 2017.

Lakshmanan, P. Consultation on Collective Action of Single Women to Access Market and Financial Resource for Multiple off farm Livelihoods and Women Empowerment. National Forum for Single Women Rights, Ranchi, Jharkhand. 27-28 November 2017.

Lakshmanan, P.Workshop on Agribusiness Strategies and Business plan Development for FPO's. Tamil Nadu Agricultural University and National Bank for Agriculture and Rural Development (NABARD),Trichy. 22-24 March 2018.

Lenka, K. C. National Seminar on Tribal Rights: Issues & Challenges. The Council of Analytical Tribal Studies (COATS), Koraput. 8-10 January 2018.

Lenka, K. C. Radio Kisan Diwas Mela. All India Radio, Nabarangpur. 16 February 2018.

Malarvannan, S. Workshop on Doubling Farmer Income in Odisha. Central Soil & Water Conservation Research &Training Institute (CSWCRTI), Koraput. 1 December 2017.

Manjula, M. Brainstorming on Strategies to Reduce Crop Losses due to Wild Animal Attack through Modified Agricultural Practices. Kerala Forest Research Institute, Thrissur. 6-7 October 2017.

Manjula, M. National Workshop on Payment for Ecosystem Services for Agricultural Systems. Kerala Agriculture University, Thrissur. 1-3 July 2017.

Manjula, M. Training on Economics of Climate Change Adaptation.United Nation Development Program-Regional Resource Centre for Asia and Pacific (UNDP-RRCAP),Asian Institute of

Technology, Bangkok.26 February –10 March 2018.

Manjula,M. Workshop on Economic Inclusivity in India: Conceptual and Empirical Recommendations for an Indicator Framework. Rockefeller Foundation,Everett Program for Technology and Change- University of California, Program for Environmental and Regional Equity - University of Southern California, Institute of Development Studies - University of Sussex and International Institute of Information Technology, Bengaluru. 19 August 2017.

Nagarajan, R. Second Technical Working Group (TWG) Meeting on Landscape Restoration Mapping and Monitoring. World Resources Institute-India, New Delhi. 23 August 2017.

Nagarajan, R. Special Course on Hyperspectral Remote Sensing. National Remote Sensing Center - Indian Space Research Organization (NRSC/ISRO), Hyderabad. 3 -7 July 2017.

Nagarajan, R. The 38th Asian Conference on Remote Sensing. Hotel Ashok, New Delhi. 23-27 October 2017.

Nandeesha, P. Training on Doubling the Farmers Income. Bankers Institute of Rural Development, Mangalore. 11-13 October 2017.

Nithya, D. J. Four Day Course on Public Health Nutrition Research Methods and Policies. Public Health Foundation of India and Centre for Chronic Disease, New Delhi. 20-23 February 2018.

Nithya, D. J. Workshop on Knowledge for Nutrition. Tamil Nadu Nutri-Alliance, Puducherry. 26-27 September 2017.

Panda, A. K. National Conference on Climate Change and our Responses for Sustainable Development. Kalinga Institute of Industrial Technology (KIIT), Bhubaneswar. 19 April 2017.

Panda, A. K. State Level Organic Farmer's Convention. AGRAGAMEE, Bhubaneswar. 27 October 2017.

Panda, A. K. Sustainable Development Goals: Preparedness and Role of Indian Agriculture. International Food Policy Research Institute (IFPRI), New Delhi. 11-12 May 2017.

Panda, A. K. Workshop on Extension Strategies for Strengthening Agri-Nutri Linkages. Department of Agricultural Extension, Indian Council of Agriculture Research (ICAR), New Delhi. 21 September 2017.

Panda, A. K. Workshop on Scaling Nutrition Sensitive Fisheries Technologies and Integrated Approaches through Partnership in Odisha. WorldFish and Department of Fisheries and Animal Resources Development, Govt. of Odisha, Bhubaneswar. 20-21 November 2017.

Parasuraman, N. Agricultural Leadership Summit- 2018. Indian Council of Food and Agriculture, New Delhi. 5-6 September 2017.

Parida, P. K. and K. C. Lenka. Regional Workshop on Plant Protection Varieties Farmers Rights Act 2001. National Rice Research Institute, Cuttack. 17 November 2017.

Parida, P. K. Training on documentation of Best practices under MKSP. Odhisha Livelihood Mission (OLM), Bhubaneswar. 29 August 2017.

Parida, P. K. Training on Indigenous Seeds Systems and Participatory Varietal Trials for Special Programme for Promotion of Millets in Tribal Areas of Odisha. National Rice Research Institute, Cuttack. 5-6 January 2018.

Prabavathy, V.R. 3rdConference and an Exclusive Round Table Discussion for Corporate and NGOs. MadrasChamber of Commerce and Industry (MCCI)& Expert Committee. Hotel Crowne Plaza, Chennai. 2 March 2018.

Prabavathy, V.R. Certificate Course on Corporate Social Responsibility (CSR). MadrasChamber of Commerce and Industry (MCCI). Karumuthu Centre, Chennai.30thNovember – 1 December 2017.

Prabavathy, V.R. Certificate Course on Corporate Social Responsibility (CSR). MadrasChamber of Commerce and Industry (MCCI). Karumuthu Centre, Chennai.15-16 December 2017.

Prabavathy, V.R. National Conference on Recent Trends in Life Science: Research, Practices and Application for Sustainable Development.BharathiarUniversity, Coimbatore.7-8 September 2017.

Prabavathy, V.R. National Conference on Technological Empowerment of Women. The National Academy of Sciences, India. Vigyan Bhavan, New Delhi. 8-9 March 2018.

Prabavathy, V.R. Workshop on Organic Farming. D. G. Vaishnava College, Chennai.9 October 2017.

Pradhan, A. Experience Sharing Seminar. Welthungerhlife, Constitution Club of India, New Delhi. 6 September 2017.

Pradhan, A. National Conference on Climate Change and our Responses for Sustainable Development, Kalinga Institute of Industrial Technology (KIIT), Bhubaneswar. 19 April 2017.

Priyanka Mohan and J. Rojarani. Trainer's and Training Programme on Understanding Public Libraries: Global Perspective. Indian Public Library Movement (IPLM), New Delhi. 29 May – 1 June 2017.

Punitha, S. Special Course on Hyperspectral Remote Sensing. National Remote Sensing Center - Indian Space Research Organization (NRSC/ISRO), Hyderabad. 3-7 July 2017.

Rajavelan, G. Training Programme on Public Financial Management System (PFMS) and Direct Benefit Transfer (DBT). SICOM, New Delhi. 10-11 April 2017.

Rajkumar, R. and K. Siranjothi. National Digital Library of India and Art of Story Telling. Pratham Books, IIT Kharagpur and Indian Public Library Movement (IPLM), Chennai. 22-23 March 2018.

Rajkumar, R., G. Sudhakar. and D. S. Girija. International Conference on Climate Change and Adaptation: Empowering Small-holders and Ensuring Food Security. Tamil Nadu

Agricultural University, Chennai. 11-12 May 2017.

