MSSRF

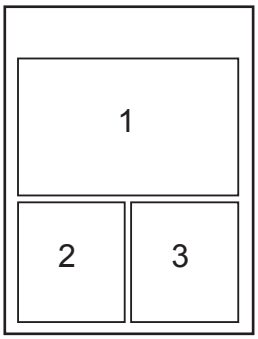
Science for Sustainable Development

M. S. SWAMINATHAN RESEARCH FOUNDATION

2014-2015

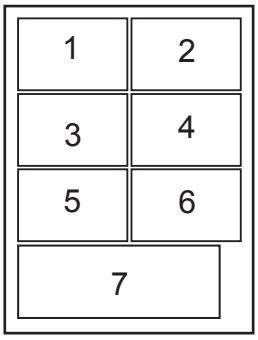
TWENTY-FIFTH ANNUAL REPORT

CENTRE FOR RESEARCH ON SUSTAINABLE AGRICULTURAL AND RURAL DEVELOPMENT, CHENNAI



Front Cover

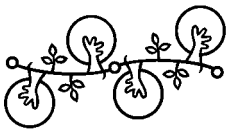
1. Prof. M. S. Swaminathan conferring fellowship to the grassroot academicians during the 10th Convocation of the Grameen Gyan Abhiyan
2. Shri. K.P. Mohanan, Minister for Agriculture, Government of Kerala inaugurating the Wayanad Traditional Seed Festival
3. MSSRF was the winner of the m-Billionth award under the category of m-Agriculture and Ecology



Back Cover

1. Village Communities involved in strengthening water harvesting structures
2. Promoting cultivation of vegetables addressing hidden hunger
3. Cultivation of selected varieties of pulses identified through participatory evaluation
4. Custodian Farmers promoting mixed cropping systems
5. Exposure visits of women farmers to the Farm School
6. Annual General Body meeting of the Federation of Women Farmers
7. Large scale cultivation of *Suaeda maritima* in saline affected soil

Twenty-Fifth Annual Report
2014 - 2015



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Chairperson's Introduction

Last year, the Board of Trustees commissioned an independent mission and management review to help us chart a path for the next 25 years. The following are the main recommendations made by the Review team led by Professor V. L. Chopra:

- **Agree on Social Good Objectives:** In line with the idea of re-aligning the work of the Foundation, integrating social, science and technology goals, the Foundation should consider reassessing its programme labels from the existing scientific identifiers to a combination that describes both desired social and scientific/technological outcomes.
- **Develop Cohesive Integrated Programmes:** Develop screening systems that ensure projects are compatible with core Foundation objectives.
- **Articulate a Comprehensive 3-5 year Strategic Plan:** The Plan should be in line with the overall social objectives and integrated programmes. The critical elements of institution building must be addressed both at the Foundation and grass-roots level.
- **Active Board Involvement in Executing Reshaped Agendas:** The Board of Trustees should be actively involved in initiating and guiding the re-orientation of work in the Foundation and necessary reorganisation. However, it should work towards eventually limiting its role to broad governance and allow the Foundation's work to be internally and professionally managed in collective fashion.
- **Raise Funds against a Comprehensive Strategic Plan:** Projects and programmes compatible with the overall plan should be presented to donors with matching concerns.
- **Remain an Autonomous Institution:** The Foundation has the potential to be a pioneer in the field of sustainable development. It should not consider becoming either a government entity or be dependent on a single funding partner. To this end, building and managing a corpus should be given priority.

The trustees constituted a Research Advisory Board, chaired by Professor Virander Chauhan, to guide discussions on developing the future research programme of the Foundation. The members of the Research Advisory Board, and expert sub-committees set up by the Board, have given many new and excellent ideas. As a follow-up, we propose a three-fold categorisation of programmes:

- Identify and strengthen those programmes which have become the flagship programmes of MSSRF based on their past impact and contemporary relevance
- Discontinue those programmes which have either accomplished their original goals or have lost their relevance in today's context of rural and tribal development
- Identify new areas where MSSRF can make its own unique and socially-relevant contribution

The restructured and priority areas thus identified will be the focus of the Foundation's work in the coming days. We solicit the support and help of our partners, donors and well-wishers as we embark on this new path.

Last year, in commemoration of the International Year of Family Farming, MSSRF organised the Asia Pacific Regional Consultation on "Role of Family Farming in the 21st Century: Achieving the Zero Hunger Challenge by 2025" in collaboration with the Food and Agriculture Organisation (FAO), International Development Research Centre (IDRC), Canada, World Food Programme (WFP), International Fund for Agriculture Development (IFAD), Department for International Development (DFID) UK, UN Women, and the Small Farmers Agribusiness Consortium. The Chennai Declaration, adopted by the participants of the consultation, recommended a concerted strategy involving conservation, cultivation, consumption, commerce and communication for achieving the Zero Hunger Challenge. It called for family farmers to be placed at the centre of policy processes aimed at ending hunger.

MSSRF was a finalist for the Times Social Impact Award under the livelihoods category. MSSRF was included in the final shortlist of the category Social Impact Award for creating Livelihood opportunities for the rural community of India. The award committee and the jury stated that "the M. S. Swaminathan Research Foundation (MSSRF) has helped thousands of farmers and fisherfolk with technologies developed through their participation."

Among our staff, Dr. K. P. Smitha, Senior Scientist at CAbC, Wayanad, was awarded the prize of Best Extension Professional at the Seventh National Extension Education Congress held at Umiam, Meghalaya, jointly organised by the Society of Extension Education and ICAR Research Complex for the North East region. Dr. R. Rengalakshmi, Principal Coordinator, Gender and Development, and Dr. Manjula Menon, Principal Scientist, jointly received the best paper presentation award for their research paper entitled "Seasonal Climate Information for Ensuring Agricultural Sustainability and Food Security of Small Holder Rainfed Farmers: Experience from India" at the 16th Annual Global Development Network Conference held at Casablanca, Morocco in June 2015. Dr. Ajay Parida, Executive Director, was elected as President of the Biological Sciences Section of the National Academy of Sciences, India.

Significant progress has been made during the year on various research and development initiatives undertaken by MSSRF. The United Nations Framework Convention on Climate Change (UNFCCC) has recognised mangrove restoration and the integrated mangrove fishery farming system (IMFFS) initiated by MSSRF as important interventions to enhance the adaptive capacity of local communities against sea level rise. The UNFCCC through its Adaptation Fund sanctioned a project to restore 200 ha and demonstrate IMFFS on 50 ha in the Krishna district of Andhra Pradesh, a region identified as vulnerable to sea level rise. The Coastal Systems Research programme restored mangroves in about 200 ha in the States of Tamil Nadu, Andhra Pradesh and Maharashtra. Biosaline agriculture has become relevant in the current context of climate change, and efforts have been taken to develop cultivation practices for five potential halophyte (or salt-loving) species, including fodder grasses.

A new project has been taken up on measuring greenhouse gas fluxes in the mangrove ecosystem, specifically to identify if mangrove forests act as a sink or source of atmospheric CO_2 and CH_4. For this, a laboratory with state-of-the-art equipment was set up in Chidambaram and a nine-metre tall Eddy Covariance flux tower (EC) has been established in the

Pichavaram mangroves. This is a long-term multi-institutional study coordinated by the Indian Institute of Tropical Meteorology, Pune, and supported by the Ministry of Earth Sciences, Government of India.

The Biodiversity programme undertook several initiatives in the area of agro-biodiversity conservation and enhancement. Significant achievements include development of several value- added millet products sold under the brand of Kolli Hills Natural Foods. Simple improvements in agronomic practices enhanced millet yields by 30 per cent in Kolli hills. The Community Agrobiodiversity Centre in Wayanad strengthened on-farm conservation which resulted in the collection and maintenance of diverse plant genetic resources. Research is underway to develop bio-control agents and identify nutritional value of local species. During the year, 200 nutrition gardens and 250 herbal gardens were established. A new plan for expansion of the M.S. Swaminathan Botanical Garden at Wayanad has been prepared. The Karshakajyothi Farmers' Training programme trained over 2000 farmers on poly house and low external input and sustainable agriculture (LEISA) farming techniques. In Jeypore, popularisation of 62 rice landraces through the field gene bank in three cluster villages was undertaken. In partnership with the Odisha State Biodiversity Board, people's biodiversity registers were prepared for twelve villages.

The Biotechnology group focused on the advancement of transgenic varieties for abiotic stress and nutritional enhancement under greenhouse conditions. The group has identified key genes and metabolic pathways functioning in drought and salt stress response by analysing the stress responsive transcriptome of selected species. Large-scale field evaluation of 160 traditional rice varieties and breeding lines and diverse germplasm of *Moringa oleifera* (drumstick) were undertaken to identify nutritionally-rich genotypes and cultivars. A novel molecule isolated from lichen cultures showed promising leads with anti-tuberculosis properties. A large number of location-specific microbial culture collections were established and characterised. Mass propagation of pipla (*Piper longum*), turmeric (*Curcuma longa*) and ginger (*Zingiber officinale*) was attempted using the tissue culture facility at the Jeypore Centre.

The Ecotechnology programme area combines on-farm, off-farm and non-farm activities in its approach to sustainable development. An important focus during the year was on enhancing pulse and oilseed (groundnut) productivity and varietal trials were carried out for this purpose. Preliminary findings suggest a doubling of pulse productivity. In paddy varietal trials, the use of urea super granules was tested. A range of agriculture-based activities were demonstrated, including integrated dairy production, value addition of tamarind and production of bio inputs. Most interventions were implemented through farmer producer companies and women's federations, whose capacity strengthening were undertaken for ensuring good governance and self-autonomy. The social capital credit system (SoCCS) introduced by Asia Initiatives enabled communities to be earn credits for their involvement in development work, which could be redeemed for other benefits. Through our links with corporates and Banks, we could strengthen livelihood activities and reclaim fallow lands in several villages.

In the Vidarbha region, with support from India Medtronics Limited, MSSRF facilitated erection of farm bunds in a contiguous stretch

of 400 acres of land, belonging to 101 farmers in the Bhidi village of Wardha. Three block-level federations of women farmers' groups were registered as autonomous bodies in Wardha. In Jeypore, the MKSP programme facilitated the formation of 63 producer groups. Social mobilisation by 90 community hunger fighters across 18 villages in Koraput district resulted in new demands from the communities for food security entitlements at the household level.

At the request of the World Food Programme, the Food Security group prepared a strategic review document on the status of food security in India. The Report followed the UN Zero Hunger framework and provided a comprehensive and detailed understanding of the national food and nutrition security situation in India, discussed possible strategies for meeting the challenges, and suggested a set of policy recommendations. The Food Security programme area also took the initiative to prepare a database on the socio-economic characteristics of individuals participating in MSSRF's community-based interventions. The database has a detailed profile of 23 districts and 40 villages where MSSRF has a presence. A web portal has been developed to manage the database through a management information system and will be launched shortly.

Our programme on Information, Education and Communication continued to render season-specific and locally-relevant knowledge services to the rural population in seven states and reached over 150,000 persons during the year. An android-based Fisher Friend Mobile Application (FFMA) was launched in regional languages (Tamil and Telugu) for addressing the crucial information needs of fisherfolk. FFMA was listed as one of five finalists for the Vodafone's Mobile for Good Award under the agriculture category. The e-plant clinics provided real time solutions to farmers for mitigating pests as well as disease loss in crops. The team has developed an android based prototype version of the Integrated Farmer Friend Application for Sustainable Agriculture (IFFSA) that is being deployed in the field for testing. The National Virtual Academy elected 229 National Fellows from 15 states and seven International Fellows from Myanmar, Philippines and Tanzania for their significant contribution towards enhancing rural knowledge.

The international consortium on Leveraging Agriculture for Nutrition in South Asia (LANSA) led by MSSRF made significant progress. In India, baseline surveys on nutrition at the household level were completed in two locations (Wardha, Maharashtra and Jeypore, Odisha) where the Farming System for Nutrition (FSN) approach is being demonstrated. Interventions have been designed for demonstration based on analysis of data on nutrition status of the population, the prevailing resource base, and crop and animal husbandry practices. With effect from May 2015, MSSRF has taken over as consortium lead for research uptake activities and policy level advocacy.

The Gender and Grass-roots Institutions (GRI) group continued their focus on gender mainstreaming and integration at the institutional level. Capacity building and hands-on guidance were given to 15 GRIs promoted by MSSRF for strengthening organisational protocols and legal compliance. Research initiatives were inter-disciplinary and focused on gendered value chain development in dairy, tamarind and pulses. Three block level single-women collectives were formed in Vidarbha region to facilitate access to entitlements and productive assets. Four village-level collectives

were promoted for sustainable harvesting, collective marketing and institutional linkages with respect to two non-timber forest products (lichens and broomstick grasses) among Paliyan tribal peoples in the lower Palni Hills.

This is a brief glimpse of the wide range of activities carried out at MSSRF during the year. These achievements would not have been possible without the dedicated work of the staff and scholars at the Foundation. I congratulate them and wish them further success in the coming years. I wish to record my sincere gratitude to the trustees for their active involvement and guidance in defining the future of the Foundation. Dr. Rita Sarin retired from the Board of Trustees of MSSRF during the year and I thank her for her sustained support to MSSRF. I wish to welcome Mr. S. Mahalingam, former Chief Financial Officer of Tata Consultancy Services, who has joined as a trustee of MSSRF.

Dr. V. Selvam, Dr. G.N. Hariharan and Ms. B. Jayashree coordinated the work, Ms. Gita Gopalkrishnan edited the contents and AMM Prints published the Annual Report. I record my appreciation and gratitude to them.

Madhura Swaminathan
Chairperson

Programme Area 100

COASTAL SYSTEMS RESEARCH

Mangrove restoration is going on in about 200 ha in Tamil Nadu, Andhra Pradesh and Maharashtra through the joint mangrove management system. The United Nations Framework Convention on Climate Change has recognised mangrove restoration and Integrated Mangrove Fishery Farming System (IMFFS) initiated by MSSRF as important interventions to enhance the adaptive capacity of the local community against sea level rise, and has sanctioned a project to restore 200 ha of mangroves and demonstrate IMFFS in 50 ha in the Krishna district of Andhra Pradesh. In biosaline agriculture, attempts were made to develop cultivation practices for 2 halophytic fodder grasses in low saline areas in coastal Andhra Pradesh. The performance of Village Development Councils in Vedaranyam was enhanced through organising various training programmes. A survey was conducted on the health status of salt workers to design structures for mitigation of health issues of this neglected coastal community. The Fish for All Centre concentrated on building capacity of the farming and fishing community in entrepreneurial development, integrated farming and inland aquaculture. A new programme on measuring carbon flux in the mangrove ecosystem has been initiated during the year.

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Conserving coastal resources for ecological and livelihood security

Programme Area 100

Coastal Systems Research

In Tamil Nadu, Andhra Pradesh and Maharashtra, about 200 ha of degraded mangroves are being restored with the participation of the local communities. However, mangrove work in Tamil Nadu has been delayed due to non-availability of resources in time. Realising the importance of mangroves as a soft solution to combat the impact of sea level rise, the United Nations Framework Convention on Climate Change (UNFCCC) has sanctioned a project through its Adaptation Fund to restore 200 ha of mangroves and develop integrated mangrove fishery farming system (IMFFS) in 50 ha in the Krishna district of Andhra Pradesh, which has been identified as one of the most vulnerable districts to sea level rise. The project will be implemented in 3 villages in partnership with panchayat raj institutions and the local community. MSSRF has received this support on the basis of the recommendation by the Ministry of Environment, Forests and Climate Change, Government of India. One of the main aspects of this project is that if the restoration of degraded mangroves located in lands not owned by the Forest Department is successful, it can be modelled to create community-owned mangroves in areas outside Reserve Forests and Sanctuaries.

There was no activity relating to non-mangrove bioshields during the reporting year.

Mangrove plantations being raised in IMFFS farms both in Tamil Nadu and Andhra Pradesh are performing well. Experiments indicate that shrimp culture rather than fish culture is more profitable in IMFFS. Cultivation of halophytes such as *Salicornia brachiata, Suaeda maritima* and *Sesuvium portulacastrum* with saline water irrigation has yielded encouraging results, indicating that there is scope to grow these halophytes in high saline soil. Improving the performance of Village Development Councils and organising regular medical camps in the villages for salt workers were the focus in the Vedaranyam project. Building the capacity of fisherwomen entrepreneurs and fishers and farmers in integrated farming and inland aqua farming was the main activity carried out in the Fish for All Centre. A total number of 670 men and 147 women were provided training in these aspects. Land use and land cover of the coastal belt (10 km inland from the shoreline) from Kanyakumari to Rameswaram (about 300 km) was analysed as part of the mapping of the Gulf of Mannar Biosphere Reserve. The measurement of carbon flux in mangroves is a new initiative and the flux of greenhouse gases such as carbon dioxide and methane is being measured between mangrove forest, mangrove water, mangrove soil and the atmosphere.

Sub Programme Area 101

Mangrove and Non-Mangrove Coastal Bioshields

Mangrove bioshield

Navi Mumbai

Bio-physical studies on floristic survey, plant community structure, micro-topography, water and soil characteristics were carried out in the Navi Mumbai mangrove restoration programme. Floristic survey identified the presence of 6 true mangrove species, namely, *Acanthus illicifolius, Aegiceras corniculatum, Avicennia marina, Excoecaria agallocha, Sonneratia alba* and *Sonneratia caseolaris*. The community structure of mangroves was assessed in 10 randomly selected quadrats and *A. marina, E. agallocha, S. alba* and *S. caseolaris* were found to be the dominant species in this area. Relative dominance (rd), relative density (rD) and relative frequency (rf) data revealed that *A. marina* was the most dominant in terms of its basal area (rd) measuring 8038 sq m/ha.

The tidal amplitude in the main creek near the restoration area was between 3.5 m and 4 m in February 2015. The topography of the restoration area is about 15 cm higher than the nearby tidal creeks. The bunds of the abandoned shrimp farms located inside the restoration area restrict the flow of tidal water. The biophysical study indicates that canals that are 40-60 cm deep will facilitate free flow of tidal water in and out of the restoration area. The surface water salinity along the creek was between 22 ppt (parts per thousand) and 26 ppt in the creeks. The domestic sewage discharge from the city through the main creek is one of the reasons for lower salinity. The soil of the degraded area is clayey. The pore water (water present between soil particleswhich is taken up by plants) is between 47to 55 ppt.

Fishermen living in Sarsole and Nerul (now a part of Navi Mumbai Municipal Corporation) collect fish, crabs and clams as well as firewood. Some carry out aquaculture inside the mangroves. Earlier, some were involved in salt production in and around the mangroves.

Muthupet

Identification and demarcation of 70 ha of degraded mangrove area to be restored was completed last year and it was decided to follow the canal method of restoration. However, plantation could not be taken up by MSSRF due to delay in the availability of resources and hence, Tamil Nadu Forest Department (TNFD) completed restoration activities with the support of the Veerankoil Village Forest Council (VVFC). New areas for restoration and raising mangrove plantations are being identified.

Thirupalaikudi

In the nursery at Thirupalaikudi, progapules of *Rhizophora* from Pichavaram and Godavari mangroves and seeds/seedlings of *Avicennia* from Pichavaram and Muthupet mangroves

have been raised and one lakh seedlings of *Rhizophora* and *Avicennia* are being grown for planting in 80 ha of the open shore area.

Eighty per cent of the saplings were affected by root rot disease. Attempts were made to save the saplings using organic manure and *panchagavya*. However, only about 20000 saplings could be saved. In October 2014, all the surviving saplings were planted in the identified open shore area which was fenced using discarded fish nets. In the field, saplings were colonised by barnacles, resulting in low survival. Considering these problems, it was decided to develop new methods to grow the saplings in the open shore area, which will be tested next year.

Godavari

During the year, restoration and afforestation work of Godavari mangroves was jointly initiated with Sri Murali Krishna Eco-Development Committee (the recognised village-level institution of the Andhra Pradesh Forest Department) of Chollangipeta village in Tallarevu mandal and Reliance Industries Ltd., Gadimoga. The area identified for mangrove development is located close to the Coringa Wildlife Sanctuary. The soil is clayey and the area is degraded due to poor tidal flushing. Fishbone-shaped canals were dug between January and March 2015 to facilitate tidal water flow inside the degraded area. Main canals of 3 m top width, 1.5 m bottom width and a depth of about 1 m and feeder canals of2 m top width, 0.75 m bottom width and 1 m depth were dug, with the distance between the side canals at 6 m.

A mangrove nursery consisting of about 5,000 saplings of *Avicennia alba*, *A. marina*, *A officinalis*, *Aegiceras corniculatum*, *Bruguiera cylindrica*, *B. gymnorrizha*, *Ceriops decandra*, and *Rhizophora apiculata* has been established. The saplings are raised in polythene bags with saline soil collected from the mangroves and watered with brackish water from the canals. The saplings are now about 40 cm in height and will be planted during August or September 2015.

Sub Programme Area 102

Integrated Mangrove Fishery Farming System

Tamil Nadu

In Tamil Nadu, IMFFS is operational in 18 ha in the Pichavaram, Vedaranyam and Muthupet regions. The A.Veeriya Vandayar Memorial Sri Pushpam College, Poondi, has given 3 ha of abandoned shrimp farm located in Eripurrakarai village near Muthupet for the development and demonstration of an IMFFS farm. The Veerankoil IMFFS Development Committee has been involved in the demonstration. An exposure visit for members of the committee to IMFFS sites in Pichavaram was organised for cross learning.

The mortality rate of saplings in all the IMFFS ponds was very low (2 to 8 per cent). The dead saplings were replaced by new saplings. The performance of mangrove plantations carried out in the Vedaranyam IMFFS farms are given in **Table 1.1**.

Table 1.1 ***Performance of mangrove plantations in IMFFS farms in Vedaranyam***

Sites	*R.apiculata*		*R.mucronata*		*B.gymnorrhiza*	
Number and height (cm) as of June 2015	**No. of saplings**	**Cm.**	**No. of saplings**	**Cm.**	**No. of saplings**	**Cm.**
Velankanni - planted November 2013	1049	130	3005	141	1500	99
Naluvethapathy - planted June 2013	241	147	1130	97	-	-
Eripurakkarai - planted May 2014	750	50	2500	58	-	-
Total	**1290**		**4135**		**1500**	

Fish culture

In Velankanni, about 5500 fingerlings of mullet (*Mughil cepahalus*), milk fish (*Chanos chanos*) and sea bass (*Lates calcarifer*) collected from the wild were stocked in May 2014 and harvested in January 2015. About 412 kg of fishes were harvested from the 3 ponds and sold for Rs.65,920. The expenditure relating to collection of wild fingerlings and other maintenance costs were only Rs.11,000. Shrimps will be tried in a few ponds in the coming year. Mixed farming will be undertaken in other ponds to get more income to the local community.

Andhra Pradesh

Fish culture

During July 2014, about 20,000 post larvae of *Penaeus monodon* were stocked in 4 ponds in Bhairavalanka. Rice bran was provided as supplementary feed. About 890 kg of shrimp were harvested after 3 months, and were sold for Rs.240300.Input costs and other maintenance costs were about Rs.85000. In future, attempts to enhance profit margins in IMFFS ponds will be undertaken.

Mangrove plantation

The survival rate of about 1,900 *Rhizophora apiculata* saplings planted along the bunds of the 4 IMFFS ponds in Bhairavalanka in June 2013 has been 100 per cent. Growth parameters such as height, number of branches and leaves were recorded every month. In March 2015, the average height of the plants is about169 cm.

Sub Programme Area 103

Biosaline Agriculture

Cultivation of halophytes

Halophytes such as *Salicornia brachiata, Suaeda maritima* and *Sesuvium portulacastrum* were cultivated in the salinity-affected land

near Papakoil village in Nagapattinam district, Tamil Nadu. Sodium and potassium levels of the soil were found high and the electrical conductivity of soil measured6.5 dS/m (4.16 ppt) at 25°C and the pH of saturated soil was7.5.

S. brachiata (4,000 seedlings), *S. maritima* (4,000 seedlings) and *S. portulacastrum* (7,000 cuttings) were raised in the nursery for 45 days in 3" x 5" polythene bags filled with garden soil. Shade net (50 per cent) was used to reduce the light and temperature. Fresh water was used to raise the saplings in the nursery. In March 2014, 45-day-old seedlings were transplanted, and each species was grown in one acre of saline land. Initially fresh water was used for irrigation (2 wettings) and then brackish water from nearby creeks was used. Since these plants are highly saline- and drought-tolerant, two wettings with brackish water were given. The salinity of the brackish water used for the first wetting in May 2014 was 28 ppt (parts per thousand) whereas salinity of the brackish water given for the second wetting in July was 23 ppt. Five plants selected at random from each plot of *S. brachiata* and *S. maritima* were uprooted for measuring shoot height, root length and biomass at monthly intervals. Above ground biomass from *Sesuvium portulacastrum* was estimated by harvesting shoots once a month from 1 sq.ft area at 5 randomly selected places. Final harvest was done in November 2014 before the onset of the monsoon since these halophytes will die thereafter.

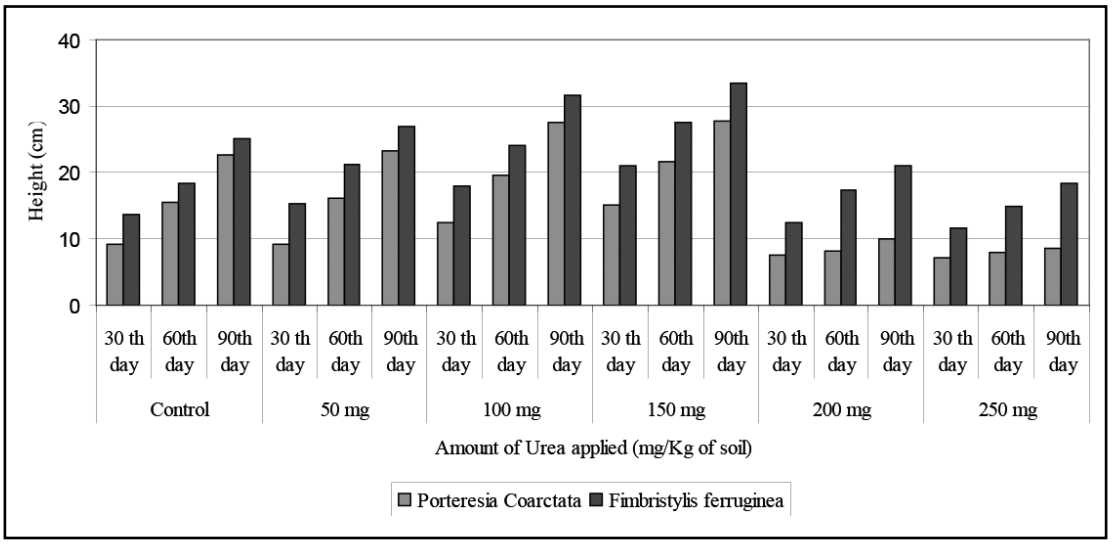
From these field trials, 23 t/ ha of *S. brachiata* (fresh weight), 17 t/ha of S.*maritima* and 9 t/ha of *Sesuvium portulacastrum* were harvested. Further, 3.8 t/ha of tender shoots of *S. brachiata* were harvested. It is important to note that many European countries import tender shoots of *Salicornia brachiata* to be used as food supplements. Hence, the possibilities of exporting this produce are being explored and if this initiative is successful, it will help in scaling up halophyte farming.

Fodder grasses

Effect of different concentrations of urea on growth

Attempts were made to grow halophytic fodder grasses such as *Porteresia coarctata* and *Fimbristylis ferruginea* in saline-affected areas with urea amendments. Young plants of these two grasses were collected with rhizomes from the wild and planted in pots of 8 inch diameter, filled with 2 kg garden soil. Soil in the pots was mixed thoroughly with urea of different concentrations (50, 100, 150, 200 and 250 mg/ kg of soil). Three replicates were maintained for each treatment as well as for control and the pots were kept in the greenhouse. Height was measured at 30 day intervals up to 90 days. *P. coarctata* and *F. ferruginea*s howed an increase in growth with increase in urea concentration upto 150 mg/kg; growth was affected in the pots containing 200 mg and 250 mg/kg urea (**Figure1.1**). The soil salinity of the soil was around 2 ppt.

Figure 1.1 ***Growth of halophytic fodder grass under various concentrations of urea***



Estimation of protein and sugar

The protein and total sugar content were estimated in leaf samples of *P. coarctata, F. ferruginea* and *P. vaginatum* collected from the halophytes farm. *P. coarctata* (4.2 mg/g fresh weight (fwt)) and *P. vaginatum* (3.9 mg/g fwt) showed almost similar amounts of protein. The protein content in *F. ferruginea* was 3.2 mg/g fwt. All the three grasses contained more or less similar amounts of sugar, values ranged from 11.08 to 13.1 mg/g fresh weight.

Assessment of energy values

The calorific values of the 3 fodder grasses were estimated using a bomb calorimeter. *F. ferruginea showed slightly higher* calorific *values (*3429.16 cal/g) *than P. coarctata (*3132.12 cal/g) and *Paspalum vaginatum* (2912.02cal/g).

Sub Programme Area 104

Integrated Coastal Zone Management of the Vedaranyam Coast

Community mobilisation and organisation

In the Vedaranyam region, 12 Village Development Councils (VDCs) have been formed, and all project components such as water management, raising mangrove and non-mangrove plantations, livelihood enhancement and access to health facilities are being implemented. A two-day workshop was organised with the following objectives:

- To strengthen the capacity of the VDC executive committees and other VDC members to achieve their organisation's

goals, effectively implement strategies, and understand structure and processes

- To build the capacity of the project staff and evolve a shared understanding on the institutional development aspects of VDC
- To evolve a detailed step-by-step process for developing VDC as an organisation

The first training programme was conducted for the VDCs of Kadinalvayal and Kovilthavu, with 28 participants (M: 12; F:16).Intensive discussions and brainstorming over a period of two days resulted in the vision set out in **Table1.2**.

Further, discussion was held on necessary values and principles of VDCs to achieve the vision. The members identified the values as:

- Transparency
- Trust
- Accountability
- Human Centeredness

The principles included 6 approaches:

1. Pro-poor, pro-women, and pro-nature
2. Inclusive development
3. Conservation and optimum utilisation of resources for sustaining livelihoods
4. Integrated approaches (integrating natural resources management and livelihood) for strengthening development initiatives
5. Sustainability of the institution
6. Participatory planning, implementation and monitoring of the programmes

Table 1.2 ***Vision of the Kadinalvayal and Kovilathavu VDCs***

Non-exploitative culture in the village

- Access to adequate credit, affordability (no high rate of interest), and people are free from local money-lenders; access to natural resources, etc.

Eco-friendly village

- Biodiversity and agro-biodiversity conserved
- Wells, ponds and tanks renovated and rain-water harvested for drinking and domestic purposes
- Conservation and optimum use of natural resources

Self-reliant village through

- Promotion of micro credit services
- Promotion of herbal gardens
- Promotion of organic farming

Poverty-free village

- No unemployment or under-employment

Village with sustainable livelihoods

Livelihoods generating income regularly and adequately, for long term with optimum use of natural resources; examples

- Salt pan-canal renovation
- Agri-allied activity: crop rotation, crop diversification

Village with complete health

- Tobacco and alcohol user free
- Organic food production
- Nutritive food consumption

Village with well-developed human resources

- Skilful resource, building youth skills, 100% literacy, etc.

Village with internal harmony and dignity

- Living with self-dignity: using individual skills and knowledge and building their capacities

Following this, the outline of a five-year plan was developed to achieve the vision. A similar kind of exercise is planned for VDCs of the other 10 villages.

Natural resource management

Non-mangrove plantation

During this year, non-mangrove plantation was taken up in another 3 acres of panchayat land and altogether it is being raised in about 59 acres of temple, panchayat and private lands around Vedaranyam. About 40 students (12 girls and 28 boys) from 3 higher secondary schools from Puducherry and a school from Villupuram visited the non-mangrove plantation oftropical dry evergreen forest (TDEF) around the Vedaranyam Salt Sathyagraha Pillar as part of their educational tour. Similarly, 40 botany students (8 girls and 32 boys) from 3 colleges also visited the non-mangrove plantation. All these students were educated about the uniqueness and importance of the tropical dry evergreen forest, and how to raise trees of this type. During this year, the panchayat raj institution of Pannal village near Vedaranyam replicated the TDEF plantation in about 5 acres of panchayat land. A school in Muthupet also replicated this model in 12 acres in its area.

Water management

The 13 community wells that were renovated in Kovilthavu village provided enough water for drinking and also for minor irrigation purposes for the user groups. As a result, there was demand to renovate more community wells in other villages. Hence, 8 community wells in Adivasi Colony and Kovilankollai were renovated. These wells were desilted and parapet walls were constructed around each well to prevent the caving in of the surrounding sand. The user group families take care of the maintenance of these wells. During this year, the Office of the Salt Commission provided a disused pond of about 0.5 acre for the use of villagers; VDC of Poovanthoppu village desilted it and the water is being used for domestic purposes. In Kadinalvayal village, VDC desilted a pond of about 1 acre, which is being used by the local youth for fish culture.

Genetic garden of halophytes

Developing and maintaining a genetic garden of halophytes (GGH) is important for conserving valuable germplasm and creating society's awareness about these plants, as well as being a source for research on halophytes. In Vedaranyam, a GGH with 29 halophyte species is under development. Among the 29 species, 17 are dicots and the remaining are monocots; 8 species belong to *Poaceae (*grass family), 6 to *Chenopodiaceae*(greens), 4 to *Cyperaceae* (fibre yielding),4 to *Aizoaceae*, 2 to *Convolvulaceae*, 2 to *Asteraceae* and one species each to Boraginaceae, *Fabaceae* (legume) and *Phyllanthaceae*. Commercially important halophytes such as *Sesuvium portulacastrum*, *Bulbostylis neglecta*, *Myriostachya wightiana*, *Sueada monoica, Sueada maritime, Fimbristylis ferruginea, Aeluropus lagopoides, Paspalam viginatum and Porteresia coarctata*are being maintained in 1 acre of saline land.

Village and community development

Performance of income-enhancing activities such as floriculture, marine and swamp fishing, dairy farming linked with organic farming, as well as saline-tolerant paddy cultivation were monitored regularly on their input and output costs. The collected data will be analysed to assess options for the identification of viable and sustainable livelihoods for the participants. During this year, 30 training programmes relating to floriculture, dairy farming, organic farming, fish culture, grass-roots institution development, gender mainstreaming, inland fishing, sea safety, net mending, etc., were conducted; a total of 1048 families participated in these.

Health programmes were started in 8 villages, catering to a population of nearly 4000. Basic investigations revealed that about 170 women were severely affected by anaemia and almost all the children (950) were found infested with hookworm. It was also found that vision acuity was not good enough. Hence, all anaemic women in the target villages were provided with iron supplement tablets, all the children were de-wormed with suitable medication and schoolchildren in the target villages were provided with vitamin A and D tablets for two months to improve their vision.

A comprehensive health survey of salt workers in the Vedaranyam region was undertaken in partnership with Jawaharlal Institute of Postgraduate Medical Education &Research (JIPMER), Puduchery, All India Institute of Medical Sciences (AIIMS), New Delhi and National Institute for Research in Tuberculosis, Chennai. About 750 salt workers in 7 villages participated in this survey. The results indicated that the common morbidities among salt workers were tuberculosis, eye problems, skin diseases, dental problems, low back ache, stomach problems, arthritis, varicose veins, as also urinary tract infections and gynaecological problems. The study shortlisted dermatological infections, low back ache, and eye problems including cataract to be attended to immediately with suitable medical interventions. It was also found that nearly 24 per cent of the salt workers were undernourished and that haemoglobin levels among the women were low. Surprisingly, hypertension among salt workers of Vedaranyam was found to affect only 19.4 per cent of men and 14.4 per cent of women.

A related issue was that the timings of the district government hospital did not suit working women who preferred not availing treatment rather than lose a day's wages. In order to solve such concerns, a consultative meeting was held and an action plan to be implemented at field, district and State (policy) levels was developed.

Sub Programme Area 105

Fish for All Research and Training Centre

Fish Processing Unit

The focus of the continued training of the fisherfolk around Poompuhar and neighbouring

areas was on maintaining the hazard analysis and critical control point (HACCP) standard practices of hygienic handling of fish during pre-processing and processing. Facilitation for marketing the products was also undertaken by the FPU. In addition to the already existing group, two more women SHGs have been formed: one group concentrates on preparing dry fish products and the other in the preparation of *chennakuni* (*Acetus sp*) shrimp powder. The products that were sold this year in the local market as well as to retail buyers from Kerala and Coimbatore by the 3SHGs (36 women) included 75 kg of prawn and fish pickles, 404 kg of dry fishes and 75 kg of *chennakuni* powder.

Integrated farming system

The Fish for all Research and Training Centre facilitates 10 Farmers' Clubs in and around Poompuhar to practise an integrated farming system which includes fish culture, poultry, dairy, fodder cultivation, horticulture and tree crops, and vermi-compost preparation. A federation of these farmers' clubs, the Kaveri Inland Fish Farmers' Association, has been formed with 210 members. The Centre provides technical support such as water quality analysis; identification, selection and procurement of quality fish fingerlings; selection of quality paddy seed and its availability to promote best practices. Three farmer groups have availed the subsidy provided by the Government of Tamil Nadu's Kuruvai Special Package Scheme-2014 to purchase 3 paddy transplanting machines and 3 power weed removers; these will be used by the group members and it may be decided to rent them out to other farmers to bring in additional income to the groups.

Inland aquaculture

Forty women, including 20 SC, from 2 women SHGs of Pudukuppam and Thenpathi villages have renovated 2 under-utilised community ponds covering an area of 1.1 ha and are using them for poly fish culture. The ponds were stocked with fast-growing major Indian carp and sea bass. The Centre provided technical support in pond preparation, water filling, selection of fingerlings, feed supplement, water quality analysis, growth monitoring and harvesting. The culture was started in October 2014 and after 180 days around 265 kg of fish were harvested. The cost- benefit analysis is given in **Table 1.3**.

Training and capacity building

A total number of 29 trainings were conducted in the Fish for All Centre over the last year in which 670 men and 147 women participated.

Table 1.3 ***Fish harvest in community ponds***

Village	Area(ha)	Yield(kg)	Gross income (Rs)	Input cost (Rs)	Net profit (Rs)
Thenpathi	0.2	132	9685	2905	6780
Pudukuppam	0.9	133	19000	4500	14500
Total	**1.1**	**265**	**28685**	**7405**	**21280**

The range of topics covered were value-added fish products, hygienic production of fish products, conservation of marine turtles, fish culture, sea bass open culture, freshwater sea bass culture, fish culture through farm ponds, dairy farming, poultry farming, integrated pest management in cotton crops, tree crops cultivation methods, kitchen gardens, demo on paddy transplanter, fodder cultivation, etc. **Table 1.4** sets out the theme-specific details of the trainings.

IGNOU Study Centre

The IGNOU Study Centre was established in Poompuhar in June 2014 and offers three academic programmes of the IGNOU School of Agriculture — Diploma in Fish Products Technology (DFPT), Certificate in Organic Farming (COF) and Certificate in Poultry Farming. A one-day induction programme was conducted by the IGNOU Regional Centre for the enrolled students.

All the three courses include both theory and practical classes. The courses are conducted with the help of part-time academic counselors from MSSRF and other partner institutions appointed by IGNOU**.** The students are from both the fishing and farming communities. There is no age limit; however, the minimum educational qualification is completion of class 12 for the first two courses and class 8 for the poultry course. The students have to appear for an examination on completion of the course and the successful students will receive certificates. The students who completed the Poultry Certificate Course were encouraged to apply for the native chicken rearing scheme of the Tamil Nadu government

Table 1.4 ***Details of theme-specific training***

Fields	No. of trainings	Participants	
		Male	Female
Marine fisheries	09	145	86
Inland aquaculture	04	40	31
Integrated farming system	16	485	30
Total	**29**	**670**	**147**

Table 1.5 ***IGNOU courses***

Course	Course duration	Course period	No. students enrolled	
			Male	Female
Diploma in Fish Products Technology (DFPT)	One year	June 2014-June 2015	3	3
Certificate in Organic Farming(COF)	6 months	June-December2014 January- June 2015 (in progress)	15	2
Certificate in Poultry Farming	6 months	July-December 2014	12	2

(*Naattu Kozhi Valarppu Thittam*). The students who underwent training in organic farming are applying their knowledge in the preparation of vermi-compost, growth regulators such as *panchagavya* and *meen* (fish) amino acid, and plant-based insect/pest repellents. Under the training in fish products technology, one woman trainee has started preparing value-added fish products for the market.

Turtle conservation programme

Fish for All Centre in association with the Tamil Nadu Forest Department has been involved in educating the fisher community in the conservation of turtles, starting with panchayat leaders, youth and women SHG members in 4 villages. Awareness was also created through distribution of pamphlets in 20 fishing villages with the help of 40 college students from nearby areas. As a result, 7522 turtle eggs were collected near Poompuhar and Vanagiri villages, incubated in the hatchery established by the Forest Department at Vanagiri, and 2225 baby turtles were released into the sea.

Sub Programme Area 106

Remote Sensing and Geographical Information System

Inventorisation and monitoring of biosphere reserves

Gulf of Mannar

Survey and ground truthing was carried out with the permission of the Tamil Nadu Forest Department all along the coast from Kanyakumari to Rameswaram (about 300 km), excluding the islands, but covering about 10 km inland from the shoreline. The data collected during the ground truth survey was used to digitally reclassify the land use / land cover processed from the satellite images of 1990, 1995, 2000, 2005 and 2010. The Champion and Seth classification method was adopted to categorise the forest types that are present along the surveyed area. The digital classification shows that Carnatic umbrella thorn forest (*Acacia* spp) covers an area of about 1355 ha, out of which a large patch was outlined covering nearly 945 ha near Valinokkam in Ramanathapuram district. This vegetation patch has been declared as a Reserve Forest by the Tamil Nadu Forest Department. Casuarina plantations cover an area of 2450 ha, and are mostly confined to Rameswaram island. Agriculture land occupies around 1,25,000 ha., salt pans are found in 6760 ha, aquaculture in 776 ha., mud flats in 3600 ha and mangroves in an area of 162 ha. One of the interesting findings is that *Prosopis juliflora* (locally known as *seemai karuvalan*), a thorny exotic species which was introduced in the early 1960s has encroached upon about 10000 ha. This drought- and salt-tolerant tree species causes groundwater depletion due to its deep root system and nothing grows around it either. The ecological impact of the colonisation of this species needs to be studied further.

