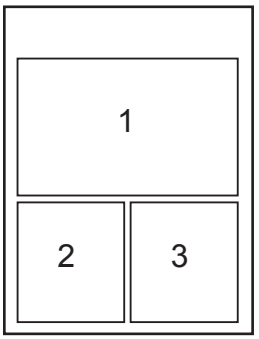
20 Years
LINKING SCIENCE AND SUSTAINABLE DEVELOPMENT
MSSRF

M. S. SWAMINATHAN RESEARCH FOUNDATION

2011-2012
TWENTY-SECOND ANNUAL REPORT

CENTRE FOR RESEARCH ON SUSTAINABLE AGRICULTURAL AND RURAL DEVELOPMENT, CHENNAI



Front Cover

1. Facilitated by MSSRF, the Traditional Agriculture System of Koraput, Odisha, has been recognised as a Globally Important Agriculture Heritage System (GIAHS) by FAO. Dr. Manmohan Singh, Prime Minister of India, handing over the certificate to Ms. Roila Muduli, representative of the tribal community of Odisha, on 3 January 2012 in the presence of Shri Naveen Patnaik, Chief Minister of Odisha.
2. Wayanad District Tribal Development Action Council receiving the Plant Genome Saviour Award 2012 instituted by the Protection of Plant Varieties' and Farmers' Rights Authority, Government of India
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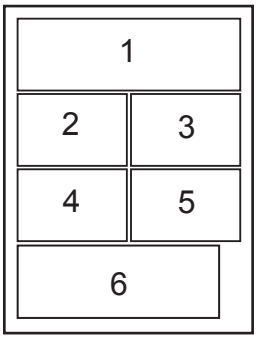

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Twenty-Second Annual Report
2011-2012

M. S. Swaminathan Research Foundation

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

M. S. Swaminathan Research Foundation

Centre for Research on Sustainable Agricultural and Rural Development

Third Cross Road, Institutional Area

Taramani, Chennai 600 113 India

Telephone : +91 (44) 22541229

+91 (44) 22541698

Fax : +91 (44) 22541319

Email : executivedirector@mssrf.res.in; swami@mssrf.res.in

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

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Chairman's Introduction

Shaping the Future We Want

It was way back in 1970 that Professor C. V. Raman seeded the idea in my mind that I should be involved in establishing a research and training centre in the field of applied ecology, relating to the improvement of the productivity, profitability and sustainability of small-farm agriculture. I decided that I could put this into action when I received the first World Food Prize in 1987. On my return in February 1988 from the International Rice Research Institute, the Philippines, I started preparations for the setting up of a research centre with major focus on the sustainable management of coastal ecosystems. Both the governments of Karnataka and Tamil Nadu were kind enough to offer facilities for setting up such a research centre. Chennai was more suitable since Tamil Nadu has a long coastline of nearly 1000 km. The World Food Prize was followed by several other prizes like the Honda Prize for Ecotechnology, Tyler Prize for Environmental Achievement, Sasakawa, Volvo and Blue Planet Environment Prizes, as well as the Indira Gandhi Prize for Peace, Disarmament and Development, all of which helped to meet the financial requirements.

Shri N. Ram, Dr. M.V. Arunachalam and Dr. V.C. Kulandaiswamy played key roles in getting MSSRF established at Chennai by helping to get land and other facilities. I was helped by Dr. Manibhai Desai, Founder President of the Bharatiya Agro Industries Foundation (BAIF), in drafting the trust deed of the Foundation and by Professor V.L. Chopra in registering it at New Delhi. At Chennai, Shri C. Subramaniam was a source of both inspiration and guidance. Right from the beginning my wife Mina has been a partner in this adventure and has played a key role in shaping MSSRF's priorities and core values.

The Foundation was registered in New Delhi on 17 May 1988 as a not-for-profit scientific trust, with me as the Founder Chairperson and Professor V.L. Chopra and Dr. V.K. Ramachandran as the Founder Trustees. The Foundation thus enters its twenty-fifth anniversary this year. Based on a series of scientific consultations, it was decided that MSSRF should be more on the model of a translational research centre devoted to converting scientific discoveries into field applications. This called for research at two ends of the spectrum: participatory research with farming families, on the one hand, and policy research designed to achieve synergy between grass-roots experience and public policy, on the other. It was also decided that the Foundation should concentrate on imparting a pro-nature, pro-poor, pro-women and pro-sustainable livelihood orientation to technology development and dissemination.

MSSRF is designed as an equal opportunity centre for all socially-committed scientists, regardless of gender, age, religion, caste or community — verily a *Vasudhaiva Kutumbakam* in action. It is also a "centre without walls", generating synergy and symbiosis in partnership with similar institutions with similar goals. Mahatma Gandhi's advice that we should keep our windows and doors open so that fresh ideas come from all directions, but that we should keep our feet firmly on the ground has guided the research philosophy. Above all, participatory

research with tribal and rural women and men and anticipatory research to scientifically checkmate the adverse consequences of climate change and sea level rise were chosen as pathways for shaping the future we wanted.

Based on several inter-disciplinary consultations during 1988-89, the following seven areas were chosen for attention by the scientists and scholars of MSSRF:

- Coastal Systems Research, involving concurrent attention to the landward and seaward sides of the coast
- Biodiversity conservation, enhancement and sustainable and equitable use, leading to an era of biohappiness
- Biotechnology as applied to the development of the biological software essential for sustainable agriculture as well as to the creation of novel genetic combinations for resistance to salinity, drought and grain quality
- Ecotechnology based on the integration of traditional ecological prudence and knowledge with frontier technologies and its spread through the biovillage model of human-centered development; the biovillage paradigm also helps to promote an ever-green revolution in agriculture leading to an increase in productivity in perpetuity without associated ecological harm
- Food and Nutrition Security as related to achieving freedom from endemic and hidden hunger
- Information Communication Technology involving the integrated use of the internet, cable TV, community radio, mobile telephony and print media
- Training, capacity building and networking, beginning with children and extending up to fisher and tribal communities

Even at the outset, I must acknowledge the outstanding support received from national and international donors and different scientific departments of the Government of India for undertaking research on the lines mentioned above. Financial sustainability is a must for the sustainability of autonomous institutions. At the same time, the achievements of a scientific institution are based on the innovative spirit and dedication of its scientists and scholars. I have often said that in building institutions, we should move away from an obsession with bricks and concentrate on brains. In his Presidential Address to the US National Academy of Sciences in 2012, Dr. Ralph J. Cicerone made the following comment on the importance of institutional support to creative scientists: 'Institutions can enable the ideas and energies of individuals to have more impact and to sustain efforts in ways that individuals cannot. Good examples are the successful Green Revolution research, field testing and realisation of large increases in agricultural crop yields, as well as current efforts to achieve more effective worldwide immunisation.'

From a small beginning in 1989, MSSRF has grown into a nationally and internationally recognised institution with its own research and training infrastructure at Chennai, Koraput in Odisha, Kalpetta in Wayanad district, Kerala, Puducherry, and Kaveripoompattinam in Tamil Nadu. A laboratory-cum-training centre is also coming up at Chidambaram for the coastal research programme. In addition to the well-developed regional centres in Koraput and Kalpetta, a third major research and training hub is being established in Vidarbha, a region suffering from serious agrarian distress.

I am stepping down as Chair of the MSSRF Board of Trustees on 6 August this year and

this will be my last "Chairman's Introduction" to Annual Reports. Hence for the sake of record, I would like to chronicle some significant facts relating to each Programme Area.

Coastal Systems Research

Nearly one-third of the human population live near the coast. Seawater is also the dominant source of water in our planet. Research on coastal ecosystems has generally been carried out by forestry specialists with reference to coastal silviculture and mangrove wetlands. Fisheries scientists have been concentrating on marine fisheries, both capture and culture. Marine biologists have been studying coastal biodiversity and marine national parks and biosphere reserves. However, a holistic approach to the sustainable management of the landward and seaward sides of the coast has been lacking. MSSRF hence started in 1990 a Coastal Systems Research (CSR) programme in order to give concurrent attention to coastal forestry and agro-forestry, coastal agriculture, capture and culture fisheries and marine biodiversity. This has the following major components:

- Conservation and rejuvenation of coastal mangrove wetlands and the development of mangrove bioshields, which can provide protection against coastal storms and tsunamis
- Revival of coral reefs and seagrass beds
- Organisation of coastal biovillages to provide income and work security through both on-farm and non-farm occupations
- Seawater farming involving agri-aqua culture techniques in order to derive benefit from the vast seawater resource of our planet
- Identification of genes for salinity tolerance in mangrove species and the transfer of such genes to rice and other crops through recombinant DNA technology
- Joint Mangrove Forest Management and the management of the Gulf of Mannar Biosphere Reserve on a trusteeship mode

Integrated mangrove-fish farming as well as integrated coastal zone management has been taken up along the coasts of Tamil Nadu, Andhra Pradesh and Odisha. Seawater farming techniques have been standardised and demonstrated at several locations. A genetic garden of halophytes has been established near Vedaranyam in order to provide raw material for seawater farming as well as for the isolation of genes for salinity tolerance. As a starting point, a survey of halophytes of Tamil Nadu and Andhra Pradesh coast was conducted, which revealed the presence of 19 species of obligate halophytes. Several species were selected in consultation with local communities for cultivation as commercial crops in seawater farms.

In 1989, I delivered a lecture in Tokyo on anticipatory action to meet the challenge of sea level rise, pointing out the need for immediate action to conserve mangrove wetlands and for initiating research on the identification and transfer of genes for salinity tolerance from mangrove species to rice and other crops of importance to coastal agriculturists. Taking up this idea, the late Dr. S. Okhita, a former Foreign Minister of Japan, got the Japanese government to grant US $ 500,000 through the International Tropical Timber Organisation (ITTO) for MSSRF to initiate the mangrove conservation and genetics programmes. The Japanese government also helped in establishing an International Society for Mangrove Ecosystems (ISME) under my chairmanship. This initial support helped MSSRF to launch a well-

planned mangrove research programme in 1990 and also to undertake a survey of mangrove genetic resources all over Asia and West Africa. With the help of the Department of Biotechnology, a genetic garden of mangrove species was established at Pichavaram. The major achievements of the coastal systems research programme over the last 20 years are:

- Nearly 3000 hectares of degraded mangrove forests have been rejuvenated and revived along the coasts of Tamil Nadu, Andhra Pradesh and Odisha.
- A joint mangrove forest management strategy has been developed so that the local communities are fully involved in the management and restoration of this unique ecosystem.
- Genes for salinity tolerance have been identified in *Avicennia marina* and have been transferred to rice and other crops. These genes have been patented, as part of the defensive patenting policy of MSSRF.
- The management of the Gulf of Mannar Biosphere Reserve has been transferred to a Biosphere Trust so that the local population regard themselves as trustees of this unique biological paradise.
- Steps have been taken to restore degraded coral reefs by establishing artificial coral reefs.
- A genetic garden of halophytes has been established in order to preserve for posterity these salt-tolerant species, whose importance will grow with a rise in sea level as a result of climate change.
- Coastal systems research is providing the basic information needed for the Integrated Coastal Zone Management Policy notified by the Government of India.
- A Fish for All Research and Training Centre has been established at Kaveripoompattinam to promote sustainable marine fisheries and their safe handling and value addition through fish processing.
- Village Knowledge Centres have been established along the coast in order to give timely information on weather and wave heights, location of fish shoals, fish marketing, value addition, etc. Mobile telephony has proved to be of particular value in communicating the right information at the right time and place and to the right persons. Such information has helped artisanal fishermen to go into the ocean with courage and confidence and return with a good harvest.

On the basis of MSSRF's proposal, FAO gave recognition to the Kuttanad Below Sea Level Farming System under its Globally Important Agricultural Heritage System Programme. MSSRF also prepared a detailed eco-development plan for Kuttanad and got a proposal for the establishment of an International Research and Training Centre for Below Sea Level Farming in Kuttanad approved by the Government of Kerala.

It will not be incorrect to say that the whole concept of CSR is a major contribution of MSSRF to the strengthening of both coastal ecological security and the livelihood security of coastal communities nationally and internationally. It will be appropriate to cite two examples.

First, at the national level the Ministry of Environment and Forest of the Government of India set up the following two committees under my chairmanship to develop a National Plan of Action for Integrated Coastal Zone Management

(i) Committee to Review the Coastal Regulation Zone Notification 1991 (February 2005)

(ii) Final Frontier – Agenda to protect the ecosystem and habitat of India's coast for conservation and livelihood security (July 2009)

Based on these reports, the Government of India has issued a new Coastal Regulation Zone Notification 2011, which incorporates the experience gained by MSSRF in integrated coastal zone management.

Secondly, at the international level the High Level Panel of Experts on Food Security and Nutrition of the World Committee on Food Security, which I chair, has recommended in its report on Climate Change and Food Security (2012), the initiation of a sea water farming programme for promoting coastal area prosperity. Such a recommendation is based on the experience and expertise gained at MSSRF.

Biodiversity

MSSRF's research on biodiversity began in 1989 with a study of genetic diversity in mangrove species and seagrasses. The greatest genetic diversity in mangroves in India was found to occur at Bhitarkanika in Odisha. From 1990 onwards, the biodiversity programme centered on community biodiversity conservation and enhancement. The study areas were Kolli Hills in Tamil Nadu, Koraput in Odisha and Wayanad in Kerala. Kolli Hills and Koraput are in the Eastern Ghats, while Wayanad is in the Western Ghats range. In all the areas, the emphasis was on the revitalisation of the *in situ* on-farm conservation traditions of tribal and rural families. All along, *in situ* and *ex situ* conservation undertaken by State Forest Departments, universities and research institutions, had been receiving attention from biodiversity experts. Unfortunately, community conservation and selection efforts in rural and tribal areas did not receive the same attention. As a result, genetic erosion became severe in such areas. For example, in the Koraput region there were nearly 3500 strains of rice 50 years ago. Now, this number has come down to less than 300. It is estimated that there may be about 150,000 varieties of rice in the world. Such rich intra-specific variability is largely due to human selection, based on genotype x environment interaction.

It is only in recent years that attention to community conservation, particularly with reference to agro-biodiversity, has started gaining momentum. MSSRF's strategy in this area has been based on the following principles:

- There is need for creating an economic stake in conservation through a 4 C model of sustainable management of agro-biodiversity involving concurrent attention to conservation, cultivation, consumption and commerce.
- The community tradition of creating Gene, Seed, Grain and Water Banks should be revitalised and promoted. This will help to develop sustainable food and water security systems at the local level.
- The concept of farmers' rights should be converted into legally binding rights.

The rapidity with which local genetic resources were disappearing through habitat destruction, land use change, alien invasive species and changes in culinary habits and climate made it clear that unless community efforts in *in situ* on-farm conservation and *ex situ* preservation are recognised and rewarded, precious genetic resources may get lost. This led to the concept of farmers' rights in the fora of FAO in the 1980s when I served as Independent Chairman of the FAO Council. MSSRF's early work in Kolli Hills from 1991 to '95 showed that the rich reservoir of genetic material in nutri-millets will vanish

in the near future as a result of a change in land use in favour of tapioca and pineapple. In two Dialogues organised by MSSRF – Farmers' Rights and Plant Genetic Resources: Recognition & Reward in January 1994 and Biodiversity and Farmers' Rights in January 1996 – I presented a draft of a Plant Variety Protection and Farmers' Rights Act stressing, that the rights of breeders and farmers should be mutually reinforcing and should not be set one against the other. My draft provided the basic text for the Government of India's legislation titled Protection of Plant Varieties and Farmers' Rights Act, which was approved by Parliament in 2001. The International Union for the Protection of New Varieties of Plants (UPOV) recognises plant breeders' rights, but unfortunately not the contributions of those who have preserved genetic resources for public good at personal cost. This is why I have proposed the need for restructuring UPOV as the International Union for Breeders' and Farmers' Rights (Sir John Crawford Lecture, Washington DC, November 1, 1990). Breeders and farmers are allies in the struggle for sustainable food security and the eradication of hunger. The Indian legislation is the only one of its kind in the world which deals simultaneously with breeders' and farmers' rights and MSSRF was the first to produce such an integrated Bill.