Rampal, P. and Sangeetha Rajeesh. Workshop on Introduction to Systematic Reviews and Meta-Analysis. Campbell Collaboration, New Delhi. 12-14 December 2017.

Rengalakshmi, R. Collaborative Workshop on Gender in Energy and International Development Research: Low Carbon Energy for Development Network (LCEDN) and ENERGIA. Loughborough University, Leicestershire, UK. 15-18 May 2017.

Rengalakshmi, R. Project Launch and Inception Workshop for Access and Benefit Sharing. Indo-German Biodiversity Programme, Chennai. 27 February 2018.

Rojarani, J. Workshop on Development through Data: How to Communicate Effectively through Data. Centre for Science and Environment, New Delhi. 30 August – 1 September 2017.

Sahu,A. K. and Max Aurthor Gill. Tribal Conclave-Odisha & Jharkhand. Ministry of Tribal Affairs, National Institute of Technology, Rourkela. 22-23 April 2017.

Sakthivel, A. Regional Workshop on Marine Fisheries Resources of Tamil NaduRajiv Gandhi Center for Aquaculture, Sirkazhi. 16 May 2017.

Sangeetha, R. 6-Week Course on Analysing Discourse. Wageningen School of Social Sciences, The Netherlands. 01 September – 12 October 2017.

Seenivasan, R. Training on Proposal Development of Climate Change Appreciation. Bankers Institute of Rural Development, Mangalore. 24-27 May 2017.

Seenivasan, R. Training Programme on Joint Liability Groups Promotion and Nurturing National Bank for Agriculture and Rural Development (NABARD), Dindigul. 22 June 2017.

Seenivasan, R. Workshop on Agribusiness Strategies and Business Plan Development for FPO's. Tamil Nadu Agricultural University and National Bank for Agriculture and Rural Development (NABARD), Trichy. 22-24 March 2018.

Seenivasan, R. Workshop on Credit Support Opportunities to FPO's. NABKISAN Finance Ltd, Chennai. 25 July 2017.

Selvaganapathy, E. Regional Workshop on Marine Fisheries Resources of Tamil Nadu. Rajiv Gandhi Center for Aquaculture, Sirkazhi. 16 May 2017.

Selvamukilan, B. Training on Doubling the Farmers Income. Bankers Institute of Rural Development, Mangalore. 11-13 October 2017.

Selvamukilan, B. Training on Hand made Paper Production and Biofertilizer Production for Scientists. Rice Biopark, Myanmar. 26 August – 12 September 2017.

Selvamukilan, B. Training on Proposal Development of Climate Change Appreciation. Bankers Institute of Rural Development, Mangalore. 24-27 May 2017.

Selvamuklan, B. National Workshop on Usage and Assemble of Foldscope. Narayani college, Vellore. 7-9 February 2018.

Selvamuklan, B. Training on Plant Clinic. National Agro Foundation, Kanchipuram. 26-31 October 2017.

Selvarasu, T. Regional Workshop on Marine Fisheries Resources of Tamil Nadu. Rajiv Gandhi Center for Aquaculture, Sirkazhi. 16 May 2017.

Shaw, D. K. Workshop on Microbial Genomics. National Centre for Microbial Research, Pune. 15-19 January 2018.

Sivakumar, K. Training on Credit Linkages for Grass Root Institutions. NABARD Financial Services (NABFIN), Krishnagiri. 27 January 2018.

Sivakumar, K. Meeting on Coffee Board Schemes. Coffee Board Department, Salem. 13 December 2017.

Sivakumar, K. State Level Workshop on Millets. Hotel Taj Coromandel. Chennai. 6 October 2017.

Sivakumar, K. Workshop on Banana Festival. National Bank for Agriculture and Rural Development (NABARD), Madurai. 21-23 July 2017.

Sivakumar,K. Workshop on Post-Harvest and Value Addition in Millets. DHAN Foundation. Madurai. 15-16 February 2018.

Sivakumar, K. Workshop on Protection of Plant Varieties and Farmers Right Act 2001. TANUVAS-KVK, Namakkal. 17 March 2018.

Sivakumar, M.N. Training on Credit Linkages for Grass Root Institutions. NABARD Financial Services (NABFIN), Krishnagiri. 27 January 2018.

Sivakumar, M.N. Workshop on Protection of Plant Varieties and Farmers Right Act 2001. TANUVAS-KVK, Namakkal. 17 March 2018.

Sivakumar,M.N. Training on Refresher Programme on NGO. National Bank for Agriculture and Rural Development (NABARD), Indian Overseas Bank (IOB) and Indian Bank. Namakkal. 21 February 2018.

Sivakumar, M.N. Workshop on Vendor Survey of Millet Machines. Tamil Nadu Rural Transformation Project (TNRTP), Ooty. 7 April 2017.

Sivan, V. V. Capacity Building in Agriculture and Environment. *Institute of Management* in *Government* (IMG), Thiruvananthapuram. 5 October 2017.

Srinath,J. and D. S. Girija. National Workshop on Innovative ICT Application Initiatives for Rural Development. National Institute of Rural Development & Panchayat Raj (NIRD & PR), Hyderabad. 1 September 2017.

Sudhakar, G. and D. S. Girija. Trainers Training Workshop on Plant Doctor for Module 1 and 2. National Centre for Rural Development, Marakkanam. 26-31 October 2017.

Thachinamurthy, K. Consultation on Agriculture, Innovation and Rural life. Ministry of Rural Development, New Delhi. 10-11 October 2017.

Thachinamurthy, K. Consultation on Linking Small Farmers into Fair Markets. Isha Foundation, Coimbatore.1 February 2018.

Thachinamurthy, K. State Level Workshop on Collective Farming. Tamil Nadu Government Agriculture Department, Trichy. 12 August 2017.

Thachinamurthy, K. Workshop onAdvantage of Tamil Nadu - Opportunities in Sunrise Industries.Federation of Indian Chambers of Commerce and Industry (FICCI), Chennai.1 November 2017.

Thachinamurthy, K. Workshop on Building Resilient FPOs. DHAN Foundation, Madurai. 23 September 2017.

Thachinamurthy, K. Workshop on Market Challenges and Opportunities of FPOs. The Covenant Centre for Development, Madurai. 2 August 2017.

Thachinamurthy, K. Workshop on Strengthening FPOs. Tamil Nadu Agricultural University, Trichy. 21-24 March 2018.

Thamizhazhayan, E. Regional workshop on Marine Fisheries Resources of Tamil Nadu. Rajiv Gandhi Center for Aquaculture, Sirkazhi. 16 May 2017.

Thangavel, P. Workshop on Banana Festival. National Bank for Agriculture and Rural Development (NABARD), Madurai. 21-23 July 2017.

Thangavel, P. Workshop on Post-Harvest and Value Addition in Millets. DHAN Foundation, Madurai. 15-16 February 2018.