Sundarbans

Intensive ground truthing was done in early 80 per cent of 10,500 sq.km of the Sundarbans

biosphere in association with the West Bengal Forest Department. Analysis of the land use/ land cover data for the years 1990, 2005 and 2010 was completed using the satellite images LISS III and Landsat. The land use / land cover for the years 1995 and 2000 have to be analysed. Once this is done, changes for the years 1990 and 2010 will be analysed at 5-year-intervals and compared. The vegetation map of the Sunderbans, which has the largest area of mangrove cover, is being prepared based on the Normalised Difference Vegetation Index (NDVI) method for the vegetational changes for each year and results will be provided next year.

Great Nicobar Islands

Since the satellite images of the land use and land cover map of the Great Nicobar islands that were prepared without ground truthing for the years 2005 and 2010 are coarse in resolution, it was found difficult to make detailed forest type classifications. Hence, the land use classes will be reclassified after the intensive ground truth survey. Due to non-availability of cloud free satellite data for the years 1990, 1995 and 2000, the mapping work is getting delayed. A special request has been made to the National Remote Sensing Centre (NRSC) to get data from its archives.

Krishna wetlands

Survey of land use and land cover is being carried out in the Krishna delta mangroves for the years 1990 and 2009 to find the changes in mangrove forests cover over the period of time due to restoration efforts taken up jointly by MSSRF, Andhra Pradesh Forest Department and the local community. For the year 2009, satellite images of LISS III Resources were used to map land use/land cover adopting the hybrid classification method. The classification shows that mangrove forests occupy an area of about 23000 ha and aquaculture is found in 18000 ha. Ground truthing has to be carried out to finalise the classification. The land use and land cover map will be prepared for the year 1990 using the LANDSAT satellite images and then the changes in mangrove forest cover between the years 1990 and 2009 will be assessed.

Mapping of pulse panchayat

The Annavasal block of Pudukottai district, which includes the Edayapatti, Thalinji, Kathavampatty, Ennai and Eswarankoil panchayats, has been declared as a pulse panchayat block in order to encourage pulse cultivation in the entire block using various agricultural interventions. In the total area of 4486 ha, about 300 farmers are currently involved in pulse cultivation in 474 acres. In order to improve planning as well as monitoring pulse cultivation in these panchayats, it was decided to create a Geographic Information System (GIS)-based spatial and non-spatial database. Spatial data covers block maps, panchayat maps, land use and land cover maps; and the non-spatial database includes details of the farmer, such as name, area of land owned, quality of the soil, cultivation practices, etc. The cadastral base maps that MSSRF procured from the Survey Department, Chennai have been digitised into

a GIS. Georeference points for the cadastral map and spatial mapping were completed during the reporting period. The non-spatial data are being collected and will be linked with the GIS for the production of different thematic maps for better planning and monitoring of pulse cultivation in this region.

Sub Programme Area 107

Greenhouse Gas Fluxes in the Mangrove Ecosystem

Increased concentration of greenhouses gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) in the atmosphere due to human activities are responsible for global warming. Current understanding of the global carbon cycle suggests that by the sustainable management of forests, the amount of GHGs can be substantially decreased by photosynthesis which fixes the carbon from the atmosphere. The annual exchange of carbon between forests and the atmosphere and the amounts of carbon stored in forests vary widely with the nature of the forests. Mangrove forests are considered very important because of their wide distribution in tropical and subtropical coastlines. Besides, their high rates of productivity, estimated at 218 ± 72 Tg C per year globally, indicates that global mangrove forests remove about 218000000 tonnes of carbon from the atmosphere every year; they also create carbon storage (C stock) in the biomass and in soil. This sequestration (rate of removal) mitigates climate change effects. However, some studies suggest that mangrove forests release methane gas into the atmosphere. Keeping this in mind, a project has been initiated in the Pichavaram mangroves, which addresses the following questions:

- Do mangrove forests act as a sink or source of atmospheric CO_2 and CH_4?
- What are the atmospheric, soil, hydrological and biological factors controlling fluxes of GHGs in mangrove forests?
- If mangroves act as a sink, what are the management actions that need to be taken to enhance capacity of mangroves to assimilate more GHGs?
- If they act as a source, what are the management actions that need to be taken to minimise GHG emissions?

In the Pichavaram mangroves, the fluxes of CO_2 and CH_4 between mangrove forest and atmosphere, between mangrove soil and atmosphere, between mangrove water and atmosphere and between mangrove soil and water are being measured to address such research questions. This data will be used to measure the annual net ecosystem exchange of carbon with the atmosphere. The collected data will also be used to fine tune climate change models for the accurate prediction of impacts on the life-supporting systems of earth.

During this year, a laboratory with state-of-the art equipment was set up in Chidambaram. A 9-m-tall eddy covariance flux tower (EC)

has been established in the Pichavaram mangroves. The EC system consists of sensors such as open path CH_4 analyser, enclosed path CO_2-H_2O gas analyser, and three-dimensional sonic anemometer-thermometer. These sensors will continuously record the flux of carbon and methane between the mangrove forest and atmosphere. Soil CO_2 flux and air CO_2 profile measurements are also being measured. Supporting measurements include air temperature and humidity, wind speed and direction, net radiation, photosynthetic active radiation, rainfall, soil moisture and temperature, soil heat flux, leaf area index, etc.

The preliminary study of flux between water and atmosphere indicates that CO_2 flux from atmosphere to mangrove water and from mangrove water to phytoplankton seems to be more during moderate saline conditions (15 to 20 ppt). This is mainly because the solubility of atmospheric CO_2 is high in low saline conditions and the rate of primary production by phytoplankton peaks when water salinity ranges from 12 to 20 ppt. Phytoplankton bloom in mangrove water might play an important role in making mangrove water as a sink for CO_2. Increased phytoplankton density as well as primary production during the bloom convert dissolved CO_2 into particulate carbon, which may be exported to the ocean and become a part of ocean carbon pump. In order to know the role of the algal bloom, detailed studies are being carried out and results will be reported next year.

Programme Area 200

BIODIVERSITY

Sustainable livelihood promotional activities continued through small orchard (wadi) development in Kolli Hills, targeting 1000 tribal farmers. Seed fairs and seed festivals were organised to promote exchange of local seeds and to promote on-farm crop diversity. Custodian farmers were encouraged to participate in local and district networks to enable knowledge and material sharing. Millet products were sold under the brand name Kolli Hills Natural Foods. The strengthening of nutrition gardens and herbal gardens among farm families in Wayanad resulted in more than 46000 seedlings of rare, endangered and threatened (RET) plants, medicinal plants and ornamental plants belonging to 430 species being multiplied. The popularisation of traditional rice varieties in Koraput led to the field gene banks in 25 villages promoting the cultivation of 62 different landraces of rice. The Community Gene Bank collaborated with Wageningen University in training PGR (plant genetic resources) managers.

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Strengthening traditional and family farms for eliminating malnutrition and enhancing income

Programme Area 200

Biodiversity

The highlights of the conservation efforts in Kolli Hills included the brand development of millet products and strengthening the custodian farmers' network. A total of 6.63 tonnes of millet products were sold under the brand name Kolli Hills Natural Foods, fetching an overall income of Rs.5,50,201.The network of custodian farmers — farmers who contribute to the conservation and cultivation of local agrobiodiversity— exchanged about 1147 kg of seed materials of 4 different millet varieties. The Community Agrobiodiversity Centre in Wayanad added 200 more nutrition gardens and established 250 herbal gardens. The *Karshakajyothi* programme extended training to around 2000 farmers on poly house and LEISA (low external input and sustainable agriculture) farming techniques. In association with the Denver Botanic Gardens, USA, a master plan has been prepared for further development of the M. S. Swaminathan Botanical Garden in Wayanad. The Biju Patnaik Medicinal Plants Garden and Research Centre popularised 62 rice landraces through field gene banks in 3cluster villages. A total of 699 farmers from 25 operational villages in Koraput district cultivated the rice landraces *Kalajeera*, *Machhakanta* and *Haladichudi* in 309.56 ha. The Community Gene Bank (CGB) coordinated the capacity building programme of PGR (plant genetic resources) managers with fund support from Wageningen University.

Sub Programme Area 201

Community Conservation Efforts in Kolli Hills

201.1 Integrated tribal development programme

The wadi project that has been targeting 1000 tribal community farmers over 1000 acres continued in 5 integrated key result areas. During the year, 213 farmers from Thiruppuli Nadu, Gundur Nadu, Alathur Nadu and Gundani Nadu panchayats adopted millet intercropping and harvested about 8,198 kg in about 25 acres.

Orchard development

A wide range of horticultural plants (batch I in 2010, batch II in 2011, batch III in 2012 and batch IV in 2013) has been raised under orchard development activities, covering the entire 1000 farm families. Monitoring and maintenance comprised timely assessment of the survival rate of the saplings, application of organic manure, bio-insecticides and bio-fungicides, basin weeding and formation, shading, staking, mulching and irrigation activities for the targeted 1000 acres.

Soil and water conservation measures

Construction of compartmental bunds and 'v' bunds was completed in 165 acres of batch I and batch II sites in Thiruppuli Nadu and Gundur Nadu panchayats and batch III and batch IV farm fields in Alathur and Gundani Nadu panchayats. Trenching work in 106

acres belonging to batches I, II, III and IV in all the 4 panchayats was completed. Work was initiated to dig a well (size of 50 ft depth and 10 ft width) each in 10 villages across the 4 targeted panchayats.

Women development

As part of creating nutritional awareness among the participating farm families, several village- level awareness camps were organised targeting women. A kitchen garden kit containing high-yielding seeds of tomato, brinjal, chilly, greens, lady's finger, ribbed gourd, bitter gourd, cucumber, bottle gourd, and pumpkin was provided. During the year, 756 tribal families harvested 25,532 kg of vegetables; the surplus after home consumption was sold. **Table 2.1** has the details.

Another notable intervention was supply of Envirofit energy-efficient biomass cook stoves to 400 families of batch III and batch IV farmers. This intervention has reduced drudgery and health hazards among tribal women as it was observed that using stoves reduced fuel wood requirement by 50 per cent and there was also a 50 per cent reduction in smoke emission.

Table 2.1 ***Yield in kitchen gardens, kharif 2014***

Panchayat	No. of families	Total yield (kg)	Consumed (kg)	Sold (kg)
Thiruppuli	205	6,640	5,520	1,120
Gundur	200	10,698	7,964	2,714
Alathur	177	5,613	3,958	1,655
Gundani	174	2,581	2,581	0
Total	**756**	**25,532**	**20,023**	**5,489**

Income-generation activities

A total number of 50 individuals received loans amounting to Rs.10,05,000 from NABARD to start various income-generating activities such as dairy farming, goat rearing, piggery, poultry keeping, petty shops, small restaurants, kitchen gardens, electrical and oil engine repairs and plumbing works. The loan amount varied from Rs. 15,000 to 30,000 per person.

Table 2.2 ***Awareness and training programmes***

Subject	Thiruppuli	Gundur	Alathur	Gundani	Total
Training on application of bio fertiliser, insecticides and fungicides	15	13	10	7	45
Training on basin weeding and formation	4	5	5	3	17
Training on shading, staking and formation	0	0	14	12	26
Training on 'v'bunding, trenching and mulching	12	7	15	11	45
Training on percolation ponds construction	2	1	3	2	8
Awareness on kitchen gardens and nutrition	15	8	10	7	40
Training on income-generating activities (composting, dairy, post- harvesting nursery)	8	5	7	5	25
Awareness on community health	4	4	2	2	12
Total	**60**	**43**	**66**	**49**	**218**

Training and capacity building

A number of training and capacity building programmes were organised for the Kolli Hills community, covering topics such as orchard development, soil conservation, water resource development, women empowerment and community health (**Table 2.2**).

201.2 Resilience of poor rural communities in agrobiodiversity hotspot areas

During the year, various interventions such as resource use enhancement activities, interviews, focus group discussions, community workshops, custodian farmers' networks, seed fairs, traditional food festivals, etc. were conducted. In all, 774 men and 726 women participated in different activities being implemented in 13 villages of Thiruppuli Nadu panchayat in Kolli Hills, covering 403 tribal households.

Seed fairs and seed festivals

An appraisal has been carried out among millet farmers in different millet cultivation zones of Kolli Hills to assess the availability of landraces of millet (around 21 landraces) and associated crops such as pigeon pea, mustard, bean and maize for cultivation. About one tonne of quality seeds of finger millet, little millet, foxtail millet and kodo millet was collected from custodian farmers; seed fairs and seed festival were organised in different panchayat locations in Kolli Hills to promote exchange of the local landraces of these food crops. Seed viability tests were conducted for all the varieties before the distribution. Local seed festivals were organised in 5 locations where more than 1000 farmers participated and exchanged about 1147 kg millet and associated seeds.

Custodian farmers' network and community seed banks

Custodian farmers are so called because they contribute to the cultivation, use and conservation of local agrobiodiversity, and share the resources with others and also contribute materials to research. A network of such custodian farmers has been formed and meetings were conducted at the block level in Kolli Hills and at the district level at Namakkal. About 40 men and women farmers participated in the block level meeting and more than 100 at the district level network meeting. Farmers from different zones exchanged their knowledge as well their local seed materials. There were more than 50 different local genetic resources such as diverse kinds of millets, rain-fed paddy, and varieties of fruits, leaves, vegetables, pulses and medicinal plants exhibited. All the community seed banks across Kolli Hills got strengthened during the year and it helped farm families to access quality seed materials of many millet varieties.

Yield enhancement trial

Yield enhancement trial was an important activity taken up to help the farmers get higher yields from small millet cultivation units by simple improved scientific agronomic practices. Two methods of cultivation were identified for this trial, one of row planting (mono crop and inter crop) by using furrow maker and another of intercropping with tapioca. Intercropping 6

lines of finger millet/little millet with one line of another crop like maize or Italian millet or mustard was preferred by individual farmers. Intercropping with tapioca was promoted to get additional food crops from tapioca fields.

During *kharif* 2014, 127 farmers cultivated millets in 26.2 acres of lands in the project villages through line sowing, intercropping and mono cropping methods. The yields of finger millets showed an overall increase of 29.57 per cent in yield under improved practices (line sowing) vis-a-vis the farmers' traditional practices. As part of the yield enhancement trials, training on vermi-compost production was facilitated, which resulted in 87 farmers establishing such production units.

Strengthening of millet value chain activities

The Kolli Hills Agrobiodiversity Conservers' Federation (KHABCoFED) has made the market promotion of millet value-added products its focus. Eleven products — *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 — are produced and marketed under the brand name Kolli Hills Natural Foods. During the year 6.63 t of such value-added products were sold and an income of Rs. 5, 50,201 realised.

Efforts were taken for getting Small-Scale Industry certificates from the District Industries Centre (DIC), Namakkal for all the millet mills promoted. Six groups received certificates from the concerned government office. Orientation classes and necessary technical support were provided to the groups on the importance of these certificates for all SHGs and Farmers' Club members. The project team facilitated 17 groups across Kolli Hills for getting certificates from the Food Safety and Standards Authority of India (FSSAI). Now these products are sold in new improved packages.

Five suitable locations were identified across the millet cultivation zone in Kolli Hills to establish VKCs in partnership with local farmers and farmers' clubs and SHGs. Remote automatic weather stations have been established in custodian farmers' villages in 6 panchayats. The data generated and captured on a daily basis on temperature, relative humidity, wind speed and direction, rainfall, etc., in different zones in Kolli Hills will eventually be used in advisory services.

Sub Programme Area 202

Community Agrobiodiversity Centre, Wayanad

202.1. Livelihood enhancement, agriculture and food security

Integrated tribal development programme

Provision of safe drinking water to 80 tribal families and to also ensure adequate availability of potable water throughout the year has been the aim in the hamlets of Wayanad; this intervention also helped to reduce the burden of women by ensuring water at their doorstep.

During the year, 200 more nutrition gardens were established in 11 Adivasi settlements of the Paniya, Katunayaka, Thachanadan, Moopan and Kuruma tribal communities located in Meppadi, Pulpally, Noolpuzha, Muppainad panchayats and Kalpetta municipality. Vegetable species that can withstand hostile conditions like flood and drought, soil erosion, attacks by wild animals and also provide a consistent yield in the fallow paddy fields, such as amaranths, other leafy vegetables, drumstick, papaya and diverse tuber crops, were selected. The nutrition gardens have helped the tribals increase their dietary diversity.

The Paniya communities have been historically deprived of land, capital, technology and other resources, and hence they remain the poorest of the poor. This year, the young women and men of the Paniya tribe were provided access to suitable agro-technologies, knowledge and skills through trainings as well as land and production units (structures for precision farming) through appropriate linkages. This has resulted in setting up a pilot poly house for precision farming and a mushroom production unit. Two crops of cucumber have been harvested from the poly house in the reporting year and one crop is expected to be ready shortly. Revenue has been enhanced by the production of 1050 kg vegetables /annum (300 kg of green peas and 750 kg of salad cucumber). Three families earned Rs. 30,200 from selling vegetables.

Medicinal plants initiative

About 250 home herbal gardens were established in various locations of Wayanad district for promotion of herbal remedies. In all, 200 households were given 10 species each and 50 households were given 20 species of medicinal plants and 5 species of grafted fruit plant seedlings. Phytochemical screening of 5 species of medicinal plants was started in collaboration with National Institute for Interdisciplinary Science and Technology (CSIR-NIIST), Thiruvananthapuram. The screening is going on and the results are yet to be published.

A total number 30 trainings on home remedies for various conditions such as asthma (*Adalodakam lehyam* and *uragulika* tablet), skin diseases, stomach disorders, back pain (*Murivenna*), muscular and rheumatic pain (*Sahadevi thailam*) toothache, earache, etc., were conducted for 131 persons at 6 panchayats in Wayanad district. Four of the trainings were for 27 *Kudumbashree* members, who have undergone 2 phases of training on the preparation of 6 products. Medical expenditure has been reduced by the use of such herbal home remedies.

Promotion of speciality rice varieties

Promotion of the selected 10 speciality rice varieties of Wayanad were continued for seed purification in the nodal plot at the Community Agrobiodiversity Centre (CAbC) and at community demonstration plots. F3 generation of purified seeds (853 kg) of varieties *Kalladiaryan* (191 kg), *Jeerakasala* (106 kg), *Chennellu* (63 kg), *Adukkan* (135 kg), *Chomala* (76 kg), *Thondi* (40 kg), *Veliyan* (30 kg), *Gandhakasala* (178 kg) and *Mullankaima* (34 kg) were distributed to 54 farmers from the

nodal plot and about one tonne of paddy seeds were supplied from the seed villages to farmers (*Veliyan*, *Chennellu*, *Gandhakasala*, *Thondi*). Two potential varieties were marketed under the brand name of SEED CARE, a grass-roots institution promoted by MSSRF. *Chennellu* (red rice with medicinal value) was procured at the rate of Rs. 25/kg as against the normal rate of Rs. 15/kg and *Gandhakasala* (aromatic variety with Geographical Identification) was procured at the rate of Rs.100/kg against the normal rate of Rs.80/kg. A farmer – trader interface was organised as part of the seed fest in CAbC for the promotion of marketing of traditional crop varieties with special focus on rice. A total of 120 farm households in the seed villages benefited from the increased procurement price of rice. Traditional practices followed in rice cultivation in Wayanad were compiled along with other organic package of practices suitable for traditional rice varieties of the district.

Microbial and biotechnological initiative

Efforts were taken to identify a media to support the growth of *Trichoderma asperellum* with varying carbon sources based on *Dioscorea alata*, *Stevia rebaudiana* and cashew apple medium. Yam dextrose broth provided the maximum colony forming units $4x10^9$ (cfu), followed by cashew apple medium with $3x10^9$. Bio-inputs produced using cashew apple medium could reduce the cost of production by 45 per cent. For mass production and marketing of this media, a linkage has been established with a commercial producer of bio-control agents.

A herbal solution prepared out of *Elephantopus scaber* and *Annona reticulata* shows promising results against severe cattle diseases like mastitis (local name *akiduveekkam*) as it is found effective in controlling pathogens like *Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus* and *S. agalactiae.* Attempts are being initiated to identify the active compounds responsible for the control of pathogens. Six varieties of *Dioscorea alata*, 4 traditional varieties of rice and 7 traditional cowpea varieties were screened for their nutritional parameters. A variety of cowpea, *Vigna unguiculata* (L.) Walp (local name *mochakottai*), has shown high protein and starch content.

About 2.5 t of bio inputs such as *Trichoderma harzianum, Pseudomonas fluorescence, Beauveria bassiana*, vermi-compost and bio-potash (a bacterial formulation for mobilising soil potash) were produced and distributed by the Harithashree organic production unit promoted by Kudumbashree. The laboratory at CAbC holds cultures of different bio-fertilisers and bio-pesticides. One more species of mushroom *Hypsizygus marmoreus* has been included in the mushroom repository of MSSRF during the reporting year. A total of 2.5 t of 4 species of oyster mushroom spawn of *Pleurotus florida, P. eous,* and *P. opuntiae* were produced and distributed. With the technical support of CAbC, a women's SHG produced and marketed 150 kg of fresh mushroom.

Rainwater harvesting in Kuttanad

MSSRF in collaboration with Rainwater for Humanity (R4H), an organisation based in

the United States, has implemented a project for constructing rainwater harvesting tanks using ferro-cement to address potable water scarcity issues of Vechoor panchayat, Vaikom taluk in the Kuttanad region. Thirteen rainwater harvesting tanks have been constructed with a total capacity of 10000 lt each for the provision of drinking water.

202.2 Education, communication and training

Karshakajyothi farmers' training programme

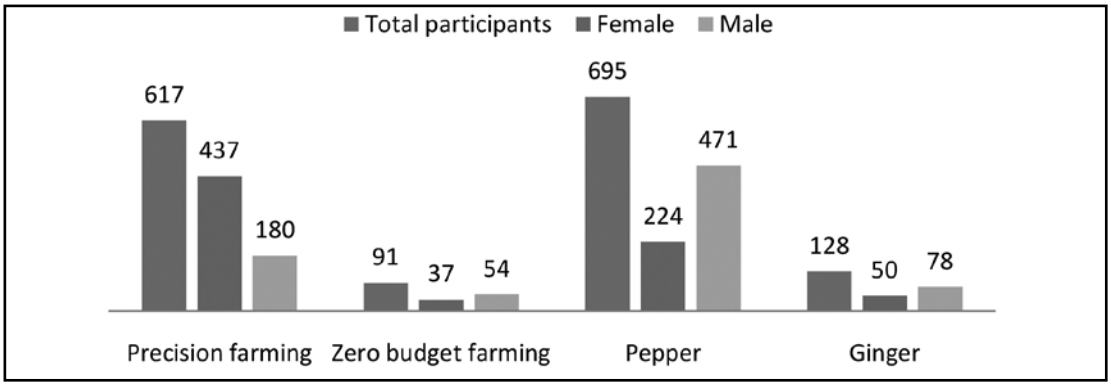
The *Karshakajyothi* programme imparted 26 trainings on various topics such as precision farming techniques in vegetable cultivation, zero budget farming and cultivation of pepper, ginger and other spices. A total of 1531 farmers (M: 783; F:748) benefited from these trainings. Fourteen exposure visits were organised for hands-on training on precision farming and spices cultivation, with 383 farmers (M: 99; F: 284) visiting plots maintained by research and development institutions and key farmers. **Figure 2.1** shows the picture.

Strengthening extension services of Village Resource Centres

Field level agro-clinic services were provided to 152 individuals in the district through VRCs, Krishi Bhavans, farmers' calls, etc. Based on the major issues reported, a booklet was prepared mainly dealing with nutritional deficiency symptoms of important crops and the remedial measures to be adopted by farmers. Forty-six counseling sessions were organised on stress management, credit management, marketing strategies, agricultural investment, improving productivity and increasing farm income for those farmers residing away from the coverage of VRCs. A total of 72 training-cum-counseling sessions were organised on topics such as value addition, marketing, etc.

CAbC provided need-based trainings to 18 farmer groups (600 farmers) on topics such as organic farming, precision farming, sustainable agriculture, vegetable cultivation, pepper, rice and ginger cultivation etc. Thirty-five visits by individual farmers and 150 farmer calls on various agricultural and allied topics were

Figure 2.1 ***Details of participants in different training programmes***



attended to. The Centre has also prepared user-friendly contents on bio-inputs, deficiency symptoms of major crops, pepper cultivation, precision farming, zero budget farming, and livestock management. This includes 8 video films for telecasting on local channels, and 6 audio materials for broadcasting through the community radio network in the district. Voice SMS services were provided to 75 farmers.

Farm School

The Eldho Baby Farm School has been linked with the Department of Agriculture, the Department of Animal Husbandry, *MILMA* (Kerala Co-operative Milk Marketing Federation), Agricultural Technology Management Agency (ATMA) and with local self-governments for its efficient utilisation by farmers. During the year, 22 training programmes on various topics, such as organic pepper and ginger cultivation, organic farming and soil and water conservation, were conducted for730 participants from different parts of the State.

Every Child A Scientist Programme

The Every Child A Scientist Programme (ECAS) held regular classes at the CAbC campus on biodiversity conservation, skill and personality development, ICT and communication techniques. Forty-eight students (27 girls and 25 boys) attended. As part of the programme, an audio podcasting website for students to upload audio contents produced on education and biodiversity was initiated. ECAS students visited the M.S. Swaminathan Botanical Gardens as well as historically significant places in Wayanad, and participated in science exhibitions.

ECAS Centres are functioning in 3 tribal hamlets with the support of the respective gram panchayats. Through regular handholding, coaching and counselling, 9 children (2 girls and 7 boys) from Panthalam tribal hamlet and 5 children (2 girls and 3 boys) from Kolagappara hamlet resumed their school education.

ECAS established 4 ECAS clubs at schools in Wayanad. Through this initiative, 200 students could interact with experts from different fields such as biodiversity, agriculture, social sciences and technology.

Table 2.3 details the ECAS programmes during the reporting year.

Table 2.3 ***ECAS programmes conducted during 2014-15***

Sl No	Programmes	Participants	Girls	Boys
1	Veetumuttathu Arogyam -Home nutrition gardens	30	12	18
2	Biodiversity film festivals	182	96	84
3	Soil testing and seminars as part of International Year of Soil	43	19	24
4	Exposure visits	32	16	16
5	Nature camps	42	24	18
6	Venal kootu - summer camps	52	27	25
7	Audio editing workshops	30	18	12

BioBlitz

As part of observing International Day for Biological Diversity, CAbC in collaboration with Kerala Forests & Wildlife Department organised Bioblitz, to photo document the biodiversity of Manikunnumala. This effort helped to document the unique floral and faunal diversity through photographs.

Vacation training programme

The Centre organised a 3 weeks' vacation training programme on bio-resources conservation and its sustainable utilisation for students who appeared for class X examination in the year 2014.Thirty students (17 girls and 13 boys) across Kerala attended the 18-day residential programme comprising a host of activities: lectures and classroom sessions; interaction with scientists, environmental activists, academicians, farmers, policy makers and politicians; laboratory work on basic laboratory techniques; institutional visits for exposure to the research world on natural resources; field trips for exploring Nature; projects to take up mini research through team work; and orientation on research methods.

Strengthening grass-roots institutions towards agrobiodiversity conservation

Along with the 2 grass-roots institutions, Wayanad District Tribal Development Action Council and SEEDCARE, several interventions were carried out by CAbC in the conservation of agro-biodiversity.

Twenty community agrobiodiversity conservation and livelihood groups were formed in 9 panchayats of Wayanad to promote the cultivation of traditional crops. Seeds of vegetables and planting materials of yam, turmeric and banana were distributed to these groups to enhance crop diversity and to ensure the nutritional security of 5 tribal communities of Wayanad.

A 3-month-long awareness campaign, organised over 26 sessions, was held from November 2014 to January 2015 on agrobiodiversity conservation. The campaign engaged around 1567 individuals including farmers, representatives of gram panchayats, and agriculture officials on the topic, The Role of Biodiversity Management Committees (BMCs) in Protecting Community Rights on Seeds. Issues such as the role of local self-governments in agrobiodiversity conservation and the rights of farmers to traditional seeds in the context of Indian laws were discussed at a 2-day State level workshop.

A community seed festival was organised in February 2015 in Wayanad to recognise the contributions of genome saviours of the district in the conservation of plant genetic resources. A total of 157 farmer delegates represented different panchayats exhibited and exchanged seeds of rice varieties, legumes, vegetables, tuber crops, and planting material of native fruit plants.

Towards encouraging those farmers who conserve diverse traditional crop varieties, a Community Agrobiodiversity Conservation Award was instituted with the interest earned from the Genome Saviour Award. The farm family which conserves the maximum number of rice varieties and the farm family that

contributes to conservation through effective crop-livestock integration were recognised with these cash awards.

An ethnographic field study explored the linkages between family farming and land governance and helped to bring out policy level recommendations through participatory engagement with community members.

202.3 Biodiversity conservation

M.S. Swaminathan Botanical Garden

A master plan for further development of the M.S. Swaminathan Botanical Garden (MSSBG) has been prepared with the technical partnership of Denver Botanic Gardens, USA. As part of making the garden more educative and self-explanatory to visitors, enumeration of plants, butterflies and birds were carried out during the reporting year and the database for each category prepared. Fourteen new signages were placed in the garden describing different groups of plants. In all, 12500 people visited MSSBG during the year.

RET plants conservation programme

More than 46000 seedlings of rare, endangered and threatened **(**RET) plants, medicinal plants and ornamental plants belonging to 430 species were multiplied in the CAbC nursery and distributed. Seedlings of 60 species of RET plants supplied to conservation gardens were m*onitored* and status assessment of *ex situ* conservation sites were carried out **(Table 2.4).** MSSBG was augmented with seedlings of RET species and other non-RET category tree species like *Cassia fistula, Saraca asoca*, *Mimusops elengi, Azadirachta indica, Butea monosperma, Pterocarpus marsupium, Terminalia bellirica, Emblica officinalis, Tamarindus indica, etc.* Detailed descriptions on 50 RET tree species were prepared.

Conservation of crop plant genetic resources

Field surveys were undertaken to locate, identify and document traditional varieties of pepper and ginger in farmers' fields in Wayanad and Kozhikode districts. A total of 26 distinct landraces of black pepper and 9 landraces of ginger were documented. Exploratory surveys were also conducted in forest peripheries and **6** wild species of black pepper and 4 wild species of ginger collected. Black pepper and ginger germplasms have been maintained with 19 traditional varieties

Table 2.4 ***Status assessment of ex situ conservation of RET species***

Sl No.	Site	Species distributed	Seedlings distributed	Seedlings survived	Percentage of survival
1	Vanaparvam, Kakkavayal,Thamarassery	50	1500	988	65.9
2	St. Antony's L. P. School, Madakkunnu, Kalpetta	25	75	53	70.7
3	Siva temple, Manikavu, Meenangadi	50	500	398	79.6
4	Nanda Kumar's garden, Madakki, Kalpetta	30	60	57	95.0
5	Forest First Samithi, Panavally, Kattikulam	50	650	531	81.7
6	CAbC, MSSRF	120	780	674	86.4

and 11 improved varieties of pepper and 9 local varieties of ginger. Further, community germplasm plots were also established for ginger at 3 sites (Muthanga, Kolavayal and Pannikkal). Multiplication trials of black pepper varieties were also carried out to cater to the requirement of the farmers. A total of 650 seedlings of 12 rare traditional pepper varieties were raised. Propagation trials of pepper vines using orthotropic shoots were performed for 9 local varieties of pepper (for both direct planting and grafting) and were found successful with an average survival rate of 70 per cent. In order to promote and popularise bush pepper for household cultivation and consumption, a total of 1600 seedlings of 12 traditional varieties were raised during the reporting period. Further, the crop germplasm at CAbC was strengthened with seed materials of traditional varieties of tubers and vegetables. The status of the germplasm is depicted in **Figure.2.2**.

Sub Programme Area 203

Biju Patnaik Medicinal Plants Garden and Research Centre

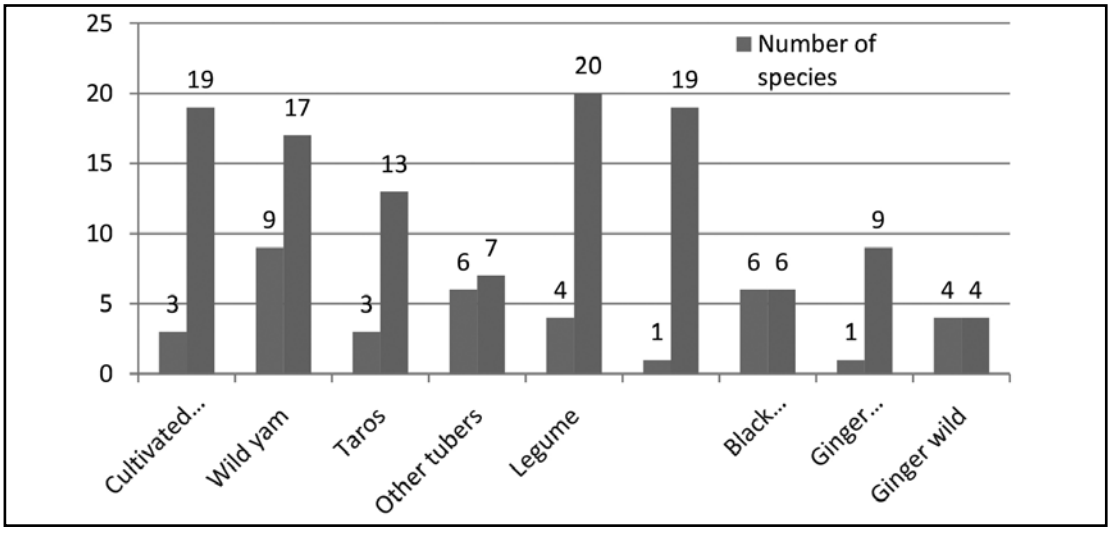
At the Biju Patnaik Medicinal Plants Garden and Research Centre (BGMP&C), this year witnessed major emphasis on three key result areas:

- Capitalisation of prominent landraces of rice
- Conservation of landraces
- Preparation of People's Biodiversity Registers

203.1 Capitalisation of prominent landraces of rice

The Jeypore tract in the Koraput district of Odisha is considered one of the secondary

Figure2.2 ***Status of crop germplasm at CAbC as on March 2015***



centres of the origin of rice. An initiative to develop a sustainable value chain for 3 selected local rice landraces by addressing various issues from the production to the consumption stage has been in operation for the past 3 years. A total of 699 farmers from 25 operational villages in Koraput district cultivated the 3land-races —*Kalajeera*, *Machhakanta* and *Haladichudi*— in 309.56 ha, and 92 farmers from other than operational villages cultivated over 30 ha. The average income received by individual farmers was Rs.10,000 from the *Kalajeera* variety and Rs.5,000 from the *Machhakanta* variety. Of the total quantity harvested, 20 per cent of the produce was kept for seed, 50 per cent was used for market promotion and value addition, and the other 30 per cent was kept for consumption. By adopting the complete package of modified SRI (system of rice intensification), yield increase of 30 to 40 per cent was observed and 20 -30 per cent yield was enhanced by adopting complete package of practice on rope planting. S_i pure lines of *Kalajeera* having >19 per cent amylose content were identified. Protein content ranged from 5.83 to 7.37per cent. All 234 lines of *Haladichudi* and 227 lines of *Machhakanta* were analysed with 24 highly variable rice microsatellite (RM) markers. Twelve community threshing yards, one community storage godown each in 2 clusters, 5 village seed grain banks and one central godown were established and managed by the farming communities. Out of 30 SHGs, 11 women SHGs were made into entrepreneur groups and each group is earning on an average Rs.3,000 to 5,000 net income from 4 value-added rice products. Thirteen Central Village Committees were formed to strengthen the community on technical, financial and social aspects for better project implementation, management and sustainability of activities. Through the adoption of improved production technologies and expansion into millet-cultivated areas, an additional employment of 30-40 per cent was generated which was estimated to be 40,000 man-days/year. Similarly, processing and value addition coupled with marketing and procurement activities have provided additional employment of nearly 15,500 man-days/year. A total of 1939 people were trained on social, agricultural and entrepreneurship development during the project period. Assets like motorbikes, land, hulling machines, tractors and bullocks were acquired by the farmer families by utilising the money.

The major interventions of this initiative included appropriate technology demystification, modified SRI and line transplanting, training-cum-demonstration, data collection and analysis; facilitation of infrastructure such as community threshing yards and storage godown; and the establishment of a registered farmers' society for collective marketing. These interventions resulted in the marketing of 120 t of branded and packaged *Kalajeera* paddy by the society. Storage facilities reduced distress sales. Strong linkages with market increased income and this resulted in increased cultivation of this variety.

203.2 Conservation of landraces

Landraces of rice (141), millets (19), pulses (10), maize (1), pop sorghum (2) and oil

seeds (2) were conserved at BPMPG&RC. A total of 62 rice landraces were popularised through field gene banks in 3 cluster villages. Suitable varieties were selected by farming communities during exposure visits. Eight new rice landraces were explored from the Semiliguda block of Koraput district; samples of 74 rice landraces were provided to research scholars of Central University, Koraput for study. **Figures 2.3** and **2.4** portray the diversity of landraces and the number of rice landraces conserved since 1999, respectively.

Figure 2. 3 ***Landraces conservation - 2014***

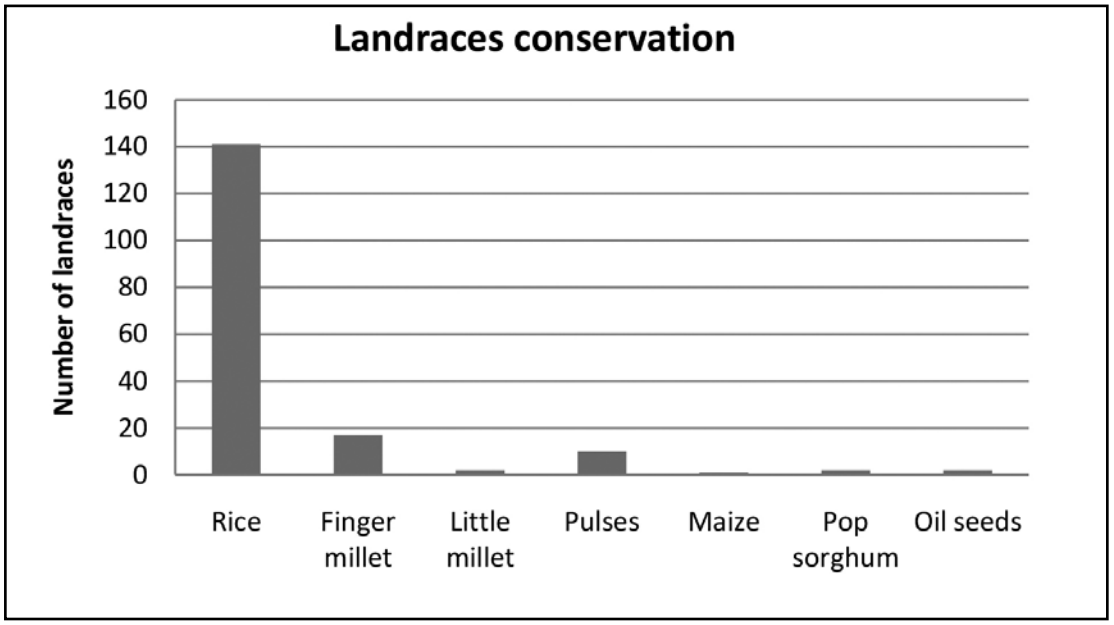
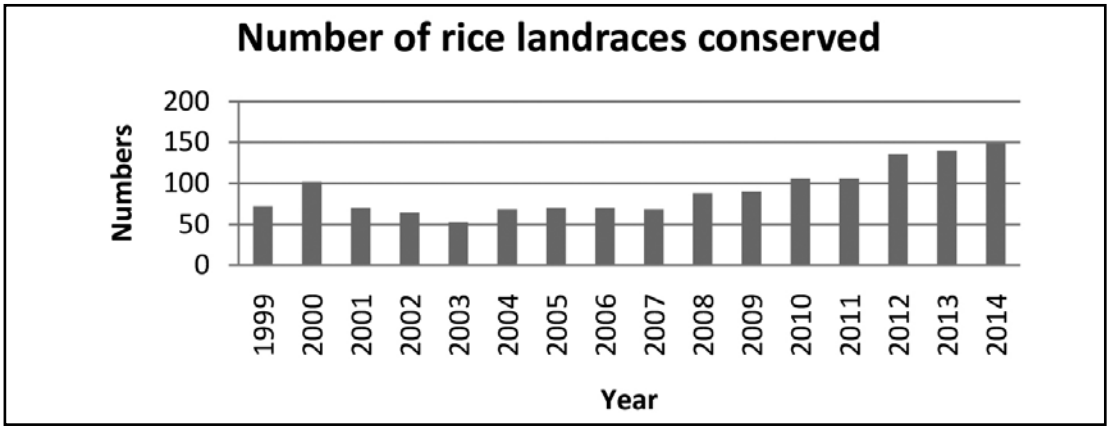


Figure 2.4 ***Rice landraces conservation (1999 – 2014)***



203.3 People's Biodiversity Register

People's Biodiversity Registers were prepared for 12 gram panchayats in the community development blocks of Boipariguda, Jeypore and Kundura of Koraput district. Twelve Biodiversity Management Committees (BMCs) were established in these gram panchayats with 84 members, of whom 42 per cent are women members. Traditional knowledge was documented from 1036 knowledge holders belonging to 68 revenue villages; in addition, 223 plant species, 28 rice landraces, 7 millet landraces, 16 tubers, 17 wild flowers, 14 wild fruits, 23 wild animals, 16 bird species, 17 fishes and 21 insects were documented.

In collaboration with the Odisha Biodiversity Board, a one-day training-cum-orientation programme was organised on creating awareness on the Biodiversity Act, 2002. Twenty-eight committee members from BMCs of 5 gram panchayats of Kundura and Jeypore blocks participated in the programme.

Sub Programme Area 204

Community Gene Bank

The Community Gene Bank (CGB) has taken up rejuvenation of the germplasm of 300 stored paddy varieties.. These varieties along with the duplicates were multiplied in the field near Chennai where Tamil Nadu Agricultural University's regional Rice Research Station is located.

CGB coordinated the capacity building programme of PGR managers with fund support from Wageningen University. So far, a total of 102 participants, including both men and women, from 24 countries representing Asia, Southeast Asia, Europe and Africa have benefitted by this programme. This year, the fifth year that this training is being conducted, 25 participants attended from Armenia, Bhutan, Ethiopia, Ghana, India, Kenya, Malaysia, Mexico, Nigeria, Sudan, Tanzania, Thailand, Uganda and Zimbabwe. The overall objective of the training programme was to enhance participants' capabilities to include community biodiversity management (CBM) as an integrated strategy for managing plant genetic resources for food and agriculture (PGRFA) and building community resilience towards climate change (see SPA 705 for details).