Several other steps have been taken to revitalise farm level conservation. Participatory plant breeding in the Koraput district with farm/ tribal families for the purpose of improving the yield potential and agronomic qualities of local strains led to the development of the *Kalinga Kalajeera* strain, which is both high yielding and has a high market value. Similar participatory breeding work is in progress in millets in Kolli Hills and in medicinal plants in Wayanad. The basic approach in biotechnology research has also been for MSSRF to remain as a pre-breeding centre and work with farm families in a participatory breeding mode. Such a combination of pre-breeding and participatory breeding will help to combine genetic efficiency with genetic diversity.

On MSSRF's suggestion, the Government of India has instituted two recognition and reward systems: the Genome Saviour Award for tribal and rural families who have conserved rich genetic diversity and the Breed Saviour Award as recognition and reward for rural women and men for their contributions to the conservation of indigenous animal breeds. A programme for the collection and conservation of rare, endangered and threatened species (RET) was initiated 7 years ago for preventing the disappearance of RET species.

The first draft of the National Biodiversity Act was prepared at MSSRF under the auspices of a National Committee set up by the Ministry of Environment and Forests under my chairmanship in 1998. The unique features introduced in this Act included:

- The management and governance of biodiversity will be at three levels – panchayat or local body level through a Biodiversity Management Committee, State level through a Biodiversity Board and national level through the National Biodiversity Authority.
- The local panchayat committee will have the power to grant prior informed consent in collection as well as benefit-sharing arrangements in utilisation.
- Local biodiversity management committees will be empowered to recognise sacred groves and other important conservation areas as heritage sites.

Thus the Biodiversity Act also incorporates the concept of farmers' rights with reference to the recognition and reward system for local conservers.

The Biodiversity programme of MSSRF, now 23 years old, has been able to generate awareness of the importance of community biodiversity conservation and of the need for mainstreaming the principles of ethics and equity in benefit sharing. It is to be hoped that such steps will not only halt genetic erosion but will lead to an era of biohappiness arising from the sustainable and equitable use of biodiversity for creating new jobs and income.

Among other significant contributions of the Biodiversity group, mention may be made of the establishment of the Community Gene Bank to provide data support to the implementation of the farmers' rights programme. The Community Gene Bank also promotes awareness and capacity building in relation to the PPV&FRA. The Koraput agricultural system was recognised by FAO for inclusion under its Globally Important Agricultural Heritage Systems (GIAHS) on the basis of the documentation prepared by MSSRF. This is in recognition of the conservation of both agro-biodiversity and local knowledge systems.

More recently, two significant programmes have been initiated to integrate agro-biodiversity conservation with the alleviation of poverty and malnutrition. The project supported by the Canadian International Food Security Research Fund through the Canadian International Development Agency (CIDA) and the International Development Research Centre (IDRC) aims to overcome malnutrition in agro-biodiversity hot spots in Odisha, Kerala and Tamil Nadu by providing agricultural remedies to nutritional maladies. The project aims to enhance food and nutrition security at individual, household and community levels, taking into account the gender dimensions of poverty and malnutrition. Another important project initiated recently is Leveraging Agriculture for Nutrition in South Asia (LANSA), supported by the Department for International Development (DFID) of UK. MSSRF is the lead agency for implementing this multi-country and multi-institutional project. The other partners of the consortium are International Food Policy Research Institute (IFPRI), Institute of Development Studies (IDS), Leverhulme Centre for Integrative Research on Agriculture and Health (LCIRAH), Bangladesh Rehabilitation Assistance Committee (BRAC), Bangladesh, and Collective for Social Science Research, Pakistan. This project is designed to promote nutrition-sensitive farming, which involves the design and adoption of cropping and farming systems to help overcome protein-energy under- or malnutrition, hidden hunger arising from the deficiency of micro-nutrients in the diet such as iron, iodine, zinc, vitamin A, vitamin B_{12} etc., and transient hunger arising from either natural calamities or civil disturbances. For ensuring adequate nutrition of the right quality to an individual, a life-cycle approach is being adopted, starting with pregnant women up to old and infirm persons.

It will be appropriate to recall the contributions of MSSRF to biodiversity conservation and sustainable and equitable use at the international level. In 1988, a legal framework for a Global Biodiversity Convention was approved at the IUCN General Assembly held at San Jose, Costa Rica, under my chairmanship. During 1988-90, the procedures for operationalising the concept of benefit sharing with primary conservers at national and international levels and of farmers' rights were developed at the

Keystone International Dialogues on Plant Genetic Resources held under my chairmanship. The crucial Dialogue, which broke the stalemate in getting the agreement of the private sector for implementing farmers' rights, was achieved at the Chennai Dialogue, held at MSSRF in January 1990. These steps paved the way for the adoption of the Convention on Biological Diversity at Rio de Janeiro in June 1992.

Development of procedures for the sustainable management of tropical rainforests constitute another significant contribution of MSSRF. In 1989, I was invited by the then Secretary General of the Commonwealth, Sir Shridath Ramphal, to help in developing a programme for demonstrating the concept of sustainable management in the one million acres of prime rainforest offered by the Government of Guyana to the Commonwealth for this purpose. This project, known as the Iwokrama International Centre for Rainforest Conservation and Development (IIC), demonstrated how a prime rainforest can be managed sustainably by adopting methods which can help to conserve and enrich biodiversity and at the same time provide jobs and income to the indigenous Amerindian population as well as the people of Guyana. Thus, the biodiversity programme of MSSRF from 1988-2002 has had profound influence in shaping the concept that "good ecology is good business".

Some of the world leaders in this field have participated in the different dialogues and discussions held at MSSRF. I would however like to name one – the late Professor Gian Tommaso Scarascia Mugnozza, who helped MSSRF to establish a Community Gene Bank and guided our work in many ways. We are deeply indebted to him for his guidance, support and friendship. In recognition of his monumental contribution to genetic resources conservation, MSSRF's Community Gene Bank is named after him.

Biotechnology

Biodiversity is the feedstock for biotechnological enterprises. Therefore, from the beginning MSSRF has tried to harness the tools of modern biotechnology like micro propagation, bio-prospecting, bio-monitoring, bio-remediation and recombinant DNA technology for the effective use of biodiversity, involving both strategic and applied research. The necessary infrastructure including the needed equipment has been set up with the support of the Department of Biotechnology (DBT), Government of India. The studies undertaken have provided significant insight into the understanding of the mechanism of salt tolerance in mangroves and other halophytes. Tolerance to abiotic stresses has been studied in *Prosopis juliflora, Jatropha curcus*, millets and some lichen species. Through large-scale sequencing, the group has been able to identify, characterise and study the regulation of several novel genetic combinations with implications for salinity and drought tolerance, bio-remediation, and nutritional enhancement. A number of specific promoters governing the expression of the identified genes have been identified and isolated. Using genetic combinations related to osmoprotectants, ion transporters, heavy metal accumulation, compatible solutes and secondary metabolite accumulation, several transgenic pure lines have been generated. These have been evaluated under contained conditions for ascertaining their level of tolerance to abiotic stress as well as the level of enhanced micronutrients, particularly iron. Some of these pure lines have been introgressed into locally adapted varieties and these are in T6 generation.

Two limited field trials have been conducted. MSSRF has obtained two US patents for these inventions: US patent for the Dehydrin gene from *Avicennia marina* responsible for conferring salt tolerance in plants (Drs. Ajay Parida, Preeti Mehta and Gayatri Venkataraman) and US patent for the Glutathione-S-transferase gene from *Prosopis juliflora* conferring drought tolerance in plants (Drs. Ajay Parida and Suja George). Thus, the programme that was initiated nearly two decades ago has resulted in generating location-specific varieties for abiotic stress tolerance as well as nutrition enhancement. Following national regulatory requirements, biosafety trials will be undertaken to take these important discoveries for product development. The scientists working on these problems have published several research papers in internationally peer-reviewed journals.

The bioprospecting programme in lichen species resulted in the isolation and characterisation of 11 compounds, of which 4 are novel molecules. These have been used for anti-tuberculosis and anti-cancer screening in partnership with the Cancer Institute and the Tuberculosis Research Centre, Chennai. The novel molecule MSSRF 009 inhibits all the tested 7 tuberculosis strains, including the multi-drug resistance strain, at a considerably low concentration. It also was found to be safe on human macrophage cell lines. Culture protocols for fungal, algal and whole thallus culture of 36 lichen species have been standardised. During the year, DBT approved a national network programme on lichen bioprospecting for secondary compounds and establishing cultures and collections involving 6 national laboratories, of which MSSRF is the coordinating institution.

The research undertaken by the microbiology group for exploring the genetic and functional diversity of the mangrove-associated rhizobacteria has resulted in the identification of four novel Vibrio spp. A total of 326 *Micromonospora* spp., 51 denitrifying bacteria, and a *Halomonas* (MSSRF176) strain capable of degrading benzene have been identified. More than 25,000 bacterial isolates were screened by high infectivity throughput screening (HITS) for anti-cancer, anti-diabetic, anti-inflammatory and anti-infectivity properties.

In 2003, I was asked to chair a committee to develop guidelines for the further progress of agricultural biotechnology. I had then recommended that we should have a Parliament-approved National Biotechnology Regulatory Authority. I maintained that the bottom line of our national agricultural biotechnology policy should be the economic well-being of farm families, food security of the nation, health security of the consumer, biosecurity of agriculture and health, protection of the environment and the security of national and international trade in farm commodities.

I also chaired meetings convened by DBT on the structure of an effective Biotechnology Regulatory Authority. As a result, draft legislation for setting up such an authority is now ready for being introduced in Parliament. There is considerable work in progress in the country in the areas of basic and applied biotechnology and a very large number of young scholars are doing creative work in this field. Therefore, the sooner a regulatory system which inspires public, political, professional and media confidence is established, the greater will be the opportunity for deriving benefits from the enormous progress made in the areas of molecular biology and genetic engineering.

A survey by MSSRF in villages revealed that the understanding of the advantages and

disadvantages of genetically-modified crops was poor. It was clear that there is need for greater efforts in the areas of public education and information. In 2004, MSSRF therefore started Genome Clubs in schools, to familiarise young students on the characteristics and implications of the genomes of rice and other crops as well as of the human genome. This genetic literacy programme was so effective that DBT came forward in 2006 to make it a national programme – DNA Clubs. MSSRF coordinates this programme in the south Indian States. There is need for more investment in informing farmers about the special features of genetically-modified crops, including the need for growing refuge in order not to put pressure on the pathogen/insect to mutate and develop more virulent forms.

The MSSRF programme in the field of genetic engineering is unique in the sense it has used plants which have not been so far investigated from the molecular standpoint, but which are very important donors of genes for abiotic stresses like salinity and drought. Bio-fortification is another field where original work has been done in the breeding of rice varieties rich in iron. The policy of MSSRF is not to worship any tool because it is new and novel, but to choose those, whether new or old, which can help in achieving the desired goal speedily and surely.

Another major contribution of the Biotechnology Group is the design and establishment of the first Womens' Biotechnology Park in the country with the generous assistance of the Government of Tamil Nadu and the Department of Biotechnology of the Government of India. It would be appropriate to refer in particular to the contributions of Dr. Sudha Nair and Dr. Manju Sharma in converting the concept of a Womens' Biotechnology Park into reality.

Ecotechnology

The implementation of a pro-nature, pro-women, pro-poor and pro-sustainable livelihood mandate required a field-level operational model. The biovillage model of sustainable human development emerged at an inter-disciplinary dialogue held in 1992 on taking the benefits of biotechnology to rural India. The biovillage model has three major objectives: the first relates to the conservation and enhancement of common property resources and natural resources like land, water, and biodiversity; the second aim is to increase the productivity and profitability of small farm agriculture on an environmentally sustainable basis, and the third component aims to improve non-farm income through value addition to primary produce and through the expansion of the services sector.

The biovillage programme was started in 1992 in three villages in Puducherry. The initial effort was in the area of enhancing non-farm income through market-driven micro-enterprises like mushroom cultivation, vermiculture, manufacture of biopesticides and biofertilisers, dairy farming, aquaculture in village ponds as also various other micro-enterprises supported by micro credit. The Biovillage Council comprising representatives chosen by rural women and men provides overall guidance to the work of the families living in biovillages. It also provides policy oversight to the micro-credit programme. The biovillage aims to address concurrently all the three major components of sustainability: economic, environmental and social. It is a human-centered programme, with community involvement and control at all stages in the production-consumption-marketing chain.

The studies so far done reveal that the biovillage has opened up new opportunities for ensuring

income and work security to the village population and more particularly to women. The biovillage model has spread to Odisha as well as to neighbouring countries like Bangladesh. Ultimately, the goal is to convert every village into a biovillage. The technologies used in biovillages fall under the broad category of ecotechnology.

Ecotechnology involves the blending of traditional wisdom with frontier technology. With the help of Tata Trusts, the JRD Tata Ecotechnology Centre was established at MSSRF in 1998. As part of the effort to conserve soil and water, community-led watershed management projects were introduced. The Tolla watershed in Odisha received this year the *Rashtriya Jal Puraskar* (National Water Prize) and the watershed project in Pudukottai in Tamil Nadu received the *Bhoomijal Samvardhan Puraskar* (Groundwater Augmentation Award) from the Ministry of Water Resources, Government of India. The local families were happy and felt encouraged that their work in the sustainable management of water received national attention. The community system of natural resource management in Koraput, Odisha also received the Equator Initiative Award at the UN Conference on Environment and Development held at Johannesburg in 2002.

To provide the scientific back-up necessary for promoting an ever-green revolution approach in farming, a Laboratory for Integrated Pest Management (IPM) and a Mobile Soil Testing Service has been established. The IPM Laboratory at Chennai has developed several biocontrol agents as well as techniques for the mass multiplication of egg parasitoids. Women SHGs have been enabled to take up the multiplication and sale of biocontrol agents and other biological software essential for ever-green agriculture.

The biovillage model of sustainable rural development will help to retain youth in farming and farm-related activities. The supplementary income received through non-farm employment will be a stimulus to *yuva kisans* and *mahila kisans*. The most urgent need in biovillages is to link products with assured markets. Other initiatives in biovillages include the introduction of information communication technology and the mobilisation of renewable energy systems, including solar energy. In many biovillages, women have mastered the technology of vermiculture and mushroom production. Jointly with the OCP Foundation of Morocco, steps have been taken to organise Pulses Villages in order to increase the production and availability of pulses.

The Fish for All Research and Training Centre at Kaveripoompattinam is another important initiative of the JRD Tata Ecotechnology Centre. The aim of this Centre is to promote sustainable fisheries and the addition of value to fish through hygienic processing. Food safety based on *Codex Alimentarius* standards is given high priority. Every step in the fish capture-to-consumption chain receives concurrent attention. The Kaveripoompattinam Centre was the outcome of the support extended by Tata Trusts and Corporates to the unfortunate victims of the 2004 tsunami. Thus a calamity became an opportunity for improving the safety and well-being of fisher families on a long term basis.