Velvizhi, S. CSR Conference and Round Table Discussion on Synergy for Maximizing Social Impact. Madras Chamber of Commerce & Industry, Chennai. 2 March 2018.

Velvizhi, S. Second Training Workshop on Capitalization of Experiences for Greater Impact inRural Development. Technical Centre for Agriculture and Rural Cooperation. Puducherry. 11-14 September 2017.

Velvizhi, S. Workshop on CSR for National Building: The HCL Grant PAN India Symposium. HCL Foundation and Adyar Cancer Institute, Chennai. 23 May 2017.

Velvizhi, S. Consultative Workshop on Biodiversity beyond National Jurisdiction. Centre for Marine Living Resource and Ecology, Cochin. 20 June 2017.

Velvizhi, S. First Training Workshop on Capitalization of Experiences for Greater Impact in Rural Development. Technical Centre for Agriculture and Rural Cooperation, Goa. 10-13 April 2018.

Yuvaraj, P. International Conference on Organic Millets. Ministry of Agriculture,Government of Karnataka, Bengaluru. 21 January 2018.

Yuvaraj, P. Workshop on Protection of Plant Varieties and Farmers Right Act 2001. TANUVAS-KVK, Namakkal. 17 March 2018.

Awards/Honours

Institutional

M.S. Swaminathan Research Foundation. 2018. Biotechnology Social Development

Awards – 2017 under organization category, Department of Biotechnology, Government of India, New Delhi.

Individual

Dhanya, C. S. 2017. Environment Literacy Award (Paristhithi Saahithya Puraskaaram). Sahyaadri Natural History Society, Thiruvananthapuram, Kerala.

Kumari, K. 2018. EMBO Short-term Fellowship. Institut National de la Recherche Agronomique (INRA), Montpellier, France.

Kumari K., V. Jegadeeson, S. Suji, V. Gaytri and A. Parida. 2017. Second Prize for Poster Presentation. National Conference on Recent Trends in Genetics Engineering and Biotechnology. SRM University, Kattankulathur.

Manjula,M. 2018.Member. Executive Council, Indian Society for Ecological Economics, New Delhi.

Parasurman, N. 2018. Member. Board of Studies in Management and Industrial Relation, University of Madras, Chennai.

Rengalakshmi, R.2018. Member. Agro-biodiversity Sub Committee, Tamil Nadu Biodiversity Board, Chennai.

Rengalakshmi, R. 2017. Member. Board of Studies in Botany, University of Madras, Chennai.

Swaminathan, M. S. 2017. Honorary Doctorate, Uttar Banga Krishi Viswavidyalaya, West Bengal.

Swaminathan, M. S. 2018. Honorary Doctorate, Orissa University of Agriculture & Technology, Bhubaneswar.

Swaminathan, M. S. 2017. Yerarignar (Icon of Farm Research). Tamil Scientific Agricultural Society, Tamil Nadu Agricultural University (TNAU), Tamil Nadu Fisheries University and Tamil Nadu Veterinary and Animal Sciences University, Chennai.

Swaminathan, M. S. 2017. Bharath Shanthi Dootha Award. World Peace Festival Society, Warangal.

Swaminathan, M. S. 2018.National Basava Krushi Award. Lingayat Panchamasali Mahapeeth, Bagalgot.

About the Foundation

The M.S. Swaminathan Research Foundation (MSSRF) was registered in 1988 as a non-profit Trust. MSSRF is recognised by the Government of India, Department of Scientific and Industrial Research, New Delhi, and by the Director General of Income Tax Exemptions, for the purpose of exemption of contributions from Income Tax under Section 80G and sections 35(1)(ii) of Income Tax Act, 1961, read with Rule 6 of Income Tax Rules, 1962. The Ministry of Home Affairs, Government of India, has recognised the Foundation for receiving funds from sources abroad under the provisions of Foreign Contribution (Regulation) Act, 1976. Department of Science & Technology, Government of India has sanctioned Grants-in-Aid support to the MSSRF.

Board of Trustees

- Professor M.S. Swaminathan (Founder Chairman and Chief Mentor)
- Dr. MadhuraSwaminathan(Chairperson)
- Mr. N. Ram
- Mr. V.Namasivayam
- Dr. Manju Sharma
- Dr. V.S. Chauhan
- Dr. Kezevino Aram
- Dr. Narayan G. Hegde
- Ms. N.L. Rajah
- Dr. SunitaNarain
- Dr. Prema Ramachandran
- Mr. S. Mahalingam

Dr. V. Selvam, Executive Director, MSSRF (Secretary to the Board)

Centre for Research on Sustainable Agricultural and Rural Development (CRSARD)

Professor M.S. Swaminathan
(President)
Founder Chairman and Chief Mentor
MSSRF, Chennai

Mr. G. Venkataramani
(Secretary)
51, Journalists Colony
Srinivasapuram
Thiruvanmiyur, Chennai

Ms. MalavikaVinod Kumar
(Treasurer)
Technical Director
M/s. Sundar Chemicals (P) Ltd
560-562, 6-G, Century Plaza
Teynampet, Chennai

Ms. Mina Swaminathan
Distinguished Chair – Gender and Development
MSSRF, Chennai

Dr. V. Selvam
Executive Director
MSSRF, Chennai

Professor P.C. Kesavan
Distinguished Fellow
MSSRF, Chennai

Mr. B.S. Raghavan, IAS (Retd.)
Ex-Policy Advisor to UN (FAO)
4, Second Street, Nehru Nagar
Adyar, Chennai

Dr. K.V. Raman
Apartment 3-A, 'Shreyas'
4th Seaward Road, Valmiki Nagar
Thiruvanmiyur, Chennai

Mr. A.M. Mahmood Hussain, IFS (Retd.)
29, 1st Main Road, Kapaleeswarar Nagar
Neelankarai, Chennai

Rtn. Mr. S.S. Rajasekhar
'River View'
Kotturpuram, Chennai

Dr. K. Ramasamy
Vice Chancellor
Tamil Nadu Agricultural University
Coimbatore

Dr. C. Balachandran
Vice Chancellor
Tamil Nadu Veterinary & Animal Sciences University,Chennai

Professor K.L. Krishna
Chairperson
Madras Institute of Development Studies
Chennai

Professor M.K.Surappa
Vice Chancellor
Anna University, Chennai

Professor P. Duraisamy
Vice Chancellor
University of Madras, Chennai

Dr. A.A. Nambi
Director (Climate Resilience Practice)
World Resources Institute
IIT Madras Campus, Chennai

Mr. J.V. Ramanujam
Partner, M/s. J.V. Ramanujam& Co.Chartered Accountants
New No.233 (Old No.113), R.K. Mutt Road
RAPuram, Chennai

Auditor

M/s. Brahmayya & Co
Chartered Accountants
48, Masilamani Road, Balaji Nagar
Royapettah,Chennai

Research Advisory Board

Dr. V.S. Chauhan (Chair)
Visiting Scientist
International Centre for Genetic Engineering & Biotechnology, New Delhi