A workshop was organised in coordination with the Kolli Hills team to create awareness and building capacity of the farmers on the legislation of PPV&FR Act 2001. A total of 112 farmers participated from Kolli Hills, Namakkal, Thanjavur, Coimbatore, Erode and Salem districts. Custodian farmers actively shared their knowledge with other farmers and learnt about PPV&FR, DUS characterisation, linkage with *ex situ* systems and registration of varieties with PPVFRA, New Delhi.

Nutritional analysis of CGB germplasm

The nutritional proximate on carbohydrate, starch, total sugar, crude protein, crude fibre, crude fat, ash content, vitamins A, C and E, thiamin, riboflavin as well as antioxidant analysis has been done for varieties such as *Veliyan, Thondi, Chennellu, Chomala, Gandhakasala, Jeerakasala* and 5 more varieties available with CGB.

Programme Area 300

BIOTECHNOLOGY

Work on assessing the levels of stress tolerance of transgenic lines in segregating lines is progressing. Deep sequencing of stress-responsive transcriptome of select plant species for better understanding of molecular mechanisms of abiotic stress tolerance has resulted in identification of key genes and metabolic pathways in response to drought and salt stress. Second season trials for field evaluation of 160 traditional rice varieties for enhanced micro-nutrient traits are underway. Diversity and nutrition analysis of Moringa oleifera accessions revealed diverse germplasm and iron-rich material. The bioprospecting programme on lichens has identified a novel molecule with anti-tuberculosis properties and has generated lichen cultures. The culturable and unculturable microbial diversity of the rhizosphere of mangroves showed high diversity of 16S rDNA genotypes and 18 different groups of bacteria involved in nitrogen fixation. Mass propagation of disease-free, elite germplasm of pipla, turmeric and ginger were carried out during the year.

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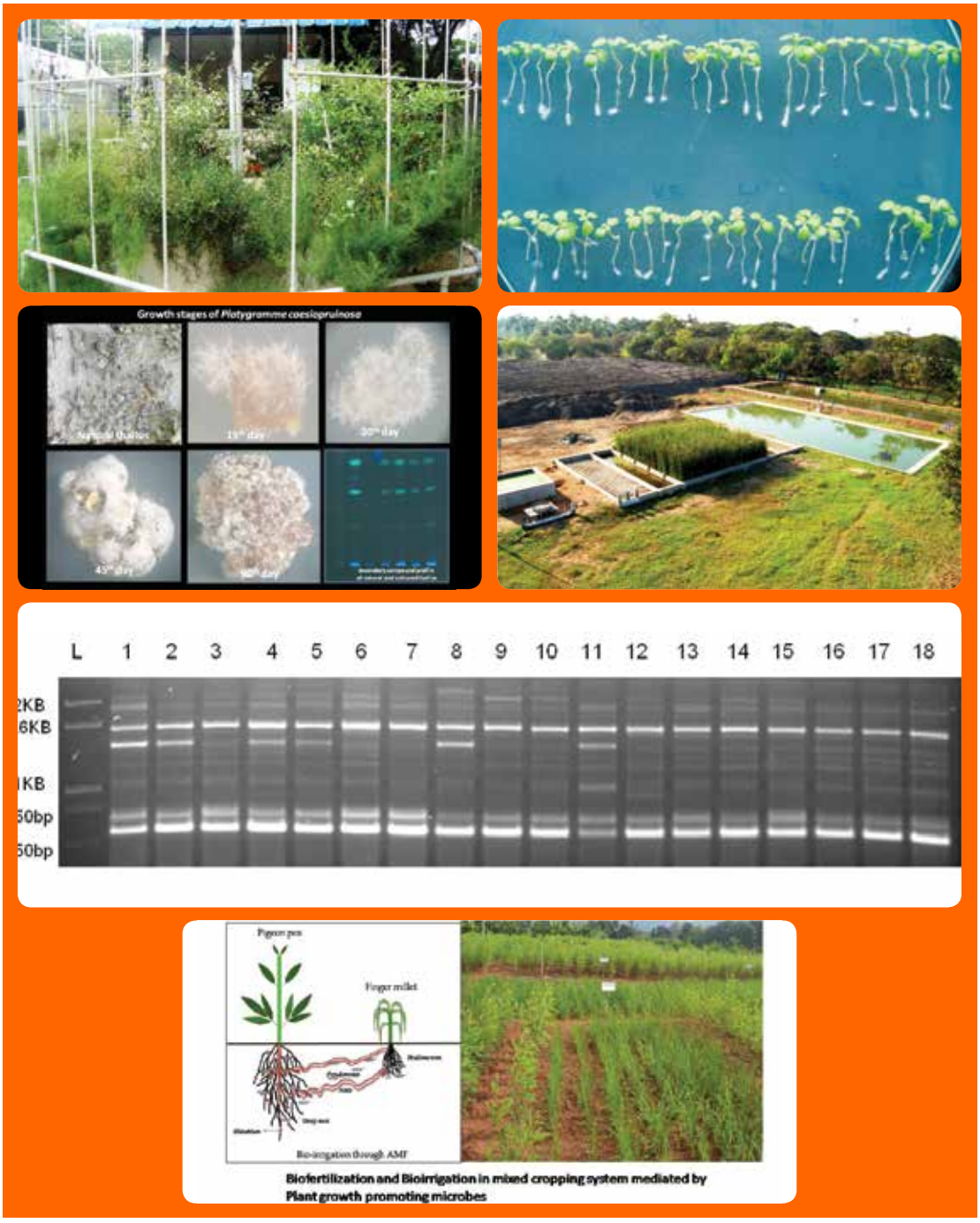

Application of biotechnologies for crop improvement, soil productivity and value addition of bioresources

Programme Area 300

Biotechnology

The Biotechnology programme uses recent advances in plant molecular biology to genetically shield crop plants against abiotic stresses to arrest decreasing plant productivity. This includes the understanding of stress-tolerant mechanisms in plants and also the identification and characterisation of abiotic stress-related genes, biochemical pathways, transcription factors, osmolyte accumulators, antiporters as well as promoter elements of genes from salt- and drought-tolerant species through cDNA libraries, subtractive hybridisation of genomes, and deep genome sequencing. Some of the genes involved in drought and salinity stress have been transformed into local varieties of rice. The transgenic lines showed better growth under stress conditions compared to control plants. Further, more traditional rice varieties have been screened for their enhanced micro-nutrient traits as well as abiotic stress pathway genes, using the marker-assisted breeding approach. The lichen bioprospecting programme has identified pharmaceutically-relevant molecules from lichen cultures and has established protocols for lichen culture, biosynthesis, isolation and characterisation of compounds and has obtained leads in anti-cancer and anti-tuberculosis studies. The bioprospecting of microbes explores the genetic and functional diversity of bacteria in enhancing crop productivity. The studies include documenting the rhizobacteria and actinobacterial diversity associated with mangroves and crop plant roots. Some of the potential plant growth-promoting bacteria inoculated in the experimental plots have shown increased crop productivity.

Sub Programme Area 301

Micropropagation

Micropropagation of *Piper longum*

Mass propagation of pipla (*Piper longum*), turmeric (*Curcuma longa*) and ginger (*Zingiber officinale*) was attempted, using the tissue culture facility of the Jeypore Centre. This year, 500 tissue culture plants of long pepper were successfully transferred to potted soil. One demonstration trial with vegetatively-propagated and tissue-cultured planting material of long pepper was laid out to assess their performance. During the year, production of disease-free planting materials (5000 plantlets) of ginger and turmeric through tissue culture was also taken up.

Sub Programme Area 302

Genetic Enhancement

302.1 Stress-tolerant rice varieties

Over the last several years, the Biotechnology group has been working on developing location-specific rice varieties for tolerance/ resistance to abiotic stress. The generation of transgenic rice varieties with superoxide dismutase gene and catalase genes isolated from *Avicennia marina* has been reported in

previous years. Transgenic rice pure lines with these genes are available in local varieties (IR 20, White Ponni, and ADT 43) and have been advanced to seventh generation. These lines are being assessed in contained greenhouse facilities for the level and extent of tolerance to salt and drought stresses. Morphological parameters are being studied, along with the analysis of structural integration and functional characteristics. It is proposed to advance these lines for toxicity and allergenicity studies, and also undertake multi-location trials for product development.

302.2 Rice biofortification with enhanced iron and zinc

Rice when supplemented with micronutrients such as iron (Fe) and zinc (Zn) is an important alternative to overcome malnutrition. There is large diversity available in rice germplasm and the grain Fe/Zn content levels are influenced by many environmental factors such as climate, soil and water. A total of 130 landraces of rice collected from Odisha, Tamil Nadu and Kerala were grown for two consecutive *rabi* seasons (November 2013 and 2014) under uniform environmental conditions at Kalpakkam and were evaluated for micronutrient levels.

The 130 varieties were laid out in three blocks. Seven rows of each variety were sown in a plot with a spacing of 30 cm between rows and 30 cm between plants. The field management followed standard recommended agronomic practices. The data was recorded from the middle rows for days to maturity, plant height (cm), number of tillers, number of productive tillers, and test weight (g) and grain Fe/Zn concentration were recorded after harvest.

The micronutrient content in the natural germplasm of rice was analysed using x-ray fluorescence (XRF). Iron concentration varied from 8.9 ppm (*Bodi kaburi*) to 18.8 ppm (*Patrali*) and Zn concentration from 16.9 ppm (*Osaganthilu*) to 33.3 ppm (*Guruji*). Very few genotypes showed Fe more than 15ppm and Zinc more than 30 ppm. An XRF analysis of the second season is underway. Genotyping of all the germplasm accessions with SSR markers is under progress to understand the diversity in the collection of germplasm and to link them to traits.

302.3 Screening and analyses of 35S: *PcIDEF1* gene in model plant tobacco

As described in earlier reports, transgenic tobacco lines have been developed using **i**ron **d**eficiency-responsive *cis*-acting **e**lement binding **f**actors (IDEF) to assess the enhancement of iron transport into rice grains. Semi-quantitative PCR (polymerase chain reaction) analyses and whole plant level studies with differential treatments showed encouraging functional efficacy of the gene. Work during this year is given below.

Leaf disc assay

Leaf disc assay was performed for the *PcIDEF1* transgenic lines, vector control (VC) and the wild type (WT) plants with 6 different treatments — control, iron deficiency (-Fe), iron deficiency in the presence of salt (-Fe+150 mM NaCl), 150 mM NaCl treatment alone, half

strength Murashige and Skoog (MS) medium at pH 7.9 and 150 mM NaCl at pH 7.9. All the treatments were given for 96 hours, at the end of which leaf discs were harvested and fresh weight of the discs recorded. The leaf disc assay results showed more chlorophyll retention in the transgenic lines, especially in Line 1 and Line 3, compared to VC in all treatments; with respect to the WT plants, there was not much difference in chlorophyll content in transgenic lines except in –Fe+150 mM NaCl treatment. This indicates that the transgenic lines are able to tolerate more salt stress.

Germination assay

Germination assay was performed using *PcIDEF1* overexpressed transgenic lines (Line 1, Line 2 and Line 3), VC and WT seeds to check for the effect of *PcIDEF1* overexpression on the germination of tobacco seeds. A better germination percentage was observed for all transgenic lines compared to VC in –Fe treatment whereas compared to WT, Line 1 showed better germination percentage. In the case of –Fe+150 mM NaCl treatment, all transgenic lines showed better germination percentage compared to VC and WT seeds, whereas in the case of 150 mM NaCl treatment, Line 1 and Line 2 showed better germination percentage compared to VC and WT.

Root length assay

Root length assay was performed for all transgenic lines, VC and WT plants. Seven days after germination in half strength MS, tobacco seeds were transferred to the differentially-treated medium as mentioned above. The petri plates were kept vertically for 2 weeks under 16 hr light/8 hr dark conditions, after which root lengths for all the plants were measured. The root growth assay revealed that transgenic lines showed better root length under –Fe and –Fe+150 mM NaCl conditions.

Previous studies have reported that *IDEF1* gene confers an early response to Fe deficiency stress by its expression. At the subsequent stage *IDEF1* switches its regulation to RY element-binding protein like late embryogenesis protein (LEA) which has a role in seed germination and water stress. This could explain the better germination efficiency and more biomass for the *PcIDEF1* overexpressing transgenic lines compared to VC and WT.

302.4 Studies on genetic diversity in *Moringa oleifera* (moringa) using SSR markers

During this year, a total of 97 accessions of *M. oleifera* collected from different districts of Tamil Nadu, Andhra Pradesh and Odisha were analysed for their genetic diversity and population structure. Seeds were sown in triplicates and DNA isolated from one-month-old leaves screened using 20 simple sequence repeats (SSR) markers and DNA fragment size based on capillary electrophoresis. A total of 140 alleles were detected with an average of 7 alleles per marker. All the 20 markers analysed were polymorphic, with the polymorphic information content (PIC) value

ranging from 0.44 to 0.81 with an average of 0.68 which clearly indicated the genetic diversity existing among the accessions studied. The gene diversity varied from 0.54 to 0.83 with an average of 0.73, while observed heterozygosity ranged from 0.81 to 1.0 with an average of 0.9. The population structure was studied using the above molecular data with the neighbour-joining method, and it resulted in 3 major clusters. The majority of the samples fall into cluster 1 which consists of an admixture of samples from all three States while the other 2 clusters contain a major portion of accessions collected from Tamil Nadu.

Leaf iron estimation

Leaf samples were collected in triplicates from 89 *Moringa* accessions and 50 mg of the dried tissue was used for estimation of iron content using atomic absorption spectrometry (AAS). The values ranged from 0.057 mg/g to 0.317 mg/g among the 89 accessions analysed. The average iron content was 0.122 mg/g for Tamil Nadu samples, 0.123 mg/g for Andhra Pradesh samples and 0.110 mg/g for samples from Odisha. The samples will be further screened using ISSR markers for their genetic diversity.

302.5 Identification and characterisation of *AmRZFP1* (RING zinc finger) gene from *Avicennia marina*

The *Avicennia marina* RING zinc finger protein 1 (*AmRZFP1*) is a DNA-binding protein involved in abiotic stress tolerance. The *AmRZFP1* gene has been isolated and cloned, as reported earlier. The homozygous T1 seeds of the transgenic tobacco plants over-expressing *AmRZFP1* were subjected to saline and drought conditions to study performance under these stresses. These transgenic lines showed better germination rate compared to the wild type seeds under 100 mM NaCl and 4 per cent polyethylene glycol (PEG). However, under 1 µM abscisic acid (ABA) (drought stress) the lines showed hypersensitivity. There was not any significant difference between transgenic and wild type plants in the root length. When the one-month-old plants were subjected to 200 mM NaCl and 400 mM mannitol, control wild type plants showed wilting and chlorosis whereas transgenic plants remained unaffected even after 10 days of exposure.

It is important to understand the protein's DNA binding activity for further elaborating its role in stress tolerance. Hence, an *in vitro* autoubiquitination assay was performed. In each reaction (30 µl final volume), 200 ng of Ubiquitin activating enzyme E1 (Calbiochem), 200 ng of UbcH5c conjugating enzyme E2 (Calbiochem), 500 ng of purified *AmRZFP1*-His E3 and 5 µg of Ubiquitin (Calbiochem) were placed in *in vitro* ubiquitination buffer and incubated for 2 h at 30 °C along with negative controls for E3, E2 and E1. The reactions were stopped by adding 5× SDS-sample buffer and incubation at 65°C for 10 min. The samples were subjected to 10 per cent SDS-PAGE gel electrophoresis and followed by Western blotting with anti-*AmRZFP1*-His antibody. The Western blot analysis showed the formation of multiple forms of ubiquitinated (binded) proteins, whereas omission of either

ubiquitin activating enzyme E1, UbcH5c E2, Trx:*AmRZFP*1:His or ubiquitin from the assay resulted in a loss of protein polyubiquitination, confirming that *AmRZFP1* has ubiquitin ligase activity.

302.6 Characterisation of a heavy metal transporter from *Prosopis juliflora* for enhanced phytoremediation

Heavy metal cadmium (Cd) is ranked number 7 of top 20 toxins and is therefore a potential target for phytoremediation. Heavy metal transporters are ABC transporters that help in homeostasis of a variety of different essential and non-essential metals inside the cell. These proteins use ATP to pump various cations across the membrane against their electrochemical gradient. They transport metals into subcellular components and target proteins, nutrition and metal detoxification or metal hyperaccumulation. *Prosopis juliflora* (mesquite) has been reported to accumulate high concentrations of Cd and copper (Cu) in textile and metal-based industrial areas and has been used in the bio recovery of Al from urban industrial sites. Due to its property of heavy metal accumulation, it has been suggested as a ''green'' solution for soils contaminated with heavy metals.

A heavy metal transporter was isolated from *P. juliflora,* (*PjHMT*) that showed high similarity only to the C-terminal region of the well-characterised *AtHMA1* (heavy metal ATPase1 from *Arabidopsis thaliana*). The genomic clone of about 4.0Kb for *PjHMT* was obtained by PCR (utilising gene-specific primers designed using 5' and 3' UTRs of *PjHMT* cDNA. This was sequenced using *ABI 3130* and the exon–intron junctions were predicted using Genevestigator. Copy number analysis of *PjHMT* shows that it exists as multiple copies.

PjHMT overexpresed tobacco lines (T_2) and control lines were subjected to heavy metal stress treatment at various stages like seed germination, root length, whole plant and differentiation on Murashige and Skoog medium (MS) containing various concentrations of Cd (0 to 200µM). Transgenic seeds showed better germination rate after 10 days of germination than control in the presence of Cd. The transgenic seedlings also showed longer roots under stress. Two-month-old plants (control and transgenic) were subjected to Cd stress for whole plant stress studies. The control plants showed toxicity symptoms by day 3 and completely wilted by day 6. ICP-OES analysis showed a better metal uptake by transgenic plants than control, thus suggesting a potential role of *PjHMT* in phytoremediation.

302.7 Glycine betaine biosynthesis genes of a mangrove halophyte, *Suaeda maritima*

Expression studies in transgenic tobacco and rice

Glycine betaine is an osmolyte that accumulates in the cytoplasm of the cells, conferring osmotic tolerance to the plants. *Suaeda maritima,* which belongs to *Amaranthaceae* (spinach family), is a halophyte growing in the Pichavaram mangroves. It accumulates glycine betaine,

involving the expression of at least 3 genes: Phospho-ethanolamine N-methyl transferase (PEAMT) that converts ethanolamine to choline by successive N-methylation, Choline monooxygenase (CMO) that oxidises choline to betaine aldehyde and Betaine Aldehyde Dehydrogenase (BADH) that converts betaine aldehyde to glycine betaine. Crop plants such as rice are more vulnerable to drought and salinity and the introduction of these genes into them would help tide over drought as well as soil salinity, both of which pose a threat to agricultural productivity.

Full-length cDNAs of all the 3 genes had already been isolated and characterised using a bacterial expression system (reported in previous annual reports). The cDNAs were cloned in specific vectors (*pCAMBIA1301*) for rice transformation studies. RNA expression analysis of all the 3 cDNAs was performed using real-time PCR. Of the 3 genes, CMO is highly induced by salt treatment when compared to that of BADH and PEAMT. Transgenic lines were generated of the double construct (CMO and BADH) in both rice and tobacco. Transgenic lines of the triple construct (PEAMT along with CMO and BADH) were also generated in tobacco.

Tobacco T_2 transgenic seeds were subjected to germination under salinity with 100 mM and 200 mM NaCl as well as under iso-osmotic concentrations of mannitol to assess the osmotic stress tolerance of the transgenic lines. Seed germination assay in the case of 360 mM mannitol showed significant increase in percentage germination in the T_2 transgenic tobacco lines compared to wild type seeds. At 360 mM mannitol treatment, wild type seeds showed about 29 per cent germination whereas L5, L10 and L6 showed a significant germination of 87, 77 and 74 per cent, respectively. In the case of 100 mM NaCl, a 40 per cent increase in germination was observed in L5 and L6 compared to wild type seeds. L7 showed a 26 per cent increase in germination compared to wild type seeds.

Chlorophyll leaching assay was performed in the case of T_2 double (CMO and BADH) as well as T_0 triple (PEAMT, CMO and BADH) transgenic tobacco lines. Total chlorophyll was extracted from the leaf discs by immersing them in 80 per cent acetone and estimating the extracted chlorophyll by spectrophotometry. The lines that were able to retain more chlorophyll are considered more tolerant to NaCl or mannitol treatment. In the case of double transgenic tobacco lines, chlorophyll content in the wild type and transgenic lines treated with 200 mM NaCl showed a significant 41 per cent increase in chlorophyll content in the case of 3 lines compared to wild type. In the case of wild type and transgenic leaf discs treated with 360 mM mannitol, L5 showed 264 per cent increase in chlorophyll content compared to wild type; L6 showed 249 per cent increase in chlorophyll content compared to wild type.

Whole plant assay of the double transgenic tobacco and rice lines were performed in 100mM NaCl and 200mM NaCl for tobacco and 50mM and 100mM NaCl in the case of rice. In the case of tobacco, those treated

with 200mM NaCl did not survive as the leaves started wilting after 48 hours of salt treatment. The plants were observed for 10 days under 100mM NaCl after which they were transferred to medium without NaCl to observe the recovery. At the end of 10 days of NaCl treatment, both wild type and transgenic lines showed signs of bleaching. Seven days after transferring to medium without NaCl, it was observed that the transgenic lines recovered faster than the wild type lines. A change in leaf colour from light green to dark green was observed after 7 days of NaCl withdrawal in the case of L5 and L6 when compared with other lines and the wild type. In the case of T_1 transgenic rice lines subjected to 50 mM and 100 mM NaCl treatment, browning of the leaf tips was observed in both wild type and transgenic lines after 7 days of treatment in both the NaCl concentrations.

302.8 Characterisation of *NHX1* antiporter gene from *Porteresia coarctata (Synonym Oryza coarctata)*

The *NHX1* genes encode low-affinity electroneutral Na (+)/H(+) exchangers of vacuolar vesicles of cells and protect them during salinity stress. Transgenic tobacco plants were generated with *PcNHX1* using *Agrobacterium* mediated transformation and its role in salinity tolerance was verified. Five transgenic lines (T_0) raised in the laboratory were transferred to the greenhouse to raise T_1 seeds. Out of the 5 lines, 3 lines demonstrated a 3:1 segregation ratio (Hyg^+/Hyg^-; Lines L3, L7 and L8). Four lines of T_1 were transferred to the greenhouse and T_2 seeds have been collected from L2, L3, L7 and L8. Analysis for salt tolerance in these transgenic lines will be initiated.

302.9 Characterisation of *PcHKT1,5* from *Porteresia coarctata*

PcHKT1, 5 is a putative sodium transporter isolated from the saline-tolerant wild rice species *Porteresia coarctata* (*Oryza coarctata*). Plasma membrane localisation of *PcHKT1, 5* was confirmed by confocal microscopy of tobacco lines stably transformed with a *PcHKT1,5-GFP* fusion. The green fluorescence was found to be localised to the periphery of the guard cells, closely appressed to the guard cell walls. Preliminary expression of mutagenised *PcHKT 1,5* in *Xenopus* oocytes suggests that it functions as a Na^+ selective transporter like *OsSKC1*. However, *OsSKC1* may have more affinity towards Na^+, compared to *PcHKT1,5*. Further detailed characterisation of the transporter function will be initiated.

PcHKT1, 5 transformed tobacco lines (single copy) were examined for salinity tolerance (seed germination and growth of seedlings under salinity). Five-day-old seedlings from lines L1, L4, L6 as well as untransformed control seedlings were transferred to 2 per cent MS containing increasing concentrations of NaCl (0, 50, 75, 100 and 150mM) for 10 days and growth monitored daily. Increased root growth in transgenic lines L1, L4 and L6 was observed compared to non-transgenic control. At 100 mM NaCl, transgenic lines L1, L4 and L6 showed significantly better root growth compared to WT and Vector controls(n=20).

In order to observe the effect of salinity on root growth over a longer time period, transgenic lines L1, L4 and L6 as well as controls were allowed to grow in MS containing NaCl (0, 50, 75, 100 , 150 and 200mM) for 30 days. Preliminary results suggest that transgenic lines L1, L4 and l6 show significantly longer root length and less root curling at 100 mM NaCl. The 5' the upstream region of *PcHKT1,5* identified previously was cloned in *pCAMBIA 1391z* and transformed into tobacco.

302.10 Molecular elucidation of biotic elicitor-mediated defense-responsive genes in sugarcane x *Colletotrichum falcatum* interaction

EST analysis and library submission

A total of 248 good quality expressed sequence tags (ESTs) were submitted to NCBI (LIBEST_028540 - *Colletotrichum falcatum* elicitor treated suspension cells of red rot resistant sugarcane), characterised from 509 differentially expressed clones sequence. Further, these 248 sequences were subjected to contig (a set of overlapping DNA segments that together represent a consensus region of DNA) analysis and 15 contigs and 28 unique singletons were identified.

302.11 Identification of salt responsive proteins from three halophytes, *Sesuvium portulacastrum, Suaeda maritima and Salicornia brachiata* through proteomic approach

Halophytes are plants that grow naturally under high salinity and are therefore tolerant of salt stress. Understanding salt tolerance mechanisms in halophytes will be of great use in developing crops which can grow under saline conditions.

Salt tolerance in three halophytes — *Sesuvium portulacastrum*, *Suaeda maritima* and *Salicornia brachiata* — was studied during the year. The stem cuttings of *S portulacastrum* were able to withstand 14 days of 200mM NaCl treatment and did not show symptoms of salt injury such as leaf curling, loss of waxy coating and wilting. At this salt concentration, *S. maritima and S. Brachiata* seedlings grew well in vermiculite and were acclimatised in modified Hoagland medium for 7 days. The acclimatised plants did not show signs of salt injury in 200mM NaCl and *S. brachiata* attained maximum growth at this concentration. Leaf proteins were extracted and quantified using BCA assay. An analysis of the differentially expressing proteins using PDQuest Advanced (BioRad) revealed that many of them were up-regulated upon salt treatment. One of the protein spots that appeared to be highly expressed in salt-treated plants was used for MALDI-TOF analysis. The differentially expressed proteins were excised, trypsin digested, and analysed. Proteins were identified using MASCOT version 2.5 search. Only the protein spots that exhibited reproducible and significant changes (p-value>2.0 fold) under NaCl treatments were included for further analysis. Five proteins each from *S. maritima, S. brachiata* and 3 proteins from *S. portulacastrum* showed two-fold up-regulation. Protein sequence analysis of the spots identified from the current study

will be compared to transcript level information to identify genes that are responsive to salt to confirm regulation at both the levels.

302.12 Deep sequencing of stress responsive transcriptome of six plant species for better understanding of molecular mechanisms of abiotic stress tolerance

In the reporting period, mRNA and small RNA libraries were constructed from control, salt- and drought-stressed leaf and root tissues of 6 selected species viz., *Avicennia marina, Prosopis juliflora, Macrotyloma uniflorum, Chrysopogon zizanioides, Sorghum bicolor, and Pennisetum typhoides*. The RNAseq libraries were pooled together and sequenced on Illumina HiSeq 2500 platform to generate 30 million paired end reads per sample. Small RNA libraries were pooled together and run on a single lane of SE 50. The entire sequence data generated were deposited in the National Institute of Health (NIH) Short Read Archive database. *De novo* transcriptome for species without a reference genome was generated using Trinity software. Differential expression profiling of genes (DEG) under salt and drought stress were carried out using EdgeR. Gene Ontology (GO) enrichment of different DEG profiles was performed with BiNGO and statistical enrichment of DEGs in KEGG pathways was tested using KOBAS 2.0. Detailed analysis of DEG profiles and other results were carried out for *S. bicolor* and *M. uniflorum*. Stress-responsive transcription factors as well as transporter genes were identified in these species. The analysis identified key genes and metabolic pathways functioning in drought- and salt-stress response in these species. In *S. bicolor*, the results revealed the genotype, tissue, stress, leaf temperature and yield specific patterns of genes expression, while in *M. uniflorum*, tissue and stress specific patterns of gene expression were revealed.

302.13 Studies on mangrove, *Avicennia marina* grown under elevated CO_2 and various abiotic combined treatments in a miniature free air CO_2 enrichment (FACE) facility

A. marina seedlings were grown in hydroponic medium in a cemented tank 1.5 m in diameter and 2 m in depth and then exposed to air enriched with CO_2 using free air CO_2 enrichment (FACE) method and other abiotic treatments. A tank which was not exposed to any abiotic treatment but elevated CO_2 alone served as control. Total RNA was extracted from leaves collected at 15 and 60 days of combined treatments and semi quantitative reverse transcriptase PCR was performed to monitor the expression profiles of some abiotic treatment responsive genes. The genes were SOD, APX, MDAR, Myb, NAC and Zinc finger. The results show that after 15 days of combined treatments all these genes were up-regulated in flooded treatment compared to control, except SOD and Myb which were down-regulated. Drought treatment shows down-regulation of all the genes except APX where expression was the same as in control. Results after 60 days of combined treatments show up-regulation of SOD, APX and MDAR

genes while Myb, NAC and Zinc finger show almost the same level of expression in drought treatment. Salt treatment did not show any significant change in expressions of any of the genes.

Sub Programme Area 303

Bioprospecting

Globally, there is an increased interest in the natural products for drug development such as lichens that are known to contain a large number of pharmaceutically potential molecules belonging to the chemical class polyketides. MSSRF is involved in bioprospecting lichen compounds against cancer and tuberculosis as well as screening lichen extracts for hepatoprotective and enzyme systems that are closely related to neural disorders.

303.1 National network programme on lichens: Bioprospecting its secondary compounds and establishing cultures and collections

Since lichens are scarce and extremely slow growing, MSSRF is involved in establishing lichen culture repositories of the secondary compounds of rich lichen species, to conserve important germplasm as well as to biosynthesise the key molecules from lichen culture. As has been reported last year, the Agharkar Research Institute (ARI), Pune and the National Botanical Research Institute (NBRI), Lucknow are the partnering lichen research laboratories for the establishment of lichen cultures. MSSRF, along with these partners, has established mycobiont and whole thallus cultures of 30 lichen species. The compounds were isolated and characterised using spectroscopic analyses at the Indian Institute of Technology Madras (IITM), Chennai. The characterised molecules were supplied to the Cancer Institute, and the National Institute for Research in Tuberculosis (NIRT), both at Chennai and the Pharmacology Laboratory of NBRI for relevant bioprospecting screens.

303.2 Establishing lichen cultures repositories

During the year, the mycobiont and whole thallus cultures of *Glyphis sp.*, *Graphis sp2*, and *Pertusaria sp.* were established. Mass culturing of *Graphis sp1*, *Buellia subsororiodes*, *Roccella montagnei* and *Trypethelium eluteriae* were also carried out. All the above cultures biosynthesised the secondary compounds that are characteristic of them.

303.3 Bioprospecting of secondary compounds

Six lichen secondary compounds were isolated and purified and were provided to IITM for characterisation. Meanwhile, the well grown cultures of 30 lichen species were harvested, and organic solvent and hydro-alcoholic extracts were prepared. The Cancer Institute has screened these lichen extracts against 5 different cancer cell lines — MCF-7 (breast), NCI H460 (lung), U251 (a human glioma) and positive controls Hek293 and HaCat. The extracts MSSRF/L3A/Se1, MSSRF/L7/Se1, NBRI/L8A/Se1, NBRI/L10A/Se1, and ARI/L9/Se1 inhibit the growth of human glioma cancer

cells at 40-60 µg/ml concentration without inhibiting the growth of normal control cells.

303.4 Screening compounds against tuberculosis

The National Institute for Research in Tuberculosis (NIRT), too, has screened these lichen extracts and 3 compounds for their anti-tuberculosis properties on *Mycobacterium tuberculosis* strain H37RV, *M. pheli, M parafortuitum, M .flavescens* and *M. kansasii.* Compounds MSSRF/TE/04 and MSSRF/TE/03 showed an inhibitory effect at a very low concentration.

303.5 Screening lichen extracts for hepatoprotective activity

Lichen extracts were evaluated for hepatoprotective activity in mice by the Pharmacology Laboratory, NBRI. Acute toxicity of 50 per cent ethanolic extract of the thallus of *Usnea longissima* and *Cladonia rangiferina* was tested in mice. Three female and 3 male mice were treated with 2g of extract /kg body weight orally by force feeding. The treated mice were observed for toxic symptoms continuously for the first 4 hours after dosing. It was observed that the mice showed no signs of lethality and toxicity and hence these extracts were considered safe to the mammalian system.

Sub Programme Area 304

Microbial Diversity

The bioprospecting of microbial diversity from the mangrove and agriculture ecosystems resulted in the identification of potential bacterial and actinobacterial isolates for alleviating biotic and abiotic stress. This sub programme also aims at bio-fertilisation and bio-irrigation mediated through a consortia of plant growth promoting microbes in mixed cropping systems of pigeon pea and finger millet in semi-arid regions to enhance productivity.

304.1 Microbial community profiling of the mangrove ecosystem

This year the culturable and unculturable bacterial diversity associated with rhizospheres of *Avicennia marina, Rhizophora mucronata, Suaeda maritima* and *Salicornia brachiata* were identified based on denaturing gradient gel electrophoresis (DGGE) sequence analysis of 16S rDNA. The results showed high diversity of 16S rDNA genotypes with 45 per cent of the unculturable bacterial population belonging to phylum *Proteobacteria*, followed by 25 per cent *Bacteroidetes*, 11 per cent *Firmicutes*, 7 per cent *Actinobacteria* and 6 per cent unclassified and *Ignavibacteriae* group. The genera *Bacillus*, *Pseudomonas* and *Vibrio* were present across the 4 rhizospheres; while species belonging to *Halothiobacillus* sp., *Halomonas* sp., *Phaeocytidibacter* sp. and *Micrococcus* sp. were observed only in *S. maritima* and *S. brachiata rhizosphere soils*. Diversity index (DI) based on Shannon Weiner showed that bacterial community diversity associated with *A. marina* rhizosphere was more diverse with index range of 1.2435 followed by *R. mucronata* (DI-1.2280), *S. maritima* (DI-1.1533) and *S. brachiata* (DI-0.7559).

Culturable nitrogen (N_2) fixing bacterial diversity associated with mangrove rhizosphere

About 52 diazotrophs harbouring *nif* H genes and capable of fixing atmospheric nitrogen were identified in 18 different groups distributed within 6 different genera, namely, *Bacillus*, *Vibrio*, *Klebsiella*, *Rhodobacter*, *Mangrovibacter* and *Azospirillum* spp. These groups are major contributors of nitrogen fixation in mangroves.

Culturable obligate mangrove bacterial diversity associated with Pichavaram mangrove rhizosphere

Of a total of 209 isolates screened, 17 isolates grew only in the mangroves and seawater agar, indicating they are obligate to this ecosystem. Based on 16S rRNA sequence analysis, they were identified as *Halobacillus* (2), *Microbulbifier* (2), *Maritaela* (4), *Arenibacter* (6), *Paraliobacillus* (2) and *Tanecibaculum* (1). These groups are not common in the mangroves but have been reported from marine environments. Among the 17 isolates, 16 isolates grew significantly in sea water agar and confer to be obligate, while the *Microbulbifier* sp. required nutrients present in mangrove water for its growth.

Identification of culturable actinobacterial diversity associated with mangrove rhizosphere

The study on actinobacteria associated with mangroves indicated their distribution within 6 families:*Micromonosporaceae*, *Streptomycetaceae*, *Thermomicrobiaceae*, *Actinoplanaceae*, *Nocardiopsaceae* and *Pseudonocardiaaceae*. Further, 9 species of *Micromonospora*, 2 species of *Verrucosispora* and a species each of *Actinoplanes* and *Jishengella* were identified. The isolates which grouped into the genus *Micromonospora* ranged from 98.5 per cent to 100 per cent. The identification of about 21 isolates revealed 9 species of *Streptomyces* and a species each of *Saccharopolyspora* and *Nocardiopsis*. This indicates the *Micromonospora* were present predominantly in the mangrove ecosystem.

304.2. Bio-fertilisation and bio-irrigation for sustainable mixed cropping of pigeon pea and finger millet

Bio-fertilisation and bio-irrigation (BIOFI) is a collaborative project partnering 6 Indian and 3 Swiss institutes to examine the concept of bio-fertilisation (nutrient mobilisation) and bio-irrigation (re-distribution of water through hydraulic lift) in a mixed cropping system of pigeon pea and finger millet under the influence of *Arbuscular mycorrhiza* (AMF) and plant growth promoting rhizobacteria (PGPR). The trial was conducted in Oliyaru village of Kolli Hills. The *Rhizobium*-pretreated pigeon pea seeds were raised in polybags with 4 different treatments — *Pseudomonas* sp. MSSRFD41 (PGPR), *Glomus leptotrichum* (AMF), PGPR+AMF and untreated control. Major yield data such as straw dry weight, number of tillers and grain dry weight for finger millet, both in mono and inter-cropping, were analysed. Among the treatments, mineral fertilisers at 50 per cent recommended dose RDF along with AMF + PGPR showed an increase of straw dry weight of about 270

per cent compared to no mineral fertiliser application. The combined inoculation of AMF and PGPR in particular increased the straw dry matter by about 32 per cent compared to no inoculation under no mineral fertiliser condition. The other parameters are still under analysis.

304.3 Microbes for biotic stress attenuation in agriculture crops

Pepper and tomato are seriously affected by the wilt pathogen *Fusarium* which accounts for yield loss of about 35 per cent. A total of 108 fungal isolates were isolated from *Fusarium*- infected pepper and tomato plants and using genus specific primers, 48 isolates were identified as *Fusarium* positive. BOX fingerprinting grouped the isolates into 7 groups. TB134 was found to be efficient in controlling the *Fusarium* isolates. The isolate *P. chlororaphis* MSSRF QS59 efficiently controlled 3 species of *Fusarium*: *F. oxysporum*; *F. solani* and *F. graminearum*. The genes encoding for antifungal metabolites PCA (*phzF*), PCN (*phzH*) and PRN (*prnC*) were amplified in *P. chlororaphis* MSSRF QS59 and confirmed by sequencing.

304.4 Exploration of *N-acyl homoserine lactone* (AHL) producing *Pseudomonas chlororaphis* (MSSRF QS59) for antifungal control

Expression of phenazine and AHL regulatory genes under stress conditions

The expression profiling of antibiotic biosynthetic gene *phzH* (Phenazine-1-carboxamide) and its AHL regulatory gene *phzI/R* and global regulatory gene *gacS* in *P. chlororaphis* (MSSRF QS59) was studied during their interaction with two fungal phytopathogens, *F. oxysporum* and *F. graminearum*; their expression was found greatly reduced compared to control. This indicates that the mycotoxins had an inhibitory effect on these genes. Similarly, the expression of these genes was down-regulated in the presence of the quorum-quenching strain *Bacillus cereus* (MSSRF Q10). However, in the presence of synthetic AHLs, the expression of the Phenazine gene *phzH* was enhanced in 12 h. and hence it can be inferred that the above gene is an AHL- dependent QS system.

304.5 Integrating bio-treated wastewater re-use with enhanced water use efficiency to support the green economy

The Water4Crops project involves multidisciplinary issues of water management, provides an opportunity to efficiently utilise low quality agro-industrial and municipal wastewater, and facilitates developing various technologies for wastewater treatment and its feasible reuse in agriculture. MSSRF is working as a partner with KCP Sugar & Industries Corporation in their Lakshmipuram and Vuyyuru sites in the Krishna district of Seemandhra to develop treatment technologies and demonstrate re-use techniques.

Lakshmipuram site

Treatment system: The treatment system is known as constructed wetland (CWL), depicting the characteristics of the natural

wetland ecosystem to improve water quality. The design of CWL was made simple for minimal energy consumption, gravity flow and low maintenance. The CWL is rectangular in shape comprising 5 beds covering an area of 242.53 m^2 to treat 24000 lt of sugar effluent (SE) per day with hydraulic loading rate at 3 m^3/day/m^2 and retention time of 7 days. The beds are provided with varied substrates to promote aerobic and anaerobic reactions to enhance treatment efficiency. The middle bed consists of organised layers of sand and soil planted with *Typha angustifolia*. The discharge of the CWL flows into a sedimentation tank to settle the degraded suspended particles; an excavated earthen pond is used for fish culture, with retention time of 14 days at the rate of 50 per cent water replenished from the sedimentation tank.

Hydrology balancing: A hybrid model of sub-surface water flow CWL system was adopted and parameters for hydrology balancing indicate that the inflow was 19.44 m^3/day, outflow was 17.95 m^3/day and losses due to evaporation and transpiration were around 8 per cent.

Improved water quality: The water quality of the treated SE was measured fortnightly for its physico-chemical and biological parameters. The SE was turbid, dark brown in colour, with an unpleasant smell to start with, and after treatment became clear, colourless and odourless. Chemical parameters of treated SE showed considerable reduction in pH, TDS, EC, total alkalinity, total hardness, magnesium, sodium, potassium, phosphorus, iron, manganese, chloride fluoride, and sulfate. Calcium alone showed minor increase. Nitrite was reduced, nitrate concentration was increased and ammonia ion was oxidised by nitrosomonas bacteria in the presence of oxygen (aerobic) to form nitrite. Biological parameters like total microbial load and pathogenic population in different beds remained constant at log 4 cfu/ml. The *Enterobacter* sp. is < 2 cfu/ml, which indicates better water quality. The results indicate that the quality of the treated water has improved and is suitable both for fish culture and agriculture.

Re-use in aquaculture and agriculture: Carps like Rohu (*Labeo rohita*) and Catla (*Catla catla)* fish were reared in 80:20 ratio, with initial weight ranging from 150 g to 200 g in treated water. The fish were fed with rice bran and groundnut oil cake with proximate protein content ranging from 16 to 18 per cent. In a period of 180 days, the average length and weight ranged from 35 cm to 42 cm and from 550 g to 750 g, respectively

Field experiments were conducted to study the effectiveness of treated SE (T1) with fresh water (T2) as control for saline-tolerant sugarcane crop variety 2003V46. The experiment was done with 4 replicates each of T1 and T2 in an area of 512 m^2. Furrow irrigation at 15-days frequency was adopted based on the crop water requirement, moisture content and water-holding capacity of soil. The results between treatments showed high variation in leaf length index followed by stem length, with minor variation in number of

leaves and negligible variation in cane girth. This indicates the feasibility of using treated SE in aquaculture and in agriculture, leading to fertiliser savings of up to 37.6 per cent of nitrogen, 100 per cent of potassium and 1.2 per cent of phosphorous.