The biovillage methodology of sustainable rural prosperity can be suitably adapted in different States and countries. It will provide a platform for partnership among all involved in promoting agrarian prosperity and rural development.

Food and Nutrition Security

Helping to achieve the goal of a hunger-free India has been one of the important aims of

the programmes of MSSRF. In the year 2000, this work was intensified in association with the World Food Programme. Food Insecurity Atlases of rural and urban India and an atlas on the sustainability of food security were brought out during 2002-03. The atlases looked at the different indicators of food insecurity under three broad categories, namely, availability, access and absorption. These atlases have since been updated. The atlases help policy makers to identify the food insecurity hotspots and develop social protection measures which can help to ensure sustainable food security. Based on a request from the Government of Cambodia, a Food Security Atlas of Cambodia was prepared by the MSSRF Food Security group. Similarly, assistance was given to South Africa in preparing a Food Insecurity Atlas.

MSSRF also helped to organise a National Coalition for a Nutrition Secure India. The Secretariat of the Coalition functioning under my chairmanship from August 2007 was initially hosted by VISTAAR and it is now being hosted by Save the Children. The Coalition is helping to bring about convergence and synergy among the programmes operated by government departments, UN and bilateral agencies and civil society organisations.

The malnutrition burden in India is very high. It is clear that we need to attack this problem from the village upward. For this purpose, MSSRF has initiated a Community Hunger Fighters programme, to start with in the Koraput district of Odisha. Community Hunger Fighters (CHFs) are a cadre of community volunteers at the grass-roots level mobilised to address hunger and malnutrition in their villages. The team comprises both men and women, with minimal or no literacy, selected by the village *palli* or Gram Sabha. In addition to the Community Hunger Fighters programme, a project titled the Healthy Child has also been initiated in the Kundra block of Odisha. The aim of this project is to reduce the infant mortality rate and the morbidity pattern in children.

MSSRF is engaged in the development of methodologies for promoting nutrition- sensitive agriculture. One approach lies in improving the productivity of small-farm agriculture, which is the backbone of the livelihood security system of a large proportion of the population of India. Another involves the design and adoption of cropping and farming systems which can provide agricultural remedies to prevailing nutritional maladies, such as protein-energy under- or malnutrition, hidden hunger (deficiency of micro-nutrients in the diet) and transient hunger arising from either natural calamities or civil disturbances. To mainstream the nutrition dimension in agriculture, a programme termed Farming System for Nutrition (FSN) is being designed and introduced in Koraput, Kolli Hills, Wayanad, and Vidharba where there is a high burden of malnutrition.

The National Food Security Bill under consideration in Parliament aims to ensure economic access to food to everyone requiring social protection for food security. Even if access is ensured, there is still need for promoting effective absorption of food in the body by providing clean drinking water, sanitation, primary healthcare and nutritional literacy. As suggested by the High Level Panel of Experts on Food and Nutrition (HLPE) of the World Committee on Food Security(CCFS) chaired by me, **the right to food must be based on a food security floor approach,** which will help to identify the minimum essential interventions necessary to ensure food security for all. The MSSRF approach to food security involves social

protection both at the inter-generational and intra-generational levels. The inter-generational approach aims to eliminate maternal and foetal under- and mal-nutrition. I hope that such an integrated and holistic approach to food security will help to accelerate progress in the elimination of endemic and hidden hunger.

Gender and Development

Available data indicate that women and girl children tend to be relatively more undernourished, leading to several health problems. Also women farmers will need gender-specific support services such as labour-saving technology as well as credit, insurance and other inputs which they are currently unable to access due to lack of entitlements. In order to address these issues in a holistic manner, a *Mahila Kisan Sashaktikaran Pariyojana* (Programme for the Empowerment of Women Farmers) was initiated by MSSRF five years ago in the Wardha and Yavatmal districts of Vidarbha. Impressed with the success of this endeavour, the Union Finance Minister provided funds in the budgets of 2011-12 and 2012-13 for initiating a national Mahila Kisan Sashaktikaran Pariyojana programme under the Rural Livelihoods Mission.

In order to eliminate the legal and other limitations regarding access to resource access and ownership from which women suffer, I introduced in Rajya Sabha in May 2012 a Private Member's Bill titled "Women Farmers Entitlements Bill 2011" for addressing the important requirements of women farmers such as access to land, irrigation water, technology, credit, insurance and markets.

Today's children are tomorrow's citizens. Their care including nutrition, healthcare and education will determine the future of a country. MSSRF has placed considerable emphasis on looking holistically at the problems and needs of women and children. The project, Action for Child Care and Education Strategies and Services (ACCESS), with support from the Bernard van Leer Foundation, has been the area of concern, expertise and achievement of the then Director, Mina Swaminathan. The target group was young children, the below sixes, belonging to the underprivileged sections of society. The aim was action to advocate, promote, and support services for the care, welfare, development and education of children, especially services those like day care, which address the intersecting needs of women, children and girls. Attention was concentrated on children in difficult or stressful circumstances, such as children of working mothers, children of migrant and itinerant labour, children in poverty, girls, and working/street children. The basic strategies were seven in number: action-research, training, networking, communication, documentation, development of resource materials, and resource expertise, delivered in an integrated manner.

MSSRF has derived immense advantage from the operation of this project as an integral part of its programmes and priorities. Project ACCESS has generated a considerable amount of resource material for the education of young children. The lessons from Project ACCESS are now being incorporated in the other programmes of MSSRF, more particularly in the biovillages.

Information Communication Technology (ICT)

MSSRF's work in the field of ICT started in 1992 with the concept of Village Knowledge Centres (VKCs). The term knowledge centre was chosen in preference to information centre since knowledge is the product of interaction between

scientists and rural families, while information is passive and is mostly one-way communication. The major goal is to make the VKC a centre of information and discussion relating to important programmes like the National Rural Health Mission, National Horticulture Mission, National Food Security Mission and all other schemes of the Government of India, the State Governments and local NGOs. Such convergence among different programmes at the field level helps to generate synergy among them and thereby enhance their benefit to rural families. The content is location-specific, dynamic, demand driven and delivered in the local language. It is also gender sensitive, with emphasis on the specific needs of women such as healthcare services. Capacity building is carried out in the local language, and in such a manner that rural women and men are able to participate in the programmes after completing their daily chores. Fortunately, software for a variety of topics of importance to rural families is now available in different languages and connectivity has now become relatively easy since there has been a large investment in this field. The community VKC is established in accommodation provided by rural families and is managed and operated by trained rural women and men. They serve as volunteers and the management is done by rotation among a group of rural volunteers. There are 73 such community managed and owned knowledge centres in Tamil Nadu, Puducherry, Maharashtra, Andhra Pradesh, Odisha and Kerala. They are extremely popular with adults for the relevance and timeliness of the information they provide, and with schoolchildren as centres where they can gain computer literacy.

In addition to VKCs, MSSRF initiated in 2004 a Village Resource Centre (VRC) programme jointly with the Indian Space Research Organisation (ISRO). VRCs have satellite connectivity and telecommunication facilities. MSSRF operates 15 VRCs and they have proved to be very effective for communication among farmers, since they provide audio-video conference facilities.

MSSRFs knowledge empowerment programme involves lab-to-land, land-to-lab, land-to-land and lab-to-lab approaches. The land-to-land, i.e., farmer-to-farmer learning is a very powerful method of extension since farmers have faith in the advice provided by fellow farmers. In order to facilitate such sharing of experience and ideas, MSSRF has initiated steps to establish Farm Field Schools in five locations, two in Tamil Nadu and one each in Odisha, Maharashtra and Kerala, with the support of Indian Overseas Bank. The main objective of the schools is to impart practical training to farmers on crop management and to transfer new and innovative technologies to improve crop production. Each farm school will have both training and hostel facilities.

MSSRF's experience shows that bridging the digital divide in rural areas also helps to bridge the gender divide. The self-esteem and pride of women volunteers who are running VKCs and VRCs have gone up enormously. In order to give social prestige and recognition to rural women and men who have mastered digital technology and who are running VKCs and VRCs, MSSRF started in 2005 the Jamsetji Tata National Virtual Academy. This Academy has currently over 1500 Fellows from 22 States in India. In addition, there are 31 Fellows drawn from six neighbouring countries.

Some other initiatives

I must also refer to two other initiatives in the field of information, education and

communication. *The Hindu* Media Resource Centre, established with generous assistance from *The Hindu* group of newspapers, is helping to bring science and the media into close partnership in order to ensure that information on scientific discoveries of value to rural families reach them. Another initiative is the Every Child a Scientist programme. Here children are exposed to various aspects of science relevant to their day-to-day life. One part of this programme is for visually-impaired children, who regularly visit the Touch and Smell Garden set up in the Chennai campus of MSSRF.

A great asset of MSSRF is its Library, both printed and digital, which has a rare collection of books in the fields of environment and sustainable development. This Open Access Library provides opportunities for research scholars from various Universities in India to carry out their review of literature studies.

2012-13 has been designated by the Government of India as the Year of Science in India. The most urgent task is to spread what Jawaharlal Nehru used to emphasise — the scientific temper. Modern technology is helping to convert ordinary rural women and men into extraordinary individuals. The small VKC programme initiated by MSSRF following the Dialogue in 1992, has now become a mass movement with the active involvement of the public, academic and private sectors and Panchayati Raj institutions.

Looking Back and Forward

This is a brief account of 24 years of adventure in science designed to bring a message of hope to the economically and socially underprivileged sections of our rural society. MSSRF's approach to poverty alleviation has been asset building, particularly imparting new skills and knowledge and promoting community organisations. Sustained donor support has ensured sustained efforts in implementing the pro-nature, pro-poor and pro-women mandate. Currently, the emphasis is on consolidation and concentration of programmes.

MSSRF is an inter-disciplinary organisation. Whatever help it has been able to render to rural and tribal families is because of MSSRF's ability to integrate knowledge from frontier areas of science like biotechnology, with field-level management structures like Biovillage Council and Self-Help Groups providing micro-credit to initiate micro-enterprises. The continued effectiveness of MSSRF will depend on its ability to stimulate and sustain a pan-MSSRF approach to technological and skill empowerment to the rural poor, at both the production and marketing ends of the micro-enterprises

Internal Developments

During the period 1988-98, I functioned as Executive Chairman, building the scientific infrastructure, recruiting staff, finalising programme priorities and above all gathering donor support both for on-going work and for building a corpus fund, which will help to provide bridging funds whenever a project comes to a close and a new one is yet to begin. Looking back, funding has not been a major problem. The principal challenge has been to identify young women and men scientists who combine scientific excellence with social commitment. Fortunately, MSSRF has a large number of young scientists who possess this combination and who are able to identify themselves with the rural and tribal poor. This has helped MSSRF to become a global leader in humanistic science and scientific humanism.

As mentioned at the outset, MSSRF has had the benefit of financial support from a wide range of donors, whose generous contributions have been acknowledged in Annual Reports. Among non-government donors, my special thanks go to Shri Ratan Tata, Shri R. M. Lala, (who also served as Trustee of MSSRF for 10 years) and the Tata Trusts, Ms. Susan Beresford and the Ford Foundation, New York, Drs. Geeta and Krishan Mehta and Friends of MSSRF, Tokyo, and Ms. Vicki Corbett and Ms. Barbara Wolveridge of Friends of Swaminathan, Australia. I am particularly grateful to the Department of Science and Technology, Government of India and its Secretary Dr. T. Ramasami for including MSSRF among institutions worthy of receiving core support. DSTs support to our core programmes will ensure their long term sustainability and effectiveness.

MSSRF has also been fortunate to have Executive Directors totally dedicated to the mission of the institution. I would like to express my gratitude to Professor P.C. Kesavan (1999-2003), Dr. M. Velayutham (2003-2007), Shri Achyut Gokhale (2007-2009) and Dr. Ajay Parida (2009 onwards) for their dedicated leadership and their commitment to the core values of the Foundation. The most important core value is that integrity, whether in science or in financial management, is not negotiable.

MSSRF has been very privileged in its Trustees. Twenty eminent scientists and scholars have served on the Board so far. Among them, Dr. K. Kanungo and Dr. K.N.N.S. Nair are no more. Dr. Kanungo served as the Chair of the Audit-cum-Finance Committee during 1995-2005. Dr. K.N.N.S. Nair, who served as Trustee from 2001-2005, spent a considerable amount of his time to develop the biovillage methodology and to impart a pro-woman orientation to technology development and dissemination. We miss their encouraging smiles and practical wisdom.

Among the past Trustees my special gratitude goes to Dr. Usha Barwale, who served as Chair of the Programme Committee for several years and Dr. Anuradha Desai for their invaluable guidance and support. Dr. Soumya Swaminathan helped to bring about a nutrition cum drug approach to the treatment of tuberculosis, HIV/AIDS and leprosy during her tenure as a Trustee. My special thanks are also due to Dr. Uma Lele and Dr. Kavita Gandhi for undertaking a thorough review of the progress made during the first 20 years. Dr. Sudha Nair did a superb job facilitating the review with appropriate documentation. Dr. Uma Lele also served as a Trustee for two years and played a helpful role in developing the LANSA project. Another past Trustee, Mr. Vijay Mahajan, helped MSSRF at an important stage in its evolution with sound management advice. To me, it has been a learning experience to have worked with such a group of eminent humanists and institution builders. It has been a pleasure to interact and work with several hundred scientists and research scholars, as well as administrators and technical staff, during the last 24 years. I have learnt much from their spirit of innovation and scientific enquiry.

Dr. N. Parasuraman has been with MSSRF from the beginning and has been a storehouse of important archival material. His memory is phenomenal and he maintains historical records with meticulous care. Dr. Rajeswari Anand, the first scientist to join MSSRF, was a pillar of strength in getting the Foundation operational. My secretaries Ms. R. Malathy and Ms. Y. Dilhara Begam have helped to maximise my output and the value of

my time by extending extraordinarily efficient assistance. Ms. Gita Gopalkrishnan has been a wonderfully supportive editor, with attention to both expression and authenticity of information. This year's annual report was compiled with great care by Dr. V. Selvam, Dr. G.N. Hariharan and Ms. R. V. Bhavani to whom I express my sincere gratitude.

As I step down from the Chairmanship of MSSRF, I wish to welcome our new Trustees, Dr. Manju Sharma, Former Secretary, Department of Biotechnology, Government of India, Professor Virander S Chauhan, Director, International Centre for Genetic Engineering and Biotechnology, Dr. Narayan G. Hegde, former President and currently Trustee and Principal Adviser of BAIF, and Dr. Kezevino Aram, Director of the Shanti Ashram at Coimbatore. They all bring life-long experience in taking the best in modern scientific knowledge to the service of rural families.

It has been both a pleasure and a privilege to have had the opportunity to work with the Current Trustees, Shri N. Ram (Chair, Ethics Committee), Shri V. Namasivayam (Chair, Finance and Audit Committee), Dr. Suman Sahai (Chair, Programme Committee), Shri K. Rajiv (Chair, Administration and Personnel Committee), Dr. Tushaar Shah and Dr. Rita Sarin. I am indebted to them for the time they are so generously sparing for MSSRF. My best wishes go to Dr. Madhura Swaminathan, Incoming Chair of the Board of Trustees. The Trustees have kindly invited me to serve as Emeritus Chairman and Chief Mentor and I shall do my best to continue to be of help to the Trustees, Executive Director and Staff and the research scholars in their efforts to serve both science and society.