Prof. M.S. Swaminathan
Founder Chairman and Chief Mentor
MSSRF, Chennai

Dr. Madhura Swaminathan
Chairperson
MSSRF, Chennai

Prof. Akhilesh Tyagi
Former Director, National Institute of Plant Genome Research
Universityof Delhi, New Delhi

Dr. Narayan G. Hegde
Trustee & Principal Adviser
BAIF, Development Research Foundation
Pune

Dr. Kezevino Aram
Director
Shanti Ashram, Coimbatore

Prof. T. Jayaraman
Chairperson
Center for Science, Technology and Society,
TISS, Mumbai

Dr. S.V. Raghavan
Office of the Principal Scientific Advisor
Govt of India, New Delhi

Dr. V. Selvam
Executive Director
MSSRF, Chennai

Programme Advisory Committees

Steering Committee, Community Agro-biodiversity Centre, Kalpetta, Wayanad District, Kerala

Professor M.K. Prasad (Chairman)
'Pratheeksha'
NearCollege of Engineering
Pangappara PO, Thiruvananthapuram

Dr.S. Edison
Former Director CTCRI
'Chandra Saras'
TC No 2/3512, Pattom PO
Kesavadasapuram, Thiruvananthapuram

Dr. Kamalam Joseph
Head, Training Education & Extension
Division, Centre for Water Resources
Development and Management,
Kunnamangalam, Kozhikode

Dr. V. Selvam
Executive Director
MSSRF, Chennai

Dr. N. Anil Kumar
Senior Director
MSSRF, Chennai

Dr. V. Balakrishnan (Member Secretary)
Head,
CAbC,MSSRF
Wayanad

Technical Advisory Committee: Community Agrobiodiversity Centre, Kalpetta, Wayanad District, Kerala

Prof. E. Kunhikrishnan
Rtd. Professor, University College
Thiruvananthapuram

Dr. M.K. Ratheesh Narayanan
Assistant Professor, Department of Botany
Payyanur College, Edat,
Kasargod District

Dr. A. Sabu
Associate Professor, Dept. Biotechnogy& Microbiology
School of Life science, Kannur university
Thalassery Campus, Palayad, Kannur

Dr. K.M. Sreekumar
Professor (Ag. Entomology),
Academic Council Member
Kerala Agricultural University
College of Agriculture, Kasaragod

Dr. T. Vanaja
Associate Professor, RARS
Pilicode, Kasaragod (District)

Dr. Anitha Chandran
Dept. of Community Science, College of Agriculture
Kerala Agricultural University,
Vellayani,Thiruvananthapuram

Dr. K. Nirmal Babu
Director, ICAR-Indian Institute of Spices Research
MarikunnuP.O.,Kozhikode

Dr. Seema Bhaskaran
Chief Operating Officer
Kudumbasree Mission, Attappady, Palakkad

Dr. Praveena Kodoth
Associate Professor, Centre for Development Studies
Prasanth Nagar, Medical College P.O,
Ulloor,Thiruvananthapuram

Dr. S. Gregory
Director of Distance Education, Kannur University and
Dean, Faculty of Social Sciences, Kannur University
Kannur

Dr. M. Jayamohan
The Principal, College of Applied Science
Konni*Attachackal Po, PathanamthittaDist*

Sri. Prakasan Puthiyetti
Sub Editor, Mathrubhumi
Kottayam

Dr. N.S. Pradeep
Senior Scientist, Jawaharlal Nehru Tropical Botanic Garden & Research Institute
Palode, Thiruvananthapuram

T.P. Paul
T.P.PAUL& ASSOCIATES
Kalpetta, Wayanad

Adv. Joseph Zacharias
Public Prosecutor
Kalpetta, Wayanad
MSSBG Advisory Committee

Dr. K.K. Narayanan (Chairman)
D 705, Mantri Elite, Bannerghatta Road
Bengaluru 560076

Dr. Madhura Swaminathan
Chairperson, MSSRF

Mr. V. Namasivayam
Trustee, MSSRF

Dr. Ganesan Balachander
Former Director
Ashok Trust for Research in Ecology and the environment (ATREE)
Bangalore

Dr. V.S. Chauhan
Trustee, MSSRF

Dr. Sarada Krishnan
Director of Horticulture &
Center for Global Initiatives
Denver Botanic Gardens, 909 York Street
Denver, CO 80206

Dr. V. Selvam
Executive Director
MSSRF, Chennai

Dr. N. Anil Kumar
Senior Director
MSSRF, Chennai

Dr. V.Balakrishnan
(Secretary)
Head
CAbC, MSSRF
Wayanad

Institutional Bio-Safety Committee

Professor M.S. Swaminathan (Chairman)
Founder Chairman and Chief Mentor
MSSRF, Chennai

Dr. K. Bhuvaneshwari (DBT nominee)
Professor, Tamil Nadu Agricultural University
Coimbatore

Dr. N. Devaraj
Department of Zoology
University of Madras
Guindy Campus, Chennai

Dr. Ajit Yadav
Head of the Department, Orthopaedics & Joint Replacement
Global Hospitals and Health City
Chennai

Dr. V. Selvam (Member Secretary)
Executive Director
MSSRF, Chennai

Project Advisory Committee: Leveraging Agriculture for Nutrition in South Asia (LANSA) Project

Prof. M.S. Swaminathan
Founder Chairman and Chief Mentor
MSSRF, Chennai

Prof. Barbara Harris-White
Senior Research Fellow
Contemporary South Asian Studies Programme
School of Interdisciplinary Area Studies
Oxford

Prof. S. Mahendra Dev
Director (Vice Chancellor)
Indira Gandhi Institute of Development Research
Mumbai

Prof.Iqrar Ahmad Khan
Vice Chancellor
University of Agriculture
Faisalabad, Pakistan

Dr.MeeraShekar
Lead Health and Nutrition Specialist
Africa Human Development
The World Bank
Washington, DC

Mr. Mohammed Syeduzzaman
Chairman
Credit Rating Agency for Bangladesh
Dhaka

Dr. Joachim von Braun
Director, Centre for Development Research and Professor of Economics and Technical Change
University of Bonn, Germany

Dr. Abdul Rashid Hakimi
Vice Chancellor for Relation Coordination
Afghanistan National Agriculture Sciences and Technology University (ANASTU)
Kandahar, Afghanistan

Technical Advisory Committee: Farming System for Nutrition: A Pathway for Malnutrition Free India

Dr. Archana Mukherjee
Director
ICAR-Central Tuber Crops Research Institute,Sreekariyam
Thiruvananthapuram

Dr. Brantley Browning
Bill & Melinda Gates Foundation
Capital Court, 5th Floor
Olof Palme Marg
Munirka, New Delhi

Dr. Meera Singh
Dean, Faculty of Home Science
Dr. Rajendra Prasad Central Agricultural University, PUSA
Samastipur, Patna 848125, Bihar