Vuyyuru site

During the year, treatment efficiency was found to have improved through reduced chemical oxygen demand (COD) with adapted bacterial and algal consortium. COD decreased from 52000 mg/L to 9425 mg/L, pH increased from 6.7 to 7.4. The electrical conductivity (EC) level decreased from 18.6 to 17.2 mS/cm while salinity was 9.1 ppt. The bio-treated distillery effluent (T1), anaerobic-treated distillery effluent (T2) and fresh water (T3) as control were studied by irrigating sweet corn F1 Hybrid Sweet Gold 95, a variety grown largely by farmers of Seemandhra. The experiment was carried out in randomised block design with 7 replicates in each of the 3 treatments in a total area of 262.5 m^2. Data analysis indicated that the cob length, cob width, 100 kernel weight, dry shoot and root weights were 14.4, 2.3, 10.1, 16 and 19 per cent, respectively, which was higher than T2.

The saline content of the bio-treated distillery effluent was 9.1 ppt, which is higher than the irrigation standards. Hence halophytes *Sesuvium portulacastrum* and *Suaeda maritima* were grown using the bio-treated and anaerobic effluent, with 8 replicates in a total area of 50 m^2 per sp, mainly to observe the growth and survival of these species. The results indicated that these species survive and grow luxuriantly in bio-treated effluent. Soil samples from the root zones of these halophytes indicated a complete reduction of pathogenic microbial population which makes them potential candidates for reducing pathogens in effluent-irrigated soils.

Decolorisation and phenol degradation: The efficiency of 4 bacterial isolates — *Terribacillus* sp. MSSRFH36, *E. indicum* MSSRFH1.1, *B. enclensis* MSSRFW 20, and *P. putida* MSSRF — showed 32 per cent of colour removal. Around 58 per cent of colour was removed due to the cumulative treatment effect of adapted bacteria and algal consortium followed by activated charcoal. A study on the determination of polyphenol in anaerobic-treated distillery effluent and biodegradation of phenol using bacterial isolates was taken up. Acclimatised rhizosphere soil microbial consortia of *Canna indica* showed 100 per cent degradation of phenol at 1000 µg/ml in 120 h due to the conversion of phenol into catechol by *Phenol hydroxylase*.

Programme Area 400

ECOTECHNOLOGY

The Biovillage framework of a job-led growth strategy was operationalised through the grass-roots institutions, Farmer Producer Companies and Women Federations in the respective sites. The various activities in natural resources management were continued with support from CSR (Corporate Social Responsibility) linkages complementing the on-farm activities, which were scaled up; productivity doubled in pulses, groundnut, onion and vegetables in about 6000 acres. Through participatory farmer-led varietal selection trials, 90 per cent seed and variety replacement was achieved in pulses and groundnut. Off-farm interventions like integrated dairy farming, tamarind processing and bio inputs production were able to provide enhanced supplementary incomes for more than 1000 resource-poor households. Non-farm activities have been a major challenge and the Kalamkari merchandise products were able to diversify and sell in new markets.

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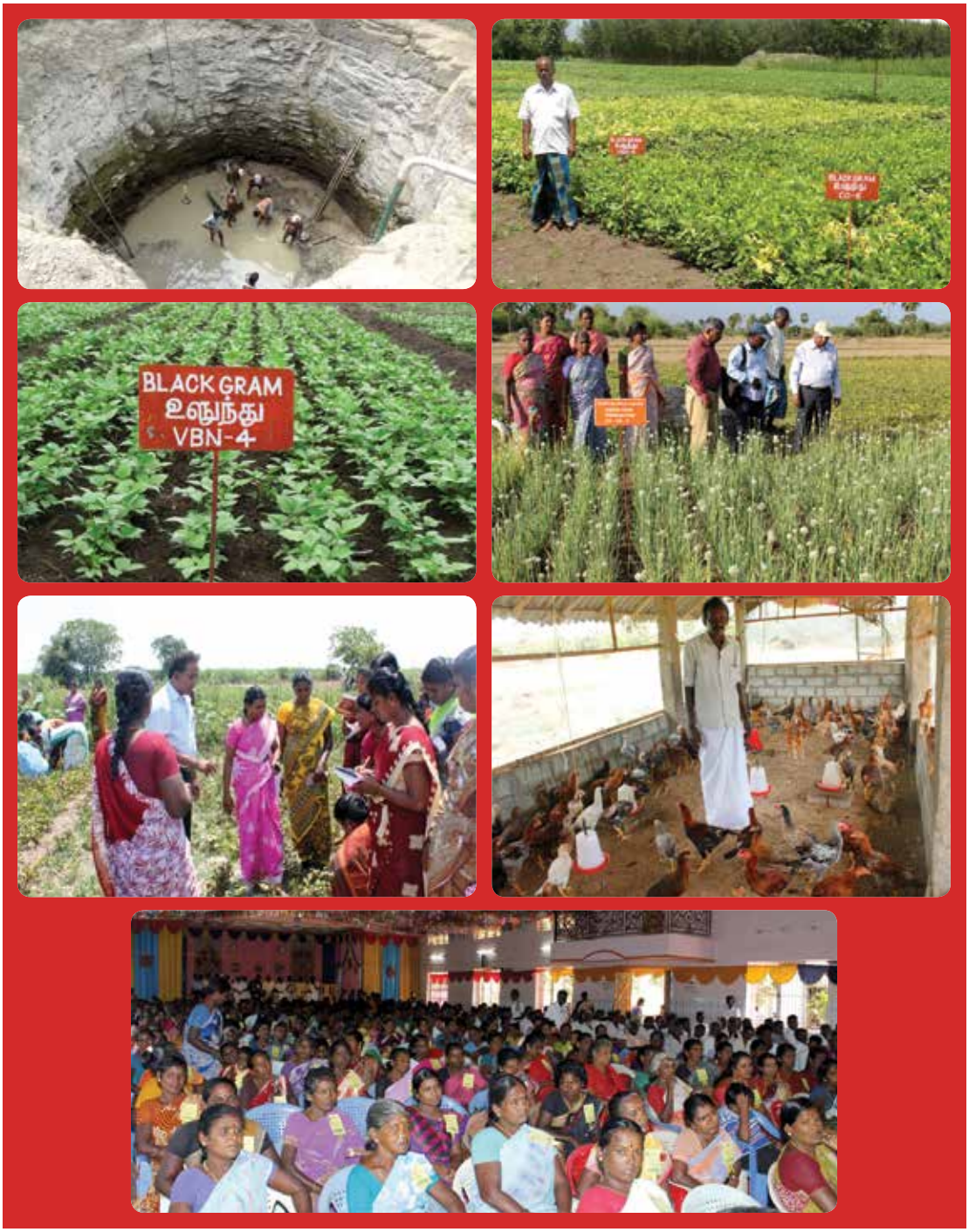

Reinforcing natural resources and capacities for rural prosperity

Programme Area 400

Ecotechnology

The Ecotechnology programme based on the biovillage framework progressed through focused interventions in natural resources management (NRM) in various agro-ecological regions. The major highlight of the NRM-based programme was increase in both surface water and groundwater storage and recharge, resulting in reclamation of more than 100 acres of fallow land brought about by leveraging about Rs. 100,00,000 from various stakeholders. The on-farm integrated crop management activities continued with respect to major crops such as pulses, millets, oilseeds, vegetables and rice through the respective Farmer Producer Organisations (FPOs). Two Farmer Producer Organisations in Villupuram and Pudukottai districts of Tamil Nadu were registered as a Farmer Producer Company and obtained licences for seed production and fertiliser trading. The various varietal selection trials (38 trials) reported last year continued to reconfirm the results; new pulse varieties were tested. The cropping area of pulses and oilseeds increased to more than 6000 acres and productivity doubled in all the project sites, as per the value chain study. Off-farm activities like poultry rearing, integrated dairy farming and value addition of tamarind were scaled up, covering more than 1000 households, which helped landless agricultural labourers as well as small and marginal farmers increase their supplementary incomes. The non-farm activities like production of Kalamkari cloth merchandise were diversified and marketed in major cities and educational institutions, fetching an annual turnover of Rs. 3 lakh.

In Puducherry, biovillage activities were mainly concentrated in Vinayagampet village and focused on capacity building of the local partner institution — Innuyir Grama Sangam. The 2 grass-roots institutions in the Kannivadi site were strengthened towards self-autonomy. In addition, knowledge management using modern ICT tools to enable farmer-to-farmer learning was facilitated, and infrastructure and local capacity built to continuously use it.

Sub Programme Area 401

Coastal Regions

401.1 Puducherry

The biovillage programme being implemented in Puducherry continued in 52 villages, with the Biovillage Resource Centre (BVRC) as the hub for the production and distribution of propagation materials (forage grass setts, seedlings of flowers and vegetables, mushroom spawn, etc.), biological inputs such as earthworms for vermi-culture, *panchagavya*, *amirtha karaisal*, and biofertilisers like *Azosprillum*, *Rhizobium*, etc.

Biovillage pilot programme

The biovillage model in Vinayagampet village in the Mannadipet commune continued to be strengthened. The village received an award from the alumni network of Pondicherry University and Pondicherry Engineering

College for being the ‘’Best Child Friendly Village in Puducherry”.

The focus on on-farm livelihoods has been to improve access to sustainable production technologies and institutional linkages. Paddy is continuously cultivated in all 3 seasons with indiscriminate use of water and chemical fertilisers, which affects the local agro-ecosystem. To start with, change in the cropping systems with low-water-requiring crops like millets, vegetables and pulses, instead of mono-cropping of paddy, was introduced. During the reporting year, 32 farmers (M: 15; F: 17) cultivated vegetables, 15 farmers (M: 12; F: 3) grew millet in 16 acres and 62 farmers (M: 47; F: 15) cultivated pulses in 100 acres, by replacing one paddy crop. To improve soil health, 30 men farmers used 25 per cent higher organic manure compared to their earlier practice, 75 farmers (M: 54;F: 21) adopted biofertiliser application, and 80 farmers (M: 57; F: 23) followed integrated nutrient management with a mix of both organic and inorganic manures based on soil testing. A total of 100 farmers (M: 63; F: 37) followed good agriculture practices (GAP) such as improving organic carbon in the soil by the use of balanced organic and inorganic nutrients, crop rotation, composting and enriched farmyard manure, optimum use of natural resources and chemicals through adopting integrated water, insect and disease management, clean post-harvest operations like threshing and storage, and so on.

Under non-farm and off-farm livelihoods, 228 households were supported to improve breed quality of livestock through artificial insemination and improve animal health through de-worming and protective practices. Low-cost cattle feed using locally available grains and products were introduced and 90 households are regularly preparing and using these; feed costs have been reduced by Rs. 10 per day and milk production improved. Other enterprise activities promoted were flower and fodder cultivation (10 households), backyard poultry keeping (46 women), goat rearing (12 women), mushroom cultivation (3 women), vermi-composting (24 farmers) and tailoring (4 women). Hands-on training was given to 5 women on paper bag production, 5 women on stitching cotton bags and 13 women on mushroom cultivation.

Approval from the District Rural Development Agency (DRDA) was received for Rs. 2.5 lakh to deepen and de-silt a village pond with an area of 4000 m^2 in order to improve water storage. Rainwater harvesting was promoted at 5 households to reduce the runoff as well as recharge the underground water; 500 trees were planted in the village common land and management guidelines were developed for post-plant care.

Health camps, including dental camps, were conducted to create awareness and understand the health issues of the village people, including children; the common problem among women is anaemia.

The nutritional garden approach was promoted through training and 150 households adopted the concept with species like greens, papaya, bananas, etc. Only 32 out of the 406 households

have toilets, and a plan to build 100 toilets has been submitted to DRDA. In addition, to recycle the crop, animal and kitchen waste, 10 vermi-compost units and 1 biogas unit have been set up. Plant and veterinary clinics are regularly held once a week and 428 men and 72 women farmers have participated so far.

The Vinayagampet Biovillage Development Council (VBVDC) is functioning independently on planning and delivering developmental programmes in the village, and monitoring their progress. During the year, 10 monthly meetings were organised to discuss the biovillage development plan and its implementation. Initially the participation of women and Dalit members were very limited; however, through conscious efforts and facilitation their participation in planning and monitoring has been ensured. Also, 20 joint liability groups have been formed to support mutual learning of technologies and to access credit from Banks.

The Village Knowledge Centre (VKC) disseminated technical and financial information through SMS/voice messages and bulletin boards. Tele-medicine services with Apollo Hospitals have been facilitated through the VKC. Women farmers and smallholders also access farm implements through the VKC.

The social capital credit system (SoCCS) introduced by Asia Initiatives allows people in rural areas to earn credit points for every good deed (pre-defined activities) performed, which can be used as virtual currency to be redeemed for needed products/services. Last year, 1356 users redeemed the points for books, stationery items, mobile recharges, medicines, seeds, etc. The biovillage concept has been extended to Sorapet, Pillayarkuppam and Ramanathapuram villages in Mannadipet commune with the support of NABARD's Micro Enterprises Development Programme and Village Development Programme.

Innuyir Grama Sangam

The Innuyir Grama Sangam (IGS) Women's Federation, registered in 2005, has currently 2828 members in 264 SHGs. Eight cluster development associations (CDAs) were formed and linked to the Federation through their representatives. Executive members meet once a month to discuss issues related to access to credit and livelihood actions and to review the financial position and performance of the staff. The total savings of the members were Rs 87 lakh and the cumulative saving Rs 1.8 crore. During this year, credit mobilised from Banks for 31 groups was Rs 60.16 lakh and through community banking, credit support was given to 145 groups to the tune of Rs 37.85 lakh. In all, 2348 members were linked to the social security scheme *Jana Bhima Yojana* and insured for an amount of Rs 5.8 crore.

IGS Federation has facilitated the formation of 30 activity groups with 362 members, in which 18 groups with 225 members are from the Mannadipet commune. The focus has been on providing training on technical aspects to enhance production and productivity and enabling linkages with relevant institutions to leverage various services like financial, insurance, technical and

marketing. Operational guidelines and detailed processes were discussed and developed to promote the activity groups in livelihoods. As a first step, the dairy livelihood group was started in July 2014 at Koonimudaku hamlet on a pilot basis with 7 members initially; slowly the membership has increased to 23 during the last eight months. The total number of milch animals is about 32. Initially, 81 lt of milk were collected per day and at the end of eight months it has increased to 132 lt per day. Due to this collective action, members have increased their profit to an extent of Rs 634 per month. Similarly, 7 members together initiated a low-cost cattle feed production unit, starting with 1 t per month, which has reached an average of 5 t per month; milk production has increased from 3 to 5 lt per day and quality has gone up too, with fat content from 4.0 to 4.3 and SNF from 7.5 to 8.0. Cost of milk production has reduced by 26 per cent.

Sustainable farming systems

In *kharif* 2014, farmer-led pulse varietal trials were conducted at Vinayagampet village with 6 varieties each in black gram and green gram. Among black gram varieties, VBN-4, VBN-6 and ADT-5 showed better yield and were moderately resistant to pest and disease. As a result, 80 farmers in 3 villages cultivated black gram variety (VBN-4) on 73.25 acres during the *rabi* season. Among green gram varieties, KM-2, CO-6 and VRM-1 showed better yield and were moderately resistant to pest and disease. Fifty-eight farmers adopted seed treatment with *T. Viride*, 91 farmers followed reduced seed rate of 8 kg/acre, and 40 farmers applied fertiliser based on soil test results. Fifty-three farmers used micronutrient mixture as basal application. Ninety-one farmers applied DAP 2 per cent foliar spray during flowering stage and at 15-day intervals. As a result, the average yield obtained was 550kg/acre during *rabi*. A total of 117 farmers cultivated moth bean (*Vigna aconitifolia*) on 123.5 acres.

In the participatory paddy varietal trial, the effective usage of nitrogenous fertiliser in the form of urea super granule (USG) was demonstrated at Pilliyarkuppam village with the participation of 27 farmers. USG trials were also conducted in Vinayagampet village during *kharif* 2014 with 6 varieties of paddy (ADT-39, ADT-49, ADT-50, CO-50, TMO-7275 and TMO-7278). Overall, paddy varieties treated with USG performed better compared with non-USG treated varieties. Among USG treated varieties, ADT-50 (2.6 t/acre) and CO-50 (2.5 t/acre) showed better yield performance.

Adopting the System of Rice Intensification (SRI) method, TM0-5091 paddy variety was transplanted in two plots — one where USG was used and another as control. The USG-treated paddy field resulted in a yield of 2.2 t/acre compared with 1.9 t/acre in the control field.

Grass-roots institutions

During the reporting period the executive members of Pasumai Agriculture Producer Organisation (PAFPO), Puducherry, interacted with Nallavur Agriculture Farmer Producer

Company Limited (NAFPCL), Villupuram, on functioning and strengthening of farmer producer organisations; they also participated in the NAFPCL general body meeting.

401.2 Villupuram

Land and water management

Through the Corporate Social Responsibility (CSR) support of Hindustan Petroleum Corporation Ltd (HPCL), Mumbai, 13 agriculture open wells in 4 villages were renovated, benefitting 31 families. A total of 4, 75,253 cubic feet was deepened in the 13 wells resulting in increase of irrigated area from 15.5 to 35.75 acres.

As part of integrated nutrient management, 216 soil samples were collected and analysed for the presence of macro- and micro-nutrients. Based on the analyses, a crop-based fertiliser recommendation calendar was prepared and soil health cards were distributed to 216 members.

Twenty SRI kits worth of Rs.40,000 were leveraged from the Department of Agriculture. Seven farmers received Rs. 3,02,400 for drip irrigation package; 2 farmers received Rs. 26,000 for sprinkler irrigation; 8 farmers received red gram seeds (*Durga* variety) worth Rs.800, while 71 farmers obtained black gram seeds worth Rs.17,040 and 27 farmers received groundnut seeds worth Rs.16,200. Thirty-two farmers received *ragi* seeds worth Rs. 3,200 while two more farmers received groundnut seeds worth Rs.3,600. Three farmers were given weedicide and pesticide kits worth Rs.1,800.

Twenty farmers participated in a two-day training programme on oilseed crops at the Oilseed Research Station, Tindivanam. Four farmers attended pisciculture training at Villupuram.

Sustainable farming systems

Farmer-led pulse and groundnut varietal trials were conducted both during *kharif* and *rabi* in 2013-2014 in the Mailam block. Four trials were carried out in two locations — Thazuthali and Nallamur villages — with 7 varieties in black gram and 6 varieties in green gram. Among black gram varieties Vamban-4, Vamban-6, and Vamban-7 showed better yield and were moderately resistant to pest and disease. **Table 4.1** gives details.

Among green gram varieties, CO-6, C0-7 and VBN-3 showed better yield and moderate resistance to pest and disease in Thazuthali village, whereas VRM-1, CO-7 and CO-6 varieties performed better in Nallamur village.

Of the 8 groundnut varieties used in varietal trials at Thazuthali village, VRI-2, ICGV-91114 and TMV-13 showed better yield and were moderately resistant to pest and disease. In both the *kharif* and *rabi* seasons, 2 pulse varietal trials, 2 groundnut varietal trials and 2 demonstrations in black gram variety Vamban-4 were conducted at Thazuthali and Nallamur villages, for which data compilation is under progress. A total of 292 farmers from Thazuthali, Kanniyam, Chinnanergunam and Kezhedayalam villages participated in the Farmers' Field Day organised at Nallamur village **Table No. 4.2.**

Table 4.1 ***Black gram participatory varietal trial, Thazhuthali village***

Parameter	VBN 9	VBN 7	VBN 4	VBN 6	CO-6	ADT 5	NUL 7
50% flowering	35.00	35.00	37.00	35.00	35.00	33.00	34.00
No. pods / plant	33.00	52.00	51.00	35.00	23.00	35.00	20.00
No. of seeds / pod	7.80	6.90	8.00	6.60	6.90	6.50	7.20
100 seeds weight (g)	4.90	3.80	4.70	3.90	5.40	4.10	4.40
Yellow Mosaic virus (%)	.0	.0	0.18	.0	2.26	3.82	3.15
Cercospora leaf spot (%)	2.61	2.43	1.82	1.10	8.21	4.34	5.08
Pod borer (%)	1.30	0.80	0.40	1.00	6.20	5.30	3.80
Powdery mildew (%)	1.28	1.18	1.90	0.52	3.45	2.34	3.92
Plot straw yield (kg)	7.80	8.20	10.30	7.10	8.90	7.60	7.90
Grain yield (kg/acre)	422.00	468.00	575.00	524.00	381.00	417.00	435.00

Table 4.2 ***Best varieties of black gram and groundnut***

Crop	Best varieties (area scaled-up)	Total acres
Black gram	Kharif – VBN 4,6,&7 (325 acres)	739
	Rabi – VBN-4, 6 & 7 (414 acres)	
Groundnut	Kharif – VRI-2, ICGV 91114, TMV-13 (203 acres)	596
	Rabi – VRI-2 (393 acres)	
Total		**1335**

NAFPCL decided to produce quality seeds of black gram (VBN-4) and onion Co (On)-5, which were identified as the best performing varieties. Thirty-six farmers in Mailam block produced black gram seed variety Vamban-4 during the *kharif* season on 36 acres with foundation seeds sourced from the Agriculture Department. As a result, 3700 kg of seeds at Rs.70/kg could be procured from the farmers through NAFPCL. During *rabi*, seeds were sold to NAFPCL farmers at Rs.90/kg resulting in a net profit of Rs.53,640. Fifty-three farmers enrolled for production of Vamban-4 black gram seed in 53 acres during *rabi* 2014. NAFPCL has procured 5 t of black gram seeds from farmers and is planning to sell them through the agriculture input service centre.

During both *kharif* and *rabi* 2014, NAFPCL provided inputs for 561 farmers to cultivate groundnut over 596 acres. In this group, 502 farmers followed seed treatment with *T.Viride*; 422 farmers adopted line sowing method; 457 farmers sowed VRI-2 and VRI-3 varieties; 293 farmers applied micronutrient as basal application while 128 farmers applied micronutrient as a combination application; 324 farmers undertook DAP foliar spray; and 68 farmers sprayed micro food as foliar application. Including integrated pest management practices, 69 farmers cultivated

castor, 223 farmers cultivated cowpea and 27 farmers went in for sunflower as trap crops. Average yield of groundnut in the *kharif* season was 660 kg per acre and in *rabi* 1376 kg per acre.

Four trainings on ICM were organised for onion cultivators on the improved Co (On)-5 varieties in Nallamur and Thazhuthali villages. Co (On)-5 variety is resistant to pest and disease, has good shelf life, and is suitable for export. During *kharif* 2014, 129.5 acres were brought under Co (On)-5 by 154 farmers covering 8 villages through NAFPCL support. About 131 farmers continued to cultivate the improved *Muttlur* variety (Co (On)-5, adopting the ridges-and-furrow method of cultivation with integrated pest and disease management practices. The average yield was 4480 kg/acre i.e., 56 bags of 80 kg/bag. Training on ICM covered 1280 trainee days in both seasons.

Technology and knowledge dissemination

A total of 419 farmers regularly received agro-advisories on climate-smart agricultural practices and various government schemes. Five phone-in programmes on animal husbandry, horticulture and SRI paddy were conducted, with 73 farmers participating. Plant clinics for 210 farmers and 3 tele-medicine programmes for 97 farmers were conducted..

Sustainable livelihoods

The Poondhazhir tailoring group continued to expand their production and marketing of Kalamkari cloth bags and earned a gross income of Rs.3,02,312 in 2014-2015.

Through the SoCCS programme of Asia Initiatives, 50 milch animals (worth Rs.10 lakh) were distributed.

Grass-roots institutions

Nallavur Farmers' Producer Organisation (NAFPCL) has been successfully functioning with 853 shareholders (M: 160; F: 692) from 49 groups in 8 villages in the Mailam region. In the reporting period, 21 new farmers' producer groups consisting of 257 members were formed in 6 villages. To enhance their skills and to play effective roles in the producer organisation, exposure trips were arranged to other producer organisations to learn and adopt management methods. The total turnover of NAFPCL during April 2014-March 2015 was Rs.84 lakh and the accounts were audited. NAFPCL provided critical inputs worth about Rs.12 lakh for 569 acres of black gram and groundnut cultivation. Training on the importance of updating books of accounts was provided to 76 representatives from 29 farmers' producer groups. Annual general body meeting of NAFPCL was organised at Kooteripattu village in which 1757 farmers participated along with various stakeholders.

Sub Programme Area 402

Semi-Arid Regions

402.1 Kannivadi

Kulumai SHG Federation

During this year, 330 farmers joined the Federation and the current strength has increased to 2950 members belonging to

200 SHGs (of which 72 per cent are landless agricultural labourers). The leaders of the 5 clusters formed last year have been nurtured to take up second-line leadership in the organisation. At district level the Federation is recognised and supported with projects by NABARD and other service Banks, line departments and DRDA.

From September 2014 onwards, Kulumai Federation has been recognised by NABARD Financial Services Ltd (NABFINS), Dindigul as their business partner. Fifty-five SHGs (715 members) received credit linkage to the tune of Rs. 1.78 crore for small-scale dairy farming and goat rearing, agriculture, education, country chick rearing, house repairing and for closing external loans charging high interest rates. In addition, 10 groups were linked with the Bank for Rs. 20.5 lakh under direct linkage. The community banking of the Federation extended credit support to 55 groups for an amount of Rs. 36.45 lakh and 15 members availed credit of Rs 2.8 lakh for enterprise development. Under the social security programme, 123 new members were included in *Janashree Bhima Yojana* this year, with the total number of members going up to 1578. The scheme extended scholarship support to 238 students to the tune of Rs.1200/year/student. Paying a premium of Rs.200/year/individual, 87 members who are above 60 years of age have been enrolled in Kulumai Insurance which provides a settlement of Rs.10000 on the death of the insured member. With the support of NABARD (Rs.1.16 lakh), a financial literacy programme was conducted for 750 members. NABFINS also sanctioned Rs.3.35 lakh to Kulumai Federation for promoting and nurturing 50 new sustainable SHGs in the region for the period from 2014 to 2016.

The annual turnover of Kulumai Rural Livelihood Foundation (KRLF) for 2014-15 was Rs 13.8 lakh. It organised 800 trainee days on business planning for various enterprises. Training on the scientific way of bio-input application was conducted for 700 farmers, of which 38 per cent are women. These trained farmers served as trainers to 3000 other farmers (30 per cent women) who applied bio-inputs produced by groups promoted by KRLF during this year. Sixty women members in 5 villages produced 20 t of bio-inputs (talc and liquid formulations) worth Rs. 8.08 lakh, mainly for marginal and small farmers. About 450 members who are engaged in small-scale dairy farming were organised into 20 milk producer groups and federated into an apex body. Collective action has been promoted in marketing with a private agency — ABT Foods. A model centre managed by women members was established at Alathuranpatty in November 2014, and on an average, the centre markets 150 lt of milk per day.

During the year, 300 women members continued backyard nutrition gardens with 11 different varieties of vegetables, including two leafy green vegetables. Financial assistance for Rs.4.2 lakh was extended to 28 members by Kulumai for construction of low-cost toilets and an amount of Rs.3.36 lakh facilitated as subsidy from DRDA.

Reddiyarchatram Sustainable Agriculture Producers' Company Limited

Reddiyarchatram Sustainable Agriculture Producers' Company Limited (RSAPCOL) has 992 shareholders (66 per cent are men and 34 per cent are women). During this year, RSAPCOL made a total input trade worth Rs.22.57 lakh towards the sale of hybrid seeds and other agriculture inputs like bio-fertilisers and herbicides. Under financial services**,** 188 (M: 19; F: 169) farmers were linked to Banks for dairy loans of Rs.46.05 lakh. The company facilitated access to government entitlement schemes for high value agriculture to 54 farmers (M: 28; F: 26) under the National Horticulture Mission to the tune of Rs.8.5 lakh. Fourteen training programmes on improved technologies were conducted, in which 505 (M: 305; F: 200) farmers participated. The local monthly newsletter *Seithisolai* continues to be published regularly. Five courses based on Open Distance Learning (ODL) principles focusing on need-based contents were conducted on different topics like soil health management, cultivation of horticulture crops, agro-based weather forecasts and advisories, and modern agriculture technologies; 1392 farmers (M: 426; F: 966) were enrolled in these courses. About 151 video clips on modern agriculture practices and experiences of farmers were captured and uploaded in YouTube. Around 161 postings on success stories of farmers were uploaded in Facebook and mutually shared by 8491 friends.

RSAPCOL's website www.l3ftn.com continues to provide information on daily vegetable and flower prices from Oddanchathram vegetable market, Dindigul, as well as weekly weather forecasts; a package of practices for 46 crops is hosted and updated regularly on the website. A 'B' type weather station in Kannivadi records the daily weather parameters and acts as a nodal centre to receive medium range weather and seasonal rain forecasts from India Meteorological Department (IMD).

With the technical support of Bayer International, a model cold storage facility was established to store and sell vegetables based on market prices.

Community informatics

There are 9 VKCs functioning in the Kannivadi region. During the reporting period, 3 men and 72 women became functional literates. Five training programmes on soil health management were conducted, 200 soil samples were collected and tested; soil health cards were distributed to the farmers with the support of the Soil Test Laboratory, Dindigul. A total of 196 farmers (M: 53; F: 143) from 8 villages were linked with 9 schemes worth Rs.10.68 lakh. Total number of users was 13112 members (52 per cent are women) and they accessed VKCs predominantly for agriculture, market status and weather forecasts.

Awareness on setting up home nutrition gardens was continued through VKCs in 8 villages in the region and 451 families (SC-201 and BC-250) established backyard nutrition gardens. Simultaneously, 6 nutritional gardens were promoted in schools and village

common lands as community-managed nutritional gardens, and students were taught about the importance of fresh vegetable consumption and the value of nutritional food. With the support of the Primary Health Centre, Kannivadi, and the village nurses, 16 awareness programmes have been conducted for adolescent girls in 7 villages. Gender sensitisation training was organised for the VKC staff to enhance their capacity.

402.2 Pudukottai

After consecutive drought for 3 years, rainfall improved, with about 626.8 mm out of the average 690 mm received during the reporting period. The project interventions reached 956 households (40 per cent) out of a total of 2,713 families. The current period saw the merging of 2 grass-roots institutions and the registration of the producer company, Illuppur Agriculture Producer Company Limited (IAPCL), through which all project activities are being implemented.

Land and water management

A total of 205 soil samples from pulses and groundnut fields were collected during the *kharif* season and tested at the Agricultural Research Station at Kudimiyanmalai. Similarly, 145 samples from pulses and groundnut fields were collected during *rabi* and tested. Organic carbon, micronutrients and acidity deficiency were found as major problems. The CSR support from Hindustan Petroleum Corporation enabled renovation of 16 individual open wells, with deepening of 65,941 ft^3. This intervention, amounting to Rs.12 lakh, provided assured irrigation for 54.2 acres. A noteworthy achievement was the conversion of 29 acres of fallow land into productive use. Through the SoCCS programme of Asia Initiatives, 9 open wells (Rs. 6 lakh) were rejuvenated.

Sustainable farming systems

Twelve farmer participatory varietal selection trials were conducted as detailed in **Table 4.3.**

Seed production activity of black gram covering 26 acres and groundnut on 6.5 acres laid the platform to establish a strong seed enterprise and ensure availability of good quality seeds for the farmer members. IAPCL received the seed trader license, enabling the seed enterprise to be vibrant. It

Table 4.3 ***Varietal selection trials***

Crop	Varieties tested	Varieties selected
Black gram	VBN-4,6,7,9,10, CO-6, ADT-5	VBN-4,6 ADT-5,
Green gram	VBN-3,VRM-1, KM-2, BGS-9,KPS-1,KPS-2,ML-618, ML-1168,NM-94	VBN-3, VRM-1, ML618
Red gram	VBN-2, LAKSHMI, KAMICA, ICPL-89039, ICPH-2740, MARUTI.	KAMICA, VBN-2, ICPH-2740
Groundnut	TMV-13, TMV-7, VRI-2, ANANDHA, KADIRI-9, K.HARITANDRA, LOCAKODI, ICGV 02266 & LOCAL.	LOCAL KODI, VRI-2, ANANDHA

is planned to procure and redistribute 2800 kg of pulses (black gram and green gram) and 160 qtl of groundnut seeds at the end of the season. IAPCL established support for pulses-cultivating farmers through providing crop loans amounting to Rs.7.83 lakh. Similarly, a sum of Rs.4.84 lakh was provided for groundnut cultivation. A small farmer-friendly manual seed drill was introduced during the year.

Production was taken up in 397.5 acres for black gram, 39.5 acres for green gram and 305.75 acres for groundnut cultivation. The yield of black gram was increased by 24 per cent and groundnut by 19 per cent through the adaptation of improved practices.

Livelihoods

The Board of Directors of IAPCL decided to have a single brand name called *Pattikaadu* for all the enterprises and finished products under the company.

Under the *Pattikaadu* label, 5.6 t of paddy seeds, 970 kg of black gram and 400 kg of groundnut seeds were successfully sold. It is planned to procure and market 2800 kg of pulses (black gram and green gram) and 1600 kg of groundnut. Similarly, *Pattikaadu Dal* was processed (680 kg of black gram and 3750 kg of red gram) and sold at a premium price in the market.

IAPCL, with the technical support of Sustainable Agriculture Alliance, has enrolled 40 farmers in the production of *Pattikaadu* organic vegetables. Every day about 100 kg of organic vegetables are being sold to urban buyers in Chennai and Coimbatore.

The *Pattikaadu* dairy enterprise has seen an increase in the membership of milk producers from 162 to 327; milk collection centres increased from 6 to 11, with the selling of milk to Apoorva Agro Foods Pvt. Limited, a private milk vendor. IAPCL is helping its members to become entrepreneurs by establishing integrated home dairies and has organised loans amounting to Rs. 21 lakh to purchase 73 cows. Through the SoCCS programme, 30 milch animals were purchased for Rs.9 lakh. A turnover of Rs. 28.11 lakh was achieved by aggregation of 1.19 lakh lt of milk, in which the net profit was Rs. 1.07 lakh. To assess the quality of milk, IAPCL has installed an Eco milk analyser machine costing about Rs.90,000. The milk producers have gained Rs. 4.5 lakh as additional benefit. IAPCL has also distributed 18,000 Co-4 fodder grass cuttings and conducted animal health care camps with the support of the Department of Veterinary Sciences.

Grass-roots institutions

IAPCL was launched in July 2014 and received the incorporation certificate from the Ministry of Corporate Affairs in January 2015. Totally, 956 (707 women and 249 men) shareholders with the share value of Rs.1000/share are enrolled with IAPCL and are organised into 67 farmer producer groups. During the financial year 2014-15, IAPCL provided Rs.47 lakh credit facility, made Rs.34.99 lakh of sales turnover and gained Rs.1.5 lakh net profit from its business activities. IAPCL has purchased 4.38

acres of land to establish a resource centre for rain-fed agriculture systems and has also placed various structures in place to support the shareholders and the farmers.

IAPCL has networked with the Small Farmers Agribusiness Corporation (SFAC) through the Department of Agribusiness and has become the affiliated producer company for SFAC and district government agencies for three years.

Sub Programme Area 403

Hill Regions

403.1 Koraput District

Integrated farming systems

The project on the integrated farming system (IFS) model for income enhancement of small and marginal farmers is currently being implemented in 6 villages in the Boipariguda and Kundra blocks of Koraput district. Tribal farmers usually adopt mono-cropping which is subject to a high degree of uncertainty in production, resulting in poor profit. Three IFS models were experimented with in an area of 0.3 acre, out of which 0.2 acre was occupied by ponds. In the case of rice + fish cultivation, fish had to be harvested early because of water scarcity, leading to low yield. Model I involving fish, duck, vegetables and horticultural crops was found to be better than the other 2 models, in terms of total profit. This model was accepted in 3 clusters in 3 villages.

In Kundra village, the number of people engaged in vegetable cultivation increased in 6 villages (326 households covering an area of more than 100 acres) by the renovation of ponds, adoption of soil and water conservation methods, supply of seeds and training to the communities.

Fish farming

The baseline survey indicated that there were 23 individual ponds and 3 panchayat ponds which were not being properly used in the Kundra and Boipariguda blocks. These were renovated and training was given on fish culture including fish feeding, netting and monitoring monthly growth. In all, 8000

Table 4.4 ***Cost benefit ratio of fish farming***

Village	Total pond area in acre	Yield of fish (in kg)	Expenditure including fingerlings (in Rs)	Income per acre per village (in Rs)	Income per village (in Rs)
Pradhaniguda	0.442	241	4365.00	55550	24555
Nuaguda	0.342	271	3238.00	79772	27282
Kumbharaguda	0.410	135	2619.00	33124	13581
Gunthaguda	0.280	78	1746.00	27193	7614
Jholaguda	0.114	98	2619.00	80184	9141
Sanatoliaguda	0.114	72	1746.00	60474	6894
Banuaguda	0.619	335	5238.00	56481	34962

fingerlings were released in all the 26 ponds. Fish growth was found to be satisfactory as assessed by sample netting. Harvest details are presented in **Table 4.4**.

Solar lights

Solar light systems were maintained in 40 villages of Boipariguda, Jeypore and Kundra blocks. Two-hundred old batteries, luminaries and battery boxes were replaced with new ones during the year. About 30 new solar street lights were installed in 9 newly identified villages. This initiative is being supported by Mitsubishi Corporation, Japan under their CSR programme.

Pulses and oil seeds

About 448 farmers were involved in pulses and oil seed cultivation such as black gram, green gram, red gram and groundnut, which covered about 565 acres.

Groundnut seed production

Trials were conducted in *kharif* with groundnut varieties *Kadri-6*, *Kadri-9* and *Narayani*. The average yield of groundnut was 560 kg / per acre. The seeds from the *kharif* harvest were used for sowing in the *rabi* season. Through integrated crop management practices, the yield of groundnut was 650 kg per acre with a net profit of Rs.13,000. The area under groundnut has increased from 54 acres in 2008 to 371 acres during the reporting period.

Grass-root institutions

Vikas Maha Sangh (VIMAS) has 65 farmer groups with 692 shareholders. Families could earn Rs.4,000 to Rs.5,000 per year per person from micro-enterprises. 19 farmers at Banuaguda village took up vegetable cultivation and, with local sales, raised the family income from Rs.15,000 to Rs.25,000/ month during the season.

Programme Area 500

FOOD SECURITY

Initiatives such as the Mahila Kisan Sashaktikaran Pariyojana (MKSP), Community Grain Banks and Community Hunger Fighters work towards enhancing household food security. Under MKSP, the formation of three block-level federations as registered autonomous bodies has been a significant development in Maharashtra, while constituting producer groups has been an important move in Odisha. Social mobilisation by the Community Hunger Fighters in Odisha resulted in village communities demanding and accessing a range of food security entitlements at the household and community levels as well as adoption of selected techniques for improving food production. The extent of foodgrain transactions from 17 Community Foodgrain Banks in 2014-15 reiterates their importance in alleviating seasonal hunger.

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Community involvement for ensuring household and nutrition security

Programme Area 500

Food Security

The Food Security programme area of MSSRF has been working with a mission to ensure the food and nutrition security of marginalised sections by promoting focused interventions in villages. The programme has continued to adopt and popularise a holistic concept of food security which takes into account the 3 basic dimensions, namely, availability, access and absorption of food. Notable interventions that have addressed food availability have been facilitation for cultivation of foodgrains and promotion of kitchen gardens. Initiatives that improved access to food included establishing community foodgrain banks and strengthening the agricultural livelihoods of farmers. Food absorption has been enhanced by the community hunger fighter approach where local volunteers are trained to create awareness on nutrition, health and hygiene among the people, as well as by helping the community in accessing government entitlements regarding non-food factors such as drinking water and sanitation. A significant accomplishment in the area of research during the year has been the compilation of a report for the UN World Food Programme that provides a macro perspective of the country's food security concerns.

Sub Programme Area 501

Community-based Interventions

501.1 Odisha

Community Hunger Fighters

Operation 2015 — an integrated approach to achieving UN Millennium Development Goal 1 (to eradicate extreme poverty and hunger) — referred to as the Community Hunger Fighters (CHF) programme, which was initiated in the Koraput district of Odisha in April 2012 came to an end in May 2015. The CHF project has been implemented in 6 revenue villages and 12 hamlets of the Kundra and Boipariguda blocks of Jeypore subdivision in the tribal-dominated Koraput district of Odisha. Other technical interventions and participatory research by MSSRF for improving agricultural productivity and conservation of biodiversity are also being implemented in these villages. The CHF intervention covered 1748 households, of which 44 per cent were Scheduled Tribes, 18 per cent were Scheduled Caste, 34 per cent belonged to Other Backward Communities and 4 per cent to Forward Communities.

Community empowerment through capacity building in food and nutrition literacy was the approach. Each village / hamlet selected 5 participants, consisting of men and women (at least 2), belonging to different castes. Starting with 3 residential modules on food and nutrition literacy, the participants were supported with further capacity building based on their demands, in the form of exposure visits

to community-managed initiatives for food and nutrition security or on specific aspects of food production. The pedagogical approach adopted in the capacity building was based on the principles of critical analysis, reflection and dialogue propounded by the educationist, Paulo Freire. The first residential training touched on nutrition security issues such as the concept of a balanced meal; understanding one's own food habits and nutritional status; locally available foods and the macro- and micro-nutrients they provide; nutritional deficiencies and how they affect human beings; safe drinking water and sanitation issues. Participants were encouraged through participatory techniques using role plays, games and activities to analyse their own social realities, their attitudes and value systems, their existing responses and the way they wanted to alter their situation.

The second module dealt with the critical life-cycle period from conception to three years, the various food and nutrition security entitlements and an analysis of class, caste and gender issues that affected the nutritional status of individuals and communities. Messages related to dietary diversity, cleanliness, sanitation, gender and caste equality, village unity and participation in village meetings, Gram Sabha and other village development activities were developed by participants and disseminated in their villages. They were provided with information, education and communication (IEC) materials in pictorial forms while entitlement cards summarising key programmes and schemes of the government were distributed to all households. In the third module, participants discussed the feedback from their families and community members on the content of the messages, and also set priorities and goals and identified ways and means of integrating nutritional concerns in agriculture.

Fourteen capacity building programmes were organised during the project period. Six of these were exposure visits. Two were on water and sanitation projects, 2 on maximising vegetable production, one on community-based planning and utilisation of MGNREGS along with goat rearing as a viable livelihood option for landless households and another on the use of drip irrigation. The rest were on various themes such as integrating nutrition concerns in agriculture, value addition and technologies for improving agricultural production. In addition, 3 interfaces with government functionaries were facilitated. CHFs along with other community members were helped in preparing village-wise action plans for achieving the zero hunger target and submitting them to the government.