My sincere gratitude goes to the Government of India as well as to the Government of Tamil Nadu, Odisha, Kerala, Andhra Pradesh, Puducherry and Maharashtra for their support to the work of MSSRF. Particular thanks go to Dr. M. Karunanidhi and Dr. Selvi J. Jayalalithaa, former and present Chief Ministers of Tamil Nadu, for their encouragement and invaluable support during the last 24 years.

I end with a quotation from a speech delivered by Abraham Lincoln before the Wisconsin State Agricultural Society in 1859:

> "An Eastern monarch once charged his wise men to invent him a sentence, to be ever in view, and which should be true and appropriate in all times and situations. They presented him the words: "*And this, too, shall pass away*." How much it expresses! How chastening in the hour of pride! How consoling in the depths of affliction! "And this, too, shall pass away." And yet let us hope it is not *quite* true. Let us hope, rather, that by the best cultivation of the physical world, beneath and around us, and the intellectual and moral world within us, we shall secure an individual, social, and political prosperity and happiness, whose course shall be onward and upward, and which, while the earth endures, shall not pass away..."

I have the same hope for MSSRF.

M. S. Swaminathan
Chairman

Programme Area 100

COASTAL SYSTEMS RESEARCH

The mangrove and non-mangrove coastal bioshield programme was extended to the west coast of India in partnership with the Gujarat Ecological Commission. Pilot testing of IMFFS was extended to about 15 ha of saline-affected lands in Tamil Nadu and Andhra Pradesh. A survey on halophytes in Tamil Nadu and Andhra coasts revealed the presence of 19 true halophytes. In Vedaranyam, a community mobilisation, participatory rural appraisal and socio-economic survey was completed in 6 project villages. A number of activities were implemented to enhance community capacity in hygienic pre-processing and processing of fish. Inventorisation and monitoring of biosphere reserves in India using remote sensing and GIS technology were undertaken.







Bhoomipuja of the Coastal Zone Management Research and Training Centre at Chidambaram and community-based activities for coastal resource management

Programme Area 100

Coastal Systems Research

During this year, partnerships were developed with various institutions, such as the Gujarat Ecological Commission, the Forest Department of Maharashtra, Tata Power Company and Dhamra Port Company Limited, in establishing, restoring, managing and monitoring mangrove ecosystems and bioshields. In Tamil Nadu and Andhra Pradesh, pilot testing of integrated mangrove fishery farming system has been extended in partnership with the community, Panchayat Raj Institutions and government and non-government organisations to assess the economic viability of this system. Survey of halophytes in Vedaranyam and Kakinada coasts revealed the presence of potential species for farming with seawater. In Tamil Nadu, a proposal sent to the government for allotment of 20 ha of land in Vedaranyam for pilot testing of seawater farming is being processed. In Vedaranyam, 6 gender-balanced village-level institutions were formed to plan, implement and monitor integrated coastal zone management activities at village level; the process of identifying interventions for community development and natural resource management has been started. Capacity building of the community in hygienic fish processing was the main focus of the Fish for All programme and during this year initiatives have been taken to extend this programme to the inland fishing community. Strengthening MSSRF's capacity in utilising remote sensing and GIS technology in programme and project planning, implementation and monitoring is being continued.

Sub Programme Area 101

Mangrove and Non-mangrove Coastal Bioshields

Community-based mangrove management

Kattumavadi mangrove bioshield

The mangrove bioshield developed in about 35 ha in Kattumavadi village in Pudukkottai district of Tamil Nadu with the participation of the local fishing community is being managed by the Village Development and Mangrove Council (VDMC) as per a long-term management plan prepared jointly with MSSRF and Panchayat Raj institutions. Many issues such as grazing in mangroves and net fishing in the plantation area were solved this year with the cooperation of the community. In the case of a few stray incidents, VDMC imposed penalties on those who violated the norms and the amount collected was put into the common fund. Because of community protection, the survival rate of the plantation was more than 80 per cent and an average height of 132 cm was reached. The local fishing community regularly harvests mangrove crab, which fetches higher prices than prawn and fish

Muthuregunathapuram mangrove bioshield

In Muthuregunathapuram village in Ramanathapuram district, also in Tamil Nadu,

a community-based mangrove bioshield has been established in 60 ha of open intertidal area. Similar to Kattumavadi, the participatory long-term management plan prepared in 2009 is being implemented by VDMC of Muthuregunathapuram village to conserve this bioshield. Deposition of seaweed on plants during the monsoon season was a serious problem this year also, affecting the growth of the mangroves. VDMC mobilised the community's *shramdan* and had the seaweed removed periodically. Attachment of barnacles and oysters on young plants was a continuing issue too. Last year, VDMC had asked MSSRF to provide a solution for this problem but no solution could be found for this natural phenomenon. However, since it was only on a few saplings, the overall health of the plantation was not unduly affected.

Sorlagondi mangrove bioshield

The mangrove bioshield established in 140 ha in Sorlagondi, Andhra Pradesh, with the participation of the local community is managed by the Village Development and Management Committee of Sorlagondi village, following the long-term management plan set up in 2009. Cattle grazing has been controlled through a community watcher as well as by the promotion of stall feeding. Sorlagondi and nearby villages now use fallow agricultural lands to graze their cattle. They also stall feed the cattle with the paddy straw available now, after the saline lands were reclaimed for paddy cultivation through an earlier project intervention. In the mangrove restored area, the survival rate of the species *Avicennia marina* was more than 70 per cent and the saplings attained a maximum height of about 180 cm, with the average height being around 140 cm. Apart from the seedlings planted in the site, a large number of *Avicennia marina* and *Excoecaria agallocha* saplings have been found growing naturally (more than 6100 saplings/ ha). Species such as *Acanthus ilicifolius, Aegiceras corniculatum, Avicennia officinalis* and *Bruguiera cylindrica* and the grass *Aeluropus lagopoides* are alto growing naturally in the restored area. Although the main canals in the plantation were free of silt, some of the side canals in the periphery were affected, particularly in the mouth region. VDMC has proposed desilting of canals under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), and a proposal has been submitted in this regard by the Sorlagondi panchayat to the Mandal Development Officer. Once the proposal is approved, desilting will be done using MGREGS funds, which will be a precedent for other districts and States to follow.

Participatory assessment of mangrove restoration and afforestation

Tamil Nadu and Andhra Pradesh

Mangrove restoration and afforestation activities, which have been going for the last 15 years in Tamil Nadu and Andhra Pradesh, were assessed last year with the participation of the community and other stakeholders, including Panchayat Raj institutions and local NGOs. The purpose was to identify technical, social, institutional and policy supports and interventions needed for the long-term

sustainability of mangrove wetlands. A report was submitted to the Ministry of Environment and Forests (MoEF), Government of India, through the Mangroves for the Future (MFF) programme. A series of workshops is planned to discuss the report with the field staff and top-level managers of the Forest Departments of the Tamil Nadu and Andhra Pradesh governments.

Gujarat

The Government of India has initiated Integrated Coastal Zone Management (ICZM) projects in Gujarat, West Bengal and Odisha. The project components include capacity building at the State level and preparation of integrated coastal zone management plans as well as a range of complementary local pilot investments in select small coastal stretches to support capacity building.

In Gujarat, one of the activities is the restoration and plantation of mangroves. The Gujarat Ecological Commission (GEC), which is an autonomous body supported by the Government of Gujarat, is implementing this project. It has proposed that a total of 15000 ha of area be brought under mangroves during the five years of the project implementation through the active support of local coastal communities in selected coastal villages of Jamanagar, Rajkot and Kutch districts.

MSSRF signed an agreement this year with GEC to assess current mangrove management practices in the State under the ICZM project. The mangrove plantations will be jointly assessed, with the participation of the community and the State Forest Department as primary stakeholders. Others involved are Panchayat Raj Institutions, NGOs and industries. The objectives are i) to monitor and evaluate mangrove plantation measures in a participatory manner; ii) to support the community, GEC, State Forest Department and NGOs in better management of mangrove plantation activities: and iii) to facilitate GEC in proper reporting and documentation. Four participatory tools — community-level workshops for a group of villages, participatory studies at village level in selected villages, technical assessments by a team of stakeholders and interviews and questionnaire surveys of executives and field staff of project implementing agencies — will be used in the assessment.

Table 1.1 lists the sites where participatory assessment has been initiated.

Table 1.1 ***Project implementation sites in Gujarat***

Location	Extant of land
Kutch district	
Bhatau, Lakhpat Block	1250 ha
Lakki, Lakhpat Block	1250 ha
Tuna, Mundra Block	150 ha
Bhadreshwar, Mundra Block	200 ha
Luni, Mundra Block	300 ha
Bedi, Lakhpat Block	370 ha
Jamnagar district	
Amran, Jodiya Block	260 ha
Jodiya, Jodiya Block	470 ha
Salaya	380 ha
Okha	170 ha
Pindhara, Bahtiya	210 ha
Sikka	80 ha

Public-private partnership in mangrove management

Odisha

The Dhamra Port Company Limited (DPCL) is a joint venture between Tata Steel and Larsen & Toubro. It is working with the Government of Odisha and international developmental organisations such as the International Union for Conservation of Nature (IUCN) to promote corporate environmental and social responsibility for DPCL operations and to develop a sound environmental management plan to address their direct and indirect effects on the surrounding ecosystems. MSSRF has been selected as one of the partners in the joint effort, particularly for promoting community-centered conservation and management of mangrove wetlands located in and around the DPCL site.

DPCL is located in the southern part of the Bhadrak district of Odisha which is sparse in terms of diversity and luxuriance, but just north of Kendrapada district where there is rich species diversity and luxuriance. Hence, the mangroves are of different types: fringe mangroves along the beach, sparse mangroves within the DPCL site, island mangroves in the open sea (Kanika sands), degraded mangroves and luxuriant mangroves of Bhitarkanika. The status analysis of these mangroves clearly indicates that they are degraded and require interventions to restore and sustain them.

MSSRF carried out a study this year to understand and identify the present status and potential areas for mangrove restoration and conservation in and around the port site and to develop guidelines and protocols for new restoration sites as well as quantify approximate budgetary requirements. The survey included a preliminary visit to the project site and a review of literature relating to mangroves and their management in and around the area, followed by a field visit by a team of stakeholders and consultations with local fishing and farming communities. Discussions were held with DPCL officials, Forest Department officials and other stakeholders. A number of interventions have been identified, which include:

- restoration of degraded mangroves following the canal technique
- establishment of a Mangrove Park consisting of a Mangrove Genetic Garden and a Mangrove Interpretation Centre
- mangrove-based ecotourism
- poverty alleviation programmes for mangrove-dependent communities

It is proposed to follow a science-based, community-centered and process-oriented approach in restoring, regenerating and sustaining mangrove wetlands, similar in scope to the earlier joint mangrove management project. In this approach, local people will be the key players in mangrove management and their perceptions, socio-economic situation and aspirations will be given priority. It is expected that these interventions will be implemented during the coming year.

Maharashtra

Maharashtra has about 18600 ha of mangroves, very many in a degraded state. Mumbai alone has lost 40 per cent of its mangroves in the past decade because of reclamation for housing, slums, sewage treatment and garbage dumps. Impressed by the results achieved in the earlier joint mangrove management project, the Government of Maharashtra has invited MSSRF again to work jointly with its Forest Department in restoring and conserving mangroves with the participation of the community and other stakeholders. A MoU has been signed between MSSRF and the State Forest Department, and a joint mangrove management programme has been proposed with Tata Power Company Limited, Mumbai, with technical support from MSSRF.

As a demonstration project, degraded mangroves in about 25 ha, located along the Thane Creek and Palm Beach in Navi Mumbai, will be restored. This will be carried out in 3 phases in about 5 years. During the first phase, restoration techniques, particularly the canal technique, will be demonstrated in 5 ha. In the second phase, hands-on training on restoration techniques in 10 ha of degraded patches will be provided to the field staff of the Forest Department as well as to the mangrove-using fishing communities of Sarsole and Nerul. Another 10 ha of degraded mangroves will be restored under the joint mangrove management programme. Restoration of degraded mangroves during phases 1 and 2 will be carried out as compensatory plantations under the tripartite agreement between the Maharashtra State Forest Department, Tata Power and MSSRF. In Phase 3, MSSRF and the Forest Department will work jointly with the community to replicate restoration as well as to develop long-term management plans.

Sub Programme Area 102

Integrated Mangrove Fishery Farming System

The Integrated Mangrove Fishery Farming System (IMFFS) wherein a mangrove plantation is raised along with fish culture is being tested for technical and economic viability in Tamil Nadu and Andhra Pradesh. In Tamil Nadu, two models of IMFFS have been demonstrated in about 4.5 acres of abandoned prawn farm since September 2009. The mangrove plantation in these two models has grown well and average height of the plantation was about 74 cm. Last year, it was decided that fish culture in IMFFS ponds would be entrusted to interested youth in the village who would like to earn a livelihood out of fish farming and they would also take care of both mangrove plantation and halophyte cultivation. However, this proposal could not be implemented this year, mainly due to lack of resources to support this activity.

In Andhra Pradesh, two IMFFS farm ponds were established in 10 acres in 2009 with the participation of 10 Yenadi tribal families. Each pond was allotted to five tribal families, mainly for crab culture and raising *Rhizophora* and *Avicennia* mangrove plantation. In September

2011, 300 wild juveniles of crabs collected from the mangrove forest were stocked in one of the IMFFS ponds. In February 2012, 47 kg of crabs, 20 kg of fish (sea bass, croakers and mullets) and 15 kg of shrimp were harvested. This earned a net profit of Rs 34,100/- within a period of six months, and this was shared among the 5 families who have been managing the pond. The mangrove saplings *Rhizophora apiculata* and *Avicennia marina* planted along the bunds of the farm have attained a height of about 148 cm and 132 cm, respectively. The survival rate of *Rhizophora apiculata* has been about 80 per cent and that of *Avicennia marina* about 50 per cent. *Rhizophora apiculata* was planted this year to replace dead *Avicennia marina* seedlings.

It is proven that IMFFS is environmental friendly since no artificial or chemical feeds are used in the farming operations. The farms are also developed only in hypersaline areas, which are not being used for any productive purposes. However, as technical and economic viability have to be tested in large-scale farms, initiatives have been taken to establish such large-scale farms in both Tamil Nadu and Andhra Pradesh. Proper water flow into the system as well as the quality of the water will be studied. Field experiments will be carried out for economic viability and replication by small-scale aqua farmers. In addition to these, baseline data on geophysical, geo-morphological, hydrological and biophysical conditions, including biodiversity of the demonstration site, will be collected to monitor the impact of saline water in the farming system. In Tamil Nadu, community-based IMFFS is being established in 15 acres at Mudasalodai near Chidambaram and in 12.5 acres at Siruthalaikadu near Vedaranyam. In Andhra Pradesh, IMFFS farms are being established in 10 acres in East Godavari district.

Sub Programme Area 103

Seawater as a Social Resource – Seawater Farming

In addition to the seawater farming project launched in Vedaranyam in the Nagapattinam district of Tamil Nadu in 2010, a similar project was launched in August 2011 in Kakinada in the East Godavari district of Andhra Pradesh. The important components of these projects are:

- Collection and identification of halophytes and studies on their salinity tolerance
- Cultivation of halophytes for production of oilseed and biosalt using seawater irrigation systems
- Establishment of the Halophyte Genetic Garden

Halophytes are generally defined as rooted plants (i.e., grasses, succulents, herbs, shrubs and trees) that grow in a wide variety of saline habitats from coastal sand dunes, salt marshes and mudflats to salt flats. The distribution and diversity of halophytic vegetation in India in general, and Tamil Nadu and Andhra Pradesh in particular, is poorly represented in literature and very often, it has been classified either with mangroves or with mangrove-associated

vegetation. A detailed study on the occurrence of halophytic vegetation along the Tamil Nadu coastline is imperative to document the distribution and to classify the species based on their existence at different soil salinity gradients as well as to select varieties to grow as crops in seawater farms.