Prof. D. Narasimha Reddy
Retired Professor in Economics and Dean
School of Social Sciences
University of Hyderabad
Prof C R Rao Road, CUC, Gachibowli
Hyderabad 500046, Telangana

Dr. Prema Ramachandran
Director,Nutrition Foundation of India
C-13, Qutab Institutional Area
New Delhi 110016

Prof. R. Ramakumar
Dean - School of Development Studies
Tata Institute of Social Sciences
V.N. Purav Marg, Deonar
Mumbai 400088

Dr. Srinivas Goli
Assistant Professor
Population Studies Centre for the Study of Regional Development
School of Social Sciences (SSS), Jawaharlal Nehru University (JNU)
New Mehrauli Road, Munirka
New Delhi 110067

Mr. S. Lakshman
TATA Trusts
World Trade Center-1, 26th floor
Cuffe Parade, Mumbai 400005

Dr. R. Sankar
Director, Nutrition
TATA Trusts
World Trade Center-1, 26th floor
Cuffe Parade, Mumbai 400005

Foundation Staff

Dr. V. Selvam, *Executive Director*

COASTAL SYSTEMS RESEARCH

Chennai

Dr. N. Anil Kumar, Senior *Director*
Dr. R. Ramasubramanian
Principal Coordinator
Dr. N. Parasuraman, *Principal Scientist*
Mr. R. Nagarajan, *Sr. Scientist*
Ms. S. Punitha, *Scientist*
Mr. R. Samaneethi, *Research Fellow*
Mr. P. Yogeshwaran, *Research Fellow*

Chidambaram

Mr. K.K. Ravichandaran, *Sr. Scientist* *
Mr. P. Gnanamoorthy, *Research Associate*
Mr. P. Santhosh Kumar, *Technical Assistant**
Mr. D. Veera Raj, *Accountant*
Mr. U.K. Saravanan, *Assistant*

Vedaranyam

Mr. G. Rajavelan, *Project Associate*
Mr. N. Kannedi Raju, *Scientist*
Mr. T. Uthayakumar, *JRF*
Mr. R. Jayakumar, *Technical Assistant*
Mr. M. Arulselvam, *Technical Assistant*
Ms. N. Amaravathi, *Field Assistant*

Machilipattinam

Mr. S.S. Chaudhury, *Principal Scientist**
Mr. N. Babji,*Social Worker*
Mr. Chenchu Ramarao Damarla,
Project Fellow

Kuttanad

Mr. R. Sanjeev, *Scientist*
Mr. Anand Zacharia, Research Fellow
Mr. Jibin Thomas, Consultant
Ms. SibiKuncharia, *Office Assistant*

FISH FOR ALL CENTRE, Poompuhar

Dr. S. Velvizhi, *Head - Fish for All Centre*
Dr. A. Sakthivel, *Project Associate*
Mr. T. Selvarasu, *Sr. Scientist*
Mr. E. Selvaganapathy, *Sr. Technical Assistant*
Mr. S. Ananthan, *Attendant*
Ms. S. Kavitha, *Attendant*

BIODIVERSITY

Community Agrobiodiversity Centre, Kalpetta, Kerala

Dr. V. Balakrishnan, *Head*
Mr. G. Girigan, *Principal Scientist*
Dr. C.S. Chandrika, *Principal Scientist*
Mr. V.V. Sivan, *Sr. Scientist*
Dr. Smitha S. Thakappan, *Sr. Scientist*
Dr. S. Meena Nair, *Sr. Scientist*
Mr. N. Gopalakrishnan, *Project Manager*
Ms. T.R. Suma, *Scientist*
Dr. Shely Mary Koshy, *Agricultural Scientist*
Mr. Joseph John, *Project Associate*
Ms. C.S. Dhanya, *Project Associate*
Mr. P. Ramakrishnan, *Project Associate*
Mr. M.K. Bineesh, *Project Associate*
Ms. K. Anitha, *Project Associate*

**left during the year*

Mr. Jayesh P. Joseph, *SRF*
Dr. M.K. Sujeesh, *Development Coordinator*
Mr. M.M. Jithin, *Garden Manager*
Mr. M.K. Nandakumar, *Research Fellow*
Ms. P. Asiya, *Project Fellow*
Ms. NinuMehnaz, *Project Fellow*
Mr. Robin Varghese, *ECAS, Coordinator**
Ms. Elsy Mathew, *Assistant Manager*
Mr. T. Manoj Kumar, *Assistant Manager*
Mr. P.M. Salim, *Sr. Technical Assistant*
Mr. Vipindas, *Programme Professional*
Ms. K.N. Shyja, *Technical Assistant*
Mr. K. Dileep,*Technical Assistant*
Mr. Rohan Mathew, *Technical Assistant**
Ms. P.K. Bushara, *Technical Assistant*
Mr. K.T. Satheesh, *Technical Assistant*
Mr. P.M. Noushique, *Assistant Engineer*
Ms. E. Radha, *Project Assistant*
Ms. P.R. Sreeraj, *Research Assistant*
Ms. Maneesha Luckose,
Development Assistant
Mr. A. Anoop, *Field Assistant*
Mr. K.K.Santhosh, *Field Assistant**
Ms. K. Saraswathy, *Guest House, Caretaker*
Mr. K. Rasheed, *Driver*
Ms. Sibi Kunchariya, Office Assistant
Mr. M.K. Pavithran Consultant

Biju Patnaik Medicinal Plants Garden & Research Centre, Jeypore, Odisha

Dr. E.D. Israel Oliver King, *Director I/C*
Dr. S. Malarvannan, *Sr. Scientist*
Mr. Prashanta Kumar Parida, *Sr. Scientist*
Dr. S. Jegan, *Research Associate*
Dr. Bikram Keshari Baliarsingh, *Scientist*
Mr. R. Jeeva, *Scientist*
Mr. JagannathKhillo, *SRF*
Mr. M. N Sivakumar, *JRF*
Mr. P. Yuvaraj, *JRF*
Mr. Pratap Chandra Jena, *Technical Assistant*
Mr. A. Lakshmana Rao, *Technical Assistant*
Ms. SulochanaPadhi, *Assistant (Administration)*
Mr. Naresh Chandra Patro,
Development Assistant
Mr. Max Aurthor Gill, *Development Assistant*
Mr. Balaji Mohanty, *Development Assistant*
Mr. Jaganath Naik, *Development Assistant*
Mr. Ghasi Takri, *Development Assistant*
Mr. Santhosh Raj Benia,
Development Assistant
Ms. SurajitKumari Turuk,
Development Assistant
Mr. Lambodar Jena, *Field Assistant*
Mr. Ranjit Kumar Dalai, *Field Assistant*
Mr. Govinda Chandra Nag, *Field Assistant**
Ms. Rama Khara, *Cleaning Assistant*
Mr. Pramod Sahu, *Technical Assistant**
Mr. Suresh Kumar Rath, *Assistant (Accounts)**
Mr. Neeranjan Gauda, *Technical Assistant**
Ms. Anurakta Beuria, *Project Assistant**