The approach of critical reflection and analysis helped CHFs to identify the key factors responsible for their undernourished state: lack of demand of entitlements and collective action leading to less utilisation of several government schemes; more priority given to livelihood activities than on attention to eating a balanced diet; and neglect of environmental hygiene and appropriate sanitation practices. Hence they individually and collectively along with other villagers took steps to seek and avail of various entitlements (**Table 5.1**).

Table 5.1 ***Details of entitlements availed 2014-15***

Food security dimensions	Number and category of entitlements availed
Food availability	• Of the 28 farm ponds applied for, 15 have been sanctioned and 10 completed under MGNREGS
	• 11 pump sets purchased from Agriculture Department with subsidy
	• 30 borewells sanctioned and digging completed with 10 being made electrically operational through lift irrigation with assistance from Irrigation Department
	• 800 papaya and 200 lemon saplings obtained from Horticulture Department with subsidy. 65 households also mobilised vegetable seeds
	• 30 households got mango plantations in 40 acres of land under MGNREGS from Horticulture Department
Food access	• 6 anganwadi buildings were demanded of which 2 were sanctioned and construction completed. In 8 hamlets, CHFs assisted anganwadi worker to distribute Rashtriya Swasthya Bima Yojana cards
	• 115 Poor Left Out (PLO) cards issued in lieu of ration cards
Drinking water and sanitation	• 6 tubewells and 5 piped water supply projects completed under solar and Swajaldhara schemes
	• 395 individual toilets sanctioned and 185 completed
Others	• 15 houses constructed under Indira Awaas Yojana
	• 7 earthen roads and 4 concrete roads completed under MGNREGS

Evidences of ownership, informed participation and keen engagement, were observed. CHFs as well as other villagers made repeated visits to the Block Office to enquire about sanction of various projects. In Lachchanaguda hamlet, the villagers supervised the construction of the anganwadi at each stage and complained to the contractors if any deviations occurred or sub- standard materials were used. In Kharaguda, the anganwadi worker was irregular and growth monitoring was not done properly, since the weighing machine was not available. After repeated negotiation with the worker and representation to authorities, the services improved.

Five technical trainings were organised which dealt with themes such as integrating nutrition concerns in agriculture, agricultural planning in different types of land, production enhancement techniques for paddy and vegetables, non-pesticide management, post-harvest technology and seed treatment. About 38 per cent of CHFs participated in all these trainings and shared the information with other CHFs and their village communities. While all of them reported that the trainings were

useful, the adoption practices varied. While 65 per cent and 70 per cent, respectively, had practised non-pesticide management and seed treatment techniques, 45 per cent and 4 per cent could use the information on crop planning for different types of land and enhance production techniques for paddy, respectively. Only 18 per cent could utilise integrated farming systems for improving nutrition security. Challenges in attempting integration of nutrition with agriculture need to be explored in depth.

It was observed during the course of the programme that women lacked mobility and their activities were largely confined within the villages. Most of the women visited their natal families only occasionally. A survey conducted over the availability and use of mobile phones in the sites revealed that 696 mobile phones were in use, all owned by men. Women family members could use the phones only when the menfolk were at home. The idea of empowerment of women CHFs (and through them the other women in the intervention sites) through ownership and operation of cell phones was mooted so that they could communicate freely with whomsoever they wanted. After due consultation, it was decided to provide two mobile phones to each site, and two women CHFs along with two other women from SHGs were trained in the use of Karbonn mobile phones. Smart phones were chosen over the base model, since other facilities could be supported and more services such as phone-in programmes be provided in the future. The phones were kept in the custody of the SHGs for use by any woman in the village. SIM charges up to Rs 400 were paid every month for a period of one year and at the end of the period, the SHGs could either own the phones by depositing a sum of Rs 1500 for each phone in their SHG accounts or return them to MSSRF for use by other SHGs. Thirty-four SHGs from 17 project sites participated in the scheme. Each SHG evolved its own method of managing the operations and the calls were recorded in a register. An analysis of the register revealed that women had called up family members in other villages, their children studying in residential institutions, Bank managers for loans, government officials to enquire about entitlements and contractors for knowing about livelihood opportunities. So far 17 SHGs have paid the deposit and taken ownership of the phones.

An issue-based functional literacy programme was initiated on an experimental basis through the Village Knowledge Centre in Nuaguda hamlet, where only about 29 per cent of adults are literate. Some instances where non-literates face difficulties are while engaging in banking transactions, business transactions involving use of digital scales, mobile applications, and reading the resolutions passed in meetings. The preparatory phase consisted of enacting a role play on the theme of hunger and poverty, followed by discussion. The key words were identified and classified, and ten sets of literacy modules were prepared on different themes. The modules consisted of the words with corresponding pictures, followed by sentences. Individual letters of these words with the *matras* (vowel signs) were also shown. Auxiliary learning materials

were developed, such as cards of alphabets for constructing words and matras, cards of numbers, picture cards, word charts, two numerical charts (both in English and Odiya), the first one showing numbers 1 to 10 with pictures, the other from 1 to 100. Related posters were also prepared.

In the classroom, the participants were shown the pictures and then the corresponding words. Group activities and games were conducted to help them match the pictures with the words. The next step was to identify the words without the pictures and then understand the individual letters in these words. Participants were encouraged to form new words with the existing letters. They were then introduced to sentences based on these words. Twenty-three people, of whom 17 were women, enrolled in the programme. Some of the challenges faced were that the tribal language does not have a script and the Odiya script had to be used, classes had to be suspended during the agricultural season, and people found it difficult to attend classes when there were other meetings in the village. Many felt that they could manage very well without literacy; and hindsight suggests that the learning modules and classroom sessions should have been linked with real-life situations, such as actually weighing goods on an electronic scale, along with other activities. Implementation guidelines along with a kit of learning modules and materials have been prepared.

A tool kit for implementing the CHF project along with the residential training modules and materials has been prepared.

Mahila Kisan Sashaktikaran Pariyojana

Mahila Kisan Sashaktikaran Pariyojana (MKSP) was initiated in 2013 in the tribal-dominated region of Koraput district, with the objective of improving the socio-economic status of women farmers (*mahila kisan*s). It is currently being implemented in 45 villages, covering 2581 households. Of the total households covered, 76 per cent are ST and 17 per cent are SC. MKSP focuses on enhancing the skill and capacity of the mahila kisans. An important implementation strategy has been to identify community resource persons (CRPs) and educated youth (para professionals) from within the village who receive intensive training and who, in turn, train the other mahila kisans in their respective villages. In each of the 45 villages a woman farmer has been identified as a CRP. Sixty-three producer groups have been formed so far with each group comprising 30 to 50 members, and these have been federated into 4 cluster-level federations.

Capacity building programmes on various themes, spread over 446 training sessions and 49 exposure visits, were organised. Trainings covered sustainable agriculture practices such as soil health management, seed preservation, non-pesticide management practices, SRI (system of rice intensification) cultivation practices and post-harvest technologies; integrated and mixed farming in vegetable cultivation; establishment of the *annadata* model of kitchen gardens; oyster mushroom cultivation; nursery raising of teak plants; value addition of rice, millet and tamarind;

monitoring and evaluation systems; and preparation of visual IEC material.

Significant results include:

- 883 kitchen gardens were promoted by women farmers with technical support from MSSRF. Of these, 96 kitchen gardens follow the *annadata* model which prescribes a specific layout design that is conducive for plant growth along with an ideal combination of vegetable and fruit plants. Papaya, drumstick, ridge gourd, lady's finger, brinjal, chilli, beans, seasonal greens, gooseberry, pumpkin, etc., are commonly grown in the kitchen gardens.
- Large-scale vegetable cultivation was undertaken as a group activity on 87 acres by 4 producer groups, comprising 94 mahila kisans. They cultivated cauliflower, tomato, pumpkin, beans, peas, onion and water melon and organised collective marketing of the produce. A monitoring tool has been developed to collect crop-wise data on consumption and sales from each household to understand the utilisation pattern and the income from cultivation. It is estimated that a household on an average earns a net income of Rs. 17000/annum from half an acre of land.
- A total of 587 mahila kisans practised non-pesticide management in paddy (*kharif*) and vegetable fields (*rabi*). These practices reduced the input cost by Rs. 500/- per acre, on an average.
- *Trichoderma viride* biofungicide was applied on 45 acres of land.
- Line transplanting of paddy with recommended spacing was carried out by 683 women farmers over 570 acres, resulting in increasing the paddy yield by 1 to 2 qtl/acre.
- Fifty-five mahila kisans undertook SRI cultivation on 34 acres of land. The yield of 18 qtl/ acre was not up to expectation because of unfavourable climate, though input cost was less than usual.
- Five films on various non-pesticide management practices were produced by women farmers themselves with guidance from Digital Green, a NGO with whom MSSRF has entered into an agreement for training community members on film making.
- Twenty-five vegetable seed banks were established across 25 villages to address the problem of vegetable seed scarcity. Seeds of brinjal, chilli, papaya, onion, tomato, beans, pumpkin, lady's finger, ridge gourd, etc., are stored in these banks.
- A total of 43 community facility centres have been established across villages to provide farm implements on a nominal rent to farmers.
- After receiving intensive training, 376 women farmers have been cultivating oyster mushroom and on an average, each earned Rs. 2000 to Rs. 5000, in a cycle of 3 months during the winter season.
- Bank accounts have been opened in the nearest nationalised Bank for the 63 producer groups.

- 12 producer groups have been involved in value addition from tamarind, and the profit of Rs. 15,000/- to Rs. 20,000/- made during the year by each group was shared by the members.
- Fish farming has been promoted by 5 producer groups in leased ponds. After the harvest in Jan-Feb 2015, each group, on an average, marketed 4.6 qtl of catch and retained 3.2 qtl for consumption. The groups plan to use the sale proceeds to purchase fingerlings in the next season.
- Four producer groups have undertaken the preparation of value-added products from rice and millet. The products are sold in their own locality and at trade fairs organised by government departments and NGOs. Each group made a profit between Rs. 5000/- to Rs. 12000/- during the reporting period.
- Village-wise action plans were prepared for all the project villages and were submitted to the Gram Sabha and the concerned government departments for convergence with various schemes.
- Six villages (210 households) were linked with the Individual Household Latrine programme as part of the Swachh Bharat Mission, to make them model sanitation-cum-hygiene villages. Latrine construction has been completed and water connection is awaited.
- Job cards were secured for 465 mahila kisans to get work under MNREGS.
- Bank accounts were opened for 863 women farmers under the Pradhan Mantri Jan Dhan Yojana.
- A total of 49 visits have been organised for the mahila kisans, CRPs and para professionals to different areas to gain exposure on sustainable agriculture, off-farm and on-farm livelihood activities and grass-root institutions. Jattu Trust in Andhra Pradesh, Naidu farm in Jagdalpur, PRADAN in Baliguda, local NGOs in Semiliguda, Harsha Trust and PRAGATI in Koraput, are some of the places visited.
- Street plays were organised in 43 villages to create awareness on non-pesticide management, post-harvest technology, sustainable agriculture, gender, health, hygiene and nutrition.

Community Foodgrain Banks

The details of foodgrain transactions were analysed in 17 out of the 25 Community Foodgrain Banks (CFBs) set up since 2010 across various hamlets of Koraput district. The main purpose of the analysis was to understand the importance of the CFB initiative in the context of substantial improvements in the public distribution system in recent times in Odisha. Eight of the CFBs were started in 2010 and 9 in 2011. Sixteen CFBs store paddy for lending to member households while 4 have supplemented paddy with rice and *ragi* and one CFB stores only rice. Paddy remains the most important grain borrowed across all 17 CFBs, in terms of the number of households borrowing as well as the quantity borrowed. Over the period under analysis, a

CFB member household has, on an average, borrowed 53.6 kg of paddy per annum, 12.2 kg of rice per annum, and 9.1 kg of *ragi* per annum. It is significant to note that the per household borrowing of paddy has registered an increase in 15 out of 16 CFBs. Maliguda and Badapar are the only two CFBs where the per household borrowing of paddy has declined from 47 kg/year to 36 kg /year and from 56 kg/year to 50 kg /year, respectively. However, these two CFBs have recorded an increase in the number of borrowing households. While the analysis clearly shows the continued importance of CFBs in the 17 remote hamlets, it also brings out the widely varied levels of usage across the district. In Nuaguda, Gunthaguda, Balia, Jhalaguda, Pujariput and Banuaguda, the total number of households accessing CFBs has declined sharply whereas in Phukiaguda, Taliaguda, Pradhaniguda and Chendia Jhiligaon, more than 80 per cent of households access the CFBs.

During the reporting period, meetings were organised in the 25 villages to prepare a plan of action for establishing vegetable seed banks. Trainings were organised for women farmers and CRPs on selection of good quality seeds from the field. Seeds of tomato, brinjal, chilli, pumpkin, lady's finger, greens, etc., were collected by the farmers to store in the seed banks.

501.2 Maharashtra

Mahila Kisan Sashaktikaran Pariyojana

Mahila Kisan Sashaktikaran Pariyojana (MKSP) has received a 'no cost' extension for two years (December 2014 to November 2016) from the Ministry of Rural Development, Government of India. Currently, the programme has a total membership of 3265 women farmers, formed into 215 *samiti*s (women farmers' groups), spread across 60 villages in the districts of Wardha and Yavatmal. The major focus areas over the reporting period have been on the formation of federations of the samitis and promotion of income-generating options for the members.

The 215 samitis in the blocks of Wardha, Deoli and Ralegaon have been federated at the block level and 3 federations have been registered under the Societies' Registration Act, 1860. Each federation is governed by an Executive Committee of 9 members and a General Body which has 3 members from each samiti in the federation.

In February 2015, the newly formed federations have launched a credit programme to strengthen the livelihood of member farmers. So far, 4 members have taken loans amounting to a total sum of Rs.54000: 2 members plan to start enterprises for the preparation and sale of vermicompost and biopesticides while 2 others have bought machineries (pulveriser and noodle maker).

The Maharashtra State Rural Livelihood Mission (MSRLM) had identified 21 MKSP members in early 2014 as resource persons to train women farmers in other villages/districts on sustainable agricultural practices.

MKSP members have been actively participating in Gram Sabhas, interacting and negotiating with government officials to get

the benefits of various government schemes. During the year, sanction orders were received for construction of 524 toilets across 10 villages; and resolutions were passed for installation of drinking water taps in 18 villages and for construction of individual toilets in 12 villages.

Providing intensive training on various components of sustainable agriculture has been an integral component of MKSP. The programme's performance in getting the women farmers to adopt good practices has improved over time. Farmers have reported that practising sustainable agriculture has helped in minimising risks during the unseasonal heavy rains in the agricultural year 2014-15. The various sustainable agricultural practices adopted by women farmers, during 2014-15 *kharif* are described below.

- 1987 women farmers had soil testing done in their fields, out of whom 1608 farmers applied the soil-test based nutrient.
- 62 women farmers have erected farm bunds in their fields covering 232 acres of land. Farm bunds help in arresting soil erosion and improving soil moisture.
- 2040 women farmers have adopted the practice of sowing across the slope. This reduces the extent of soil erosion and water runoff from the fields, thereby containing the nutrient loss from the soil. Further, soil moisture in the fields is enhanced.
- 2425 women farmers have opened ridges and furrows in their fields, thus improving soil moisture retention and draining out excess water from the fields.
- 1708 women farmers have adopted a mixed cropping system wherein, along with the main crops of cotton or soya bean, other crops such as sesame, green gram, black gram, sorghum, pigeon pea and cowpea are also grown simultaneously. Such a mixed cropping system helps in enhancing household food security while improving the fertility of the soil.
- 1500 women farmers have adopted various measures of integrated nutrient management and integrated pest management.

In 2014, MSSRF entered into an agreement with Digital Green, an NGO, to train women farmers to produce short (5 to 8 minutes) videos on all relevant good practices. So far 10 videos have been produced and 646 dissemination sessions have been held. These videos have proved to be very powerful tools for farmer-to-farmer extension of practices as the message is in the local language and the demonstration is by one of their own community. This activity has so far been carried out in 30 villages and is now being expanded to another 30 villages.

Seed banks have been promoted across 58 villages for storage and distribution of vegetable seeds. Fourteen community kitchen gardens have been set up in common lands in 7 villages. A total of 1539 samiti members out of 3265 (about 47 per cent) have kitchen gardens on their homestead land, significantly improving their access to fresh vegetables and fruits. Sixty samiti members have started various agro-based income-generating activities.

Thirty-three samiti members, across 30 villages, have been identified as *Swastha Mitra*s, a cadre to spread awareness among member households on health- and hygiene-related issues as well as on government entitlements pertaining to these issues. The Swastha Mitras have received intensive training and are in a position to function as extension workers.

From April 2014 to March 2015, convergence of government schemes dealing with access to agricultural implements, seeds and bio inputs, construction of houses and toilets, as also health schemes was to the tune of Rs.57.4 lakh, benefiting 1798 samiti members.

Facilitation with the Mahatma Gandhi Institute of Medical Sciences, Sevagram, ensured that 703 women farmers had availed health insurance schemes covering themselves and 2353 of their family members.

A meeting of the Programme Advisory Committee (PAC) of MKSP was organised in February 2015 under the chairmanship of Professor M.S. Swaminathan. The progress made by the programme and the extension received for a two-year period were both greatly appreciated by the members of the PAC.

Field-based Soil and Water Conservation Measures

Farm bunds are significant soil and water conservation measures and are extremely useful to prevent soil erosion. During May-June 2015, MSSRF facilitated the erection of farm bunds in a contiguous stretch of 400 acres of land belonging to 101 farmers in Bhidi village of Wardha district. The effect of these bunds is expected to be seen in the productivity of the land, the quality of the produce as well as improvement in soil health. This intervention has been made possible with funding received from India Medtronic Pvt. Limited.

Education Support Programme

In the year 2013-14, of the students who are supported by the Education Support Programme (ESP) for suicide-affected families, the pass percentage was 75 per cent in Class 10 and 100 per cent in Class 12. It is significant that all the 9 students who cleared Class 12 are continuing their education: 3 have joined engineering and 6 are pursuing general degree courses

Through the facilitation of MSSRF, 41 students who are under 18 years and have a single parent, have availed the benefit of Bal Sangopan Yojana, a Government of Maharashtra Scheme that offers a scholarship of Rs. 425 per month per student, for the academic year 2014-15.

Sub Programme Area 502

Research

Gagad Pila

The participatory research with tribal communities initiated in mid-2010 in the revenue village of Boliguda in the Boipariguda block and hamlets of Gunthaguda and

Nuaguda in the Kundra block of Koraput district, Odisha, for addressing undernutrition in children up to three years came to an end in January 2015. The UNICEF conceptual framework for addressing undernutrition was adapted to map and work simultaneously with all the actors and players at the community, household and panchayat levels to sensitise and mobilise people to provide a supportive environment for mother and child.

At the village level, Community Hunger Fighters were trained along with ward members on food and nutrition security issues, child care, and infant and young child feeding (IYCF) practices. At the household level, a meeting was facilitated once a month with caregivers to discuss issues that affected child feeding, including seasonal work patterns and combining work with feeding, availing various entitlements, feeding problems and their management, locally available ready-to-eat food and their nutritive value, management of illnesses, cleanliness and sanitation, to name a few. Monthly growth monitoring was undertaken from 2012. Periodic surveys were done to collect data on household food availability, IYCF practices, illnesses and their management. The CHFs along with other villagers and, in some cases, the ward members raised the issue of child care and health services in the Gram Sabhas and managed to improve implementation of the existing services.

People's assessment on the impact of the programme in the study sites during the last five years as well as on issues of child care, feeding, and health are provided below:

- All households have kitchen gardens and fruit-bearing trees. Best practices in seed selection and storage, line transplanting, and cultivation of green gram, black gram, groundnut and maize have been adopted by several households. Irrigation facilities have improved through construction of ponds and the use of diesel and pedal pumps. Production of high-yielding varieties of rice has increased from 15 to 20 qtl per acre and traditional varieties from 10 to 15 qtl, leading to improved food availability.
- Since productivity of land has improved, there are food stocks available and people need to engage in wage labour for shorter periods.
- People are able to afford better clothes and are thus better dressed.
- Villages are cleaner, with drains and proper roads. Personal hygiene has improved.
- Boiled water is given to children up to three years. Skin diseases have disappeared. Immunisation is 100 per cent, though home deliveries are still preferred.
- Exclusive breastfeeding is practised till 6 months. Older children are fed at least 4 times and with several varieties of food groups.
- Different strategies have been adopted to improve child feeding. In Boliguda, parents preferred to take their children to the work spot to feed them better. In Gunthaguda, caregivers are taking a keen interest in child feeding.

A detailed analysis of the nutritional status of children is underway.

Tool for Assessing Complementary Feeding Practices of Caregivers

A study was undertaken to identify variables that could be used for developing a tool for assessing complementary feeding practices of children between 9 and 12 months of age. Feeding practices were considered as predictor variables while children's nutritional status was the dependent variable. Following a literature survey, the study, designed as a cross-sectional one, was undertaken at four levels.

Household typologies, such as caste, landholding, access to forest, mothers' separation from children and the presence of multiple caregivers, which had a bearing on the feeding practices were studied. Feeding practices were assessed through a questionnaire that included food frequency and practices since birth. A 24-hour recall diet survey measured the quantity and quality of food given. Observation of a feeding session to assess caregiver-child interaction during feeding was undertaken, along with videography. Nutritional status was assessed by taking heights and weights. Forty children between 9 and 12 months of age from 16 villages were studied.

Eighty-five per cent of the mothers had initiated breastfeeding within 2 hours of birth and 95 per cent had not given anything before breast milk. All the mothers were breastfeeding at the time of the survey and all the children were being given other foods. However, complementary feeding had been initiated at 7 months for only 45 per cent of children. Sixty-five per cent of children were having a minimum acceptable diet of three meals a day with 4 food groups. Food was adequately mashed only in 7 cases and only 8 children appeared hungry. Mothers had to resort to force-feeding 15 children, while 17 children, most of whom were in the older age group, stopped eating after a few mouthfuls. Forty per cent of children were well nourished and undernutrition progressively increased with age. No differences could be discerned between the feeding practices of well-nourished and undernourished children, except that children who were not separated from their mothers were well nourished. Hence, the variables impacting child feeding for inclusion in the tool could not be clearly determined.

It was observed that due to wide variation in the day-to-day diets of children, direct weighment method over 24-hour recall and a three-day diet survey would be more appropriate to study food intake. Other areas that need to be studied are nutrition derived from breast milk, intake of snack foods and activity patterns of the children. Birth weight is an important predictor of nutritional status and it could be that the well-nourished children are better off because they had higher birth weights than the undernourished ones, rather than due to any overt differences in food intake. A further study incorporating these suggestions, surveying an equal number of well-nourished and undernourished children for each month of age, has been recommended.

A Strategy Paper on Food Security and Nutrition for India

A strategy paper on food security and nutrition in India was prepared for the UN World Food Programme (WFP), India. The first draft of this paper was discussed at a national consultation in New Delhi in February 2015, involving noted experts in the field. Based on the comments received at the consultation, the paper was revised and submitted to WFP in April 2015. The strategy paper follows the zero hunger framework enunciated by the Secretary General of the United Nations: it provides a comprehensive and detailed understanding of the national food security and nutrition situation in India, discusses possible strategies for meeting the challenges, and suggests a set of recommendations for policy.

Programme Area 600

INFORMATION, EDUCATION AND COMMUNICATION

Three new projects have been added to the regular programmes of ICT-based information and knowledge enhancement of the rural communities, particularly farmers, fisherfolk and women entrepreneurs. Knowledge connectivity services through various ICTs has reached 1,52,966 people in 1052 hamlets of 336 revenue villages in the 6 regions of Tamil Nadu, Puducherry, Maharashtra, Andhra Pradesh, Kerala and Odisha. The Fisher Friend Mobile Application has been launched in English, Tamil and Telugu and is being used by 3250 fisher-folk. The FFMA Mobile Application has been adjudged the best mobile-based service and honoured with the mBillionth Award South Asia; it has also been chosen as one among the finalists of Vodafone's Mobile for Good Award. The Hindu Media Resource Centre re-strategised its pathway through 5 pillars and fostered the outreach of research outputs and impacts of the Foundation to the public through social media, conferences and millennium lectures.

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Knowledge empowerment of rural communities for economic prosperity

Programme Area 600

Information, Education and Communication

The Information, Education and Communication programme continues to play a crucial role in linking science with society by harnessing multiple communication technologies and enabling the resource-poor rural communities gain access to information and knowledge and thereby reduce risks and increase economic benefits. Efforts have been initiated to evolve multifaceted low cost technologies encompassing mobile-, browser- and electronic-based dissemination strategies.

Virtual Knowledge Gateways (VKGs) which are virtual platforms that engage multiple ICTs such as mobile applications, bulk voice campaigns, helplines, audio and video conferencing, phone-in programmes, GSM-based public address systems, etc., have been set up for disseminating knowledge among rural communities in places where Village Knowledge Centres (VKCs) are not present. Strategic alliances have been established with public, private, research and academic institutions to strengthen the land-lab, lab-land and land-land connections.

The research initiative of redesigning the Fisher Friend Mobile Application (FFMA) culminated in the launch of the Android-based FFMA and fetched the attention of multiple stakeholders, especially the Fisheries Departments in the State governments. In Tamil Nadu, a pilot initiative has been e-Plant Clinics that disseminate appropriate recommendations on crop diseases and pest management instantaneously to farmers through SMS messages. Rice Check identifies key check points in different stages of paddy cultivation, and provides need-based season-long knowledge and skill building among farming communities through ICT and training programmes. The effort to aggregate knowledge resources into a single platform titled Knowledge Management System (KMS) has been very successful in depositing a diverse and large content base for the rural community, available both on-line and off-line.

Sub Programme Area 601

Jamsetji Tata National Virtual Academy for Rural Prosperity

The Jamsetji Tata National Virtual Academy for Rural Prosperity (NVA) consists of the hub- and-spokes model of Village Resource Centres (VRCs), VKCs, NVA Fellows and Grameen Gyan Abhiyan (GGA).

601.1 Jamsetji Tata National Virtual Academy Fellows

A systematic process was adopted to select suitable candidates as NVA Fellows both at the national and international levels. The regional peer review committee identified 229 NVA Fellows (Male: 163; F: 66) from 15 States in India, keeping linguistics as the base. Similarly, a three-member peer review committee was set up to select the international fellows,

and 7 were selected from 3 countries, viz., Myanmar, the Philippines and Tanzania. Professor M. S. Swaminathan inducted both the national and international Fellows during the 10th convocation of NVA Fellows on 2 February 2015. A Participatory Knowledge Management workshop was held prior to the Convocation through the Jamsetji Tata Training School, in which the fellows shared their expertise and experiences to ensure cross-learning and to build a network among themselves.

601.2 Village Resource and Knowledge Centres

The Village Resource and Knowledge Centres understand the information and knowledge needs of the community, leverage knowledge resources that rest in diversified institutions, process the location-specific content into actionable knowledge and disseminate it to the rural communities using appropriate technology. Each VRC operates with a thematic focus in accordance to the requirement of the rural community it serves.

A systematic assessment of the existing VKCs was carried out to understand their capacity and to decide whether they are to be continued under MSSRF or handed over to the local community or converted to virtual coverage. This facilitated the streamlining and consolidation of the VRCs and VKCs. Currently there are 14 VRCs and 62 VKCs including 17 pan-VKCs across 36 districts in 7 States. VKGs cover 241 villages in 36 districts. The total coverage of the programme has increased, as shown in **Table 6.1**.

Table 6.1 ***Number of VRCs and VKCs users (April 2014-March 2015)***

Themes	Male	Female	Total
Agriculture	48427	24127	72554
Fisheries	52340	2366	54706
Animal Husbandry	783	325	1108
Health and Education	7291	7779	15070
Government Schemes	4738	1789	6527
General	995	2006	3001
Total	**114574**	**38392**	**152966**

The programmes implemented through VRCs and VKCs cover different fields such as Farmer Friend Programme, Fisher Friend Programme, and Health and Education. The interventions have been taken to the target communities using ICTs in the form of one-minute voice and text messages on mobile phones, video-conference and audio-conference programmes, helpline services, phone-in programmes and KMS.

601.3 Farmer Friend Programme

Agriculture interventions in the IEC programme area have been through 2 new projects. The e-Plant Clinics supported by CABI ensure process efficiency using a tablet-based application to capture and store data into the server instantaneously. Appropriate advisories are disseminated to farmers through SMS after a scientific study of pest-affected crop samples using laptop-aided microscopes for diagnosing small and tiny insects, as well as infections due to bacteria, virus and fungi. The Rice Check project in Thanjavur district, supported by the International Rice Research Institute (IRRI), the Philippines, promotes learning scientific methods of paddy cultivation.

Knowledge building and adoption using ICTs

There has been increased participation of farmers in the programmes organised by VRCs in Tamil Nadu, Puducherry, Andhra Pradesh, Maharashtra and Odisha. A total of 73,662 farmers have participated in various ICT and direct programmes, including 33 per cent women participation. **Table 6.2** shows the gender-wise participation in ICT-based programmes.

Table 6.2 ***ICT-based interventions in agriculture (April 2014 -March 2015)***

Programmes	Male	Female	Total
Audio advisories	4757	2436	7193
Helplines	1236	211	1447
Audio conferences	1428	987	2415
Phone in programmes	1785	1250	3035
Video conferencing	498	1227	1725
Total	**9704**	**6111**	**15815**

Cattle in Tamil Nadu were badly affected by foot-and-mouth disease during November-December of 2014. Due to continuous alerts through voice messages and phone-in programmes on their mobile phones as well as notice board postings in the VKCs, the farmers took immediate measures to control the outbreak. In one case in Karaikal, a farmer was able to save animals worth Rs. 40,000 to 50,000. A sample survey and feedback revealed that about 60 per cent of the farmers had vaccinated their livestock in time.

Direct sowing of paddy in practice in Karaikal and Nagapattinam regions resulted in heavy weed problems, leading to low yield. Knowledge sharing through voice messages and notice board announcements in VKCs on proper methods of pre- and post-emergence weedicide applications along with demonstrations in the field resulted in reduced weeds in the *kharif* paddy crop. As the weeds host mealy bugs, the damage to the crop used to be quite high. According to farmers in Keelaboothanur village, this did not occur this year due to much less weeds, resulting in 10 per cent gain in yield and 5 per cent gain in income.

Capacity building programmes

The direct interventions for farmers such as soil testing and agro-advisories on fertiliser input management (including guidance on organic inputs by using composted manure, biological inputs such as *Azospirillum*, *Pseudomonas* and *Azatobacter* and green manures), training on disease and pest management, value addition and storage have helped nearly 25,000 farmers in enhancing their knowledge and gaining in yield by managing the multiple crops with appropriate practices. **Table 6.3** shows the details of gender-wise participation of farmers in the programmes.

Nine livestock care and management camps were conducted covering 17 villages of the Kundra block in Odisha, in which 3758 cattle were vaccinated, de-wormed and provided with vitamin tablets; 1380 cattle were treated for foot-and-mouth disease by vaccinating; and 1250 poultry birds were treated for Ranikhet disease.

Promotion of nutri-gardens

Nutrition literacy through audio conferences, phone-in programmes and regular voice

Table 6.3 ***Capacity-building interventions in agriculture (April 2014 -March 2015)***

Programmes	Male	Female	Total
Soil testing and fertiliser management	1028	317	1345
Seed treatment and irrigation	1438	743	2181
Pest and disease management	6395	1551	7946
Value addition and storage	2789	1475	4264
Best-fit technology helpline and insurance	6778	2241	9019
Total	**18428**	**6327**	**24755**

messages on nutri-gardens were provided to 400 households, particularly encouraging women to cultivate vegetables in their backyards They were also supported by providing good quality seeds and demonstrations were held on plot making, seedling and crop management in collaboration with the APM (alleviating poverty and malnutrition) project of Kolli Hills. The case studies showed social and economic benefits such as increased knowledge in the consumption of nutritious food as well as in nutri-garden development, care and management. Each household saved nearly Rs 8000-10,000 in the 4 months of the crop period. Most of the families have saved seeds for the next season and some have shared them with neighbours, thus increasing interest in the community. In addition to vegetables, these families also planted fruit trees such as papaya, guava and pomegranate in their backyards. Both ICT and non-ICT initiatives complemented each other in realising the results.

Friends of Coconut Tree programme

The Friends of Coconut Tree (FoCT) programme of the Coconut Development Board is being promoted by all the 6 VRCs in Tamil Nadu, and Puducherry has shown great interest too. Some VRCs have disseminated ICT-based knowledge services pertaining to best management practices in coconut cultivation before and after the training programmes. In other places, it was done only through training programmes. This year 480 farmers (M: 412; F: 68) have participated in 24 programmes. The participants have been provided with a machine to climb coconut trees, free of cost. The follow up has shown that 40 per cent of the participants have been using it and saving expenses incurred towards harvest of nuts.

Soil- and water-testing services

The demand-driven programmes on soil testing and agro-advisory services to farmers in Tamil Nadu, Puducherry and Maharashtra have been carried out by using the mobile laboratory facility in Thiruvaiyaru VRC and the two laboratories in Wardha and Yavatmal VRCs in Maharashtra. The systematic approach of increasing awareness on the importance of soil fertility maintenance, various functions of micro- and macro-nutrients, correct methods of soil sample collection, soil sample analysis and fertiliser advisories has helped farmers. **Table 6.4** shows the details of the services provided.

Table 6.4 ***Details of soil testing services***

No. of soil samples analysed	3504
No. of water samples analysed	145
No. of farmers supported with soil testing	2624 (M: 1430; F: 1194)
No. of villages	239
No. of districts	11
No. of States	4
No. of awareness and advisory meetings conducted	43

Helpline advisories

Expert advisories through helpline call services to farmers in Tamil Nadu, Andhra Pradesh, Puducherry and Maharashtra have been a great success, with 2756 farmers from 525 villages sending in 2982 queries in all. The panel of experts have been receiving on an average 30 calls per day, particularly during the *kharif*, *rabi* and summer cropping seasons.

Plant clinic services

Plant clinic programmes conducted in Tamil Nadu, Puducherry and Maharashtra have been found to be extremely useful to farmers in the correct diagnoses and prescriptions on insect and disease management. In all, 3700 farmers, including 510 women farmers, visited 19 clinics in 74 villages, and 2369 samples were submitted to 27 plant doctors (including 9 women) for diagnosis and advice. In Tamil Nadu, the plant clinics are conducted by trained plant doctors (who are knowledgeable farmers) in the presence of the agriculture scientists of MSSRF while in Maharashtra. the MSSRF agriculture scientists conduct the clinics.

Voice and text messages through mobile phones

Agro-advisories at every stage of cultivation, including weather forecasts and market information in the form of short text and voice messages have been an on-going programme, with 7193 farmers covered this year, including 2436 women farmers. One-minute vernacular voice and text messages are sent to the farmers through the MSSRF gateway at the times chosen by them. The messages include generic practices as well as crop-specific advisories.

Farm Schools

In Odisha, 7 farm-oriented training programmes such as pest and disease management, bio-fertiliser production and application, seed treatment and mushroom cultivation, were conducted, in which 227 members, including 83 women, participated. Five exposure visits from various institutions were also organised. A participatory learning and action research exercise was organised in the farm school to understand the existing pattern of linkages that the community has with block / grass-roots level institutions; 22 international Plant Genetic Resources (PGR) trainees, including 12 women, participated. In all, 297 farmers including 168 men and 129 women participated in the training programmes. Farm schools have also taken up activities like tamarind processing, preparation of rice value-added products, *Trichoderma* production, etc.

A sum of Rs 33,500/- has been raised for the sustainability fund, created in November 2014. Five progressive farmers have been involved in facilitating peer-to-peer learning among farmers on best agricultural practices.

Exhibitions

Exhibitions were organised to showcase MSSRF's work in nutrition and conservation among the tribal communities in Odisha — at the State level at the Conclave on Nourishing the Tribal Children of India organised by UNICEF in Bhubaneswar in January 2015; and for the communities at the annual tribal festival PARAB at Kolhapur in November 2014, which recorded 2.5 lakh visitors. A Community Seed Fair was organised in November 2014 at Nuaguda village in which 234 farmers from 20 villages of the Kundra block participated. Seeds of 152 landraces with more than 1500 samples of different crops like cereals, legumes, minor millets, oil seeds, vegetables, spices, tubers, fruits and nuts were exhibited by the farm families. Village-wise diversity of crops was evaluated by a panel and prizes were awarded to the 3 best villages.

601.4 Fisher Friend Programme

Adopting a cluster approach, the Fisher Friend Programme focuses on the shore-to-shore knowledge needs of the fishing community, rendering locale-specific, timely and demand-driven information and knowledge. Usage of multiple ICTs enabled the expansion of knowledge services to fishers in 2 new States in addition to the existing 3 States. Thus, the programme covers 29 coastal districts, spanning 611 villages across 5 coastal States. Services such as ocean state forecasts, weather, potential fishing zones, market prices, sustainable fishing techniques, sea safety measures, marine conservation and quality fish management facilitated fishers to benefit through increased knowledge, reduced risks and enhanced economic return. **Table 6.5** gives the details. The gender division of labour is such that the primary fishing activity is carried out by men while women are involved in post-harvest measures and sale of fish and hence ICT services are provided based on the local needs of each group.

Table 6.5 ***ICT tools and coverage in fisheries April 2014 -March 2015***

Programme	Male	Female	Total
Audio advisories	16016	45	16061
Helpline	17323	0	17323
Audio conferences	65	31	96
Phone-in programmes	106	0	106
Training and Awareness	16482	607	17089
VRC and VKC	2348	1728	4076
Total	**52340**	**2366**	**54706**

The 24/7 multilingual helpline service was expanded to the coast of Kerala from August 2014, aligning it with the existing helplines in Tamil Nadu and Andhra Pradesh. When the Hudhud cyclone hit Andhra Pradesh and Odisha in October 2014, the helplines disseminated periodic and timely information on cyclone movement to the fishers in order to help them in critical decision making during the disastrous situation. Communication strategies like FM radio also helped to disseminate dynamic and static information

Table 6.6 ***Capacity-building interventions in fisheries (April 2014 -March 2015)***

Programme	Male	Female	Total
GPS maintenance and its trouble shooting	758	0	758
Marine conservation and sustainable fishing	4878	739	5617
Hygienic handling of fish products (on sea)	435	0	435
Fish value-added products	0	300	300
Sea safety measures	261	148	409
Diesel engine mechanism and trouble-shooting techniques	201	0	201
Dry fish production and processing	173	520	693
Awareness on INCOIS & FFMA	9776	607	10383
Total	**16482**	**2314**	**18796**

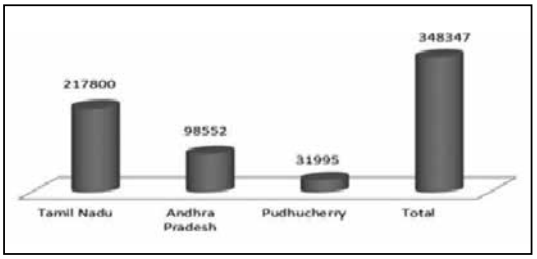
and knowledge beyond the mobile coverage area.

In order to promote community cadres and facilitate peer-to-peer learning, master trainers have been identified and trained to serve as ambassadors of the Fisher Friend Programme. Training programmes have been organised to ensure the translation of knowledge into action. The list is given in **Table 6.6.**

Fisher Friend Mobile Application

Twenty-three revisions were made to the Fisher Friend Mobile Application (FFMA) and it was re-launched on Android platform in February 2015. Along with the existing services on ocean state forecasts, potential fishing zones, weather forecasts, market rates, risk zone mapping, international border line alerts and government schemes, additional features include SOS (to send predefined texts in distress/emergency situations on sea through SMS), My Tracker (navigating to harbour locations), media advisories (static contents to enhance fishing efficiency), notification of data upload, language changing options and feedbacks for improvement. During the pilot phase, 1538 fishers from 27 districts in 3 States downloaded and used FFMA in their mobiles. Together, 348347 screen views by users have been tracked as seen in **Figure 6.1.**

Figure 6.1 ***Screen views by users***



Significant results

- A cadre of 360 (M:338, F:22) master trainers from 223 villages covering 22 districts in 5 States gained knowledge on INCOIS services and became ambassadors of the Fisher Friend Programme to their fellow fishers.
- Fourteen fishers were rescued from life-threatening maritime distresses through the 24/7 helpline due to timely networking

with the Indian Coast Guard and the local fishing community.

- Helplines recorded 350 callers seeking information during the Hudhud cyclone, for taking timely decisions to reduce loss of life and livelihood. .
- Sample case studies undertaken among 40 fishers who used FFMA indicated an economic gain of Rs. 2393800 in all.
- Search time and number of days spent in the sea have come down from 5-6 days to 3-4 days due to PFZ information.
- Fifty per cent of small craft fishers gained additional net income between Rs.10000 to 15000 per trip and 75 per cent of mechanised fishers gained an additional net income of about Rs 50000 per trip.

Outcomes

- In July 2014, the Fisher Friend Mobile Application won the mBillionth Award South Asia 2014 competing against 300 entries from 9 South Asian countries under the category of m-Agriculture and Ecology, in recognition of "its remarkable support to the most vulnerable community of India that makes its livelihood by venturing the rough sea each day". The FFMA was also adjudged one among the 5 finalists for the Mobile for Good Award bestowed by Vodafone in 2014.
- The discussion with the Government of Odisha has advanced to the stage of designing a tripartite proposal among MSSRF, the State Fisheries Department and Indian National Centre for Ocean Information Services (INCOIS) to scale up FFMA in Odisha.
- Towards the progression of its sustainability, INCOIS has agreed to port crucial scientific information directly into the FFMA portal for automating the services to attain substantial reach.
- The preliminary analysis of the longitudinal market study conducted during the reporting period indicates that regular dissemination of advisories on potential fishing zones and tuna species forecasts facilitated fishers to change from trawl netting to gill netting.

601.5 Health and Education

Health

Tele-health education

The transmission of periodic tele-health education in the local vernacular in collaboration with Apollo Telemedicine Network Foundation (ATNF) virtually connecting 15 locations at a time gained momentum. This enables rural communities gain good understanding on the prevention of various diseases and hold discussions directly with medical professionals. In all, 24 sessions on different topics including occupational health issues such as back pain and its preventive measures, rheumatoid arthritis, dermatology, bronchial asthma, and also concerns in cardiology, neurology, menstrual issues, thyroid and epidemics like dengue and malaria were covered. A total of 3427 persons, including 480 men and 2947 women, from 36 villages participated in the tele-health sessions.

Considerable efforts have been made to meet the health requirements of salt workers in Vedaranyam through the VRC. A total of 240 (M: 67; F: 173) members have received audio advisories on health.