This year, a survey was completed along the Vedaranyam coast, covering a distance of 60 km, and along the Kakinada coast for about 40 km length. The study areas are noted for the existence of a mosaic of saline habitats such as sand dunes, beaches, estuaries, intertidal areas, swamps, mangroves, mudflats, salt pans, etc. An assessment was carried out among the local communities of the coastal areas to understand the nature of the saline habitats and existence of halophytic vegetation. A rapid survey was conducted to list the halophytic vegetation and saline habitats there. To record the existence or the occurrence of the halophytic species in detail, the line-intercept method using a transect line ranging from 50 to 100 m (according to the area of distribution in different sites) was

Table 1.2 ***Coastal saline-tolerant plant species, including halophytes identified along the Vedaranyam coast***

Halophytes (as listed in Joshi, 2011)	**Exclusive mangroves**	**Other coastal flora**
Aeluropus lagopoides	*Acanthus ilicifolius*	*Anacardium occidental*
Arthrocnemum indicum	*Aegiceras corniculatum*	*Azadiracta indica*
Cressa cretica	*Avicennia marina*	*Borassus flabellifer*
Cyperus conglomeratus	*Excoecaria agallocha*	*Calotropis gigantea*
Halopyrum mucronatum	*Rhizophora mucronata*	*Cassia fistula*
Heliotropium curassavicum	*Sonneratia apetalla*	*Casuarina equisetifolia*
Ipomoea pes-caprae	***Mangrove associates***	*Cocos nucifera*
Porteresia coarctata	*Calophyllum inophyllum*	*Dodonaea viscosa*
Prosopis juliflora	*Clerodenron inerme*	*Enicostema axillare*
Salicornia brachiata	*Pandanus tectorius*	*Jatropha glandulifera*
Salvadora persica	*Pongamia pinnata*	*Lanaea coromandalica*
Sesuvium portulacastrum	*Sarcolobus carinatus*	*Odian wadia*
Sporobolus coromandelianus	*Thespesia populnea*	*Pedalium murex*
Sporobolus virginicus	*Spinifex littoralis*	*Sauropus bacciformis*
Suaeda maritima		*Vitex negundo*
Suaeda monoica		
Suaeda nudiflora		
Trianthema portulacastrum		
Trianthema triquetra		

applied. The occurrence of the species at different habitat types, species association and soil salinity were recorded. The presence-absence data was subject to PCA ordination to understand the distribution of the species in different sampling sites and to know the site similarity. Cluster analysis helped to classify the species association pattern.

Along the Vedaranyam coast, about 47 different coastal saline-tolerant plants and tree species were recorded. Of these, about 19 species were classified as halophytes, irrespective of their genetic adaptation. About 6 exclusive mangroves, 7 mangrove-associated flora and 15 coastal-associated vegetation species were noted along this coastal belt (**Table 1.2**). In the Kakinada coast, 63 species — 18 true halophytes, 17 mangroves, 13 mangrove associates and 15 coastal-associated flora — were documented. The species classified as halophytes by Joshi (2011) were grouped separately to differentiate them from other coastal flora. This includes succulents, non-succulent grasses, herbs, shrubs, creepers and strand tree species.

Next year, seawater-farming systems will be developed and demonstrated to show how some of these halophytes can be grown as crops using seawater irrigation. For this purpose, the Government of Tamil Nadu has been approached for allotment of 50 acres of land in saline mudflats. In addition, a Halophyte Genetic Garden is planned, where halophytes collected from India's coastal areas will be maintained for research and development purposes.

Sub Programme Area 104

Integrated Coastal Zone Management of the Vedaranyam Coast

The Vedaranyam coast located in the southern part of Nagapattinam district is geomorphologically complex, ecologically sensitive, culturally rich and economically at the crossroads. The coastal zone of Vedaranyam is depositional in nature, growing towards Sri Lanka at the rate of 10 m per year. The landforms include lagoons, mudflats, creeks, spits, swamps and sand dunes, which support high coastal biodiversity and also provide livelihood security to the coastal communities. The Point Calimere Wildlife Sanctuary, which is located about 12 km south of Vedaranyam town, is home to endangered blackbuck (a species of antelope), spotted deer and a variety of other mammals. A considerable part of the sanctuary is coastal tropical dry evergreen forest, regarded as the richest tract in the entire country in terms of diversity. The sanctuary is also noted for the large variety of migratory water birds. The Point Calimere Wildlife Sanctuary, the mudflats (also called the Great Vedaranyam Swamp), the Muthupet and Thalainayar mangrove wetlands together have been declared as a Ramsar site in 2002. The rural economy is largely based on agriculture, fisheries, salt production and minor forest produce. The major crop grown in wetland agriculture is paddy, with the majority of farms categorised as marginal

and small scale. Crops that grow in sandy soil, such as casuarina, tobacco, jasmine and coconut, are cultivated in large scale as dry land crops. In general, interest in agriculture is declining gradually, due to uncertainty in water availability, increased input cost, scarcity of labourers during peak season of operations, etc. The annual marine fish production in the district is estimated to be 80,000 tonnes (18 per cent of the State production) and the annual inland fish production is estimated to be 4900 tonnes (14 per cent of the State production). Salt production is another important economic activity in the Vedaranyam block. Salt pans are spread over 11,000 acres along the coastline, including those of small, medium and large salt manufacturers. However, natural resources and ecologically sensitive areas in the Vedaranyam coast are in a degraded state, mainly because of various human-induced stresses.

MSSRF is engaged in a project designed to enhance the capacity of stakeholders to restore and manage the Vedaranyam coastal zone in such a way that ecological security provided by coastal systems and livelihood security provided by coastal resources are enhanced. The project adopts the practices and principles of sustainable development, joint coastal zone management, community participation and gender equality in development. At a larger level, MSSRF is working with stakeholders to identify macro-level issues and find solutions that will lead to the sustainability of coastal systems, coastal resources, community development and livelihood security. These solutions will be linked to various government programmes and schemes. At the micro level, the project is working in selected villages, continuing the approach followed in earlier joint mangrove management programmes. In the entire process, MSSRF is working with government agencies, community institutions, and grass-roots NGOs and professional institutions to form a participative coalition for the sustainable management of the Vedaranyam coastal zone.

Six villages have been selected as project villages (**Table 1.3** shows the details), on the basis of the following criteria: prevailing socio-economic conditions, community involvement in salt production (farmers and workers), community interest in natural resources management, community willingness to field test innovative technologies in seawater farming, and potential for the development of ecotourism and low impact rural tourism.

As seen, different caste groups prevail in these hamlets; settlements with SC and ST dominance were carefully selected as they are marginalised in terms of caste, class and ethnicity. The different occupational patterns facilitate the understanding of livelihood issues.

The project has been divided into 3 phases:

Phase I: Preparation and data collection (6 months)

Phase II: Development and demonstration of interventions and capacity building (12 months)

Phase III: Pilot scale projects on integrated conservation and development (18 months)

Table 1.3 ***Details of project villages in the Vedaranyam coast***

Panchayat	Kadinalvayal	Adanur	Agasthiyam Palli	Kodiyakaddu		Pancha nathikulam
Name of villages	Kadinalvayal	Kovilthavu	Poovan thoppu	Adivasi colony	Kovilan kollai	Siruthalai kadu
Total no. of households	410	136	95	143	124	262
Total population	2282	958	437	920	857	1057
Caste	Agamudayar - BC, SC	Ambalakarar - MBC	SC	Adivasi - ST Pandaram - BC	Pandaram BC	Thuluva Vellalar - MBC
Major occupations	Agriculture, fishing, salt workers	Agriculture, fishing, salt workers	Salt workers	Fishing, salt workers, forest collection	Salt workers, fishing	Fishing, agriculture

Community mobilisation and organisation

Village-level orientation meetings were organised with the following major objectives:

- To orient and refine objectives, approaches and process of the project
- To take the consent of the community to develop gender-balanced village development and management committees
- To ascertain willingness to participate in exposure visits and organise the same

Both men and women of different age groups and occupations actively participated in the 5 village-level meetings conducted. Kadinalvayal and Kovilthavu villages are scattered settlements, hence women representation was less. In Poovanthoppu village women outnumbered men. Meetings were held in a participatory manner. A lot of discussion was conducted on village issues and both men and women expressed their willingness to participate in the entire project process, constitute gender-balanced village institutions and take it forward in a sustainable way. The project team was able to capture the communities' major concerns and expectations from the project and was also able to acquire an overview of the socio-economic dynamics and power relations. This facilitated the team to evolve village-specific strategies for further processes.

Exposure visit

Observations during initial interactions with the villagers revealed that women were generally not included in local institutions, particularly in traditional governance structures. Such power imbalance put women in a disadvantaged position, despite focus on women's empowerment. To break this

barrier and ensure gender inclusion and community participation in development activities, exposure visits were organised to successful conservation and development projects that had mainstreamed gender concerns. Community representatives of all the project villages were taken to MGR Nagar, near Chidambaram in Tamil Nadu, where a joint mangrove management programme has been successfully implemented by MSSRF, Tamil Nadu Forest Department and the community. MGR Nagar is steadily making progress in terms of participatory mangrove restoration and conservation, institution building at village level with an emphasis on gender inclusion and establishment and management of the Village Knowledge Centre (VKC). The participants studied the concept and practical approach and role of the VKC functioning in MGR Nagar. Five exposure visits were organised during January 2012, in which representatives of communities from the 6 coastal villages of Kadinalvayal, Kovilthavu, Poovanthoppu, Siruthalaikadu, Adivasi Colony and Kodiyakadu (totally about 186 participants: 97 females and 89 males) participated. Classroom lectures, field visits, interactions with the community were the tools used in the exposure visits. Feedback sessions clearly indicated that the participants understood that active community participation is essential for effective village development and natural resource management and in the efficient functioning of VKCs.

Other activities such as formation of village-level institutions, participatory rural appraisal and socio-economic survey are ongoing.

Sub Programme 105

Fish for All Centre

Hygienic processing of fish

The Fish Processing Unit (FPU) set up at the Fish for All Centre at Kaveripoompattinam, Nagapattinam district, Tamil Nadu, is continuing in educating the fisherfolk in standard hygienic pre-processing of local fish and preparation of value added-items, enhancing their livelihoods and in assisting them in establishing a good market linkage for selling hygienically processed fish and fish products.

Detailed fish landing data were collected every month for nearly 10 months from 3 randomly selected villages — Poompuhar, Vanagiri and Chinnangudi — to understand fish landing trends in the area and to plan the operations of the Fish Processing Unit. Details of boats operated, gear used, area of operation, fishermen involved, price and markets, average catch per day, catch per month, etc. were collected. The major species caught included sardine, tuna, carangids, catfish, flying fish, shrimp, lesser sardine, mackerel and mullet. Good months when high landings were obtained were from July to October 2011 and from January to March 2012. Data collected from Poompuhar revealed that, high value fishes constituted 16.48 per cent of the catch, medium-value fishes 36.96 percent, low-value fishes 40.45 per cent and trash fish comprised 6.11 per cent. Nearly 60 species of fish/shellfish were landed at Poompuhar.

With a view of forming SHGs of fisherwomen, identify their training needs and empower them to take up enterprises with the help of FPU, and make use of FPU for hygienic pre-processing and processing of fish, details related to the work patterns of fisherwomen (1584 fisherwomen from 7 villages) — fresh fish vendors, fish buyers through auction, dry fish vendors, etc. — were collected and documented. Initial discussions have been finalised with CIFT scientists on imparting training to selected groups of fisherwomen on the production and successful marketing of value-added fish products. Funding is expected from Indian Overseas Bank (IOB). Action is being initiated to formulate a MoU between CIFT and MSSRF regarding the training. Scientists from CIFT have already visited Poompuhar.

Through constant interaction and discussion, the confidence and understanding of both traditional panchayat leaders as well as elected panchayat officials have been gained. This will help us mobilise the fishers for productive activities. Rs. 25 lakh from the MPLADS fund through Professsor M.S. Swaminathan, Member, Rajya Sabha, has been facilitated for building a community centre at Poompuhar. Six solar lamps have also been fixed in the landing centre at Poompuhar village at MSSRF's cost, to help fishermen ply freely in the landing area even at odd hours.

A detailed market survey was conducted to identify potential retailers who would be interested in buying and selling hygienically processed fish/shellfish and fish products and also use the FPU in hygienic pre-processing/ processing of fish and fish products. Five retailers have been selected and given awareness training. Similarly, through detailed discussions, 17 fisherwomen have been selected to be trained in the productive use of the FPU for their livelihoods. Through such measures, the procuring/processing/ transporting /selling of hygienically pre-processed fish was carried out 10 times, of which 9 sales yielded profits. A total of 3341 kg fish/shellfish of 19 species were marketed in Tiruchi, Dindigul, Papanasam and Thittakudi. The fish and crab for processing were procured from Nagapattinam, Palayar, Karaikkal and Vanagiri by the fisherwomen.

Many entrepreneurs have shown interest in using the FPU for hygienic pre-processing/ processing of fish. One such entrepreneur utilised the FPU on a regular basis whenever fish was available and processed the fresh fish into ready-to-cook products. He was also able to sell the products in distant markets. Needed equipment and infrastructure for processing fish will be added to the FPU. The intention is to establish a viable market linkage for the fish vendors to sell hygienically pre-processed fish. With the proposed training promised by CIFT, fishermen/women will be given the scientific awareness and skill to process fresh fish into value-added products that would fetch better prices and thus raise their livelihood status.

Mobilisation of inland fish farmers

Constant interaction to provide technological support and scientific skill development was

continued with inland freshwater fish farmers (180 farmers in 3 blocks) in the Sirkali area. Thirty farmers were clustered under NABARD. Farmers were regularly facilitated in getting quality seed and subsidies for pond preparation with the help of the government's Agricultural Engineering Department and with the Electricity Board for getting electric connections. Three trainings and 3 exposure visits related to carp farming were organised. Manuals in Tamil on carp culture have been provided to farmers and scientific advice has been given to farmers on doubts related to carp farming as and when required.

A major problem faced by inland fish farmers is in the procurement of quality fish seed of different species. Hatcheries are few and are situated far away from the main culture areas, thus leading to heavier transportation costs. To ameliorate the problem, DBT has been approached with a project with a budget outlay of Rs. 35.5 lakh to train 200 farmers on modern methods of hatchery seed production of carp. The training is proposed for inland fish farmers of Sirkali and Kolli Hills in Tamil Nadu and Boipariguda, Jeypore and Kundura in Odisha. The plan is to train farmers in carp seed production using the portable plastic hatchery designed by CIFA.

Integrated farming

Small and marginal farmers were exposed to the benefits of integrated farming systems (IFS). Out of the 154 farmers covered, 50 are practising IFS. Monitoring of the farms of 26 farmers in Sirkali taluk to encourage them in adopting IFS was continued and the needed technology provided. Components like aquaculture, dairy, poultry, goat rearing, cropping (paddy followed by pulses), horticulture crops, banana, forage crops, vermicomposting, *azolla* pit and agro-forestry make up the IFS system. Among the different IFS models studied, the crop + fish + poultry approach registered a maximum gross income of Rs.70919/ ha, net income of Rs.35946/ ha. and BC ratio of 2.0. IFS with fish showed Rs. 90,000/ ha. net income over arable farming. With a view to mobilise external funding for developing a model IFS farm in 1 acre of land belonging to Fish for All, and further train 200 farmers on the practical aspects of IFS, a project for Rs.41.6 lakh is ready for submission to DBT for funding.