Ganjam

Dr. M. Kartik Charan Lenka, *Scientist*
Mr. Susanta Kumar Mishra,
Development Assistant

Community Biodiversity Programme, Kolli Hills, Namakkal

Dr. N. Kumar, *Project Associate*
Mr. R. Baskar, *Sr. Technical Assistant*
Mr. P. Thangavel, *Technical Assistant*
Mr. R. Gnanaprakasam, *Technical Assistant*

**left during the year*

Mr. M. Joseph Arutselvan, *Technical Assistant**
Mr. S. Chinnathambi, *Field Technician*
Mr. A. Annadurai, *Field Assistant*
Mr. K. Sivakumar, *Field Assistant*

BIOTECHNOLOGY

Dr. G.N. Hariharan, *Director*

Chennai

Dr. S. Rajalakshmi, *Principal Coordinator**
Dr. V.R. Prabavathy, *Principal Scientist*
Dr. Gayatri Venkataraman, *Principal Scientist*
Dr. Suja George, *Principal Scientist*
Dr. J. Deepa, *Post Doctoral Fellow*
Dr. J. Shilpha, *Post Doctoral Fellow*
Mr. S. Gothandapani, *Research Associate*
Mr. S. Sekar, *Scientist*
Mr. S. Subash Kumar, *Scientist**
Mr. S. Muthukumar, *SRF*
Mr. R. Raja, *SRF*
Ms. Kumkum Kumari, *JRF*
Ms. P. Shalini, *JRF*
Mr. Deepak Kr Shaw, *JRF*
Mr. R. Karthikeyan, *JRF**
Mr. M.M. Saravanan, *Sr. Technical Assistant*
Mr. G.K. Dayanandham, *Sr. Secretary*
Mr. E. Siva, *Attendant*
Mr. M. Kannan, *Attendant*
Mr. M.Thiyagarajan, *Attendant**
Ms. N. Nagalakshmi, *Assistant*

Kalpakkam

Mr. R. Kalaimani, *Scientist*

New Delhi

Ms. Manisha Jain, *Project Assistant**
Mr. Govind Kumar Jha, *Project Assistant**
Ms. Poonam Thakur, *Project Assistant*
Mr. Narender Singh, *Technical Assistant**
Mr. Pankaj Chandra, *Technical Assistant*

Karnataka

Mr. Vinayak Edke, *SRF**
Mr. C.D. Shrishaila, *SRF**
Mr. Kiran Dhareshwar, *SRF*
Mr. L. Mohankumar, *SRF*
Mr. Manikantha V. Gunaga, *Field Assistant*

ECOTECHNOLOGY

Dr. R. Rengalakshmi, *Director*

Chennai

Dr. Manjula Menon, *Principal Scientist*
Mr. P. Lakshmanan, *Scientist*
Dr. R. Kathiravan, Research Associate*
Dr. J.D. Sophia, *Principal Scientist**
Dr. R. Jastin Samuel, *Research Associate**
Ms. J. Hemamalini, Research Associate*
Dr. K. Bhuvaneswari, *Research Associate*
Mr. V. Narasimharao, *SRF**
Mr. Paramananda Sahu, Project Fellow
Ms. S. Geetha, *Assistant Manager*
Mr. S. Mohan, *Attendant*

Pudukottai

Mr. K. Thachinamurthy, *Site Coordinator*
Mr. A. Parthiban, *Technical Assistant**

Villupuram

Mr. P. Nandeesa, *Site Coordinator*

Wardha

Ms. Manda Bhondawe, *Scientist**
Ms. Smita Someshwer Nakshine
*Technical Assistant**

**left during the year*

Kannivadi

Mr. M. Devaraj, *Sr. Scientist*
Mr. R. Seenivasan, *Sr. Scientist*
Dr. B. Selvamukilan, *Sr. Scientist*
Mr. M. Karthikeyan, *SRF*
Mr. V. Balamurugan, *Project Fellow*
Mr. K. Rajaram, *Accounts Assistant*
Mr. M. Santhiveeran, *Field assistant*
Mr. V. Sakthivel, *Office assistant*

Puducherry

Mr. P. Santhamurthy, *Sr. Scientist*
Ms. P. Pakkialatchoumy, *Project Associate**

New Delhi

Dr. Govind Kelkar, *Lead Researcher - Gender*
Prof. Dev Nathan, *Political Economist*
Ms. Sneha S. Banerjee, *Research Assistant*

FOOD SECURITY

Dr. R. Rukmani, *Director*

Chennai

Dr. G. Anuradha, *Principal Scientist*
Dr. R. Gopinath, *Sr. Scientist*
Dr. K. Anusha Priyadarsini, *SRF**
Mr. Varunkumar Yadav, *SRF*
Mr. A. Sakthivelan, *Sr. Secretary*

Vidarbha

Mr. Kishor P. Jagtap, *Principal Scientist**
Ms. Charusheela Uttamrao Thakare, *Scientist**
Ms. Jyotsna BhimraoRaut, *Scientist**
Ms. Nalu Sukhadeorao Shambharkar, *Scientist**
Ms. ManjushaBhagat, *Project Assistant**
Mr. Atul Narayan Naik, *Project Assistant**
Mr. Pravin R. Kumbhalkar, *Asst. Manager (Accounts)**

Jeypore

Mr. Ajit Kumar Sahu, *Technical Assistant*
Mr. Malaya Kumar Nayak, *Field Assistant*
Mr. Rajdeep Behera, *Field Assistant*
Mr. Sanjay Kumar Bhuyan, *Office Assistant*

INFORMATION, EDUCATION AND COMMUNICATION

Ms. Nancy J. Anabel, *Director*

Chennai

Mr. R. Rajamanikkam, *Sr. Scientist*
Ms. T. Aruna, *Sr. Scientist**
Mr. R. Srinivasan, *Scientist*
Ms. J. Rojarani, *Scientist*
Ms. D. Suvitha, *Scientist*
Ms. K. Siranjothi, *Project Associate*
Mr. K. Sunder Vadivelu, *Assistant Manager*
Mr. R. Guru Prakash, *Sr. Technical Assistant*
Mr. S. Kannappan, *Sr. Technical Assistant*
Ms. R. Jayashree, *Assistant Accounts & Admin*

Thangachimadam

Mr. J. Arockia Kevikumar, *Sr. Technical Assistant*
Mr. K. Abdul Salam, *Sr. Technical Assistant*

Puducherry

Ms. D.S. Girija, *Sr. Scientist*
Mr. R. Elangovan, *Scientist*

**left during the year*

Mr. C. Lourdessamy Maleappane,
Sr. Tech. Assistant
Mr. M. Senthil Kumaran
Sr. Technical Assistant
Ms. K. Soundary, *Field Assistant*