Nutrition literacy

A research initiative on the role of ICT in ensuring nutrition literacy was taken up in collaboration with the National Institute of Nutrition (NIN). The study aimed at examining the effects of communication through VKCs to increase the knowledge of rural women on nutrition issues.

A series of about 10 interactive nutrition education sessions were conducted by subject experts from NIN in the local language, using VRC-VKC action platforms. The various topics covered comprised dietary guidelines including macro- and micro-nutrients; dietary sources of various nutrients and balanced diets; nutrition- deficiency disorders; nutrition for adolescents; nutrition during pregnancy and lactation; infant and young child feeding; lifestyles and non-communicable diseases; good cooking practices; food safety at household level and reading food labels when buying packaged foods.

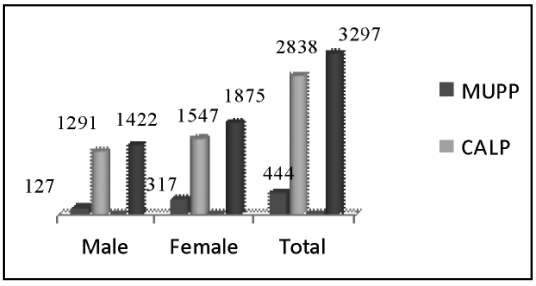
The sessions led to significant increase in knowledge levels about nutrition among women. There was an increase of 32.5 per cent after the first intervention and 29.3 per cent increase among women attending the audio conferences. 75.3 per cent learnt about night blindness; 76.6 per cent of the women gained knowledge on iron-rich food items; 77.8 per cent acquired information about anaemia due to iron deficiency and 82.2 per cent on iodine deficiency.

The preliminary analysis indicates that after 2 time-points, educational interventions in the form of audio conferences were helpful to bring awareness among the population, mainly among women in the reproductive age group.

Education

Figure 6.2 shows that 3297 users, including 1875 women, benefitted from the digital literacy courses that were conducted. It is clear that women were active participants and recipients of this intervention. In Odisha, basic Computer Literacy Programme (M: 28; F: 21) and Computer Aided Learning Programme (CALP) benefiting 71 boys and 55 girls were offered to the rural communities covering 16 villages under 6 VKCs.

Figure 6.2 ***Digital literacy programmes***



MSSRF-IGNOU Community College

Under the vocational training programme, a six-month course in horticulture and gardening was conducted. A total of 51 tribal students were admitted in two batches, with a success percentage of 67 in the first batch. Term-end examination was conducted, as per the

notification from IGNOU, in which 18 students appeared. Results of the Certificate Course in Computer Application (45 students) and the one for Watershed Management (2 students) are awaited from IGNOU.

601.6 Grameen Gyan Abhiyan

The 9th Convention of GGA (Rural Knowledge Movement) titled "Role of Information Communication Technologies (ICT) in Achieving Sustainable Development Goals and Zero Hunger Challenge" was held in February 2015 in Chennai. The focus was to address the growing gap between food production and hunger deaths with ICT playing a critical role in providing timely information and knowledge to the rural communities, especially farmers, fisherfolk and women entrepreneurs.

Sub Programme Area 602

Informatics Division

An R&D wing has been established within the programme to focus on evolving innovative technology solutions for developmental and livelihood issues and widen the scope of designing or customising low-cost technologies for knowledge dissemination. Strategic alliance has been established with academic institutions, particularly the engineering section, to create a collaborative space, in which interns learn and contribute to technology development. Ten students with computer science background from R.M.D. Engineering College provided support for some of the projects.

A number of initiatives have been taken up to evolve IEC technologies; some are at the prototype stage while a few are ready for pilot testing.

- The FFMA has been upgraded to include new features such as SOS, audio and video advisories, user feedback and other updates related to user interface. The application has undergone 23 versions and a total of around 1502 new users registered during the year. The team is currently working on developing the Application in Malayalam.
- A prototype version of the Integrated Farmer Friend Application for Sustainable Agriculture (IFFSA) has been developed and is being deployed in the field for testing. It is an Android mobile-based application which helps farmers to take informed decisions about key farming activities such as fertiliser application, to increase awareness about pest attacks and to foster sustainable agricultural practices. The key feature of this application is to provide region-specific and timely information which will help farmers anticipate the associated risks well in advance and take appropriate action.
- Soil Watch is a web-based application which uses images to help farmers identify nutrition deficiencies and apply appropriate fertilisers. Currently, fertiliser recommendations for paddy, groundnut and vegetables are available. This application is under expert review and will be ready for piloting later in 2015.

- The in-house Voice Blast Bridge Mode Audio Conferencing System was successfully hosted. Through this, 8500 voice messages are being sent per day to the rural communities. This new system has helped to cut the cost of operations drastically..
- The upgraded secured Wireless Public Address System for broadcasting and dissemination of early warning information has been designed, pilot tested and materials dispatched to 25 locations in the Vidarbha region during the year. The advantages of this system are that it is a secured system that can be accessed from anywhere, is user friendly to operate and can be gradually deployed and expanded.
- **A** centralised Knowledge Management System has been developed at the programme and project level to capture the wealth of knowledge, information and learning generated among different stakeholders like researchers, policy makers and other relevant users and disseminate it to the rural communities, both on-line and off-line. Totally 2230 contents have been uploaded under different thematic heads, which have yielded 1,266 page views during the year according to Google analytics. Additional features such as RSS feeds, web links, and a news section have been added to help widen the scope of this knowledge-sharing platform. The KMS is available in Tamil, English, Hindi and Marathi. An exclusive KMS has been developed for the Clima Adapt project, which is described under PA 700.
- Electronic prototypes such as the internet-based Vegetable Crop Surveillance and Soil Parameter Analysing Kits, a communicating tool for expanding wireless communication and multiple wireless speaker systems were developed and are ready for pilot testing.
- To increase the security of wireless connectivity, a new JAZE WI-FI Access Manager has been installed at MSSRF, Chennai. New facilities such as atomised projector screens and live broadcasting have been successfully incorporated in both the auditoriums, which have also been completely renovated with new technologies like HDMI support.

Sub Programme Area 603

Youth in Development

The prime focus of the Youth in Development (YiD) programme is to attract and retain youth in agriculture. A combination of interventions has been carried out engaging several experts in diverse fields of agriculture to motivate youth to participate in discussions and capture their voices towards policy suggestions. These include:

- The 6th Youth Science Congress focusing on the theme of “Food Security and the Zero Hunger Challenge” in January 2015 at Acharya Nagarjuna University, Guntur. A total of 812 (M: 480; F: 332) students and

delegates from 26 States across India participated. A compendium of abstracts from invited speakers representing academia, research institutions and NGOs was published during the Science Congress.

- Two district-level workshops on enhancing the capacity of rural youth in agriculture at Thiruvarur and Theni in Tamil Nadu, in which 400 (M: 250; F: 150) rural youth participated.
- Sixteen training programmes on coconut climbing for 320 rural youth (M: 180; F: 40) at Theni, Pudukottai and Vedaranyam in Tamil Nadu.

Sub Programme Area 604

Every Child a Scientist

As has been reported in earlier Annual Reports, the Every Child a Scientist (ECAS) programme benefits economically underprivileged students. The ECAS centre is equipped with computers and multimedia learning materials and uses ICT in education. Students from Chennai Corporation Zones X, XI and XIII regularly attend the 15-day training programme which consists of lectures, practical experiments and projects. During the year, about 400 students participated.

A non-residential science camp was organised for Standard X students from different schools from 6 to 17 May 2014. Twenty students participated in this science camp which sensitised them to recent advances in biotechnology and environmental engineering. Students were taken on field trips to the Adayar Poonga, Modern Bakery, Roja Muthiah Library, Anna Centenary Library and the Centre for Wind Energy, Pallikaranai. Guest lectures and workshops were conducted regularly. An ECAS brochure and a small booklet with objective questions and answers in science for school students have been brought out.

Touch and Smell Garden

Renovation of this garden, which helps visually impaired people experience the joy of nature and learn by exploration through the senses of touch and smell, was undertaken during the year. With the help of Scope International, a regular calendar for the students from blind schools is being planned from the coming academic year.

Sub Programme Area 605

The Hindu Media Resource Centre

A brainstorming meeting held with experts in April 2014 helped re-align the strategy and activities of *The Hindu* Media Resource Centre (*TH*MRC) for the year ahead. The five-pronged approach arrived at included

- Maintenance of resources on development and science for media, research and society
- Engagement in media outreach to facilitate reporting across various formats and regions
- Capacity building of stakeholders in development, science and the media
- Advocacy with the public, key policy makers and stakeholders in development

- Facilitation of discussion platforms for scientific and development concerns

A new brochure on the M.S. Swaminathan Research Foundation was released; the website www.mssrf.org was re-designed and is updated on a daily basis; micro sites were introduced on the website for special occasions, with a large volume of reading material and resources posted online; social media was integrated into the Foundation's communication plan, with campaigns on core issues; newsletters and e-newsletters have been initiated on a regular basis. Some results:

- Average of 20,000 page views of the Foundation website each month
- MSSRF Twitter and Facebook collectively reaching over 10,000 views each month
- E-newsletter and print newsletter *Synergy* (7 e-newsletters and 3 print editions) sent out to internal and external stakeholders
- Professor M. S. Swaminathan using Twitter from March 2015, reaching an average of about 21,000 impressions in the very first month

Regular press releases were issued for events; regular media engagement on the Foundation's work and statements by Foundation leadership were facilitated. Some results:

- MSSRF impacted over 450 news stories through 2014-15, an average of over 37 news stories each month in mainstream English and language newspapers as well as web editions.
- MSSRF partnered with Thanthi TV (Tamil current affairs network of a leading media group) for a 13-part programme series of 25-minute episodes on rural innovators and change agents in MSSRF sites.
- Case studies from the field on development were developed across 5 issues in partnership with *Grassroots* publication. Partnership with other websites to showcase research and updates has been initiated.
- During the year, 24 press releases were issued in connection with events, updates and issues.
- Interviews and media coverage with various national and international media organisations were facilitated.

An internal capacity building exercise was held for senior MSSRF staff in July 2014, to enable greater understanding of the media-scientist interface and for effective external engagement. The exercise was facilitated through Panos South Asia. A social media orientation was held for all staff at Chennai by Social Beat as part of the seminar series on external engagement, in connection with MSSRF's foray into social media.

A Publications Committee was set up to screen and facilitate quality publications emerging from the Foundation

*TH*MRC provided support and co-ordination for enhanced public and media outreach and impact for Foundation events across the Programme Areas. *TH*MRC participated in 2 public information campaigns along with government media units to showcase themes and areas of work of the Foundation. It was

also part of an international workshop on communication strategy for millets organised by ICRISAT.

A variety of seminars were held on a range of topics during the year. In all, 18 seminars and discussions were held from April 2014 to March 2015 with an average participation of about 40 to 50 members comprising scientists, scholars and external invitees at each programme. Details are given in the above Table.

Date	Topic	Speaker
April 17, 2014	Freedom from Hidden Hunger - Nutrient Enriched Salt	Dr. Malavika Vinod Kumar, Managing Trustee, Sundar Serendipity Foundation
May 2, 2014	New Developments in Harnessing Solar Energy	Dr. R. Ramarathnam, Chairman, Basil Energetics Private Limited
May 16, 2014	Edmonton Workshop Experience	APM team
June 10, 2014	Integrated Organic Dairy	Akshayakalpa Farms & Foods Private Limited
July 4, 2014	Transforming Democracy and Development: Ethics, Aesthetics and Responsibility	Dr. Ananta Kumar Giri, MIDS
July 18, 2014	Union Budget 2014-15	Dr. Venkatesh Athreya, MSSRF / MIDS
July 25, 2014	How You Can Contribute to MSSRF's Social Media	Ms. Anuradha Nair, Social Beat
August 4, 2014	The Other Asian Enigma: Explaining Rapid Reduction of Under-Nutrition in Bangladesh and Nepal	Professor Derek Headey, Development Economist, IFPRI
August 13, 2014	Project Work on Water4Crops	Lillianne Brown, WFP Intern
September 5, 2014	Nutrition on Camera - Screening of 3 Videos	Ms. R.V. Bhavani, Dr. C. Manjula, Ms. B. Raghini
September 20, 2014	Applications of Geospatial Tools	Mr. R. Nagarajan
October 6, 2014	Aadhar: Gender, Identity and Development	Dr Govind Kelkar, LANDESA
October 31, 2014	Determinants of Infant and Child Morbidity: Evidence from Andhra Pradesh, India	Ms. Sowmya Dhanraj
November 7, 2014	Journey Towards a Hunger-Free World	Chennai Food Bank
December 2, 2014	Technology and Public Policy Interaction	Professor T. N. Srinivasan, Yale University
February 5, 2015	Gender, Caste and Change in Agrarian Society	Dr. Amit Mitra and Professor Nitya Rao
February 9, 2015	Agroforestry and Ecosystem Services	Dr. P. K. R. Nair
March 6, 2015	Gender and Nutrition – LANSA	Dr. Swarna S. Vepa, Dr G.N.V. Brahmam
March 24, 2015	Land Rights for Women Farmers	Ms. Lalitha Kumaramangalam, Dr. Rukmini Rao, Ms. Geeta Ramaseshan

Sub Programme Area 606

Library and Information Services

The Boothalingam Library plays a vital role in providing information services to support the research activities of MSSRF. It services the knowledge needs of the scientists of this Foundation as well as those of research workers and students from other research and educational institutions.

The Library has 18,270 books of which 123 were included during the year. In addition, it holds 508 CDs, 84 journals, 122 newspapers clippings for the year 2014-2015 and 4,424 bound journals. The Library also has a good collection of technical reports, and annual reports from various institutions. The following services are provided.

- Current Awareness Services (CAS)
- Selective Dissemination of Information (SDI)
- Article Alert Services (AAS)
- Document Delivery Services
- Publication and Distribution Services
- Reprographic Services
- Newsletter Alert Services

The web-based MSSRF Open Access Archives (OAA) has been initiated for the benefit of the MSSRF research community. On-line databases such as India Stat, EPWRF, JSTOR, SAGE, etc., have also been acquired.

During the year around 285 students from various universities located across India have accessed and benefited from the library services, particularly with regard to CABI abstracts in the areas of biotechnology, agricultural sciences and life sciences.

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Programme Area 700

CROSS-CUTTING THEMES AND INSTITUTIONAL INITIATIVES

Steps were initiated to build the capacity of members of project teams on gender and development to integrate, monitor and document changes and to sensitise community leaders and members on gender issues for effective participation in developmental activities. Specific efforts were taken to foster inter-disciplinary research with focus on gender by mentoring Gender Institutionalisation and Mainstreaming group members. Projects with specific objectives on gender were initiated in collaboration with other Programme Areas. The organisational restructuring of grass-roots institutions to strengthen the institutional framework was continued with need-based technical support across the field sites. Use of ICTs for climate change management in increasing water use efficiency, communicating seasonal climate forecast information for risk reduction, and developing a cadre of village-level Climate Risk Managers were key highlights this year.

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Strengthening grass-roots governance and community-based institutions and consultations

Programme Area 700

Cross-cutting Themes and Institutional Initiatives

Gender, grass-roots institutions (GRIs) and climate change are the 3 important cross-cutting themes across all the Programme Areas. Gender mainstreaming and integration were continued through capacity building in the field sites, extending support at the planning and implementation stages for field activities in specific projects, nurturing Gender Institutionalisation and Mainstreaming (GIM) group members on gendered research as well as organising consultations and workshops. Research initiatives continued on gendered value chain development in dairy, tamarind and pulses, empowerment of single women to access productive assets and resources in Vidarbha, collective farming and gender relations among the tribal and non-tribal groups promoted by Kudumbashree in Kerala, and access to natural resources and institutional linkages to Paliyan tribal communities in the lower Palni Hills.

Two new projects were started this year: one with a focus on political economy and gender issues in access to, and use of, energy for tribal communities in Koraput district and another on gender and other socio-economic issues in finger millet and pigeon pea intercropping systems involving bio-fertilisers and bio-irrigation applications. .

Efforts have been continued to sustain the developmental interventions through GRIs across Programme Areas in implementing the revised framework and adopting the operational guidelines. Specific procedures were established for staff members as well as community leaders to complete audits and follow legal compliances as per the requirement of registration forms.

With regard to the climate change component in the project on enhancing the adaptive capacity of men and women farmers, knowledge management and gender mainstreaming are the responsibilities of MSSRF. Specific information and training relevant to climate-smart technologies by consortium partners were facilitated to augment the learning process. Developing a cadre of climate risk managers at the local level through building their capacity to create and access institutional linkages to obtain information related to weather and climate is ongoing.

Sub Programme Area 701

Gender

701.1 Gender integration and mainstreaming

Building capacities

A workshop for the preparation of a gender-responsive logical framework analysis (LFA) was organised in Wayanad in June 2014. This helped the team members identify the areas of gender mainstreaming and share insights on gender issues. Following this, a workshop on documentation in August 2014 set out guidelines on integrating the

gender element in the respective projects, strengthening gendered data collection and analysis, and writing reports. A similar kind of documentation workshop was conducted in Jeypore in September 2014. In the Kolli Hills, Vedaranyam, Villupuram and Illupur field sites, guidelines for gender integration were given during various implementation phases. A one-day orientation was given to the team members of PA 600 on monitoring and documenting indicators related to gender equity. Inputs were provided on gender integration at the proposal development phase in three projects — APM (alleviating poverty and malnutrition) second phase, enhancing pulse productivity, and up-scaling millet production. Inputs were also given to integrate gender perspectives in the participatory appraisal framework for the LANSA project.

GIM group members

Consolidating and sharing results of the activities with gender focus is one of the key activities of the GIM members, who were facilitated to prepare a case study showing how gender integration is practised at the field level. The discussions on gender integration continued among members through emails and e-discussion groups. In order to sharpen their perspectives on gender research, a two-day workshop was organised in February 2015 with the following objectives: to reflect and discuss gender issues relevant to their individual research study; to sharpen the research questions and designs, and discuss applicable research tools and methods on gender and development; and to strengthen academic writing skills by practising and reflecting on the strategies of analytical writing with gender perspectives. Six papers on interdisciplinary research on gender were presented by the members. The mentoring support extended by external resource persons in fine tuning the research questions and framework and extending detailed comments on the drafts helped the members to gain confidence, especially in this inter-disciplinary work.

Clima Adapt

In the Clima Adapt project, implementation support for gender mainstreaming was continued in all the 4 sites in Tamil Nadu, Andhra Pradesh and Telangana. Some of the initiatives:

- A detailed step-by-step plan to carry out gender analysis and integration in identified climate-smart technologies was discussed in October 2014, along with gender-sensitive monitoring indicators at output and outcome levels. In order to bring gender into the analytical framework, a simple format was developed for analysing socio-economic dimensions of technological adoption and this was shared with project partners.
- A research study was conducted in all the 4 project sites on i) differential impacts of climate change on men and women farmers and agricultural labourers; ii) on-going adaptation and coping practices at the household and community levels; and iii) its implications on gender relations.

- Community-level gender sensitisation was undertaken for men and women leaders and staff members are regularly following up the implementation part.
- Up-scaling climate-smart technologies in partnership with State departments and institutions is the next important step. A simple guideline to bring gender sensitivity in up-scaling methodology was developed and presented to team members for further discussion. Similarly, guidelines to integrate the gender perspective at the analysis and advocacy phases were formulated and discussed.

Alleviating poverty and malnutrition

In the project on alleviating poverty and malnutrition (APM), a framework for field-level gendered outcome evaluation was evolved and tested in Kolli Hills and subsequently at both Wayanad and Jeypore field sites with the support of GIM members. The results of the gender intervention have been consolidated and discussed, to be presented in the final project report.

701.2 Research initiatives

Empowerment of farm widows and other single women farmers in the Vidarbha region

As a preliminary effort, a baseline survey was conducted to gather information on landholding and ownership, land transfer and access to schemes and entitlements by the target population. Out of 494 single women surveyed, 55.4 per cent have land in their family but access and control in use was very limited. The initiative commenced in June 2013 to mobilise poor farm widows and other single women into collectives, to generate awareness on access to, and control of, productive assets, especially land, and to develop interface mechanisms to access schemes and entitlements is continuing. In 2014-15, focus was given to organising these women, building their capacities and creating linkages with institutions.

A consultative meeting was organised with single women farmers and farm labourers in the Wardha and Ralegaon clusters to facilitate a common platform where socio-economic issues could be heard and deliberated. External resource persons, including lawyers and representatives from NGOs, with sufficient experience on developing participatory methods for securing productive assets to women, especially land, participated in the consultation. A total of 180 participants in Wardha and 183 in Ralegaon attended the consultation. Problems of land transfer, inability to get benefits from government schemes, lack of support from local governments, issues of abuse, insult and stigma associated with being a widow and a single woman were discussed in detail. The result was the formation of a *Ekal Nari Sangh* (ENS), with all the single women population that the project has identified becoming members. Committees have been formed at block level, with leaders from villages in each block enrolled as members.

A two-day leadership training was carried out by Prakriti Foundation, Nagpur, for selected

members of the block level committees of ENS. Fifteen members were trained on the Domestic Violence Act with the support of the Tata Institute of Social Sciences. A capacity building workshop was organised for block level committee members on securing land rights by the Working Group for Women and Land Ownership, Gujarat. In November 2014, 2 community members along with the staff attended the annual meeting of the Advisory Committee of the National Forum for Single Women's Rights in New Delhi. It gave them exposure to understand the needs and demands of single women from various States and the efficacy of collective action. In January 2015, the field staff attended the Forum for Women's Farmer's Rights, a network group working for the rights of women farmers and established linkages with *Kashtkari Ekal Mahila Sangharsh Samithi*, Thane, who is working on issues concerning single women.

Action to access pensions for widows was taken up to gain experience in the process as well as to create confidence among members. Thirteen village-level workshops were organised in Wardha and Deoli in which widows were facilitated to prepare and submit applications for pensions with all necessary documents. With the support of the District Legal Services Authority (DLSA), legal aid was extended to 3 women to put up their claims over marital land; one woman succeeded in getting Rs. 1 lakh, an amount equal to her share of the marital land. Efforts are being taken to formally affiliate the Maharashtra State unit of ENS with the National Forum for Single Women's Rights.

Collective farming and gender relations in Wayanad

The study on collective farming and gender relations among women farmer groups promoted by Kudumbashree has been completed. Data entry and analysis has been done and the preparation of the report as well as research articles has been initiated. A research article on 'Social Inclusion and Exclusion among Tribal Communities on Collective Farming' has been submitted for publication. Two more research studies related to the process of collective farming and its impact on empowerment of women and women groups' control over crop choices have also been started.

Economic empowerment of women farmers through value chain development

Begun in October 2012, the economic empowerment of women farmers is being implemented across 3 sites through the value chain development of 3 different products — Kannivadi (dairy), Illupur (pulses) and Jeypore (tamarind).

In Jeypore, women moved from their traditional role of collectors of raw tamarind to non-traditional roles such as tamarind procurers, processors and bulk sellers; the tamarind was sold under the brand name NINI. The women tamarind activity groups, formed and institutionalised by August 2014, became part of Vikas Maha Sangh (VIMAS), a farmer producer organisation (FPO) operating in Jeypore, and accessed services related to finance, technical and market domains.

The project team made modifications in the tamarind processing machine and now women are directly handling the machines. During the year, 2.5 t of processed tamarind were sold by the groups. Out of this, 1.7 t were sold through VIMAS while the remaining was directly sold to the markets by the women. Processed tamarind was sold at the rate of Rs.50/kg as against the raw tamarind pod for Rs 12 per kg. In addition to this, 1.6 t of tamarind seeds were sold to local traders at the rate of Rs. 10-12/kg.

In Illupur, in order to reduce women's drudgery, participatory technology designing was attempted in modifying the available weeding machines; however, this was not possible due to inability in finding suitable local fabricators. In the reporting year, women members of the pulses activity group processed, packaged, labelled and sold 1.2 t of broken dhal at an average rate of Rs.89/kg with the support of the FPO in the region as against the price of raw pulses at Rs 6-8 per kg.

In Kannivadi, women dairy farmers were active in the preparation and sale of concentrate feed and in the collective marketing of milk; they also provided para-veterinary (paravet) services to dairy producers. Through production of concentrate feed using locally available raw materials, the cost of feed decreased by about Rs 2.50 per kg, which in turn reduced milk production costs to an extent of 16 per cent. About 15 women small dairy producers have become paravet experts and they provide animal health services at the doorstep for a nominal fee. The women-managed and operated milk collection centre in Kannivadi is also an innovation in that region. These two interventions have been instrumental into getting women into roles across the value chain that have traditionally been male bastions. On the collective marketing front, prices were based on milk quality, which motivated the farmers to give importance to nutrition management. As a result, the price of milk rose to Rs 30 per lt as against the average price of Rs 23.5 per lt.

Biofertilisation and bioirrigation for sustainable mixed cropping of pigeon pea and finger millet

The biofertilisation and bioirrigation (BIOFI) project initiated in October 2014 aims at developing and implementing an environmentally and economically improved finger miller and pigeon pea intercropping system for arid/semi-arid zones, using bio-fertilisers to augment the process of bio-irrigation between the crops. Under the Indo-Swiss Collaboration on Biotechnology (ISCB) BIOFI network, this is a bilateral project between India and Switzerland, involving multiple partners in the fields of biotechnology, crop physiology, plant breeding, agronomy, microbiology, gender, agricultural economics and agricultural extension. This is being implemented in Kolli Hills in Tamil Nadu and Mandya in Karnataka. MSSRF is partnering in both the biotechnology and socio-economic components of the project.

The major role of the socio-economic team of MSSRF is in conducting baseline surveys, participatory on-farm trials with farmers and promotion of eco-enterprises for production of

bio-fertilisers. Baseline surveys to understand the farming system, seed systems and innovation system were conducted in both Kolli Hills and Mandya. The sample size for the survey was 200 in each district, with an equal number of men and women included as respondents. Results will be presented next year. Meanwhile, a potential design for participatory on-farm trials has been developed. Assessment for eco-enterprise development has been completed and a detailed discussion held with the Kolli Hills Agrobiodiversity Conservers' Federation (KHABCoFED) to establish the units. The site for the production unit has been identified and members were given training on mass multiplication of AM (*Arbuscular mychorhiza*) fungi at the already functioning unit managed by women group members in Kannivadi.

Sustainable management of lichens and other NTFPs

This project on the sustainable management of lichens and other NTFPs is being implemented in the lower Palni Hills in Tamil Nadu with the participation of the Paliyan tribes and the Tamil Nadu Forest Department. Seven marketable non-timber forest produce (NTFP) were identified for project interventions in sustainable collection, processing and marketing. However, only 2 products — broomsticks grasses and lichens — were prioritised for action on the basis of extent of collection, contribution to income and women's participation. As a first step, norms for the sustainable collection of broomstick grasses were developed with the participation of the community as well as scientists. The activities were started in 3 villages and facilitated through Village Forest Councils (VFCs) formed by the Forest Department. Joint meetings were held with the village men and women as well as officials of the Forest Department, and 3 collection centres were established, which function as the focal points for aggregating the products and ensuring sustainable harvesting methods.. The stages of value addition to the primary grasses were traced with the involvement of tribal men and women leaders, and 3 direct market linkages established. The community leaders interacted with the buyers and negotiated the prices as well as quality of the products. So far around 5 t of broomstick grasses from 3 hamlets have been marketed with this new tie-up, keeping away intermediate traders. Through this direct market linkage, the members are getting 30 per cent higher prices than selling to local traders. Efforts are being taken to develop a similar initiative in lichens and to start with enhancing the community's skills in simple value addition.

Political economy and gender in energy sectors

'Does a gendered approach provide greater empowerment to women and girls than traditional approaches in the energy sector?' The response to this question is expected to be provided by the project on the political economy of energy sector dynamics vis-à-vis gender, supported by ENERGIA (a network focussing on gender and energy), part of the ETC Foundation, the Netherlands. MSSRF is

the lead organisation working in partnership with the Centre for Rural Technology, Nepal, as consortium partner. The research aims to contribute to the incorporation of gender concerns and women's rights in 3 levels of energy policy — policy formulation (macro), administration (meso) and implementation (micro) — by creating better understanding of the issues through a political economy approach, studying the formal and informal power exercised in energy policy and by strengthening marginalised groups and women's agency.

The geographical scope of this project is rural and peri-urban areas in Nepal and India. The research has two phases: scoping study and field-based studies. Publishing of peer-reviewed papers, innovative case studies, blogs and policy advocacy workshops are included. In the scoping study, research methodology is being developed to include the local contexts of institutions and social structures, and inclusion and exclusion of women and men from the political economy of energy use in the two countries.

The inception meeting organised by the ENERGIA capacity-building programme led to a detailed framework for combined analysis of political economy and gender being developed. The preliminary field work identified key areas of research in the domestic, productive and enterprise level energy needs of men and women in the Koraput district of Odisha. It is planned to complete the scoping study in October 2015. The results will help to design the activities for the detailed research phase of the project.

Sub Programme Area 702

Grass-roots Institutions

Currently there are 14 grass-roots institutions functioning across MSSRF field sites, of which 3 are focussing on common property resources. The remaining 11 focus on private ownership of resources, with 3 GRIs being SHG federations and 8 farmer producer groups.

The revised framework developed at the Jeypore, Wayanad and Illupur sites was reviewed and the activities are progressing as planned. Annual general body meetings were organised for the Panchabati Grama Unnayan Samiti (PGUS) in Jeypore as well as the Wayanad Tribal Development Council (WTDC) in Wayanad. The structures of both the organisations were revisited. The necessary statutory compliances were followed and documents submitted to concerned authorities. Participatory organisation development programme was undertaken at WTDC to review and develop the vision, mission, goals and activities for the next 5 years. Based on that, the annual action plan was developed for implementation. Support and guidance was extended to register 2 farmer producer organisations (Illupur and Nallavur in Villupuram district) under the Producer Company Act. The registered GRIs were facilitated to prepare annual progress reports, to conduct annual general body meetings and external audits, and to submit documents as per legal requirements. In this process, due

care was taken to change the leadership on the Board. As part of organisational management, the cluster approach was introduced in 7 GRIs to ensure the functioning of proper governance mechanisms, promote second-line leaders and facilitate decentralised management and decision making. Under organisational financial sustainability, two GRIs (Kulumai Federation at Kannivadi in Dindigul district and Innuyir Grama Sangam (IGS) at Pillayarkuppam in Puducherry) have reached the stage of cost coverage practice to meet the salaries of the field staff, travel allowances and other administration costs.

Sub Programme Area 703

Climate Change

703.1 Clima Adapt

Taking forward the Clima Adapt integrated science-stakeholder project that focuses on climate change adaptation with particular reference to water and agricultural sectors, VKCs in Tamil Nadu, Andhra Pradesh and Telengana continue to provide knowledge services on weather and crops, government schemes, water-related information, drip irrigation measures, livestock health issues, and also strengthen the lab-land and land-lab links through ICTs. Gendered need assessment has been carried out. **Table 7.1** summarises the thematic coverage of the services to the farming communities in the 3 States.

A gamut of ICT tools such as mobile-based audio and text advisories, helplines, public address systems and notice boards, KMS, phone-in programmes, video and audio conferences and webinars have been used for enhancing the knowledge of farmers on water use efficiency and agriculture development in the context of climate change. Knowledge service initiatives catered to 7771 farmers, including 1889 women farmers. **Table 7.2** sets out the details.

Table 7.1 ***Number of users of VKCs knowledge services (April 2014-March 2015)***

Topic	Tamil Nadu	Andhra Pradesh	Telangana
Agriculture	1144	466	336
Animal husbandry	322	48	17
Health	96	30	-
Education	221	105	-
Government schemes	128	47	-
About VKCs	232	131	192
Newspaper reading	204	443	30
E-Services (online)	319	452	148
Others	469	-	-
Total	**3135**	**1722**	**723**

Table 7. 2 ***ICT tools and coverage (April 2014-March 2015)***

Programmes	Male	Female	Total
Helplines	227	38	265
Audio advisories	2849	914	3763
Audio conferences	854	317	1171
Phone-in programmes	442	96	538
Trainings	525	187	712
Video conferences	187	94	281
Plant clinics	79	33	112
Soil & water testing	617	161	778
Webinars	102	49	151
Total	**5882**	**1889**	**7771**

Plant clinics have helped farmers to distinguish the difference between pests and infestations, understand the harmful effects of red-labelled/ banned pesticides, and learn about pest resurgence, resistance to pesticides, etc. The mobile soil- and water-testing vans have been greatly utilised in creating awareness among the farming community on quantified application of crop inputs to reap maximum yields with minimum expenditure while also protecting soil health.

The new generation ICT tool, Webinar, through which presentations, lectures, workshops or seminars can be transmitted over the Web, provides opportunities for face-face interactions between experts and farmers. The Webinar programmes on climate change have brought about good awareness about global warming and its consequences.

M-Library, a new initiative to actualise peer-peer learning by dissemination of SD cards with audio, video and text files containing contents based on assessed needs, has been processed.

Under KMS, a total 440 contents have been uploaded under different categories and 3,378 page views have been accessed by 430 users over the reporting year. New features of porting village-specific weather forecasts from yr.no (Norwegian weather forecast service) directly into the regional vernaculars are now available to be accessed and further disseminated to the community through GSM-based public address systems.

703.2. Seasonal climate forecasts to improve food security

The project on seasonal climate forecasts (SCFs) aims to investigate the usefulness of probabilistic forecast information in strategic decision taking by players across the value chain in semi-arid agro ecosystems. The major thrust during the reporting period has been on building the capacity of men and women farmers in interpreting and communicating SCFs and capturing the value of SCFs to different stakeholders across the agricultural value chain. The important research outcome from this project will be inter-disciplinary in nature, with climate science and social science jointly working to comprehend the relevance of the technology and fine-tune it to benefit user needs.

To build the capacity of the different stakeholders in understanding, interpreting and using SCFs in decision making to reduce the risk in their respective activities, key nodes (individuals who are looked upon as key points for sharing information within the community) were identified using social network analysis. Several communication tools were developed and tested for their effectiveness in communicating SCF to the different stakeholders. Capacity of the participants (men and women farmers and input dealers) on deciphering probabilistic SCFs was built through representing different probabilities of rainfall for the season and using decision tree analysis for decision making in farming or business. The communication tools used in the decreasing order of their complexity

have been decision trees, decision graphs and wonder bean. Decision trees, which layered multiple decisions in an Excel spreadsheet, were found to be less user-friendly by both men and women farmers, while wonder bean, which depicted a single decision of land allocation between 2 crops, was found to be easily understandable by the farmers. But decision tree and decision graphs were found to be effective in communicating SCF to off-farm players like input dealers and private companies. Subsequently, using hindcast (wave) information, men and women farmers as well as input dealers were facilitated to make action plans at household, village and community levels. These decisions were compared with the actual decisions that were taken during the years for which hindcast information has been provided.

A study using a mixed-methods approach was undertaken to assess the acceptability, potential use and likely effects of seasonal climate forecasts on the future decisions of cotton and maize value-chain participants in selected regions, which included men and women farmers, farmers' associations, input agencies, traders and processing mills. Initially, 18 respondents were contacted for this study and 14 of them said they did not understand SCF information, mainly due to the fact that such information is expressed in a probability mode and the articulation of utility came from a misunderstanding of 'probabilities of chances of occurrence of above/below/normal rainfall' as 'percentages of actual rainfall'. Hence efforts were taken to build awareness on the probabilistic nature of managing seasonal risks by providing local examples involving probability as well as hindcast information of the last 3 years, and to facilitate them to relate the decisions taken to the forecasts. **Table 7.3** sets out the potential use of SCF for players across the agricultural value chain.

The learning and experience on challenges and opportunities in communicating the SCF information to manage risks were shared at a workshop with participants from members of the Indian Ocean Rim Association (IORA). Fresh concept notes for taking the project forward were developed in the workshop and have been submitted for funding approval to the IORA forum.

703.3 Capacity building for climate risk management at the local level

A capacity building programme on climate risk management (CRM) at local level is being

Table 7.3 ***Potential use of SCF***

Stakeholder	Probable decision based on SCF
Men and women farmers	Land allocation, livestock management and crop choices
Input dealers	Input stocking rates
Aggregators	Planning based on potential turnover or volume
Produce/ Wholesaler	Predicting incoming stocks of the produce from different regions
Extension agents	Agricultural planning for the season, and advice to farmers
Credit institutions	Lending rates, loan ceiling for different crops

implemented with the support of the Ministry of Earth Sciences. In the first phase, the focus had been on places in Tamil Nadu where MSSRF is working. A Training of Trainers programme of farmers was piloted, including women farmers from the community who would in turn train others on CRM concepts.

In the second phase, during the reporting year, the Training of Trainers programme was initiated at Jeypore, Odisha and Wayanad, Kerala. The resource persons for it were from among the community, experts and staff of MSSRF. A 3-module Master's Training Programme was developed, which included CRM concepts, assessment of vulnerability, adaptation practices and tools to support adaptation. Two modules were implemented at Wayanad, comprising field visits and interactions with resource persons from among farmers and experts. One module was implemented at Jeypore. The participants were given exposure to the use of agro-metrological data and available weather forecasts. Support was extended to the farmers to access and use weather forecasts. The training covered 45 participants in both sites. A manual on assessment methods and compilation of adaptation practices is under preparation. A short film was prepared on MSSRF's experience in Kannivadi on the use of weather forecasts and agro-advisory services. It was dubbed into Malayalam and Odiya for use by farmers in those areas. This provided an opportunity for the trainee participants to learn and relate with experiences of farmers on the ground.

Sub Programme Area 704

Institutional Initiatives

Social Science Unit

Over the reporting period, the main efforts have been towards constructing a consolidated database of MSSRF's community-based interventions, pertaining to the geographical location, thematic focus and socio-economic characteristics of participants as on September 2013. Community-based interventions undertaken by MSSRF may be classified as (a) initiatives that engage with specific target groups, such as, Self-Help Groups, Farmers' Groups, etc., with defined membership; and (b) initiatives that engage with the entire village community. An analysis of the data collected so far, pertaining to September 2013, indicates that MSSRF's interventions with the former categories cover a total membership of 18868 (indicating that many households have been touched by MSSRF's interventions) and the latter covers a population of 4,45,089. A web portal has been developed to manage the database through a management information system. Detailed profiles of 23 out of 30 districts and 40 villages out of 832, where MSSRF has a presence, have been prepared and uploaded on the database web portal. The analysis of geographical coverage and thematic focus of MSSRF's interventions has been completed and available on the web portal, while the analysis on socio-economic characteristics of individuals engaged in the community-based programmes is ongoing.

Sub Programme Area 705

Workshops and Conferences

Annual General Body Meeting of SVAPO and RWEF, 12 July 2014, Illuppur

The two grass-roots institutions being facilitated by MSSRF since 2012 at Illuppur, Pudukkottai district — the South Vellar Agri-Producers' Organisation (SVAPO) and the Rural Women Entrepreneur Federation (RWEF) — jointly conducted their annual general body meetings. An awareness rally was organised in which 600 women and men farmers participated and displayed slogans related to improved agriculture technologies. The annual reports and financial reports of RWEF and SVAPO were presented before the forum, and new representatives elected. A new joint producer company, the Illuppur Agriculture Producer Company Limited, was launched along with its logo. The function was attended by representatives of various government departments, research institutes and panchayats.

Asia Pacific Regional Consultation on Role of Family Farming in the 21st Century: Achieving the Zero Hunger Challenge by 2025, 7-10 August 2014, Chennai

The Asia Pacific Regional Consultation on Role of Family Farming in the 21st Century: Achieving the Zero Hunger Challenge by 2025 was held in Chennai, with MSSRF hosting the event in partnership with FAO, International Development Research Centre (IDRC), Canada, World Food Programme (WFP), International Fund for Agriculture Development (IFAD), Department for International Development (DFID), UK, UN Women, Small Farmers' Agribusiness Consortium and other national and international agencies. The Consultation brought together a large gathering of ministerial delegates, diplomats and academicians from across the world with over 375 delegates participating in the 4-day programme. There were 5 plenary sessions on sustainability, gender, profitability, nutrition and technology in relation to family farming and 4 thematic sessions on productivity, profitability and sustainability of family farms in different ecosystems.

The **Chennai Declaration** arising from the Consultation set out recommendations towards formulating and shaping policy and development work for building a more equitable region leading to a hunger-free world. It emphasised the fact that due to pressures of population on resources and adverse changes in climate, decentralised family farming based on gender and nutrition sensitive agriculture is the hope for food for all and forever.

Leveraging Agriculture for Nutrition in South Asia (LANSA) Consortium Advisory Group (CAG) Meeting, 17 August 2014, Faislabad

The third meeting of the LANSA CAG was held at Faislabad, Pakistan hosted by CAG member

Dr. Iqrar Ahmed Khan, Vice Chancellor, University of Agriculture, Faislabad. Professor M.S. Swaminathan and Professor Mahendra Dev — CAG members from India — and Mr. Syeduzzaman, CAG member from Bangladesh participated. Dr. Abdul Rashid Hakimi, Vice Chancellor, Afghanistan National Agricultural Sciences and Technology University, Kandahar was a special invitee to the meeting. Members recommended that he be invited to be a full member of the body.

Attention to food loss and food safety, nutrition education, capacity strengthening for linking agriculture and nutrition, reaching out to policy makers and co-funding opportunities were some key issues discussed at the meeting.

Roundtable Meeting on Agriculture and Nutrition with LANSA Consortium Advisory Group (CAG) and Various Stakeholders, 17 August 2014, Faislabad

A roundtable meeting with special reference to agriculture- and nutrition-related issues was held at the University of Agriculture (UAF), Faislabad. The participants included faculty and researchers from the university, government officials, representatives of donor agencies and civil society, LANSA CAG members and researchers. Dr. Sartaj Aziz, Advisor to the Prime Minister of Pakistan on National Security and Foreign Affairs, was a special guest.

Professor M.S. Swaminathan made a presentation on LANSA and Meeting the Zero Hunger Challenge, highlighting the problem of malnutrition in South Asia, explaining the transition of focus from food security to nutrition security. He stressed the need to simultaneously address the three main dimensions of hunger: calorie deficiency, protein deficiency and micronutrient deficiency / hidden hunger. The major challenges ahead, he maintained, would be food losses and food waste; climate change, temperature, precipitation, and sea level rise; shrinking per capita land and water resources; expanding biotic and abiotic stresses; adverse cost-risk-return structure of farming; market volatility; and the lack of demographic dividend because of the reluctance of youth to adopt farming.

Promotion of bio-fortified crops, need for population control, trade-off between commercial and food crops and its impact on nutrition, ensuring affordability of essential staples, effective land and water use policy were some of the points that came up in the discussions that followed. It was suggested that in a vein similar to the aims of LANSA, SAARC countries should share best practices with one another. If India could help Pakistan on issues such as wheat productivity this could also help reduce the potential conflict between the two countries.