Concrete pedal pumps

On successful completion of 2 interventions on the fabrication and supply of concrete pedal pumps, which are very efficient, fuel-saving, low-cost interventions, an outlay of Rs.5.69 lakh was sanctioned for the third phase of the Water for the Third World project. This programme is being implemented now in Sirkali and the fabrication and supply of 200 concrete pedal pumps are planned during 2011-2012.

Mud crab fattening

The mud crab fattening programme practised by a WSHG comprising 10 fisherwomen of Madavamedu village of Sirkali taluk was continued. Fattening of mud crabs in cages has become a regular source of income

for these 10 women, fetching not less than Rs.6393 on an average from a fattening cycle of around 25 days involving 15 cages. Detailed data on the fisherwomen concerned, package of practices followed, market channels and economics were collected and recorded.

Training and capacity building

To enhance technical skills on modern scientific practices among ordinary fishermen/ women, inland fish farmers and agri-farmers, a series of trainings using experts in the particular fields were conducted in the Fish for All centre. A total of 15 trainings on various aspects of marine fisheries, freshwater fish culture, fish processing, etc., were conducted for nearly 508 farmers/fishers (203 males and 305 females). The important training modules included safety at sea, hygienic handling of fish, various shrimp processing methods, composite culture of carp, disease management and treatment in freshwater fish culture, fresh water ornamental fish culture, diversification of aquaculture practices, preparation of idli powder using small sized shrimp species, etc.

Similarly, 5 trainings on various aspects of agriculture, such as setting up kitchen gardens, integrated pest management, weed management, etc., were given to 184 farmers (130 males and 54 females). The Centre also organised a 6-day training programme funded by Indian Overseas Bank for farmers on freshwater fish farming. IOB has also sanctioned 3 trainings during 2012-2013.

Farmers' clubs

Four farmers' clubs were formed as per NABARD norms, comprising 521 members. Of these, Vivekanandar Farmers' Club from Valluvakudi was selected as the best farmers' club in Nagapatinam district by the lead bank, Indian Overseas Bank.

Sub Programme Area 106

Remote Sensing and Geographical Information Systems

106.1 Coastal Systems Research

Inventorisation and Monitoring of Biosphere Reserves in India using Remote Sensing and GIS Technology

An urgent need has been felt to develop a coordinated programme to strengthen research on critical issues and to formulate a perspective plan for intensive management of Biosphere Reserves (BRs) in the country. In this context, with the funding support of the National Natural Resource Management System (NNRMS) programme of the Ministry of Environment and Forests, Government of India, a national project has been initiated by the G.B. Pant Institute of Himalayan Environments and Development along with MSSRF, the National Remote Sensing Agency and the Forest Survey of India. The objectives of this initiative are:

- To create a natural resources and social database using latest remote sensing

images of existing BRs in India, with a focus on land use/land cover maps

- To study temporal changes in land use dynamics (at 5-year intervals starting from 1990 or from the date of notification)
- To make recommendations for effective management of BRs and redefining zones / boundaries

MSSRF has been assigned the task of completing the study in the Gulf of Mannar, the Sundarbans and the Great Nicobar islands. During the year under report, basic GIS data structure, scale and projection, classification schema for land use and other issues were finalised in consultation with nodal agencies and partnering agencies such as the Forest Departments of Tamil Nadu, West Bengal, and Andaman and Nicobar. Orders were placed on the National Remote Sensing Agency, Hyderabad, for the purchase of satellite images LISS III for the years 2000, 2005 and 2010 and LISS IV for the year 2010. The Landsat satellite images for the year 1990 and 1995 were downloaded from the freely available US-based server.

A reconnaissance survey was carried out for the three Biospheres. Base maps were also created. The toposheets of the Gulf of Mannar and Sundarbans were collected and geo-referenced for the geometric correction of the satellite images. In the coming year, thematic maps — such as landuse / landcover, forest canopy density, forest fragmentation and disturbance — based on multi-criteria analysis will be prepared using remote sensing imageries and information collected by intensive groundwork. These maps will be availed to prepare corridor connectivity maps and change maps, which will be further used to refine the management processes of the Biosphere Reserves.

ICZM of the Vedaranyam coast

The base map for the Vedaranyam area was prepared from the toposheets and available cadastral maps. The land use /land cover map was prepared using the LISS IV satellite image for the year 2010. The base maps for the villages Siruthalaikadu, Kadinalvayal, Kovilthavu, Poovanthoppu, Adivasi Colony and Kovilankollai were also prepared by digitising the cadastral map from the Survey Department, Government of Tamil Nadu. GPS-based critical facilities survey was done for the 6 villages and these facilities were mapped. The land use change dynamics of the Vedaranyam coast for the years 1990, 1995, 2000, 2005 and 2010 is being prepared using Landsat and LISS III satellite images. GPS-based household survey was completed and the non-spatial data collected will be linked to the household data, and socio-economic thematic maps will be prepared for the villages.

Enhancing adaptive capacity to sea level rise

GIS-based activities such as participatory GIS to assess the saline areas in MGR Nagar, Kalaignar Nagar and Mudasalodai as well as GIS-based vulnerability assessment using high-resolution remote sensing data and

differential global positioning system (DGPS) data were initiated this year.

Prediction of land inundation by the impact of sea level rise

The digital elevation model (DEM) derived from DGPS data, combined with overlay techniques in GIS, is used in determining the inundation zones in the study area. The vulnerability to inundation of coastal areas in the Vellar-Coleroon estuarine region was quantified, based on projected sea level rise scenarios of 0.5 m and 1 m. The findings reveal that out of 6540 ha of land use, 4400 ha of the land use and land cover of area would be permanently inundated by 0.5 m sea level rise and 5942 ha by 1 m sea level rise and would also result in the loss of three major coastal natural resources like coastal agriculture, mangroves and aquaculture. It was identified that 11 hamlets that depend on these resources are highly vulnerable to a sea level rise of 0.5 m and 16 hamlets to that of 1 m.

106.2 Ecotechnology

Spatial databases based on Remote Sensing (RS) and Geographic Information Systems (GIS) were prepared as a support tool in project planning and monitoring of the project sites at Pudukottai (Tamil Nadu), Karasanur (Puducherry) and Koraput (Odisha). Based on the field requirements, various maps were prepared capturing the temporal and spatial aspects of the project's progress in the field. At all three sites, maps were prepared to show the watershed boundary superimposed with the cadastral and field boundaries. Elevation maps (with 20 m contour lines) were prepared using Shuttle Radar Topography Mission (SRTM) data for determining suitable locations to execute farm ponds; the maps also included the existing water bodies. Land use/ land cover maps using satellite images (LISS IV) were prepared showing the existing status. Soil nutrient maps showing variations across seasons were prepared for selected farms based on soil tests. Other supporting maps were prepared on drainage, soil series, soil depth, soil pH, soil erosion, ground water permeability and crop suitability. Periodically, at every 6-month intervals, maps showing the extent and type of interventions have been prepared for the purpose of planning and monitoring.

All the maps generated for the Pudukottai project site were compiled in a booklet form with interpretations and guidelines in Tamil and was disseminated to the community through the Thalinji VKC.

106.3 Strengthening research and organisational capacity of MSSRF

As reported last year, geo-spatial technology has been incorporated as one of the components of the project on strengthening research and organisation capacity of MSSRF The specific objective is to integrate GIS and RS tools in the research and development programmes of MSSRF at both village and organisational levels and to facilitate programme area integration. An orientation programme was conducted on the utilisation of remote sensing and GIS tools for the representative staff of all Programme Areas (PAs). Following this,

the needs of each Programme Area as well as nominated sites for action were elicited. Identification of relevant spatial data for selected villages of each Programme Area were presented to the respective PAs to obtain their requirements of different scenarios. It was agreed that the spatial database should have the basic information layers and additional layers as required for planning and monitoring based on the demand of the project. These data can be entered, edited, analysed, mapped and documented using GIS software. The scenarios with inferences will then be developed and demonstrated among each PA for decision making in planning, implementation and monitoring of activities. In the current year, in addition to the spatial data, required non-spatial primary and secondary data were collected and basic layers and additional layers for 5 villages of PAs 100, 200, 400, 500 and 600 were prepared. However, the process is at a different stage in each of the villages.

PA 200 Biodiversity: Gundur Nadu panchayat in Kolli Hills was identified for the integration of GIS and RS and hands-on training on GPS was given to the staff at Kolli Hills. The feasible application areas of GIS and RS, such as generating farm boundaries for all the organic farmers using the GPS tracking system, converting the existing non-spatial data into spatial data base with farm boundary, generating thematic maps using farmers' data base and updating and monitoring the organic farming activities, were finalised. To achieve these tasks, a cadastral map was collected from the Survey and Land Records Department. The organic farmers' database has been collected from the Kolli Hills site. The database will be organised and will be incorporated in the GIS platform and different thematic maps will be prepared.

PA 400 Ecotechnology: From this PA, Pudupatti panchayat of Kannivadi site, Dindigul district, was selected by the core members. The panchayat includes 7 villages, 18 SHGs, 6 farmers' groups (72 members) and 2 enterprise groups. It was decided by the core team that a database of farming families and farming operations would be prepared and linked to GIS-based FMB map. It was also decided to map the Women SHGs in the panchayat and link the available database to the spatial database. GPS co-ordinate points for the houses of the presidents of each SHG for spatial reference were recorded to create the linkage and critical facilities such as schools, temples, electric posts, hospitals, etc., in the villages were also mapped

PA 600 Informatics and Communication: As reported last year, livestock mapping was the major area of application identified by the Informatics team for Embalam village of Puducherry. Data collection is completed. Data entry is in process.

Programme Area 200

BIODIVERSITY

Millet conservation, cultivation and consumption was promoted, involving more than 500 members of KHABCoFED. Work undertaken at Wayanad included promotion of cultivation of traditional rice varieties, establishment of home gardens and soil and water conservation activities covering more than 1500 ha. Project Mazhanidhi that aims at reaping rainwater and restoring rural ponds was initiated in the Kuttanad region. In Jeypore, large-scale cultivation of traditional rice varieties, introduction of appropriate technologies and management practices for enhanced productivity and marketing were among the main highlights of work. Traditional Agriculture System of Koraput and Below Sea Level Faming System of Kuttanad were recognised as Globally Important Agricultural Heritage Systems by FAO. The Wayanad Tribal Development Committee received the 2010-2011 Genome Saviour Award.







Creating an economic stake in conservation – documentation of new species, improved cultivation methods, value addition and market linkage

Programme Area 200

Biodiversity

The activities under the Biodiversity Programme Area continued in all the three intervention locations — Kolli Hills, Tamil Nadu; Jeypore, Odisha and Wayanad, Kerala.

Large-scale cultivation of local rice landraces *Machhakanta, Kalajeera and Haladichudi* was promoted in Odisha using modified SRI technology in partnership with the communities in 11 operational villages covering an area of 11.5 acres. The work in the area of revitalisation of the rice cultivation traditions of Koraput paved the way for it becoming the first site in India to be declared by the UN Food and Agricultural Organization (FAO) as a Globally Important Agricultural Heritage System (GIAHS). Prime Minister Manmohan Singh, in the presence of the Chief Minister of Odisha Naveen Patnaik, declared Koraput as the first GIAHS site in India during the 99th Indian Science Congress held at Bhubaneswar in January 2012.

The work of the Community Agrobiodiversity Centre (CAbC), Wayanad, in the area of traditional plant genetic resource (PGR) management resulted in the Wayanad Tribal Development Committee receiving the Genome Saviour Award 2010-2011, from the Protection of Plant Varieties and Farmers' Rights Authority (PPV&FRA), Ministry of Agriculture, Government of India. Seven new species of angiosperms from the forests of Wayanad were described this year too. CAbC has been identified as a resource support organisation for NABARD to monitor and evaluate the activities of 56 watershed development programmes covering 36,000 hectares of land across Wayanad district — a hot speck in the global biodiversity hotspot of the Western Ghats.

The NABARD-funded tribal development project in Kolli Hills focusing on orchard development was extended to 373 tribal farm families in 25 settlements, covering an area of 350 acres.

The major highlights of the Community Gene Bank management work are the distinctiveness, uniformity and stability (DUS) testing of 135 rice varieties and the education programme on PPV&FRA to farmers and NGOs of Koraput district.

The Biodiversity team at Chennai facilitated the preparation of India's position paper on the issue of Green Economy to be placed in Rio+20, the United Nation's Conference on Sustainable Development held in Rio de Janeiro in June 2012.

Sub Programme Area 201

Community Conservation Efforts in Kolli Hills

201.1 Tribal development programme

MSSRF has been implementing the NABARD-funded tribal development programme at Thirupuli, Alathur, Gundur and Gundani

(TAGG) panchayats in Kolli Hills since July 2010. The key objective of this action research project is to curtail migration of tribal farm families and to provide them with options for on-farm livelihood diversification by creating wadi (*siruthottam* or orchard) farms that integrate silviculture, horticulture and animal husbandry. Soil and water conservation measures are also key interventions in the programme. During the reporting year, the project support has been extended to 373 tribal farm families in 25 settlements in the TAGG panchayats.

Prior to the implementation of the programme, a comprehensive field survey was organised to capture the status of the total acreage (600 acres) of wadi farms. The survey included details such as level mapping, farm type, survival estimate, status of field bund preparation, suitability assessment for locating mini percolation ponds, intercropping status of the wadi farms, and also membership status of the wadi families in the community institutions.

Quality saplings of 20 jackfruits, 40 cloves and 128 silver oaks were procured from the State Horticulture Department, research stations and authorised nurseries and planted in 350 acres. Plastic diffusers (pitcher pots), farmyard manure and neem cakes were supplied to every participating family.

As part of water resources development, the wadi famers were encouraged to establish 10 ft x 10 ft x 10 ft size mini percolation ponds in suitable locations within the farms. Eighteen such ponds were created at Thirupuli and 10 at Gundur clusters, and served as the source of water for cattle and life-saving irrigation to plants. Some of the participating farmers deepened these mini ponds into small wells, while some of them used oil-powered engines for irrigation since the water supply was copious.

Wadi farmers were also encouraged to undergo training on freshwater fish culture at KVK, Namakkal. Catla, rohu, mrigal, grass carp and common carp varieties of fingerlings were introduced in the percolation ponds with an average of 20 fingerlings in each. In addition, 2000 numbers of varieties of carp fingerlings were also introduced in the community pond at Gundur panchayat.

During the reporting period, a survey was conducted to find out the status of participants of wadi in other community institutions such as SHGs. The survey indicated that about 60 per cent of the participants who were ready to join the wadi initiative, particularly women, were already serving as members in other SHGs that are promoted by various NGOs, mostly as thrift groups. Efforts are on for the formation of 16 Farmers' Clubs in Gundur and 17 in Thirupuli clusters. A veterinary camp, organised with the support of TANUVAS, benefited the farm families in Gundur and Thirupuli panchayats.

As part of the preparatory work for further extension to cover an additional 400 farm families, the project team has undertaken a field appraisal in Alathur and Gundani. Information such as criteria for the selection of farmers, field suitability, field mapping,

identification of water seepage areas, revenue record details of possible farms, etc. are in progress.