Nagercoil

Mr. A. Mubarak Ali, *Project Associate*
Ms. K. Amutha, *Field Assistant**

Dindigul

Mr. C.A.S. Britto, *Sr. Technical Assistant*

Thiruvaiyaru

Mr. G. Sudhakar, *Scientist*
Mr. G. Murugan, *Sr. Technical Assistant*
Mr. P. Silambarasan, *Technical Assistant*
Ms. S. Sujitha, *Field Assistant*
Mr. A. Gopal, *Driver*

Pudukottai

Dr. Rajkumar Ramasamy, *Sr. Scientist*
Mr. A. Mohamed Bhilal, *Scientist*
Mr. N. Yesudas, *Technical Assistant*
Mr. R. Vinoth Kanna, *Technical Assistant*
Mr. R. Jeevanraj, *Technical Assistant*

Poompuhar

Mr. E. Thamizhazhagan, *Project Associate*
Ms. J. Shanmuga Priya, *JRF**
Mr. M. Kannan, *Sr. Technical Assistant*
Ms. S. Ranjitha, *Technical Assistant*

Tiruchirappalli

Ms. P. Kuyili, *Project Associate*
Mr. S. Murugesan, *Scientist**

Puri

Mr. Bhabani Sankar Bhuyan, *Research Intern**
Mr. Suryakanta Behera, *Field Assistant**

Andhra Pradesh

Mr. B. Janakiramulu, *Project Associate**
Mr. N. Veerabhadra Rao, *Technical Assistant*
Mr. Karri Dhanaraju, *Technical Assistant**
Mr. Srinivasarao Divisam, *Research Intern*

Kerala

Mr. A. Sahaya Pradeep, *JRF**
Mr. S. Kumar, Project Associate*
Mr. E. Edison, *Field Assistant*

Vidarbha

Mr. J. Srinath, *Principal Scientist**
Mr. Nilesh G Patkar, *Scientist**
Mr. Dildarkhan Pathan, *Sr. Technical Assistant*
Mr. Irfan Turabkhan Pathan, *Field Assistant**
Ms. Sushma Sanjay Pistulkar, *Field Assistant**
Mr. Dnyaneshwar M. Ghawade
*Field Assistant**

LEVERAGING AGRICULTURE FOR NUTRITION IN SOUTH ASIA

Dr. R.V. Bhavani
Project and Outreach Manager
Ms. Sangeetha Rajeesh, *Research Uptake Manager*
Dr. Aliza Pradhan, *Coordinator, FSN Study**
Ms. Priya Rampal, *Post Doctoral Fellow*
Dr. D.J. Nithya, *Scientist*
Mr. Rohit Parasar, *Research Associate**
Mr. S. Raju, *Scientist (Social Science)*

**left during the year*

Ms. R. Surya, *Research Uptake Assistant*
Ms. Usha Priyadharshinee, *Secretary**

Jeypore

Mr. Akshaya Kumar Panda, *Sr. Scientist*
Ms. Menaka Choudhury, *Project Assistant**

Wardha

Mr. Prashant L Deokar,
*Coordinator, FSN Study in Wardha**
Ms. Rupal D Wagh, *Research Associate**
Mr. Manoj Sayre, *Sr. Technical Assistant**
Mr. Mahesh V Sadatpure, *Technical Assistant**
Ms. Pranali S Halge, *Project Assistant**
Mr. Vikas P Meshram, *Project Assistant**
Ms. Anjali G Baraee, *Project Assistant**
Mr. Prakash Polkade, *Assistant Accounts**
Mr. Rahul Yedkar, *Office Assistant**

RICE BIOPARK

Myanmar

Dr. Hameeda Banu N Itagi
Project Manager (Technical)

CLIMATE CHANGE PROGRAMME

Dr. A. Saleem Khan, *Sr. Scientist* *

THE HINDU MEDIA RESOURCE CENTRE

Ms. B. Jayashree, *Principal Scientist**
Ms. Annie Thomas, *Manager - HMRC*
Ms. Aparna Narayanan, *Media Associate*

LIBRARY AND INFORMATION SERVICES

Mr. A. Janakiraman, *Sr. Scientist*
Mr. G. Suresh Kumar, *Sr. Technical Assistant*

PERSONNEL AND ADMINISTRATION

Ms. Reena Eappen, *Head – Administration**
Ms. Vidhya Subramaniam
Head - HR & Administration
Mr. C.V. Parthasarathy, *Executive Secretary*
Ms. R. Malathy, *Executive Secretary*
Mr. B. Anandakumar,
Assistant Manager-Estate
Ms. R. Nalini, *Assistant Manager**
Ms. A. Uma, *Sr. Executive (HR)*
Ms. Y. Dilhara Begum, *Sr. Secretary*
Ms. J.D. Sharmila, *Secretary*
Mr. K. Suresh, *Assistant*
Ms. A. Syed Habi Banu Begum, *Receptionist**

ACCOUNTS

Mr. S. Nandakumar, *Manager*
Mr. Abhishek Vyas, *Manager*
Ms. K. Selvi, *Associate Manager*
Mr. K. Saravanan, *Assistant Manager*
Ms. R. Kavitha, *Accountant*
Ms. Nalina Muthukumaran, *Accountant*
Mr. R. Suban, *Accountant*
Ms. R. Selvarani, *Accountant*
Mr. S. Karthik, *Attendant*

SUPPORT SERVICE

Mr. P. Muthukumar, *Electrician*
Mr. B. Sivakumar, *Electrician*
Mr. E. Thiruvengadam, *Electrician*
Mr. T. Krishnamoorthy, *Guest House, Caretaker*
Mr. P. Balaji, *Driver*
Mr. C.H. Venkateshwaralu, *Attendant*
Mr. G. Niyas, *Attendant*

**left during the year*

Ms. V. Vijaya Lakshmi, *Attendant*

Ms. S. Santhi, *Attendant*

Ms. S. Soundari, *Attendant*
Ms. M. Kousalya, *Attendant*
Ms. B. Lakshmi, *Attendant*

Ms. G. Jayasudha, *Gardener*

DISTINGUISHED CHAIR & FELLOW

Ms. Mina Swaminathan
Distinguished Chair - Gender and Development

Professor P.C. Kesavan
Distinguished Fellow

CONSULTANT

Dr. P. Pillaiyar

Dr. L. Vedavalli

Dr. A. Thiagarajan*

Mr. P. Senthilkumar

Mr. M.K. Pavithran

Ms. Priyanka Mohan

Mr. P. Dhanaraj

Mr. K. Prabakaran

Ms. Samyuktha Kannan

SHORT TERM CONTRACT

Mr. Anirudh Barik, *Development Assistant*

Mr. Nirmal Raj, *Visual & Web Designer*

Mr. P. Sasikumar, *Android Developer*

Mr. Jibin Thomas, *Education Officer*

Mr. Anand Zacharias, *Development Associate*

Ms. Purna Chandra Samantray, *Field Assistant*

**left during the year*

List of Donors 2017-18

Institutional Donors – National

Bajaj Capital Ltd

Diana Travels Pvt. Ltd, Chennai

Wealth Advisors (India) Pvt. Ltd., Chennai

Individual Donors – National

Mr. V. Namasivayam

Dr. Madhura Swaminathan

Jagathguru Shree Basav Jaya Mruthyunj

Dr. Sudip Mithra

Dr. Latha Rangan

Prof. P.C. Kesavan

Sources of Project Support

Programme Area 100: Coastal Systems Research

National	*International*
Indian Institute of Tropical Meteorology, Ministry of Earth Sciences, Government of India, Pune	Mitsubishi Corporation, Japan
National Bank for Agriculture and Rural Development (NABARD), Mumbai	UNFCCC, Adaptation Fund, USA
Tata Power Co Ltd, Mumbai	ALSTOM Foundation, France
Society for Integrated Coastal Management (Ministry of Environment and Forests and Climate Change), Government of India, New Delhi	The World Bank, New Delhi
Charities Aid Foundation India, New Delhi	ORACLE, USA
Department of Agriculture, Government of Karnataka, Bengaluru	Rainwater for Humanity, USA
NTPC Tamil Nadu Energy Company Limited (NTECL), Chennai	