Dr. Sartaj Aziz in his special remarks emphasised the great need for complementarity between India and Pakistan. He said that one should learn from Professor Swaminathan that unless one studied issues related to the farmer community, it would be difficult for agricultural research to be meaningful; and that improved nutrition could not be discussed without talking about poverty reduction as they are interrelated.

Consultation on New Opportunities for Nutritious Foods and Climate Smart Agriculture, 21 August 2014, Delhi

The various studies and research outcomes from the project on alleviating poverty and malnutrition in agri-biodiversity hotspots of India (APM) were discussed during the National Consultation on New Opportunities for Nutritious Foods and Climate Smart Agriculture in Delhi, in which stakeholders from government, development and multilateral agencies participated.

Dr. Peter Kenmore, FAO Representative in India, spoke about the importance of traditional and local knowledge in his inaugural address. Dr. J. S. Sandhu, Agriculture Commissioner, Government of India, decried the waning interest in millets and described the various efforts being taken by the Government of India in the area of millets under the Food Security Mission.

The research outcomes of APM ranged from increasing farm productivity, enhancing food and nutrition security, farm livelihood diversification, ICT for increasing development impact, and capacity building of community-based organisations (CBOs) for sustainability. The recommendations of the consultation included advocacy for promotion, procurement and distribution of nutritious millets in the PDS; effective extension; reduction of gender, social and economic barriers; productivity in agro biodiversity hotspots; improved access to water; nutrition training; education; technology and mechanisms for CBOs to work effectively with other organisations.

Annual General Body Meeting of Nallavur Agriculture Farmer Producer Company Limited, 29 September 2014, Kooteripattu, Villupuram

The Nallavur Agriculture Farmer Producer Company Limited, initiated in 2013, held its first annual general body meeting at Kooteripattu village. Over 1680 members participated in a rally, and the progress report for 2013-2014 and the action plan for 2014-2015 were presented. During the occasion, the Bank of India CSR project on the bio-village programme was launched by Mr. Kulbhushan Jain, General Manager Bank of India. He also inaugurated the construction of the sluice and weir of the Nallavur village lake. With the support of Asia Initiatives, the social capital credit system (SoCCs) programme was also launched.

Workshop on Using Optifood Tool for Diet Analysis, 8 to 10 October 2014, Chennai

A three-day workshop on using the Optifood tool for diet analysis was conducted by MSSRF with LCIRAH (The Leverhulme Centre for Integrative Research on Agriculture and Health). Faculty from various Food Science and Nutrition colleges, researchers from the National Institute of Nutrition, UNICEF and MSSRF attended the workshop, numbering fifteen in all. Elaine Ferguson from LCIRAH conducted the workshop.

Optifood is a software using linear programming developed by WHO that can be used to make population-specific food-based recommendations and rapid diet formulations;

it can also evaluate existing recommendations and identify the need for alternative nutrition intervention strategies to address nutrients that cannot be provided in adequate amounts using local foods and the population's food patterns. Participants learnt to use the software with various practical examples to develop low cost diets for a population using local foods to meet their nutritional requirement. There was overwhelming request for a follow-up workshop where data from India can be used to develop food-based recommendations.

International Training on Plant Genetic Resources, 27 October to 9 November 2014, Jeypore; 10-14 November 2014, Chennai

In collaboration with the Centre for Development Innovation, Wageningen University and Research, the Netherlands, MSSRF organised an international training course on Plant Genetic Resources and Seeds: Community Resilience in the Face of Change: On-farm Management of Diversity for Empowerment at Jeypore, with the concluding session at Chennai. In all, 25 participants attended, from Armenia, Bhutan, Ethiopia, Ghana, India, Kenya, Malaysia, Mexico, Nigeria, Sudan, Tanzania, Thailand, Uganda and Zimbabwe. This is the fifth year that this training is being conducted.

The overall objective of the training programme was to enhance participants' capabilities to include community biodiversity management (CBM) as an integrated strategy for managing plant genetic resources for food and agriculture (PGRFA) and building community resilience towards climate change. The training drew upon experience among partners — LI-BIRD (Local Initiatives for Biodiversity, Research, and Development) Nepal; EOSA (Ethio-Organic Seed Action), Ethiopia; and Santa Catarina Federal University, Brazil — in the global CBM and Resilience project, initiated under the Benefit Sharing Fund of the International Treaty on PGRFA; special attention was paid to participatory and multi-stakeholder approaches, placing CBM into relevant local, national and international policy contexts.

Annual General Body Meeting of Kulumai Federation, 28 October 2014, Kannivadi

The sixth annual general body meeting of the Kulumai Federation was held at Kannivadi. Over 1800 members participated from 225 SHGs, of which a majority were women agricultural labourers. During this occasion, their annual report was released, reporting activities such as initiation of new microenterprises, low cost toilet construction, nutritional garden promotion, facilitation of access to productive resources, etc., along with progress made in accessing the rural finance sector. Also, the financial report of the Federation was submitted to its members. Senior representatives from MSSRF, the Rural Development Department, NABARD, and other Bank and government officials participated in the meeting. New micro-enterprises for livelihood and awareness generation activities were announced.

Annual General Body Meeting of Reddiyarchatram Sustainable Agriculture Producers' Company Limited, 29 October 2014, Kannivadi

The annual general body meeting of the Reddiyarchatram Sustainable Agriculture Producers Company Limited (RSAPCOL) was attended by over 1100 men and women farmers, as well as by officials of horticultural and marketing boards, Banks, NABARD, veterinary department, and private input dealers, among others. The activities of the past year as well as proposed plans for the coming year were presented, along with the financial status of the organisation. The issues on collective marketing were discussed in detail; also described was the initiative to promote life-long learning among men and women farmers in the region using different tools, including farm schools. As a part of the event, a cold chamber unit was inaugurated which will help farmers to sell their products according to market situations.

Technology Platform Meeting on Farming System for Nutrition, November 2014, Bhubaneswar; December 2014, Jeypore; February 2015, Nagpur

Meetings of the Technology Platform and Stakeholder Platforms (see SPA 802) constituted to support the FSN study in Koraput and Wardha were convened at Bhubaneswar in November 2014, Jeypore in December 2014 and Nagpur in February 2015, for feedback and suggestions on the ongoing study and for leveraging partnerships. The prevailing socio-economic and nutrition status in the study areas based on analysis of baseline surveys conducted and the on-farm demonstrations undertaken were presented at these meetings, and suggestions sought on the FSN intervention design. Technology institutions like the Central Institute for Cotton Research, agriculture and veterinary universities, Central Tuber Crops Research Institute and Nirmal Seeds have been partnering the on-farm demonstrations.

Annual General Body Meeting of Innuyir Grama Sangam, 13 December 2014, Puducherry

The annual general body meeting of Innuyir Grama Sangam, the grass-roots institution in Puducherry, started with a mass rally of 1800 members. It was flagged off by Mr. Praveer Ranjan, IPS, Inspector General of Police, Puducherry, along with Mr. Ruthrakumar, i/c Director of Prosecution, Puducherry, and Dr. Ajay Parida, Executive Director, MSSRF. The highlight of the event was the inauguration of the unit to produce cattle feed (under the brand name KAMATHENU). The model cattle feed unit is run by a 7-member team adopting low-cost production technology using local resources. MSSRF will provide technical guidance, inputs, and strategies to scale up and market the cattle feed. Pulses production under the biovillage pilot programme was also launched on the occasion.

Consultative Meet of Single Women Farmers and Farm Labourers, 15 December 2014, Ralegaon

The initiative for the empowerment of single women farmers and farm labourers in Vidarbha gaining momentum across 60 villages of Wardha and Yavatmal districts held its day-long consultative meet of single women farmers and farm labourers in Ralegaon, with over 190 single women farmers/farm labourers participants. In addition, external resource persons from Working Group on Women and Land Ownership, Ahmedabad, and Domestic Women Workers Union, Thane, interacted with the participants. The interactions helped the understanding of issues of social security and livelihoods of aged single women farmers / farm labourers, with emphasis on issues pertaining to productive resources, rights and entitlements. Suggestions including need to give specific times in a day, week and month for Ekal Nari Sangh activities and allotting work according to the potential and ability of the individual, were made. The consultative meet concluded with the formation of Ekal Nari Sangh of Ralegaon block.

DNA Club Festival, 28-30 December 2014, Jeypore

A three-day DNA Club Festival was conducted at MSSRF, Jeypore with 46 students (25 boys & 21 girls) and 9 teachers from DNA Club schools in 9 districts of Odisha. Various competitions like debates, essay writing, model making, poster and quiz competitions were conducted and prizes were awarded to successful students. The two best all round performers were awarded the Green Gold Boy and Green Gold Girl prizes.

Sixth Indian Youth Science Congress, 19-21 January 2015, Guntur

The 6th Indian Youth Science Congress was held at Guntur, in partnership with SRM University, Rajiv Gandhi National Institute of Youth Development, and the host, Acharya Nagarjuna University. The Congress was inaugurated by the Minister of State for Science & Technology, Shri Y. Sujana Chowdary and Andhra Pradesh Agriculture Minister Shri P. Pulla Rao. There were 914 delegates from 14 States participating under 3 categories via posters/ oral presentations. The theme, Science and the Zero Hunger Challenge, was appropriate as 2015 marks the beginning of the UN Decade for Sustainable Development. Cash awards were given for best oral presentations and posters to recognise and encourage young scientists to innovate and develop entrepreneurial skills.

The highlight of this Congress was a farmers' interactive session with Professor M. S. Swaminathan, with over 200 farmers sharing their concerns and challenges.

Multi-stakeholders Consultative Meeting on Coastal and Marine Zone Management, 28-29 January 2015, Chennai

A multi-stakeholders' consultative meeting on coastal and marine zone management was held at MSSRF, Chennai. Representatives from academic institutions, Central and State governments, NGOs and industry participated.

The 2-day panel discussions covered the following topics:

- Current status of coastal zone management
- Coastal biodiversity and bio-resources management
- Implications of coastal regulation zone (CRZ) on livelihoods
- Implications of CRZ on industry and development
- Capacity building for CRZ mapping
- Capacity building for coastal zone management (CZM) planning

The major points that emerged during the meeting included demarcation of the high tide line along coastal areas, mangrove management, marine environment regulation, development projects with safeguards, definition of terms such as 'critical vulnerable area' and the urgent need to demarcate the hazard line. The recommendations from the consultative meeting were shared with the relevant government departments.

Launch of Fisher Friend Mobile Application, 2 February 2015, Chennai

The MSSRF-Qualcomm–TCS partnership developed the Fisher Friend Mobile Application in Android platform for fisherfolk in Tamil Nadu and Andhra Pradesh. After several rounds of feedback from the users, the application was refined to provide information on potential fishing zones, sea surface conditions and weather of the day, besides other information. The application was launched in the inaugural session of the NVA Fellows Convocation by Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences, Government of India and Ms. Shawn Covell, Vice President, Qualcomm. To commemorate the launching of FFMA, new mobile sets with the application loaded were given to 4 master trainers from Nagapattinam and Rameswaram.

Ninth Grameen Gyan Abhiyan Convention, 2-3 February 2015, Chennai

The 9th National Convention of Grameen Gyan Abhiyan was on the Role of Information Communication Technologies (ICT) in Achieving Sustainable Development Goals and Zero Hunger Challenge. The focus was to address the growing gap between food production and hunger deaths with ICT playing a critical role in providing timely information and knowledge to rural communities, especially farmers, fisherfolk and women entrepreneurs. The two-day Convention had 30 scientists from as many public, private, research, international and academic institutions sharing their knowledge and experiences on the various technologies adopted for knowledge dissemination that result in improving livelihoods of farmers. The key recommendations included capacity building of knowledge disseminators in rural areas, people-centric approach for policy, ICT infrastructure improvement and high-speed network connectivity in rural areas and information access, including video-conferencing facilities.

Tenth Convocation of Jamsetji Tata National Virtual Academy, 2-3 February 2015, Chennai

MSSRF commemorated the tenth anniversary of the Jamsetji Tata National Virtual Academy

(NVA) with the tenth Convocation of NVA Fellows. The event honoured and inducted 231 Fellows, including 66 women from 15 Indian States, and 6 International Fellows from Myanmar, Tanzania and the Philippines. Dr Shailesh Nayak, Secretary, Ministry of Earth Sciences, Government of India, expressed happiness at seeing so many rural women and men with practical knowledge in the field recognised in a national forum. Ms Shawn Covell, Vice President, Quallcom described the work of these rural men and women as unmatched and congratulated the Foundation for identifying and honouring them. The directory containing the profiles and expertise of the Fellows was released in the Convocation. Prior to the convocation, a participatory knowledge management workshop for NVA Fellows was conducted on1 February 2015.

Dialogue on Gender, Caste and Change in Agrarian Society, 6 February 2015, Chennai

A dialogue on gender, caste and change in agrarian society was organised in a conversation mode between Professor Nitya Rao of the University of East Anglia and Dr. Amit Mitra, independent consultant at MSSRF. The dialogue focused on how changes in social, political and economic spheres are impacting the lives, livelihoods and power relations of rural women and men. The major issues discussed included institutions and micro changes, migration, labour and markets, changes in the caste-based hierarchy, education, improvements in science and technology, and so on.

Wayanad Community Seed Fest 2015, 6 February 2015, Wayanad

Wayanad Community Seed Fest 2015 was inaugurated by Sri K. P. Mohanan, Minister for Agriculture, Kerala in an event held at the Community Agrobiodiversity Centre campus, organised by the Wayanad District Tribal Development Action Council (WDTDAC) and SEEDCARE along with MSSRF, Kerala State Biodiversity Board, NABARD and local self-governments.

Guardians of traditional seeds, including Sri Cheruvayal Raman, affectionately called *Vitthachan* (father of seeds), were felicitated at the event. Kurichya families of Peruvati and Palookappil and a Kuruma family of Nochanvayal were given the Community Agrobiodiversity Award 2015, instituted by WDTDAC, for their agrobiodiversity conservation efforts. The inauguration was followed by a seminar on the Role of Local Self-Governments in Conserving Agrobiodiversity, an interface between farmers, scientists, practitioners and civil society.

Reinforcing Resilience of Poor Rural Communities in the Face of Food Insecurity, Poverty and Climate Change through On-farm Conservation of Local Agro-Biodiversity, 17-18 February 2015, Chennai

The final meeting of the III and IV phases of the International Fund for Agricultural Development Neglected and Underutilized Species (IFAD NUS) project on ***r***einforcing

the resilience of poor rural communities in the face of food insecurity, poverty and climate change through on-farm conservation of local agrobiodiversity took place at MSSRF, Chennai. Attended by the national project team and representatives from Bioversity and IFAD, the meeting aimed to impart achievements, constraints and challenges experienced during the implementation of the project and to share and learn from other stakeholders such as partner NGOs, academics, private sector institutions, and farmers' organisations involved in on-farm conservation in the country.

Key recommendations:

- ***In situ* Conservation**: Strengthening network of custodian farmers and validation of traditional knowledge on landraces for climate resilient traits
- **Cultivation**: Empowering farmers, disseminating improved practices and reducing drudgery by gender-friendly processing equipment
- **Consumption**: Partnering with various institutions and media and including NUS in social welfare programmes
- **Commerce**: Popularising millets and their products and partnering with socially responsible private sector businesses

Strategic Review of the Food Security and Nutrition Situation in India, 21 February 2015, Delhi

World Food Programme (WFP) entrusted MSSRF with the task of developing a strategic review document to provide a comprehensive and detailed understanding of the food security and nutrition situation in India through the lens of the Zero Hunger Challenge and to include an evaluation of the existing situation in India, including government policies and schemes as well as efforts of UN agencies, civil society actors and the private sector.

The draft Report was presented at a consultation at New Delhi attended by representatives from academia, bureaucracy, national and international NGOs, UN agencies, etc. Important suggestions pertaining to the content as well as organisation of the Report were received during the consultation.

Professor Venkatesh Athreya prepared this report along with consultants from the National Institute of Nutrition and, the National Institute for Research in Tuberculosis; Dr. V. Prakash, former Director, CFTRI and Mr. Biplab Sarkar of the Indian Statistical Institute also provided relevant inputs. Following this consultation, the final report was submitted to WFP.

Fifth Meeting of the Programme Advisory Committee of the Mahila Kisan Sashaktikiran Pariyojana, 22 February 2015, Nagpur

The fifth meeting of the Programme Advisory Committee of the Mahila Kisan Sashaktikiran Pariyojana (MKSP) was held at CICR, Nagpur. Professor M.S. Swaminathan, Chairman of the Programme Advisory Committee, explained how a small initiative of MSSRF has become a national programme that covers 3250 women farmers across 60 villages in Wardha and

Yavatamal districts. He spoke of access to credit, market, technology, land and resources as being crucial for the well-being of women farmers and the importance of MKSP in addressing these concerns.

Kishor Jagtap and Prashant Deokar, MSSRF, made presentations on the progress of MKSP, highlighting significant achievements over the past year and pointing out areas of focus for the current year, including Federation formation, launch of a credit programme and promotion of income-generating activities. Seven women farmers shared their experiences, followed by discussions. A video film produced by MKSP women farmers, with the support of Digital Green titled 'Samiti meeting' was screened. Advisory Committee members appreciated the confidence of the women farmers which indicated that a major benefit of the MKSP programme has been in raising their self-confidence, self-esteem and self-reliance.

DST-National Training on Agro-biodiversity, 24-28 February 2015, Jeypore

The Department of Science and Technology, Government of India supported a one-week national training programme on agro-biodiversity conservation and sustainable livelihoods at MSSRF, Jeypore. There were 22 participants representing 7 states — Tamil Nadu, Andhra Pradesh, West Bengal, Rajasthan, Jharkhand, Himachal Pradesh and Odisha — and universities and organisations such as Birsa Agricultural University, Sambalpur University, Berhampur University, Directorate of Oilseeds Research, Central Rice Research Institute, Tamil Nadu Agricultural University, Utkal University, Tamil Nadu Department of Agriculture, Silk and Sericulture Research Centre, Odisha and ANGRAU (Acharya N.G. Ranga Agricultural University). The resource persons were from National Bureau of Plant Genetic Resources (NBPGR), Protection of Plant Varieties and Farmers' Rights Authority (PPVFRA), Central Rice Research Institute (CRRI), *Orissa University of Agriculture and Technology* (OUAT) and World Agroforestry Centre (ICRAF) along with senior officials of MSSRF.

The overall objective of the training programme was to enhance participants' capacities to understand the present status of agro-biodiversity from a global, regional and national perspective and the manner in which agro-biodiversity contributes to sustainable livelihoods of the resource-poor farmers living in marginal environments.

Seminar on Gender and Nutrition, 6 March 2015, Chennai

There were two presentations during a seminar on the theme Gender and Nutrition that was organised to observe International Women's Day. Dr. Swarna Vepa made a presentation on women's agency and nutrition outcomes, examining the association of aspects of women's agency like work participation and education level with the nutrition status of children. Dr. G. N. V. Brahmam, retired Scientist, National Institute of Nutrition, Hyderabad spoke on the nutrition status of women and children in rural India.

Using the results of the National Nutrition Monitoring Bureau (NNMB) surveys of 10 States, he highlighted the nutrition status of the population in rural areas, with particular focus on women and children.

Key takeaways from the day's event were that women are significant actors within the food system, but are regularly disempowered in some parts of the country, and that women's roles are important for strengthening the link between agriculture and nutrition.

Panel Discussion on Land Rights for Women Farmers, 24 March 2015, Chennai

Ms. Lalitha Kumaramangalam, Chairperson, National Commission for Women, Ms. Rukmini Rao from Gramya Resource Centre for Women, Hyderabad, and Ms. Geeta Ramaseshan, Senior Advocate, participated in a panel discussion on land rights for women farmers. The Women Farmers' Entitlements Bill, 2011 introduced in the Rajya Sabha in 2012 by Professor M. S. Swaminathan served as the background resource material.

Setting the context for the discussions, Ms. Mina Swaminathan, Distinguished Chair, Gender and Development, MSSRF, pointed out that while 80 per cent of the work in agriculture was done by women, their actual ownership of land was only 13 per cent. Ms. Lalitha Kumaramangalam was of the firm opinion that lack of control over their financial resources is the main reason for violence against women in India, and that to reduce such systemic violence, inclusion of women in planning and policy frameworks was essential. Dr. Rukmini Rao appealed for holistic support towards rights of farming, fisheries, forest rights and livestock. Based on discussions through the MAKAAM (Mahila Kisan Adhikar Manch) network for women farmers across 16 States, she presented a charter of 100 demands to the Chairperson, National Commission for Women, appealing for support to implement existing laws and encouraging legal literacy for the community. Ms Geeta Ramaseshan reiterated this aspect, emphasising on nurturing paralegals to strengthen the system. Citing various legal provisions for women under different religious laws, especially with regard to property and inheritance, she stressed the need for women to write a will, for their own safety. At the end, Professor Swaminathan highlighted the need to engender the research agenda.

Programme Area 800

SPECIAL PROJECTS

The three-and-a-half year project on Alleviating Poverty and Malnutrition in Agro-biodiversity Hotspots (APM) implemented in three agro-biodiversity rich regions of India —Jeypore in Odisha, Kolli Hills in Tamil Nadu and Wayanad in Kerala — formally came to an end in August 2014. Several policy-related research studies were completed under the project during the year. Interventions under the Farming System for Nutrition study in the two locations under LANSA are being designed based on the analysis of the baseline survey data on nutrition status of the population and prevailing crop and animal husbandry practices. The Rice Biopark at the Yezin Agriculture University, Nay Pyi Taw, Myanmar, has been completed and is ready for inauguration in October 2015; 12 different modules for demonstration and training for the local farmers in the development of various rice and agriculture products have been set up.

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Boosting agriculture for addressing malnutrition and eliminating poverty

Programme Area 800

Special Projects

The research-for-development project on alleviating poverty and malnutrition in agro-biodiversity hotspots (APM) investigated the possibilities for interventions in integrated agricultural systems to contribute towards alleviating poverty and malnutrition among small-holder farm families. Studies were undertaken to understand the operation of the major food security schemes — Public Distribution System (PDS), Mid-Day Meal Scheme (MDMS), Integrated Child Development Services (ICDS) and Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) — at the 3 project locations in Odisha, Kerala and Tamil Nadu and make recommendations for policy. Studies on policy determinants of household economic development as well as on wild foods were also undertaken.

As part of ongoing research under Leveraging Agriculture for Nutrition in South Asia (LANSA), 3initiatives were identified for detailed study of the agri-food value chain with a nutrition focus. The baseline surveys under the Farming System for Nutrition (FSN) study were completed and the data analysed. Three meetings of the technology and stakeholder platforms were convened during the year. The FSN interventions at Wardha and Koraput are being designed based on the nutrition status of the population, the prevailing crop and animal husbandry situation and feedback from stakeholders. A Farmers' Knowledge Centre was inaugurated at Saheli village in Wardha in November 2014. MSSRF has taken over as consortium lead for Research Uptake (RU) activities from May 2015.

Sub Programme Area 801

Alleviating Poverty and Malnutrition in Agrobiodiversity Hotspots

The APM project implemented in 3 agro-biodiversity-rich regions of India, namely, Jeypore in Odisha, Kolli Hills in Tamil Nadu, and Wayanad in Kerala, ended during the year. This research-for-development project worked in close partnership with communities and established that integrated agricultural systems with concurrent attention to knowledge transfer and harnessing local agro-biodiversity can provide cost-effective and sustainable solutions to poverty and malnutrition. The project also attempted to enhance capacity and human skills for making appropriate choices and decisions on farm management, family diet, and adoption of new enterprises. Five distinct objectives were addressed: 1) increasing farm productivity; 2)improving food and nutrition security, especially for women; 3) diversification of on- and off-farm livelihood sources; 4) training and capacity building; and 5) knowledge management and policy advocacy through carefully-defined, environmentally- sustainable, location-specific and gender-sensitive interventions. In the process, an innovative approach was taken to

resolve the enigmatic contradiction between prosperity of nature and poverty of people, involving multiple actors with comparative advantages to integrate technological, policy and institutional components that respond to changing poverty, nutrition, market and policy conditions.

The team was engaged in the end-line survey data collection in Jeypore, Kolli Hills and Wayanad for a period of 3 months from May to July 2014. This was followed by data entry and submission of data to the University of Alberta for analysis. A summary of the research studies done under the project is given below.

Review of Indian policies related to food security

Analysis based on primary and secondary data was undertaken to study the operation of PDS, MDMS, ICDS and MGNREGS in the 3 project sites. It was found that these programmes have had positive impacts on the lives of sections of the populations in all the sites.

- **PDS:** In the Kolli Hills, supplies were regular, the products sold in PDS retail outlets were seen as being of good quality, the outlets were within a km of the habitations, a range of commodities such as pulses, edible oil, kerosene, dhal and wheat were available at the notified price and in adequate quantity as per the norms. In Jeypore, rice was in regular supply, and all card holders bought it from PDS. Malpractices in weighing and black marketing of PDS grains were also, however, reported.
- **MDMS:** The MDMS in schools seems to be functioning relatively smoothly and regularly at all 3 sites. Among problems reported in Jeypore were poor infrastructure for cooking, costs of firewood and raw food materials, lack of a separate staff for running MDMS and uneven quality of meals. In all 3 sites, respondents wanted MDMS to identify local sources of nutritive foods, including millets, in order to increase variety in food served to the children.
- **ICDS:** Though ICDS is functioning at all the 3 sites, implementation requires improvement. The demographic composition is such that Jeypore sees the highest proportion of sample households availing ICDS. Given the workload of the ICDS field functionaries, it is not possible for them to ensure that all adolescent girls, pregnant women and lactating mothers receive their supplementary nutrition entitlements regularly.
- **MGNREGS:** Using policy claim literature and 12 focus group discussions across the 3 project locations, it was found that a) the scheme offered employment as a last resort, but the wages were too low; b) there was a differentiation of wages paid to MGNREGS workers, despite the assertion in most groups that there was a common wage for all workers; c) the method of payment for MGNREGS work varied both between and within sites, d) unemployment insurance was not mentioned by participants in any of the sites, even though it is a key component of

MGNREGS policy; e) the implementation of MGNREGS seemed to provide labourers with more power, thus influencing labour relations in ways that were advantageous for "at-risk" workers; f) women were more likely to use MGNREGS, but substantial barriers to this programme meeting their needs was evident. In particular, the type of work and lack of adequate childcare were the main barriers identified.

Policy determinants of household economic development

As part of the study on policy determinants of household economic development, an analysis of poverty in Wayanad was undertaken for 5 time periods (2013-14, previous year, five years ago, 10 years ago and 20 years ago). An inter-temporal comparison of households that were beneficiaries of the government programmes/welfare schemes in relation to their income, expenditure and poverty status throws light on the fact that there has been a shift in poverty levels over the last 5 years. A continuous decline observed in the number of the poor indicates that some of beneficiary households have indeed escaped the poverty trap. The risk factors associated with the households falling back to poverty need to be identified and analysed in tandem with the role and relevance of these poverty eradication policies.

In Jeypore and Kolli Hills, a study was undertaken with the overall goal of understanding how government policies and services can help households to escape poverty traps in rural India in general, and for rural areas in particular. The specific research objectives of the study were to:

- identify the existence of poverty traps among households in rural India
- evaluate the determinants of the existence of (or departures from) poverty traps with focus on examining the role of local implementation of government policy and programmes in the study locations
- examine heterogeneity in the effect of the policy determinants —whether they are substitutes or complements at different levels of regional aggregation

The study computed head count ratio by employment category for both the locations. An attempt was made to understand the changes in probability of being poor, or in poverty, using different parameters. For example, with the change from having no children of 0-6 years old to 1 child, there is a possibility of sliding down to poverty by 16.3 per cent in the case of Jeypore and 9.4 per cent in the case of Kolli Hills. However education, employment and public policy such as MNREGS play an important role in enhancing income for households. Local people are themselves diverse, with sharp contrasts of preferences and priorities by age, gender, social and ethnic group, and wealth. Hence, targeting for a poor-less state or a country can be achieved if synergy between public policy and local environment related to poverty can be addressed.

Studies on wild foods

A research study to understand the knowledge and use of wild foods and neglected and under-utilised crop species either to tide over scarcity or to supplement diets in rural areas was initiated in the Kundra block of Jeypore. Additionally, studies were also conducted at the Wayanad and Kolli Hills sites. A research scholar also undertook documentation of wild foods at the Kolli Hills site. The research methodology for the studies included getting prior informed consent, documenting the traditional knowledge, species used, collection, access and usage issues, erosion of knowledge, declining species and other related issues regarding wild foods through focussed group discussions , semi-structured questionnaires and transect walks. Specific gender-related information was collected. A few species were tested for their nutritive values.

The studies from Jeypore and Wayanad showed that in both sites, thickets, scrub jungles and forest areas are places for collection, implying issues in accessing such areas; wastelands, fallow fields, plantation areas, water bodies, etc., are other areas for sourcing wild edibles. A large number of leafy greens (43 in Wayanad, 46 in Jeypore), followed by fruits (30 in Wayanad, 42 in Jeypore), tubers (15 in Wayanad, 20 in Jeypore), and mushroom (21 in Wayanad, 8 in Jeypore) from the wild are consumed by the communities at these 2 sites. The initial exploratory study showed that there is a decline in the consumption of such species due to availability of market-purchased food and erosion of knowledge regarding wild edibles. Wild edibles are not just important for food security but can play a role in the nutritional security of poorer communities, by providing invaluable micronutrients in their diet. The research also analysed the nutritive value of 7 wild yams (*dioscorea* species) and compared it with the commercially available tuber food. *Dioscorea* species collected from wild showed high carbohydrate values 53-75 g/100g; a few species showed high protein values between 8.39 **±** 0.07 and 9.08 **±** 0.07 per cent, which is not seen in cultivated tubers; low values of fat (less than 2 per cent) and high polyphenolic content were also seen. Value addition and innovative usage of wild edibles were also undertaken during the research phase. Revitalising traditional knowledge and setting up demonstration plots of wild edibles were some of the other activities undertaken. A 15-minute film on wild foods titled, Wild Edibles for Nutrition and Food Security was produced.

Another study was carried out in two villages of Valappur Nadu in Kolli Hills to examine foraging, trapping and hunting for wild foods from commons across seasons, and the roles of women and men. Data was gathered through a survey covering a total sample of 40 tribal households. The survey recorded diversity of wild food species across different food groups and their household consumption. The results depict the significant contribution of women to the household food basket, mostly during the rainy season, which they fulfil by foraging greens, vegetables, mushroom, fruits, roots and tubers. Men are more involved in trapping and hunting.

Promoting positive dietary behaviour among women and children

A rapid assessment of nutritional issues prevailing among women and children of Valappur Nadu of Kolli Hills was undertaken. Discussion with medical staff of the primary health centre (PHC), review of records maintained by the PHC as also physical observation revealed that iron-deficiency anaemia among adolescent girls, ante-natal mothers and post-natal mothers was widespread in the project area. Records of the PHC indicated that the birth weight of children was in the range of 1.5 to 2 kg against the normal of 3 kg. Observation and interaction with parents of children under age-five revealed that more than 90 per cent were suffering from multivitamin deficiency. Food habits of the people were identified as one of the major causes for prevalence of nutritional disorders. Decline in consumption of millets and vegetables were attributed to decline in area of these crops cultivated. A baseline survey on knowledge, attitude and practices was undertaken among 143 adolescent girls, ante-natal women and post-natal women. Key findings related to practices showed that nearly 50 per cent of the respondents ate vegetables fewer than 5 days in a week, and nearly 43 per cent ate green leafy vegetables fewer than 3 days in a week.

The results indicated that lack of knowledge, negative attitudes and non-availability of foodstuff (vegetables, millets, fish, etc.) and services (distribution of iron tablets from PHC) were key areas of concern. Accordingly, a nutrition literacy programme was designed with the objective of promoting positive dietary behaviour among adolescent girls, ante-natal mothers and post-natal mothers through a behaviour change communication strategy consisting of the following elements:

- Increasing positive knowledge and attitude related to consumption of nutritious food to prevent iron and vitamin deficiencies (knowledge and attitude intervention)
- Increasing access to services related to iron supplementation from Public Health department (access intervention)
- Increasing consumption of iron- and vitamin-rich millets and vegetables among women and children (access intervention)

Communication materials such as flip charts, fixo-gram, hanging cards, pairing cards and posters on health and nutrition were developed. Posters and wall paintings were displayed at common and strategic points in the villages to create basic awareness about nutrition. Street theatres, puppet shows, video films were also used. A training module consisting of 12 sessions about nutrition and hygiene was developed and education programmes conducted at village, school and residential school levels. Cooking demonstrations were also organised. Some of the people were involved in self-monitoring and a large number of school students participated in the non-invasive Hb testing camps followed by counselling.

Some of the access interventions like establishment of kitchen gardens were already an integral part of the project. Interventions

like distribution of iron and de-worming tablets, and promotion of fish consumption in diets were made. The behaviour change communication methods used were found to have a positive effect on the knowledge of the target groups, but did not get translated into adoption of practices. The school-based nutrition education programme was found to be effective in imparting knowledge among adolescent girls. Open defecation is seen as an important factor responsible for anaemia. More than 95 per cent of the households in the project area do not have toilet facilities and people defecate in the open. Promotion of use of toilets is likely to help. A manual in Tamil and a handbook on nutrition for use by health animators/nutrition volunteers has been prepared.

Assessing complementary feeding practices of young children

Inappropriate complementary feeding practices after 6 months of age in young children are responsible for high levels of undernutrition in children. Simple, valid, and reliable tools are lacking to measure child feeding in the context of programme development, for designing and targeting interventions, and for monitoring and evaluating progress. It is in this context that a study was undertaken to attempt developing a tool for assessing complementary feeding practices of young children. Children in the age group of 9, 10, 11 and 12 months from 16 villages in the Kundra block of Koraput district in Odisha were studied.

A set of key infant and young child feeding practices considered as determining nutritional outcomes in children were identified through a review of literature. These were initiation of breastfeeding, age of introduction of complementary feeding, presence of protein / iron / vitamin A rich food in the daily diet, adequacy of number of times of feeding and dietary diversity. In addition, an observation tool comprising of 8 items, including consistency of food, caregiver strategies, child response and hygiene behaviour, was also developed. Some household typologies such as caste, landlessness, type of family, access to forest, etc., considered as having an association with young child feeding were also included in the study.

A household survey schedule for eliciting the feeding practices and household typologies was developed and field tested. The observation schedule consisted of the following parameters: consistency of food, hygiene practices before feeding, feeding devices used, adult caregiver interaction, child's response to feeding and portion consumed. The feeding episode during the observation was also videographed with permission from parents, and shown to experts to validate the observations of the field staff. A 24-hour recall method was used to estimate child food intake. Prior to this, common household recipes were standardised to understand their nutritive value. Nutritional status assessment of children was done using anthropometry. Heights and weights were taken and children were classified as normal, stunted (inadequate height for age) and wasted (inadequate weight for height).

Key findings

Overall, the breastfeeding and complementary feeding practices were found to be sound. All mothers were breastfeeding at the time of the study and nearly 72 per cent had not delayed complementary feeding; 65 per cent of the children were found to be having a minimum acceptable diet of 3meals a day and having 4 food groups in the everyday meal. However, the dietary quality was poor with only 38 per cent and 8 per cent, respectively, having protein and iron / vitamin A sources in their daily diet. The mean food intake of children in the age group of 9,10,11 and 12 months were 300 g, 266 g, 345 g and 376 g, respectively. The diets of only 9children were found to be energy-dense, giving 1calorie per gram of food; only 25 per cent of children's food was found to be adequately mashed; only 28 per cent appeared hungry and ready to eat at the time of feeding; about 60 per cent were disinterested after a few mouthfuls. While 53 per cent ate less than half the portion in the plate, only 14 per cent of children finished their portions. These observations corroborate the finding that the mean food intake of children does not increase appreciably with increasing months of age. Only 45 per cent of children in the overall sample were normal. About 20 per cent were stunted and an equal percentage were wasted and 15 per cent were both stunted and wasted. Nutritional status steadily declined as the children became older. However, there was no correlation between the quantum of food intake and nutritional outcomes, which could be because part of the calorific need was met through breast milk which has not been accounted for and estimates of food intake were based only on homemade meal preparations and did not include ready-to-eat food purchased and given to children, especially those in the older age group. The number of normal children was few and not evenly distributed across age in months in the sample, for any meaningful comparison.

Household typologies did not have a bearing on nutritional outcomes, except when mothers were separated from their children for a considerable period of time which could have affected breastfeeding and which involved feeding by caregivers. The study highlights the need to include observation of a feeding episode as an important component for inclusion in the tool for assessing complementary feeding practices and has identified a checklist of practices to be studied in depth to arrive at the final tool. Further research with equal number of normal and undernourished children for each month of age is needed to arrive at visual quantitative estimates of food needs. A manual of common household recipes with their nutritive values has been developed for practical use by field functionaries while imparting nutrition education.

Dissemination and communication of the APM studies and project outcomes were mediated through the website www.ua-mssrf.org, press coverage and nearly 100 poster paper presentations and peer-reviewed published research papers. During the period September to November 2014, the team prepared the final technical report of the project and also

revised the APM Going to Scale (G2S) proposal based on the comments received from the reviewers. This phase was however not sanctioned.

Sub Programme Area 802

Leveraging Agriculture for Nutrition in South Asia

Research studies made progress and research uptake and capacity strengthening activities were undertaken with regard to the 3 themes under the Leveraging Agriculture for Nutrition in South Asia (LANSA) project. MSSRF also coordinated overall consortium activities as the lead institution of the LANSA research programme consortium.

Research

An overview of the ongoing work and progress made under the 3 research themes is highlighted below.

Enabling environment for connecting agriculture and nutrition

Work under this theme addresses issues related to the importance of an enabling environment for the reduction of under-nutrition, and explores how agriculture and food systems can be linked to the underlying determinants of nutrition such as women's status, poverty-induced food insecurity and poor sanitation.

Five papers were produced using state, district and household level data on different aspects of enabling environment of women's agency, water, sanitation and health and their effects on agriculture-nutrition links in India:

- Agriculture and child under-nutrition in India: A state level analysis
- Farm production diversity, household dietary diversity and women's BMI in rural India
- Women's agency and child underweight rates in India in the context of agriculture: A district level analysis
- Agricultural productivity and high burden of malnourishment: A district level analysis
- Child under-weight and agricultural productivity in India: Implications to public provisioning and women's agency

The broad conclusions emerging from the studies helped in understanding the nature of agriculture-nutrition linkages and the enabling conditions that impact positively on child nutrition and the directions where policy level thrust is required:

- The link between growth in GDP from agriculture and child nutrition outcomes is weak; but the links between agricultural land productivity and child nutrition are stronger, albeit nuanced. These links appear to relate to both agricultural and non-agricultural work opportunities, and to increase in productivity of both food and non-food crops.
- The availability of health and sanitation services is very relevant for better nutrition outcomes. Services such as full vaccination

and administration of oral rehydration salts (ORS) have stronger links to child nutrition, though it is not clear whether the services are provided by the public sector or private sector.

- Diversity in crop production along with livestock ownership at the household level leads to better dietary diversity of the household and is associated with higher BMI for women in the household.
- Women's education together with women's work participation at the district level, seem to be associated with reduction in the incidence of child underweight.

Agriculture policies and strategies for making agriculture and agri-food value chains pro nutrition

Focusing on policies, MSSRF has proposed undertaking a study to assess the implications and impact of introducing millets in the PDS. This will have direct policy relevance in the light of the provisions in the Food Security Act for inclusion of millets in the PDS. On agri-food value chains in South Asia, a collaborative multi-country study using a common framework and methodology is underway with the Collective for Social Science Research (CSSR) in Pakistan, BRAC in Bangladesh, MSSRF in India and the Institute of Development Studies (IDS), UK. A country review of pro-nutrition value chains in India, Pakistan and Bangladesh, under the 3 categories of naturally nutrient-dense foods (e.g. millets), foods with increased nutritional value (e.g. fortified milk, biscuits) and food distribution (e.g. food delivery under mid-day meal programme), was completed last year. The India country review selected 40 cases for evaluation from a list of 122, based on a set of exclusion and inclusion criteria. Following this, researchers from the partner institutions met in BRAC, Dhaka in October 2014 and identified initiatives for detailed case studies in each country. The focus of research under each case study will be on how agri-food value chains can bring about substantive and sustained consumption of nutrient-dense foods by poor households, with a particular focus on children and adolescent girls.

The initiatives identified for the study in India are:

- Integrated Child Development Service (ICDS): This will examine the value chain of delivery of both hot cooked meals at ICDS centres and fortified food. The study will attempt to understand the advantages and disadvantages of systems of delivery operating in two States — Andhra Pradesh and Tamil Nadu — and the implications of the same for policy makers.
- Amul Spray as a fortified weaning food to examine how effective a business driven initiative is in reaching infants of poor households
- Tiger Brand Biscuits of Britannia Industries to examine the supply chains through which nutrient-enriched products can reach target households

Pro-nutrition agriculture interventions and their impact

MSSRF's Farming System for Nutrition (FSN) study explores the feasibility of tailoring agricultural support to resolve defined nutritional problems in rural communities in two different agro-ecological zones — Koraput in Odisha and Wardha in Maharashtra. Both are rain-fed farming areas. While agriculture in Koraput is characterised by subsistence farming, in Wardha, it is commercial farming. The study villages in both the areas have been classified as 'FSN villages' where intensive farming systems and nutrition-focused interventions will be undertaken, and 'non-FSN villages' where there will be some form of engagement to maintain continuing rapport. In Koraput, a cluster of 7 villages covering 658 households with a population of 2845 comprise the FSN villages, and 4 villages covering 263 households with a population of 1113 are the non-FSN villages. In Wardha, a cluster of 5 villages covering 556 households with a population of 2254 comprise the FSN villages and 3 villages covering 266 households and a population of 1033 comprise the non-FSN village cluster. During the year, focus was on completing baseline surveys in the 2 study locations. The purpose of the surveys was to build a baseline by capturing information on demographic and socio-economic characteristics, crop and animal husbandry profiles, nutrition status of the population in terms of anthropometric indicators, biochemical analysis of blood samples and food and nutrient intakes based on 24-hour dietary recall as well as access to resources, decision making and time use by gender. The FSN design at the 2 locations is being given shape, based on the picture emerging from analysis of the data collected. Entry point activities have been undertaken in all the FSN villages at both sites. Two papers, one on the FSN protocol and the other on operationalising FSN, were published during the year.