201.2 Kolli Hills Agrobiodiversity Conservers' Federation

The Kolli Hills Agrobiodiversity Conservers' Federation (KHABCoFED) is a community-based organisation promoted and nurtured by MSSRF. Currently this Federation has 40 member groups with 237 male and 275 female members organised into four clusters. The member groups own 9 millet and paddy processing mills, 3 organic produce procurement centres, 2 natural foods shops, one grocery store run by a SHG and two VKCs. The member groups participate in the supply chain of millets and also in contract farming and marketing. MSSRF has facilitated strengthening this Federation by harnessing support from the State government and handholding efforts. During the reporting period, 10 SHGs received a revolving fund of Rs. 6 lakh from the District Rural Development Agency (*DRDA*) and 8 groups received a direct loan of Rs. 10.40 lakh as consumption loan and livelihood support.

The members of the KHABCoFED actively participated in the popularisation of millet conservation, cultivation, and consumption to general public on various occasions, such as

- Innovation Marketplace exhibition organised by Global Conference on Women in Agriculture at the National Agricultural Science Complex (NASC), New Delhi, March 2012
- Sivarathri festival organised by Isha Foundation at Velliyankiri, Coimbatore, February 2012
- Training programme on small millet cultivation and marketing in KVK, Namakkal. February 2012
- Annai Therasa Mahalir Vaniga Vazhagam, Valluvar Kottam, Chennai, organised by Mahalir Thittam DSMS, January-February 2012
- Mahalir Thittam DSMS expo at Namakkal. December 2011
- Adi *patinettam perukku* festival at Kolli Hills. August 2011

Sub Programme Area 202

Community Agrobiodiversity Centre, Wayanad

The Community Agrobiodiversity Centre (CAbC) at Wayanad is now in its 15th year of operation and has been continuing the process of developing and disseminating management solutions for operationalising the 4C — conservation, cultivation, consumption and commercialisation — dimensions of sustainable genetic resources management

202.1 Sustainable livelihoods and food security

Crop-based interventions

The interventions have been in rice, vegetables, wild/traditional tuberous and

leguminous species, pepper, ginger and medicinal plants.

A baseline survey was conducted to find out the traditional varieties of rice cultivated and area of cultivation, with special focus on speciality rice varieties. Based on the survey, seeds of 10 speciality rice varieties were procured for purification. Farmer clusters were identified and preliminary meetings were convened at 4 locations to implement the seed village programme. The Wayanad District Tribal Development Action Council was strengthened to identify and to induct more farmers involved in the cultivation of traditional rice varieties.

A baseline household survey was conducted in 2 villages to document the information on food habits and primary health care practices of 1000 families and the details of existing kitchen gardens and herbal gardens. Based on the results and in order to strengthen the nutrition security of the focus villages, 440 home nutrition gardens (2 cents land per household) were established with 12 species of vegetables for cultivation. The participating members were given adequate training in the cultivation and management of vegetables.

A directory with contact details of over 5000 pepper farmers and 25 pepper development committees of Wayanad district was prepared. More than 100 farmers, who are cultivating traditional pepper varieties, were also identified through a telephonic survey. A study on the identification and evaluation of traditional varieties of pepper has been initiated in 4 pepper cultivating zones of Wayanad. More than 25 individuals of 9 pepper cultivars viz., *Arakkalamundi, Karimunda, Karimundi, Kuriyilamundi, Kuthiravally, Muttiyarmundi, Chumalanamban, Vellanamban*, and *Wayanadan* have been collected and tagged for observations on their distinctiveness, uniformity and stability with respect to yield and other morphological parameters. A Germplasm Bank of pepper was established with 8 traditional varieties, 9 improved varieties and 2 wild spp and 3 cultivars (*Chukumaran, Himachal* and *Riodi*) and 4 wild species of ginger, following a field survey. Traditional knowledge associated with the cultivation and storage of ginger in 3 taluks was also documented. A total of 195 home herbal gardens were established in 2 villages with 15 species of medicinal plants commonly used in home remedies. At CAbC, the construction of a tissue culture lab and storehouse-cum-semi-processing unit for medicinal plants is progressing, while mass multiplication of 25 species has been initiated using conventional methods such as vegetative and seed propagation.

Soil and water conservation/ bio-inputs/ bio-control agents

The NABARD holistic watershed development programme has been implemented at Pannikkal and Mundakkai by CAbC to conserve soil and water and promote sustainable agricultural practices. A total area of 1709 ha in these 2 sites involved land treatment and drainage line treatment, and the convergence of various livelihood activities will be the focus for the third year.

A major achievement of the Centre this reporting year has been NABARD's recognition of CAbC as a Resource Support Organisation to monitor and evaluate the activities of 56 watershed development programmes supported by them and operated by 13 different NGOs across Wayanad district, covering 36,000 hectares of land.

A baseline survey for the demand for bio-fertilisers and bio-pesticides (bio inputs) was conducted across the district with farmers and marketing agencies. Based on the demand, the cultures of 5 selected bio inputs — *Azetobacter* spp., *Pseudomonas* spp, *Trichoderma* spp, vermicompost, and *Vesicular-arbuscular mycorrhiza* — were collected from the Kerala Agriculture University. These cultures are being maintained in the microbiology laboratory for mass multiplication and for distribution to farmers. A media for the mass multiplication of *Trichoderma* was formulated with coffee husk and neem cake (9:1) and was found successful. CAbC laboratory has screened, isolated and identified the pathogens causing the rhizome rot disease of ginger (fungus: *Pythium aphanidermatum;* bacteria: *Ralstonia solanacerum*) and the pathogen causing capsule rot disease of cardamom (*Phytophthora meadii)*. Tests were carried out using 7 selected bio-control agents and *Bacillus subtlis* was found to be the best control measure with 84 per cent inhibition rate.

Popularising the multiplication and effective application of *Trichoderma* as a bio-control agent for the revival of pepper cultivation in Wayanad was tried with the support of the Kerala Biotechnology Commission. Two *Trichoderma* mass multiplication units were established by Women Self-Help Groups at Vythiri (*Haritha*) and Pozhuthana (*Mythri*) gram panchayats. The women's groups were provided with adequate training on production, storage and use of *Trichoderma*. Both gram panchyats offered necessary infrastructure facilities to these groups. This project has been implemented through Wayanad Agricultural and Rural Development Association (WARDA), a grass-roots organisation working in collaboration with CAbC. About 850 kg of *Trichoderma* have been marketed by these groups at the rate of Rs 40/kg during the year.

Project Mazhanidhi: Reaping rain and restoring rural ponds in the Kuttanad region

The *Mazhanidhi* project is jointly implemented by MSSRF and Kuttanad Vikasana Samiti, the local NGO partner, and is aimed at securing safe and clean water for drinking and household use for about 1000 families of Kainakari panchayat of Kuttanad in Alappuzha district. This region receives an average rainfall of 2,500 mm/year. Most of the area in this panchayat is 50 to 250 cm below sea level. It is the most vulnerable region of Kuttanad as nearly 95 per cent of the 6000-odd families do not have access to pollution-free water. The scarcity of good quality fresh water has lead to innumerable health problems and vulnerability to diseases such as cancer, Japanese encephalitis, dengue fever, rat fever,

etc. The project aims to harvest 25 lakh litres of water per good rainy day. The primary role of MSSRF is to spearhead the project through the formation of a group of youth trained in rainwater harvesting and its sensible use. The project, with a site office at Monkompu, Alappuzha, was launched by Professor M. S. Swaminathan in January 2012. The Advisory Committee constituted for the guidance and monitoring of this project had its first meeting in April 2012.

202.2 Education, communication and training

Empowering farmers, youth and women

Training for empowering farmers, youth and women were provided under the *Karshakajyothi* programme supported by NABARD. This programme created 125 training days in the areas of innovative agricultural techniques. It trained a total of 5,301 participants, out of which 1,654 were women. The topics included organic farming, precision farming, integrated farming, zero-budget farming, soil and water conservation, good livestock practices, mushroom cultivation, pisciculture, crop-specific modern farming techniques, herbal medicine preparation, plant nursery techniques and value addition of fruits and vegetables. As part of lateral learning about innovative practices adopted by successful farmers, CAbC organised 6 exposure visits to different farms in Kerala and Tamil Nadu. For understanding integrated intensive farming, the Wayanad farmers visited model farms managed by different farmers under diverse combinations of crop and animal integration. Thirty-one selected farmers interacted with the progressive farmers adopting innovative models. CAbC also documented farming practices followed by 4 innovative farmers in order to disseminate best practices. This documentation and dissemination includes video material on integrated intensive farming, precision farming, coffee cultivation, dairy farming and pisciculture. Such trainings have motivated 68 farmers to initiate different ventures.

The Centre has identified 7 progressive farmers of the district and recognised their contribution to sustainable farming. Sosamma Abraham and Eldho Baby for integrated farming; Digol Thomas for precision farming; N. H. Murali for dairy farming; Babu Thomas for zero-budget farming; M. P. Ashok Kumar for coffee production and Cheruvayal Raman for the cultivation of traditional paddy varieties were identified by the Committee chaired by the Principal Agricultural Officer, Wayanad, and given certificates of appreciation signed by Professor M. S. Swaminathan, recognising their efforts towards ensuring food and nutritional security and sustainable development of the country. Later, the Kerala Minister for Agriculture and Animal Husbandry K. P. Mohanan extended his appreciation to these farmers during a ceremony held at the Centre.

A training programme for tribal farmers named *Gothrajyothi* was launched with the support of the Department of Scheduled Tribes Development, Government of Kerala. The selection of the participants for the training course has been completed during this year.

Empowering children

This year, the Every Child A Scientist (ECAS) programme enrolled 30 new students. A field centre for ECAS was started in a tribal hamlet at Kolagappara to attract more tribal children. This centre is aimed at providing education to 40 students including school dropouts. A community teacher was appointed and given training and motivation to care for the tribal children and ensure a good learning environment. A computer centre was also established in the hamlet to attract students towards ICT-based integrated biodiversity education.

CAbC continued the implementation of the DNA Club activities in 8 selected schools located in 8 districts of Kerala. The major activities under DNA Club included 20 invited lectures, 4 exposure visits to the student to biodiversity rich spots and research institutions, 10 scientific experiment demonstrations and a few audio visual shows on biodiversity and nature. DNA clubs have created awareness and campaigned for a plastic-free campus and also established medicinal gardens and vermicompost units in the selected schools.

The initiative for creative learning provided an opportunity for foreign students to learn about the biodiversity of the Wayanad area of the Western Ghats. A team of 12 students from Gems Wellington International School, Dubai, attended an 11-day training programme focused on biodiversity conservation, agriculture and sustainable utilisation of natural resources.

Farm school

The Farm School, financially supported by Indian Overseas Bank, is to facilitate farmer-to-farmer learning and also to create a platform for farm-level trainings, seminars, and group meetings involving government departments, farmers' groups, farm clubs, NGOs and civil societies. The integrated farm of Eldho Baby at Idiyamvayal village of Pozhuthana gram panchayat was selected to establish the first farm school in Wayanad district. Eldho Baby is an innovative organic farmer who adopts integrated farming and earns approximately Rs. 3 lakh per year from one acre of land. The foundation stone for the infrastructure facility was laid in January 2012 and 60 per cent of the construction work of the farm school has been completed.

Documentation project

NABARD has supported a project for documenting successful and bankable farming practices adopted by lead farmers in the district. The major objectives of the first phase of the project are to bring out a database of 250 successful farmers from the district and to produce both printed and soft versions of a compendium document comprising successful and bankable farming practices. A trained survey team has been formed in this regard with the help of agriculture officers, veterinary doctors, local self-government institutions and key persons from the respective panchayats. The survey team has short listed 10 progressive farmers from 25 gram panchayats. Video documentations of successful dairy farm practices and fruit farm practices have been

completed. A memorandum of understanding has been signed with Government Engineering College, Mananthavady, for developing the database in soft version.

BioDIVA transdisciplinary research on land use change and agrobiodiversity

BioDIVA is building interdisciplinary insights on rural development, gender studies, ecology, resource economics, land use change modelling and institutional analysis. All the researchers (3 from MSSRF, 5 from Leibniz University of Hanover) from the sub-projects Agroecology, Resource Economics, Rural Sociology, Land Use Change and Institutional Analysis have started their research in the reporting year. A socio-ecological study on land use change in Wayanad district with special emphasis on tribal agriculture has been completed. The researchers have conducted 3 field-level farmer stakeholder workshops (which are methodological tools to integrate the knowledge of local experts on their own situation) and 5 district-level scenario workshops with different stakeholders (which are aimed at gaining insights into decision-makers' assessment of the situation, verifying the primary findings and gathering feedback) during the year.

202.3 Biodiversity conservation

This year 69 varieties of little-known crops have been added to the germplasm collection maintained at CAbC. Ten farmer clusters were identified for the Seed Village programme with 5 selected traditional rice varieties. Seven new species of angiosperms have been described this year from the Wayanad part of the Western Ghats. The RET conservation programme has raised 51,750 seedlings of 68 species for *ex situ* conservation and re-introduction. The Botanic Garden at the CAbC has been recognised as a lead garden by the Ministry of Environment and Forests, Government of India. The Western Ghats Endemic Plants Information Centre (WEPIC), a part of the garden project, has developed a database on 1465 endemic plants of the Western Ghats with photographs of 179 species and has added 500 herbarium specimens, taking the total number to 3220.

Saving indigenous rice varieties

The traditional rice varieties conservation programme and capacity building has resulted in bringing the Genome Saviour Award 2010-2011 awarded by PPV&FRA to the Kurichya and Kuruma communities of Wayanad. These communities have been conserving 20 traditional rice varieties with a range of characteristics, including tolerance to drought and flood, medicinal properties and aroma. These communities have been recognised earlier for their conservation efforts with the Second Plant Genome Saviour Community Recognition Award for the year 2008.

Saving rare endemic and threatened tree species

This year 72 field trips were conducted to different places on the Kerala side of the Western Ghats and the natural populations of 66 RET target species located. Further familiarisation of the target species were also achieved by examining the herbarium

specimens at the Kerala Forest Research Institute, Peechi, at the University of Calicut, and at the Tropical Botanic Garden and Research Institute, Thiruvananthapuram. The identification of the located species was confirmed based on detailed morphological study and by comparing them with the herbarium specimens.

Propagation of 66 target species was attempted and a total of 24,454 seedlings of 46 species were raised through seed germination (with 59 per cent survival) as well as vegetative means (with 26 per cent survival). A mist chamber was also established in the CAbC for better propagation trials.

Ex situ and in situ conservation

A RET plant conservation garden, named M. S. Swaminathan RET Reserve, has been initiated at Jawahar Navodaya Vidyalaya, Wayanad. Another garden has been initiated at the Kerala Veterinary and Animal Sciences University campus. *Punyavanam* conservation gardens have been established in 2 temples at Valliyoorkaavu and Chedaatinkaavu. This programme envisages planting of 10,000 seedlings of sacred, endangered and endemic tree species of the Western Ghats in 100 selected temples of the Malabar Devaswom Board. One of these gardens is an exclusive *Ashokavanam*, where more than 100 seedlings of the *Asoka* tree (*Saraca asoca*) were planted.

Documentation on the faunal diversity of the Wayanad Wildlife Sanctuary including wild animals, birds, local breeds of cattle, goats, fowls and honey bees, fishes of the minor tributary of the Kabini River and spider diversity of paddy ecosystem was completed.

CAbC in association with National Green Corps conducted education and awareness programmes on biodiversity and its conservation in Wayanad district this year, which included 23 awareness classes in schools across the Malabar area, an RET plant exhibition at Kozhikode, one-day training programme for forest guards and one-day training programme for science teachers.