Fish for All Centre

National Bank for Agriculture and Rural Development (NABARD), Chennai	Technical Centre for Agricultural and Rural Cooperation (CTA), Netherlands

Programme Area 200: Biodiversity

National	*International*
Department of Science and Technology, Government of India, New Delhi	International Fund for Agricultural Development, Rome
National Bank for Agriculture and Rural Development (NABARD), Chennai and Trivandrum	Bioversity International, Rome
State Medicinal Plants Board , Government of Kerala	
Kerala State Biodiversity Board, Govt. of Kerala	
Kerala Council for Science, Technology and Environment, Government of Kerala	
Indian Institute of Millet Research, Hyderabad	
Indian Institute of Rice Research, Hyderabad	
Odisha State Biodiversity Board, Government of Odisha	
National Academy of Sciences, Alla	
RKVY –Government of India and Directorate of Agriculture and Food Production, Government of Odisha	
Department of Environment and Climate Change, Government of Kerala	
Odisha Millet Mission, Government of Odisha	
Odisha State Rural Livelihood Mission, Government of Odisha	
National Biodiversity Authority(NBA), Government of India	
SBI Life insurance Company Ltd, Trivandrum	

National	*International*

Programme Area 300: Biotechnology

Department of Biotechnology, Government of India, New Delhi	University of Basel, Basel, Switzerland
Council of Scientific and Industrial Research (CSIR), Government of India, New Delhi	
Science and Engineering Research Board (SERB), Department of Science & Technology, Government of India, New Delhi	
University Grants Commission, Government of India, New Delhi	

Programme Area 400: Ecotechnology

Hindustan Petroleum Corporation Ltd, Mumbai	International
Bank of India, Chennai	Asia Initiatives, USA
Indian Meteorological Department, Ministry of Earth Sciences, Government of India, New Delhi	Global Challenges Research Fund, UK
National Bank for Agriculture and Rural Development (NABARD), Chennai	Asia Pacific Network for Global Change Research, Japan
Department of Biotechnology, Government of India, New Delhi	Commonwealth of Learning, Canada
InsPIRE Network for Environment,	OCP Foundation, Morocco
UNDP - Ministry of Environment, Forests and Climate change, Government of India, New Delhi	
VA Tech Wabag Ltd, Chennai	

National	*International*

Programme Area 500: Food Security

Department of Rural Development, Ministry of Rural Development, Government of India, New Delhi

Tata Trusts, Mumbai

Maharashtra State Rural Livelihood Mission, Government of Maharashtra, Mumbai

Odisha State Rural Livelihood Mission, Government of Odisha, Bhubaneswar

Programme Area 600: Information, Education and Communication

Indian National Centre for Ocean Information Service (INCOIS), Ministry of Earth Sciences, Government of India, Hyderabad

State Planning Commission

Government of Tamil Nadu

District Rural Development Agency (DRDA), Pudukottai, Tamil Nadu

NASSCOM Foundation, Noida

CABI, New Delhi

Qualcomm, USA

Bill & Melinda Gates Foundation, USA

Norwegian Institute of Bioeconomy Research, Norway

Access Agriculture, UK

National	*International*

Programme Area 700: Gender, Grassroots Institutions and Climate Change

National Bank for Agriculture and Rural Development (NABARD), Mumbai

Indian Meteorological Department, Ministry of Earth Sciences, Government of India, New Delhi

Regional Representative, Central and South Asia Biodiversity International, India

Protection of Plant Varieties and Farmers' Rights Authority, Government of India, New Delhi

Department of Science and Technology, Government of India, New Delhi

Kerala State Council for Science, Technology and Environment, Government of Kerala

Odhisha State Biodiversity Board, Government of Odisha

National Biodiversity Authority,

Government of India

Kerala State Biodiversity Board,

Government of Kerala

B M Bio Energy, Puducherry

ATMA, Wayanad

SBI Life Insurance Co. Ltd, Mumbai

Rajiv Gandhi National Institute of Youth Development, Ministry of Youth Affairs and Sports, Government of India Sriperumbudur

Hivos, The Netherlands

The Royal Norwegian Embassy, New Delhi

World Scientific Publishing Co. Pvt Ltd, Singapore

Qualcomm, USA

World Food Prize Foundation, USA

Access Agriculture, Kenya

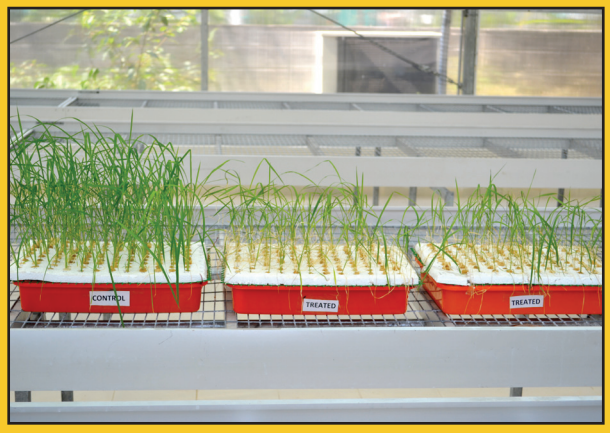
Institute for Global Environmental Strategies, Japan

Swiss Agency for Development and Cooperation – SDC, Embassy of Switzerland, New Delhi

National	*International*
ICRISAT, Telangana	
All India Poultry Development and Services Pvt Ltd, Hyderabad	
Academic Consulting and Editorial Services Pvt Ltd, Chennai	
Ministry of Environment, Forest and Climate Change, Government of India, New Delhi	
SRM Institute of Science and Technology, Kattankulathur	
Indian Council for Agricultural Research, New Delhi	

Programme Area 800: Special Projects

Ministry of External Affairs, Government of India, New Delhi	Department for International Development (DFID), UK
	Ministry of Agriculture and Irrigation, Government of Myanmar



Address:
M. S. Swaminathan
Research Foundation
III Cross Road
Institutional Area
Taramani
Chennai 600 113, India