Socio-economic characteristics

A large proportion of the population (40 per cent and above) belong to the Scheduled Tribe (ST) community. Open defecation is the predominant practice with 98 per cent of the households in Koraput, while in Wardha it is slightly lower at 75 per cent in the FSN villages and 86 per cent in the non-FSN villages. All the villages have road connectivity. The majority of households in Koraput depend on tubewells for drinking water while the main source is piped water in Wardha. Firewood is the major source of cooking fuel at both locations.

Agriculture profile

Agriculture is the primary occupation of the majority of the population followed by agricultural labour, in both Koraput and Wardha. A sixth of the population is landless in Koraput and 80 per cent have operational landholding of less than one hectare. The proportion of landless is higher in Wardha, ranging from 32 per cent in the FSN villages to 55 per cent in the non-FSN villages. The average size of operational landholding is higher in Wardha and 38 per cent of the households in FSN and 25 per cent in non-FSN villages have landholding of less than

2 hectares. About half of the households in Koraput have homestead land and 80 per cent have some form of livestock holding. In Wardha, only a fifth of the households have homestead land and about 45 per cent of the households have some form of livestock holding.

Paddy dominates the cropping pattern in Koraput; millets and some pulses are also cultivated. Commercial crops (cotton and soybean) are the mainstay in Wardha, with pigeon pea as an intercrop. A small number of farmers with irrigation facility cultivate wheat and Bengal gram during *rabi*.

Nutrition profile

Anthropometric measurements were taken for all members of the households across all the villages and the level of undernutrition calculated for each. The prevalence of undernutrition among adult women (50 per cent in Wardha and 47 per cent in Koraput) is found to be higher than adult men (39 per cent in Wardha and 43 per cent in Koraput) in the FSN villages at both locations.

Blood samples were collected from all children in the age group of 1 to 5 years to test for anaemia and vitamin A deficiency (VAD), and from adolescent girls (12-17 years) and adult women (18-45 years) to test for anaemia. Necessary approvals were taken and village meetings conducted before undertaking the exercise. The blood samples collected were analysed at the National Institute of Nutrition, Hyderabad. High levels of anaemia (above 50 per cent) are observed in all the FSN villages. About a third of the children in the age group of 1 to 5 years are found to be affected by VAD.

Diet surveys based on 24-hour recall method was undertaken with a sub-sample of 150 households each in the FSN and non-FSN village clusters at both Koraput and Wardha. In Wardha, consumption of cereals, pulses and legumes, sugar and jaggery, and fats and oils is at 75 per cent or more of the recommended levels of dietary intake (RDI) given by the Indian Council of Medical Research (ICMR) while that of vegetables and fruits and milk and milk products is very low at less than 20 per cent of the RDI. In Koraput, cereals are consumed in high quantities (150 per cent) as against the RDI but consumption under all the other food groups is low at 60 per cent or less than the RDI.

The data on intake of nutrients calculated from the information on food intake using the nutritive value of Indian foods given by ICMR indicates that in Koraput, all nutrients (proteins, vitamins, minerals, fat and dietary folate) are not consumed adequately and so the consumption of all the nutrients has to be increased. In Wardha, attention is required particularly to increase the intake of calcium and vitamins A and C. Thrust also has to be given to creating awareness on the importance of balanced diets and increasing dietary diversity.

Entry point FSN activities in Koraput

During *kharif* 2014, improved varieties of paddy were made available to farmers and advice provided on better technology practices

like line sowing and efficient fertiliser use. Intercropping of millet and black gram was facilitated. Following up from the experience of *rabi* 2013-14, cultivation of maize, millet and pulses was taken up in the 2014-15 *rabi* season also. Nutrition garden, freshwater aquaculture and backyard poultry activities are ongoing.

Kharif: Under paddy cultivation, prilled urea applicaton and urea deep placement was compared under farmers' method of cultivation and formal method of cultivation for 2 varieties; 89 farmers cultivated improved varieties of paddy over 73 acres, with 15 of them using urea deep placement technique over 15.25 acres. In both cases, grain yield was found to be higher with urea deep placement. Ten farmers were facilitated to intercrop black gram with finger millet, covering 7.5 acres of land. It was observed that the yield of finger millet increased by 49 per cent and that of black gram by 43 per cent under intercrop compared to mixed cropping practice adopted by farmers. The yields were however affected by cyclone Hudhud that struck shortly before harvest time in October 2014.

Rabi: In *rabi* 2013-14, a short duration rice variety was taken for demonstration on 1 acre of land using urea deep placement on half acre and modified practices on the other half; about 20 per cent higher yield was observed with urea deep placement. Intercropping of cowpea with winter maize in 1:2 ratio was undertaken as demonstration of a cereal-pulses combination on 0.5 acre of a farmer's field. Three qtl of maize and 0.6 qtl of cowpea were harvested from the plot. In the case of maize, 20 per cent higher yield was observed compared to the average productivity of this area. The pulses crops, green gram and black gram, were damaged due to low temperature and water scarcity. Intercropping finger millet with black gram (4:2) was undertaken on 0.3 acres of land. Due to cool climatic conditions, very poor yield was observed in black gram (15 kg); finger millet yield from the plot was however 60 kg. During *rabi* 2014-15, improved varieties of seeds of maize, black gram, green gram and pea were made available to farmers. Seeds of rice and finger millet and black gram collected from farmers' fields following the *kharif* harvest were also used. Seven farmers intercropped maize with black gram; 15 hectares of land covering 78 farmers was brought under green gram. The data collected is being analysed.

Freshwater aquaculture and backyard poultry: Group fish farming has been initiated in 23 ponds across 4 villages involving 145 farmers. Each group comprises 5 to 7 members. In August 2014, 23000 fingerlings of *catla, rohu, mrigal* and grass carp were released. Locally suited practices are being employed. The first harvest has been done in 10 ponds. Of the total of 166 kg fish harvested, about half was consumed by the members, a portion given as payment to those engaged for harvesting the fish and the balance sold within the villages.

Backyard poultry was introduced as an activity in late 2013 with 10 chicks each of *Banaraja* variety being given to 15 landless families from

the 7 FSN villages. Some of the chicks were however fatally affected by *Ranikhet* disease and only 34 per cent of the birds survived. Twelve households reported that average production was 63 eggs per household over three 20-day cycles; the remaining 3 households did not have a female bird. Out of the total production, 61 per cent was consumed and remaining 39 per cent was sold within the village. Average production of meat was 5.4 kg per household of which 55 per cent was consumed and the rest sold.

Nutrition garden: A total of 199 households from across the 7 villages have been supported to start nutrition garden activity on homestead land or on a patch of their farm land. During *kharif* 2014, fruit-bearing plants and other tree species like papaya, drumstick, banana, custard apple, guava, pomegranate, lemon, curry leaf and *bauhinia purpurea* (a wild leafy vegetable) were distributed according to the land availability of each household. This was followed up with making available planting material of seasonal vegetables like amaranthus, spinach, coriander, cabbage, carrot, tomato, bitter gourd, ridge gourd, cucumber, pumpkin and cluster bean to 120 of the households during *rabi* 2014-2015. Maize has also been cultivated by 62 farmers in the nutrition garden. Households have been given nutrition garden cards to record the produce harvested and data collection is being streamlined.

Sweet potato, including 3 orange-fleshed varieties, was cultivated by 69 farmers in their vegetable garden during *kharif* 2014. Of the total produce, 46 per cent was consumed by the farmer households, 44 per cent sold and the rest distributed among neighbours and relatives. During *rabi* 2014, 102 farmers have cultivated sweet potato in the nutrition garden. A model nutrition garden (40 m x 15 m) with a low-cost drip irrigation system has been established in the office campus to demonstrate efficiency in water use. The garden consists of fruit-bearing plants (papaya, banana, custard apple, guava, pomegranate, lemon) drumstick, curry leaf and *bauhinia purpurea* along with seasonal vegetables of all the 3 groups of vegetables — green leafy, roots and tuber — and other vegetables. Besides these, yam, beans and 3 varieties of sweet potato (two orange-fleshed and one normal variety) have been planted in the garden. Planting materials of elephant foot yam, *dioscorea*, colocasia, yam bean has been collected from the garden this year. Nearly 400 farmers visited the garden and got exposure on nutrition gardens and seasonal vegetable rotation.

Entry point FSN activities in Wardha

Delay in onset of monsoon by more than a month resulting in delayed sowing, deficit rainfall and moisture stress during the end period of the crop were challenges faced by farmers during the year. This affected the yield and performance of all the crops. Performance of soybean in particular was affected by lack of availability of seed for re-sowing. A Farmers' Knowledge Centre was inaugurated in Saheli in November 2014. It has helped facilitate greater rapport with the community. A special effort to promote cultivation of root and tubers in the nutrition garden is being attempted.

Planting material of sweet potato, cassava and colocasia obtained from the regional centre of the Central Tuber Crops Research Institute (CTCRI) at Bhubaneswar have been sown for multiplication.

Kharif*:* Cotton cultivation under the high density planting system (HDPS) is being promoted with the technical guidance and support of the Central Institute for Cotton Research (CICR), Nagpur. Under HDPS, early maturing varieties are grown in narrow row spacing, resulting in more plant population. It has the advantage of a lower cost of cultivation including lower seed cost. Following up from the experience of 20 farmers in *kharif* 2013, 30 farmers cultivated 30 acres with *Suraj* variety cotton under HDPS in *kharif* 2014. Less square shedding character of the variety was preferred by the farmers. Further, insect resistance management (IRM) helped in managing insect population; the increase in the population of beneficial insects leading to reduction in the number of sprays was highly welcomed by farmers. Thirteen farmers intercropped the cotton with green gram and 17 of them intercropped with pigeon pea. The average yield of cotton was 6.9 qtl/ha. The experience with HDPS and IRM in cotton has been encouraging and show potential for improving farmer incomes.

During project initiation, very few farmers were cultivating sorghum; however after observing the performance of the improved variety during demonstrations, farmers expressed interest in cultivating the crop this year. Seventeen acres was cultivated with improved variety of sorghum by an equal number of farmers. Increased area under the crop this year resulted in reduced damage by birds. Although the crop yield was affected by erratic monsoon, farmers were able to sell fodder at Rs. 20 to 25 per bundle. Pigeon pea seems to be the most suitable of the pulses in this area of varying slope, soil type and rainfall. Besides intercrop with cotton, 6 farmers cultivated pigeon pea as a sole crop. Crop growth was however affected by deficit rainfall, and wilt attack was a challenge. Twenty-nine farmers cultivated green gram as an intercrop/sole crop/mixed crop. But delayed monsoon affected germination in some cases and erratic rainfall thereafter affected crop yield. Cultivating green gram during *kharif* can provide both food and fodder in a season where other crops are predominantly for commercial purposes.

Rabi: During *rabi* 2014-15, 78 farmers have cultivated 56 acres with a micronutrient dense variety of wheat (28 acres), gram (15 acres), *rabi* sorghum (12 acres) and linseed (5 acres). Onion planting material is being multiplied by 17 farmers. Improved varieties of wheat — AKAW 4210, NIAW 1415, GW 496 — were promoted and taken up by 28 farmers. The highest yield recorded was 5012 kg/ha. Bengal gram cultivation was taken up by 18 farmers. The highest yield recorded was 3972 kg/ha. Eleven farmers cultivated sorghum but the crop was damaged by birds and wild pigs. Farmers have however been able to get fodder for their animals. Groundnut is being tried out as a summer crop this year by 4 farmers.

Animal husbandry and fishery: Fish farming was introduced in 3 farm ponds with technical support and guidance from the Maharashtra Animal and Fishery Sciences University (MAFSU). The ponds were stocked with 2500 fish fingerlings. The stocking was delayed due to late onset of monsoon and 2 of the 3 farm ponds dried up early this year due to low water availability. However, in one of the old farm ponds where there is permanent water, stock growth is being observed. An animal health camp was conducted in Saheli village by the district Department of Animal Husbandry in August 2014. Experts from MAFSU visited the field sites last year and have given suggestions on activities that can be undertaken, including fodder cultivation. A MoU has been signed with the University for collaboration under the study.

Farmer's Knowledge Centre: The abandoned building of the sub-health centre in Saheli village made available by the panchayat was renovated and inaugurated as a Farmer's Knowledge Centre in November 2014. The Centre has a library, a garden of nutritious vegetables, tubers and fruits and also a vermi-compost pit. It has now become a regular meeting place for farmers in the village and has helped create greater synergy within the community. Two plant clinic camps were conducted with the help of colleagues from the IEC programme. A health camp was conducted in collaboration with Acharya Vinoba Bhave Rural Hospital, Wardha and 375 individuals were examined; 80 patients were further referred for various treatments.

Nutrition garden*:* Community nutrition gardens (CNG) managed by groups of women farmers have been operating in 3 villages; however, 2 of the villages have not been able to sustain the group effort and the initiative has slackened. CNG volunteers have now been appointed in the 3 villages to monitor maintenance and operation by the members and record produce. In spite of problems, the produce per family was seen to have increased this year due to early initiation in July, better choice of crops and better management. Backyard nutrition gardens (BNG) were initiated by 176 households across the 5 FSN villages last year with support for seed as well as guidance on maintenance. These BNGs provided additional vegetables to the families (1.2 kg of green leafy vegetables and 7.6 kg of other vegetables per family) for household consumption. The production and consumption is recorded by each household in nutrition garden cards given to them. Lack of availability of water and space as well as damage by domestic animals are said to be the main constraints for such small-scale production.

Following a MoU with the Ramkrishna Bajaj College of Agriculture, Wardha, a model nutrition garden was set up on the college campus. This has a well-planned layout for the different categories of vegetables. The maintenance is monitored by a faculty member from the Horticulture department and students work on the garden for practical experience. The produce goes to the students' hostel. As the garden develops, regular exposure visits of farmers to the garden and sourcing of planting material from there are planned.

Technology and stakeholder platforms

Besides regular discussion with the village community, a technology advisory group of research institutions and private sector companies and a stakeholder group comprising district government functionaries, NGO representatives and farmers' groups has been constituted at each location, to forge collaboration, leverage strengths and receive constructive suggestions. Meetings of the technology and stakeholder platforms were convened at Nagpur in February 2015 for the FSN study in Wardha and in Bhubaneswar in November 2014 and Jeypore in December 2014 for the FSN study in Koraput (see SPA 705).

The Central Institute for Cotton Research (CICR), the Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV) and Nirmal Seeds have been supporting the crop and technology interventions under the FSN study in Wardha. MAFSU provided guidance for the fishery intervention and further collaboration is set to ensue from this year. A MoU was signed with them in June and a animal health camp was conducted in all the villages by faculty and staff of MAFSU on 14 June 2015. In Koraput, CTCRI, the Orissa University of Agriculture & Technology (OUAT) and the Central Rice Research Institute (CRRI) have been supporting the crop and technology interventions.

Community Hunger Fighters

As part of the nutrition awareness generation strategy it was decided to train a cadre of village-level volunteers as community hunger fighters (CHFs) on the lines of the initiative under Programme Area 500. The CHFs are selected by the village community following discussions with them on what is envisaged. They are given training on various aspects like balanced diets, kitchen gardens, importance of eating vegetables, accessing entitlements, safe drinking water, health and nutrition of mother and child and child feeding practices. In Wardha, 5 males and 3 females from the FSN villages were selected to undergo training as CHFs; the training in ten modules including field exposure visits was spread over 3 months and conducted by MSSRF staff from PA 500. In Koraput, the programme had been initiated earlier in 3 of the seven villages. CHFs have been identified in the remaining 4 villages and training has to be organised for them.

Going forward, based on the nutrition status of the population at the 2 sites, the prevailing crop-animal husbandry status and the experience gained from the entry point activities, the FSN intervention design for *kharif* 2015 has been finalised.

Research Uptake

Taking a cue from the stakeholder interviews conducted in early 2014 as part of the research under enabling environment, 3 capacity strengthening workshops on tools for accessing evidence-based research was organised by MSSRF in collaboration with the Institute of Development Studies (IDS), UK in June 2014. The purpose was to help agriculture and nutrition stakeholders access, use and assess the quality of research evidence available to them.

A short documentary film was made on the FSN intervention study. The film is a first attempt to communicate the FSN concept to stakeholders; it has been uploaded on LANSA's YouTube channel as part of the communication and dissemination strategy — https://www.youtube.com/watch?v=Mwx2xq-U9oU.

The social media strategy for LANSA was finalised and operationalised during the year. A social media campaign was organised to observe National Nutrition Week in September 2014 and draw stakeholders to the LANSA website and Facebook page. In November 2014, MSSRF and LANSA partnered with HarvestPlus for an interactive online webinar, What's Next for Bio-Fortification Post-Kigali? The web-based conference was targeted at stakeholders in South Asia and was very relevant to the LANSA partners' regions. The Research Uptake (RU) lead was invited to give a presentation on the new, experimental and innovative techniques adapted to communicate LANSA research in India at the ResUp MeetUp Symposium in February 2015 at Nairobi, Kenya. The RU approach and strategy was received well, and there was a lot of interest around the FSN film as well as on the social media campaign around the National Nutrition Week.

To generate stakeholder interest around the agri-food value chain research study, a 3-day Online Dialogue was organised in February 2015 using the IDS-Eldis platform. RU played a vital behind-the-scenes role in organising, disseminating, facilitating and reporting on the same. From India alone, 61 stakeholders registered and there was more than 50 per cent contribution. A LANSA e-newsletter for stakeholders in India was launched in March 2015. It is a bi-monthly publication. The same month, RU organised a media interaction and field trip for journalists from Nagpur and Wardha to the FSN study villages. Several news articles were published in the regional and national press as a result of this exercise.

MSSRF is now responsible for Research Uptake for the whole Consortium with IDS handing over charge in May 2015. The process was initiated from October 2014 with a handover strategy developed for systematic shifting of responsibilities from IDS to MSSRF; it culminated in April 2015 with Julia Powell, the RU Manager at IDS handing over charge to Sangeetha Rajeesh of MSSRF.

RU facilitated an online discussion from 18 May to 5 June 2015 on FAO's Food Security and Nutrition Forum platform to get inputs from stakeholders for LANSA's second Responsive Window call due in early July. The objective was to identify potential ideas of innovations in agriculture, which could promote better nutrition in South Asia that can feed into the call for proposals. A blogpost, Are There Any New Ideas in Nutrition-sensitive Agriculture? was up on the World Bank's Secure Nutrition website preparatory to this. This partnership with FAO and Secure Nutrition enabled LANSA to reach out to a wider group of stakeholders.

Capacity strengthening

Capacity strengthening for researchers in the organisation and the region is an important

LANSA mandate. Training was organised in Aug-Sept 2014 on the tools and techniques of participatory rural appraisal (PRA) for researchers working on the FSN study.. This was conducted from 18-22 August 2014 at the FSN study site in Koraput with the help of resource persons from MSSRF and a local language speaking resource person. Participants reported a 66 per cent increase in knowledge and skill level at the end of the workshop. The PRA exercise has since been completed in all the 12 FSN project villages and reports prepared. Tying up with the training in Accessing evidence based research using social media network organised by RU in Bhubaneswar and Hyderabad for capacity strengthening of researchers and decision makers, a day's training was organised for researchers at MSSRF in June 2014.

In October 2014, MSSRF with Elaine Ferguson from LCIRAH as resource person organised a 3-day workshop on using the Optifood tool for diet analysis (see SPA 705).

The RU officers from CSSR, BRAC and MSSRF were supported to participate in a capacity strengthening workshop as part of the ResUp MeetUp Symposium and Training Exchange organised by IDS and the African Institute for Development Policy (AFIDEP) in February 2015 in Nairobi.

Coordination

Consortium Management Team meetings are now held on the third Thursday of every month via conference call arranged from MSSRF, Chennai. The Consortium Advisory Group (CAG) meeting was held at the University of Agriculture, Faislabad in August 2014. The Vice Chancellor of the University, CAG member Iqrar Ahmed Khan, hosted the meeting. The Vice Chancellor (Relationship Coordination), Afghanistan National Agricultural Sciences and Technology University (ANASTU), Kandahar, Abdul Rashid Hakimi, was a special invitee to the meeting. At the CAG's recommendation, he has since been invited to be a full member of the CAG. A meeting on agriculture nutrition linkages was also organised in Faislabad in August 2014 (see SPA 705).

The LANSA Annual Partners' meeting was held at BRAC, Dhaka in October 2014. The Consortium Steering group meeting was also held during this period. Five of the six CSG members attended the main partners' meeting as well and gave valuable suggestions. The CMT and CSG met in April 2015 at IDS and reviewed progress of work.

Four studies focusing on enabling environment and agri-food policy were selected for funding under the first Responsive Window Call in October 2014; contracts have been drawn up between the grantees and MSSRF and the studies are underway. Three of the studies have an India focus while the fourth covers India and Bangladesh.

Sub Programme Area 803

International Projects

MSSRF's project, supported by the Ministry of External Affairs, Government of India,

on establishing a Rice Biopark at the Yezin Agriculture University, *Nay Pyi Taw*, Myanmar, has been completed. The project consists of a number of small-scale units for producing various marketable commodities, a training centre with residential facility, storage facility and administrative building and an integrated knowledge centre. This centre will provide demonstrations for producing commodities like stabilised rice bran, cattle and poultry feed, improved livestock feed by increasing protein content of rice straw, oyster mushroom using paddy straw and husk and also facilitate cleaning hulling, polishing, grading and packaging of rice.. Technical support from the Central Food Technological Research Institute (CFTRI), Mysore, Indian Food Processing Institute, Thanjavur, and other organisations have been established for providing need-based training to faculty members and farmers from Myanmar. The Biopark will be ready for inauguration by October 2015.

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Janakiraman, A. Creating Institutional Repository Using DSPACE, Kerala Agricultural University. Mannutty. 26-27 March 2015.

Jegan, S. Indo Swiss Collaboration in Biotechnology. Student Exchange Programme. University of Basel. Basel. 20 March-20 May 2015.

Khillo, J, 6th Indian Youth Science Congress. Acharya Nagarjuna University. Guntur. 19-21 January 2015.

King, E. D. Israel Oliver. International Dialogue on Food Security. University of Alberta, Edmonton, Canada. 30 April-2 May 2014.

King, E. D. Israel Oliver. Collaborating for Research and Promotion of NUS in Nepal: Sharing Workshop. LIBIRD, Pokhara. 23-24 February 2015.

Kumar. N. Workshop on Attracting Youth in Agriculture (ARYA-II), Tamil Nadu Agricultural University and M. S. Swaminathan Research Foundation. Coimbatore. 5-6 April 2014.

Kumar. N. Indian Biodiversity Congress. SRM University, Kattankulathur Campus. Chennai. 18-20 December 2014.

Kumar. N. 6th Indian Youth Science Congress, Acharya Nagarjuna University, Guntur. 19-21 January 2015.

Lakshmana Rao, A. 6th Indian Youth Science Congress. Acharya Nagarjuna University. Guntur. 19-21 January 2015.

Lenka, K. C. National Seminar on Organic Agriculture. Palampur. 28-30 May 2014.

Lenka, K.C. 6th Indian Youth Science Congress. Acharya Nagarjuna University. Guntur. 19-21 January 2015.

Lenka, K. C. Seminar on Biodiversity and Conservation Initiatives of Koraput Region. School of Biodiversity and Conservation of Natural Resources, Central University of Orissa. Koraput. 28-29 March 2015.

Menon, Manjula. Workshop on Cross Indian Ocean Region Climate Risk Management. The Commonwealth Scientific and Industry Research Organization (CSIRO) and the Australian Department of Foreign Affairs and Trade (DFAT). Colombo. 24-26 September 2014.

Menon, Manjula. Seminar on Non-Market Valuation of Ecosystem Services of Pallikaranai Marshland: A Contingent Valuation Approach. Madras Institute of Development Studies. Chennai. 28 November 2014.

Menon, Manjula. Training on Programme Evaluation. South Asian Network for Development and Environmental Economics (SANDEE) & Duke University. Kathmandu. 3-6 December 2014.

Menon, Manjula. Research and Training Workshop on Environmental and Natural Resource Economics. SANDEE, Kathmandu. 7-11 December 2014.

Menon, Manjula. Technical Workshop for Stakeholders for the Project Adaptation to Climate Change in Asia (ACCA). Commonwealth Scientific and Industry Research Organization (CSIRO), Australia and Telengana State Agricultural University. Hyderabad. 9 April 2015.

Menon, Manjula. Socio Economic Research Methodology. Indo-Swiss Collaboration in Biotechnology. Bern University of Applied Sciences School of Agricultural, Forest & Food Sciences (HAFL), Bern. 20-21 April 2015.

Mishra, C. S, R. Mahana and Seema Tigga. International Dialogue on Food Security. University of Alberta, Edmonton, Canada. 30 April-2 May 2014.

Mishra, C. S. and Seema Tigga. Preparation of an Approach Paper on Gender Mainstreaming, Bangalore. 11-12 August 2014.

Mohanty, B. 6th Indian Youth Science Congress. Acharya Nagarjuna University. Guntur. 19-21 January 2015.

Mohanty, B and M. Aurthor Gill, Training on Fish Production. Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar. 28 February-2 March 2015.

Nag, G.C. 6th Indian Youth Science Congress. Acharya Nagarjuna University. Guntur. 19-21 January 2015.

Nagarajan, R. Satellite Observations and Products for Agro-meteorological Applications. Indian Institute of Remote Sensing. Dehra Dun. 1-5 December 2014.

Nampoothiri, K. U. K. National Consultation on Oil Palm and All India Coordinated Palms Project Workshop. Hyderabad. 26-27 July 2014.

Nampoothiri, K. U. K. National Seminar on Sustainability and Profitability of Plantation Crop Farming. Central Plantation Crops Research Institute (CPCRI). Kasaragod. 22-23 August 2014.

Nampoothiri, K. U. K., S. Swain and A. K. Panda, Knowledge and Technology Platform Meeting on Farming System for Nutrition. Bhubaneswar. 17 November 2014.

Nayak, J. National Seminar on Organic Agriculture. Palampur. 28-30 May 2014.

Nithya, D. J. South Asia Conference on Policies and Practices to Improve Nutrition Security. Coalition for Food and Nutrition Security. New Delhi. 30-31 July 2014.

Nithya, D. J. Sector Specific Workshop on Nutrition and Keeping Girls in School. DASRA, Mumbai. 8-10 December 2014.

Nithya, D. J. Training on Monitoring and Evaluation of Developmental Intervention. SAMBODHI. New Delhi. 28-30 January 2015.

Padhan, B. National Seminar on Organic Agriculture. Palampur. 28-30 May 2014.

Padhi, J. Workshop on Evidence-based Research. Directorate of Research on Women in Agriculture (DRWA). Bhubaneswar. 23 June 2014.

Panda, A. K. Workshop on Evidence-based Research. Directorate of Research on Women in Agriculture (DRWA). Bhubaneswar. 23 June 2014.

Panda, A. K. South Asia Conference on Policies and Practices to Improve Nutrition Security. New Delhi. 30-31 July 2014.

Panda, A. K. The National Academy of Agricultural Science (NAAS) 12th Agricultural Science Congress. Karnal. 3-6 February 2015.

Panda, A. K, Tribal Conclave on Nourishing India's Tribal Children. UNICEF, Bhubaneswar. 15-16 January 2015.

Parameswaran, Prajeesh. Introduction to the UPOV System of Plant Variety Protection under the UPOV Convention. Distance Learning Course (DL-205). World Intellectual Property Academy, Geneva. April-June, 2014.

Parameswaran, Prajeesh. Plant Variety Protection Course. Centre for Development Innovation, Wageningen UR and Naktuinbouw, the Netherlands. 16-27 June 2014.

Parida, P. K. Tribal Conclave on Nourishing India's Tribal Children. UNICEF, Bhubaneswar. 15-16 January 2015.

Patro, N.C. 6th Indian Youth Science Congress. Acharya Nagarjuna University. Guntur. 19-21 January 2015.

Phate, Sonali M. National Children's Science Congress 2014-15. Jalgaon. 29-30 November 2014.

Prabavathy, V.R. IFAT: India's Leading Trade Fair for Water, Sewage, Refuse and Recycling. Mumbai. 9-11 October 2014.

Prabavathy, V.R. Indo-Swiss Collaboration in Biotechnology, Biofertilization and Bioirrigation (ISCB-BIOFI) Network Partner Meeting. Bern University of Applied Sciences School of Agricultural, Forest & Food Sciences (HAFL). Bern. 17-18 March 2015.

Rajeesh, Sangeetha. Media Curriculum Workshop on Marine and Coastal Biodiversity. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) India. Mumbai. 23-24 July 2014.

Rajeesh, Sangeetha. Training in Data Journalism. International Centre for Journalists USA. New Delhi. 5-7 September 2014.

Rajeesh, Sangeetha. Training of Trainers in Participatory Methods of Effective Content Delivery. GIZ India. New Delhi. 11-13 September 2014.

Rajeesh, Sangeetha. WTO, India and Agriculture Seminar. Observer Research Foundation (ORF). Chennai. 20 December 2014.

Rajeesh, Sangeetha. ResUp MeetUp Symposium and Training. Nairobi.10-13 February 2015.

Rajeesh, Sangeetha. Conference on Nutrition & Food Security, Confederation of Indian Industry (CII), Chennai. 17 March 2015.

Rajkumar, R. National Seminar on Climate Change and Water: Improving Water Use Efficiency. Water and Land Management Training and Research Institute (WALAMTARI), Hyderabad. 13-14 November 2014.

Raju, S. Training on Monitoring and Evaluation of Developmental Intervention. SAMBODHI. New Delhi. 28-30 January 2015.

Rengalakshmi, R. Regional Conference on Achieving Gender Mainstreaming through Convergence. Ministry of Women and Child Development, Asian Development Bank and UN Women. Bangalore. 12 May 2014.

Rengalakshmi, R. Workshop on Women's Economic Empowerment: Achieving Gender Equality. WORLD Policy Analysis Centre, University of California and Landesa. New Delhi. 27-28 August 2014.

Rengalakshmi, R. Workshop on Cross Indian Ocean Region Climate Risk Management. The Commonwealth Scientific and Industry Research Organization (CSIRO) and the Australian Department of Foreign Affairs and Trade (DFAT). Colombo. 24-26 September 2014.

Rengalakshmi, R. Inception Meeting of a Project on Gender and Energy. ENERGIA and ETC Foundation. Geneva. 9-14 Feb 2015.

Rengalakshmi, R. Indo-Swiss Collaboration in Biotechnology, Biofertilization and Bioirrigation (ISCB-BIOFI) Network Partner Meeting, Bern University of Applied Sciences, School of Agricultural, Forest & Food Sciences (HAFL), Bern. Switzerland. 17-18 March 2015

Samantray, P.C. 6th Indian Youth Science Congress. Acharya Nagarjuna University. Guntur. 19-21 January 2015.

Sivakumar. M. N. Workshop on Attracting Youth in Agriculture (ARYA-II), Tamil Nadu Agricultural University and M. S. Swaminathan Research Foundation. Coimbatore. 5-6 April 2014.

Sivakumar. M. N. 6th Indian Youth Science Congress (Acharya Nagarjuna University. Guntur.19- 21 January 2015.

Smitha, K.P. Organic Farming, Training Material: State-level Workshop on Organic Farming. Vegetable and Fruit Promotion Council Keralam. Kochi. 9 January 2015.

Srinivasan, S. Workshop on ICT for Agriculture and Water Resource Management. Information Technology Research Academy (ITRA). Hyderabad. 6-8 January 2015.

Srinivasan, S. Workshop on Introduction to Plant Pest and Disease Risk Forecasting. Water and Land Management Training and Research Institute (WALAMTARI) and International Water Management Institute (IWMI). Hyderabad. 7 January 2015.

Suma, T. R. National Seminar on Family Farming: Agroforestry Options for Food, Nutritional and Ecological Security in Humid Tropics. Thrissur. 21-23 December 2014.

Swain, S. Conference on Biodiversity Conservation and Sustainable Development in Odisha. Odisha Biodiversity Board. Bhubaneswar. 22 May 2014.

Swain, S. Workshop on Socio-Economic Assessment of Coastal Resource- Based Livelihood Activities for the Coast of Odisha. Bhubaneswar. 24 September 2014.

Swain, S. Second South Asia Conference on Decentralization and Poverty Reduction. Thiruvananthapuram. 27-29 November 2014.

Swain, S. Workshop on Climate Change and a Global Research Agenda for High Altitude Agriculture in Central Asia and India. American Association for the Advancement of Science and World Academy of Sciences. Trieste. 9-11 December 2014.

Swain, S. 5th Odisha Environment Congress. Regional Museum of Natural History. Bhubaneswar. 22 December 2014.

Swain, S. Tribal Conclave on Nourishing India's Tribal Children. UNICEF, Bhubaneswar. 15-16 January 2015.

Swain, S. Seminar on Biodiversity and Conservation Initiatives of Koraput Region. School of Biodiversity and Conservation of

Natural Resources, Central University of Orissa. Koraput. 28-29 March 2015.

Tosh, R. 6th Indian Youth Science Congress. Acharya Nagarjuna University. Guntur. 19-21 January 2015. .

Velvizhi, S. Training Programme on Application of ICTs in Fisheries. National Institute of Agricultural Extension Management, Thiruvananthapuram. 7 January 2015.

Velvizhi, S. Intensive Training Workshop on Innovative/Best Practices in National e-Governance Plan:Agriculture & Allied Sectors. Centre for Innovations in Public Systems, Government of India. Port Blair. 24-26 March 2015.

Wagh, Rupal. 6th Indian Youth Science Congress. Acharya Nagarjuna University. Guntur. 19- 21 January 2015.

Awards / Honours

Ganesan, G. 2014. A Short-Term Research Fellowship in the International Rice Research Institute (IRRI), the Philippines.

Muthukumar, S., Balakrishna, K., Karthik, S., Hariharan, G.N. 2015. Third Prize for Poster at 6th Indian Youth Science Congress. Guntur.

Nagarajan, R., S. Punitha and V. Selvam. 2015. Award for Best Poster at the Seminar on Current Status and Future Prospects of Coastal and Marine Biodiversity in Gulf of Mannar. GoMBRT, Rameswaram.

Panda, Akshaya K., Mohanty, Balaji and R. B. Santosh 2015. Second Prize for Poster at 6th Indian Youth Science Congress, Guntur.

Parida, A. 2014. Ruchi Bharat Jyoti Samman, Ruchi Foundation, Odisha.

Parida, A. 2014. President, Biological Sciences, National Academy of Sciences, India.

Parida, A. 2014. Member, Regional Advisory Group for Farms, Farmers and Rural Areas, NABARD.

Prabavathy, V.R. 2014. Best Women Scientist Award, National Academy of Biological Sciences, Chennai.

Selvamukilan, B., S. Nair, S. P. Shanthakumar, V. R. Prabhavathy, R. Rengalakshmi and S. Nakkeeran. 2015. Best Paper Award at the 36th National Conference and National Symposium on Challenges and Management Approaches for Crop Disease of National Importance - Status and Prospectus. TNAU, Madurai.

Sivaprakash, R. 2014. Ramalingaswami Re-entry Fellowship, Department of Biotechnology, Government of India, New Delhi.

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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.

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Society of Integrated Coastal Management, Ministry of Environment, Forests and Climate Change, Government of India, New Delhi	
Tata Power Co Ltd., Mumbai	

Programme Area 200: Biodiversity

Department of Science and Technology, Government of India, New Delhi	Denver Botanic Garden Inc, USA
Directorate of Arecanut and Spices Development, Government of India, Calicut	Food and Agriculture Organization, Rome
India Meteorological Department, Ministry of Earth Sciences, Government of India, New Delhi	International Fund for Agricultural Development, Rome
Indian Council of Agricultural Research, Ministry of Agriculture, Government of India, New Delhi	International Plant Genetic Resources Institute (IPGRI), Rome
	LI-BIRD, Nepal
	Mitsubishi Corporation, Japan
	Rainwater for Humanity, USA

National	*International*
Ministry of Rural Development, Government of India, New Delhi	University of Passau, Germany
National Bank for Agriculture and Rural Development, Mumbai	Wageningen International, The Netherlands
Odisha Livelihoods Mission, Government of Odisha	World Food Programme, Rome
Small Farmers Agribusiness Consortium, New Delhi	
State Medicinal Plants Board, Kerala	

Programme Area 300: Biotechnology

Council of Scientific and Industrial Research (CSIR), Government of India, New Delhi	Food and Agricultural Organization of the United Nations, Rome
Department of Atomic Energy, Government of India, New Delhi	International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad
Department of Biotechnology, Government of India, New Delhi	
Department of Science and Technology, Government of India, New Delhi	
Indira Gandhi Centre for Atomic Research (IGCAR), Government of India, Kalpakkam	

Programme Area 400: Ecotechnology

Bharat Petroleum Corporation Limited, Mumbai	African Centre for Technology Studies, Kenya
Hindustan Petroleum Corporation Limited, Mumbai	Asia Initiatives, USA
Jamsetji Tata Trust, Mumbai	OCP Foundation, Morocco
	The World Food Prize Foundation, Des Moines, USA

National	*International*
Ministry of Earth Sciences, Government of India, New Delhi	
National Bank for Agriculture and Rural Development, Chennai	
VA Tech Wabag Ltd., Chennai	
World Noni Research Foundation, Chennai	

Programme Area 500: Food Security

Medtronic Pvt Ltd, Mumbai	World Bank, New Delhi
Ministry of Rural Development, Government of India	World Food Programme-India, New Delhi

Programme Area 600: Information, Education and Communication

All India Poultry Development and Services Pvt Ltd, Pune	CABI, New Delhi
Coconut Development Board, Ministry of Agriculture, Government of India, Kochi	International Rice Research Institute, Los Banos, the Philippines
District Rural Development Agency, Pudukkottai	Norwegian Institute for Agricultural and Environmental Research, Norway
Indian National Centre for Ocean Information Services (INCOIS), Ministry of Earth Sciences, Government of India, Hyderabad	Qualcomm, USA
Jamnalal Bajaj Foundation, Mumbai	World Wide Web Foundation, USA
Marco Technocraft, Karur	
MARG Karaikal Port Pvt. Limited, Karaikal	
Media Lab Asia, Mumbai	

National	*International*
National Bank for Agriculture and Rural Development, Chennai and Pune	
National Fisheries Development Board, Ministry of Agriculture, Government of India, Hyderabad	
State Planning Commission, Government of Tamil Nadu, Chennai	

Programme Area 700: Cross-Cutting Programmes and Institutional Initiatives

Agricultural Technology Management Agency, Government of Tamil Nadu, Chennai

Coconut Development Board, Ministry of Agriculture, Government of India, Kochi

Department of Biotechnology, Government of India, New Delhi

India Meteorological Department, Ministry of Earth Sciences, New Delhi

Indian Bank, Chennai

Indian National Science Academy, New Delhi

Indian Overseas Bank, Chennai

Kemin Industries South Asia Pvt. Ltd, Chennai

Ministry of Women & Child Development Government of India, New Delhi

National Centre for Sustainable Coastal Management, Ministry of Environment and Forests, Government of India, Chennai

Protection of Plant Varieties and Farmers' Rights Authority, New Delhi

Bern University of Applied Sciences School of Agricultural, Forest and Food Sciences, Switzerland

Commonwealth Scientific and Industrial Research Organization, Australia

ETC Foundation, the Netherlands

Syngenta Crop Protection AG, Switzerland

The Norwegian Institute for Environment and Agriculture Research (Bioforsk), Norway

National	*International*
Rajiv Gandhi National Institute of Youth Development, Sriperumbudur	
Rotary Club, Coimbatore	
Syngenta India Ltd, Pune	
Venkateshwara Hatcheries Pvt Limited, Bengaluru	
Uttara Devi Endowment	

Programme Area 800: Special Projects

Ministry of External Affairs, Government of India, New Delhi	Department for International Development (DFID), UK
	International Development Research Centre (IDRC), Canada

FINANCIAL STATEMENT 2014-15

M.S.SWAMINATHAN RESEARCH FOUNDATION

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

BALANCE SHEET AS AT 31ST MARCH 2015

FOUNDATION (Rupees in Lakhs)

LIABILITIES	SCH	2014-15	2013-14	ASSETS	SCH	2014-15	2013-14
OWN FUNDS				**OWN ASSETS**			
CORPUS FUNDS	1	479.25	139.22	FIXED ASSETS	5	583.70	575.29
GENERAL FUND & OTHER FUNDS	2	3353.89	2909.27	INVESTMENTS	6	6251.90	5900.43
ENDOWMENT FUNDS	3	4531.92	4473.54	CURRENT ASSETS			
CURRENT LIABILITIES	9	565.11	583.81	CASH & BANK BALANCES	7	844.70	530.16
				ADVANCES	8	1249.87	1099.96
TOTAL [A]		**8930.17**	**8105.84**	**TOTAL [A]**		**8930.17**	**8105.84**

PROJECTS

LIABILITIES	SCH	2014-15	2013-14	ASSETS	SCH	2014-15	2013-14
PROJECT FUNDS & OBLIGATIONS	4A	1114.19	1978.76	PROJECTS RECEIVABLES	4C	616.58	575.35
CURRENT LIABILITIES	4B	741.99	783.28	ADVANCES	4D	154.91	591.66
				BANK BALANCES	4E	1084.69	1595.03
TOTAL [B]		**1856.18**	**2762.04**	**TOTAL [B]**		**1856.18**	**2762.04**
GRAND TOTAL [A]+[B]		**10786.35**	**10867.88**	**GRAND TOTAL [A]+[B]**		**10786.35**	**10867.88**

Provisional (Unaudited)

M.S.SWAMINATHAN RESEARCH FOUNDATION

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

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2015

FOUNDATION **(Rupees in Lakhs)**

EXPENDITURE	SCH	2014-15	2013-14	INCOME	SCH	2014-15	2013-14
SALARIES	12	908.57	866.73	INTEREST INCOME	10	794.71	600.23
ENDOWMENT EXPENSES	13	141.85	150.26	DONATION	11	355.28	317.10
MEETINGS & OTHER RELATED EXPENSES	14	97.96	96.38	DST CORE GRANT		545.52	162.81
OTHER ADMINISTRATIVE EXPENSES	15	112.82	171.91	OTHER RECEIPTS			
DEPRECIATION ON FIXED ASSETS	5	46.52	51.62	RENTAL RECEIPTS		18.24	9.52
10% OF ENDOWMENT INTEREST INCOME TRANSFERRED TO ENDOWMENT FUNDS		58.38	43.81	CREDIT BALANCE WRITTEN BACK		13.95	0.47
EXCESS OF INCOME		444.61	(251.85)	MISCELLANEOUS	11	83.01	38.73
OVER EXPENDITURE FOR THE YEAR TRANSFERRED TO THE GENERAL FUND							
TOTAL		**1810.71**	**1128.86**	**TOTAL**		**1810.71**	**1128.86**

Provisional (Unaudited)

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