Farm and conservation garden

The CAbC farm is dedicated to demonstrate sustainable practices in the cultivation and management of plantation crops (coffee-based cropping system). The integrated farm maintains 5 milch cows, backyard poultry with 30 local birds, vermicomposting unit, mushroom spawn production unit and a bio-control production unit. A pepper and a general nursery are also maintained with saplings of cinnamon, coffee, pepper and anthurium (an ornamental herb). During the year, rejuvenation measures have been undertaken by planting seedlings (1200 coffee, 1000 pepper and 200 kg of turmeric) for effective utilisation of available space.

The farm produced 12,096 kg of coffee, 70 kg of pepper 3,200 kg of areca nut, 1900 lts of milk and 682 eggs during the reporting year. The pepper mother nursery produced 12,500 vines of *Karimunda* and *Panniyur* varieties. The farm also maintains a demo plot of 1500 pepper vines (around 1 ha) with varieties *Panniyur* 1, *Panniyur* 5 and *Thevam.*

The mushroom spawn production unit produced 4210 bottles (250 g each) of spawn and supplied the farmers' and women's groups as per their requirement. The production of vermicompost in the farm went up to 10 tonnes and mushroom to 10.7 kg.

The bio-control production unit produced 16 lts of *Trichoderma* culture (broth) and supplied the women's groups in Vythiri and Pozhuthana panchayats. The culture was also produced as talc (dry powder) (10 kg) and supplied to the local farmers. *Pseudomonas* was produced in the unit as liquid formulation (5 lts) for controlling foot rot of pepper.

A demonstration plot for soil and water conservation activities has been successfully implemented in the farm land. The activities during this year included construction of 2880 running m of earthen bunds, 958.34 m^2 stone-pitched graded bunds, 114 nos. water percolation pits and 8 nos. of loose boulder check dams.

The garden has been augmented with 19 distinct components: Rose (with 20 varieties); Fernery (with 130 species), Hibiscus (with 25 varieties); *Myristica* swamp (with 100 individuals of 4 species); wild food garden (with 200 leafy greens and 150 fruiting species); legume zone (with 28 varieties of 4 species); tubers/Yams/Taros/Rhizome zone (with 55 varieties of 20 species); Palm and rattan garden (with 10 individuals); Butterfly garden (with 150 species of butterfly host plants); *Zingiberatum* (with 30 species of rhizomatous plants); *Bamboosetum* (25 species); RET trees conservation garden and nursery (arboretum with 450 individuals of 132 species; nursery with 30,000 individuals of 132 species); climbing plants zone (with 250 species); medicinal plants garden (with 100 species) and *Orchidarium* (with 120 species).

Networking and partnership building

The Wayanad Agricultural & Rural Development Association (WARDA) and Wayanad District Tribal Development Action Council (WDTDAC) are the two grass-roots organisations working in partnership with CAbC. These organisations have partnered actively in the implementation and monitoring of various programmes of CAbC during the year. The Centre also kept good rapport with different government departments, Panchayat Raj Institutions and NGOs to effectively implement the conservation of biodiversity and sustainable development programmes. The opportunity to partner with international agencies like the Satoyama Initiative (based in Japan for the advancement of socio-ecological production landscapes) and the IUCN network has been very beneficial.

Sub Programme Area 203

Biju Patnaik Medicinal Plants Garden and Research Centre, Jeypore

Biju Patnaik Medicinal Plants Garden and Research Centre (BPMPGRC) works mainly in the Jeypore, Kundura and Boipariguda blocks of the district, with as many as 62

tribal communities inhabiting the region. BPMPRGC has primarily been concerned with the conservation of local landraces, especially rice, finger millet and pulses, vegetables and medicinal plants. Income-generation activities through aspects such as sustainable use of natural resources, food and nutrition and capacity enhancement have also been priority areas of intervention. Recognition of the communities of the area through the conferment of GIAHS by FAO, Genome Saviour Award from PPV&FRA as well as the National Water Award from the Ministry of Water Resources, Government of India received during 2012 are testimonies to the work undertaken by the Centre over the past 15 years.

One of the major projects operated during the year was the capitalisation of prominent landraces of rice in Orissa through the value-chain approach. The lead institution of this project is MSSRF partnering with Central Rice Research Institute (CRRI), Cuttack, Orissa Rural Development and Marketing Society (ORMAS), Koraput, and Krishi Vigyan Kendra (KVK), Semiliguda.

203.1 Large-scale cultivation and market promotion

Large scale cultivation of traditional rice varieties *Machhakanta, Kalajeera* and *Haladichudi* was promoted in the 15 operational villages of Koraput district. The Kalinga Kalajeera Rice Growers' Cooperative Society (KKRGCS) which has been shouldering commendable responsibility on production aspects is now working on marketing components. The strategy adopted this year was to provide more training-cum-demonstration on bio-pesticide preparation and its application, promotion of green manure (*Sesbania sp.*), cluster-wise training on seed treatment and quality seed production. A participatory plan of action was developed and decisions were taken with regard to seed distribution, farmers' selection, and crop monitoring, storage and market promotion. The area under cultivation under *Machhakanta* and *Haladichudi* was increased from 41.5 to 79.7 acres and 7.5 to 35.8 acres, respectively, whereas the area under *Kalajeera* was reduced from 176 acres to 141.5 acres. (**Table 2.1**) Sixty farmers adopted green manure application with *dhanicha* by linking with the State Agriculture Department. Kalajeera cultivation has been sustainably maintained and the figures for productivity, production and marketable surplus have also been good. (**Table 2.2**)

Since minimum amylose content acceptable is 20 per cent, selections were made for the character, leading to the selection of 6 pure lines. The quality analysis of these potential lines of *Kalajeera* rice was done at CRRI, Cuttack, which showed that it varied from 16.2 to 19.8 per cent and it is therefore necessary to go for further selection to obtain lines with the desired amylose content. *Kalajeera* collected earlier as *Nua Kalajeera* from the Jeypore tract and released by CRRI had a satisfactory amylose content of 20.7 per cent.

A total of 233 lines of *Haladichudi* and 227 lines of *Machhakanta* were analysed

Table 2.1 ***Area, farm families and production of three varieties***

Variety	No. of farm families			Area under cultivation (acre)			Avg. production (qntl/area)		
	2009	2010	2011	2009	2010	2011	2009	2010	2011
Kalajeera	121	212	105	98	176.00	141.50	1054.00	2094.00	1881.95
Machhakanta	06	51	70	05	41.50	79.70	47.50	551.90	1036.10
Haladichudi	00	10	26	00	7.50	35.80	.00	76.50	375.90

Table 2.2 ***Production, productivity and selling surplus of Kalajeera***

Year	Area	Production (qtl/acre)	Productivity (qtl/acre)	Selling surplus (qtl/acre)	Rate (Rs/qtl)
2005-06	66.20	452.00	6.80	293.00	1000
2006-07	100.70	1208.40	11.90	451.00	1000
2007-08	408.90	4907.00	12.10	843.50	1000
2008-09	121.90	1340.90	11.00	431.70	1500
2009-10	98.20	1054.00	10.70	339.60	1500
2010-11	176.00	2094.00	11.90	672.50	1700
2011-12	141.50	1881.95	13.30	865.00	1700

with 24 highly variable rice microsatellite (RM) markers. Eight markers could detect polymorphism in the *Haladichudi* population and 15 markers could detect polymorphism in the *Machhakanta* population. This indicates the heterogeneity existing in the population and the need for two more generations of selection to get a homogeneous population of these landraces.

Appropriate technologies and management practices for enhanced productivity

The major reasons for the low yields of traditional varieties are impure seeds, lack of seed treatment, inadequate application of farmyard manure (FYM), poor knowledge of improved cultivation practices, improper water management, inadequate knowledge on use of modern agricultural implements and climatic variation. This year, two appropriate technologies were tested in farmers' fields to address these problems, after imparting appropriate training and setting up demonstrations.

Modified SRI technology: In the context of rain-fed cultivation in the Koraput area, the SRI method requires suitable modification, especially in the adaptation of intercultural practices to get better yields. (**Table 2.3**)

The modified SRI technology was tested in 11 operational villages covering 11.5 acres for the cultivation of all 3 varieties. Modifications were adopted based on discussion with the executive members of the Central Village Committees of the concerned villages on the trial planning, land selection, farmers' selection, varieties grown and inputs required.

Table 2.3 ***Suitable modification of SRI method - intercultural operation***

Intercultural operation	SRI technology	Modified SRI technology	Remarks
Seed rate	2 kg / acre	3 kg/acre	To maintain the crop density in the event of early drought or flash floods
Seed treatment	Seed treated with Bavistine, Thiram, etc	Use of salt water cow urine or cow milk for treatment	Better use of available local bio-resources
Nursery raising	Seedlings to be raised on polythene spread with FYM, chemical fertiliser, husk and soil mix bed	Seedlings raised on nursery bed (10m x 1.5m x 0.05m) with appropriate vermicompost in the farmers field	For faster vegetative growth of seedlings
Transplanting	8- to 12-day-old seedlings to be transplanted	15- to 17-day-old seedlings transplanted	Easy to uproot and manual planting by women
	One seedling is to be trans-planted in the 25 cm spacing	Two seedlings transplanted	To circumvent effect of dry spell
Weeding	Mechanical weeders to control weeds (around 5 to 6 times during cropping period)	Mechanical weeders used for initial weeding but later on manual weeding was encouraged	To suite the soil texture of this region
Water management	Intermittent drying and wetting	Intermittent drying and wetting if the farmers receive good rains.	Farmers have to keep standing water to avoid dry spell, in the absence of rains
Fertiliser application	Both chemical and FYM	FYM and other organic nutrients like dhanicha (Sesbania spp.), vermicompost	To encourage organic farming and use local resources

Rope or line transplanting: Demonstrations on line transplantation was conducted in 9 villages covering 12.45 acres. In this method, 21 to 25-day-old seedlings were transplanted in line by using rope with a spacing of 20 cm from row to row and 10 cm from hill to hill. Planting markers and mechanical weeders were not used here. All the other intercultural operations were the same as in modified SRI technology.

Table 2.4 sets out the agronomic characters under both technologies.

It can be seen that *Kalajeera* and *Machhakanta* varieties performed better for all the agronomic characters under SRI compared to line sowing. However, *Haladichudi* gave a better performance under line sowing than in SRI, indicating that this landrace may not respond positively to the wider spacing recommended for SRI.

Table 2.4 ***Agronomic characters of varieties under modified SRI cultivation and line transplanting***

Characters	*Kalajeera*		*Machhakanta*		*Haladichudi*	
	Mod. SRI	**Line**	**Mod. SRI**	**Line**	**Mod. SRI**	**Line**
Plant height (cm)	113.94	126.77	123.69	118.22	137.54	97.80
No of tillers (n.)	10.00	9.00	12.00	11.00	15.00	7.00
No of panicles(n)	10.00	8.00	12.00	11.00	10.00	6.00
Panicle length (cm)	23.41	24.39	21.81	20.89	22.93	16.12
Grains/panicle (n)	200.00	191.00	161.00	152.00	168.00	86.00
Chaffs/panicle (n)	30.00	24.00	11.00	10.00	11.00	7.00
Grain wt / hill (gm)	9.87	13.27	21.40	16.40	15.11	14.53
Straw wt / hill (gm)	36.87	33.73	27.27	21.33	25.41	15.60
Grain yield (qntl/ha)	52.27	43.00	43.85	43.17	24.15	26.80
Straw yield (qntl/ha)	202.35	148.37	70.82	57.235	59.85	42.15

Trainings, demonstrations and exposure visits

Street plays, video shows and training-cum-demonstrations were organised to create awareness and build up the capacity of the farmers in the technologies. Training-cum-demonstrations were organised for clusters in a participatory mode on seed treatment, nursery raising, planting, weeding, seed selection, water management, etc. Classroom teachings were organised in three batches to train 124 (M: 74, F: 50) farmers from 13 villages. Agricultural implements like weeders, planting markers, winnowers and diesel pumpsets as well as agro inputs like seeds of *Sesbania* spp., vermicompost and FYM were provided. Farmers were advised at each and every step of inter-cultural practices for mid-term corrections. Exposure visits to SRI fields were organised to capture more practical knowledge. Both vegetative and agronomic characters were collected and analysed. The results, such as increased tillering and grain yield in SRI compared to line planting, were disseminated among the farm families through Central Village Committee meetings.

A two-day residential training on integrated pest management (IPM) was organised in which 54 farmers from 18 villages whose fields had been affected with pest and diseases participated. Focus was on identifying the diseases and pests at different stages and controlling them by application of bio-pesticides. Training on application of bio-fertiliser, FYM and vermicompost was also given. A survey conducted in 10 villages immediately after the training indicated that 75 per cent of the farmers were able to identify and control common pests and diseases. *Dhanicha* seeds (*Sesbania spp*.) collected from the Agriculture department were also applied in the fields. The bio-pesticide *panchagavya* that can control most of the rice pests like case worm, stem borer, leaf folder, etc., was prepared by a women's group and it was found effective both on rice and vegetables.

Fifteen farmers from 13 villages visited the Central Rice Research Institute, Cuttack, and were exposed to seed storage systems, agricultural engineering, crop fields, gene banks and crop protection. Twenty-five farmers from 10 villages were invited to the demonstration plot on SRI at Chhendia Jhilligaon village, and they evaluated the phenotypical differences of the crop under traditional and SRI methods. Most of the farmers — after observations on plant height, panicle length, density of tillers, panicle type, grain yield and straw yield — agreed that the SRI method was better than the traditional method of cultivation.

Village Gene-Seed Banks

The Village Gene-Seed Banks (VGSBs) are attached to the Grain Banks to promote conservation of landraces by ensuring their availability for local exchange**.** Out of the 15 seed banks managed and monitored in Odisha, 10 have permanent storage facilities established during different periods. This year, 3 additional seed banks were added to the existing gene banks in Cherkaput, Khutuguda and Jhalaguda. A total of 109 rice varieties were conserved at MSSRF, Jeypore, to support the gene banks. Three conservation plots were designed in such a way that the farmers could see the diversity in rice landraces all through the year; 73 varieties were grown *in situ* and 19 new rice landraces were collected from Kotpad and Boriguma blocks. Farmers from cluster villages selected the appropriate varieties for the ensuing *kharif* season. The farm families have re-sown 25 per cent of the seeds reserved in the seed banks in order to meet the early drought this year.

Thirteen VGSB committees were formed with 5 members each. The committee members were trained on post-harvest technology and safe storage systems, and were taken on an exposure visit to CRRI. The women members were mainly concerned with the quality of seeds, storage system and cleanliness of seed banks, while the men prepared a detailed list of farmers who wanted to avail loan of seeds. In this reporting year, the committee distributed 3551 kg of rice seeds among 175 households of 13 villages, and 85 per cent of the loan has been recovered. A total of 133 acres of area has been cultivated using the seeds from the seed bank.

203.2 Strengthening local institutions

In order to ensure sustainability of the activities taken up, local institutions, such as Central Village Committee (CVC) Panchabati Grama Unnayan Samiti (PGUS), Kalinga Kalajeera Dhan Utpadak Samabaya Ltd. (KKDUS) and Women Self-Help Groups (WSHGs), were strengthened both financially and technically and also properly monitored and managed. Regular training and capacity building programmes were organised both at village level and at the institution level. Central village funds were created in each village to meet emergency needs.

Central Village Committee

During the period under report, 91 CVC meetings were conducted in which participation

of males and females varied from village to village (M: 52 to 59 per cent and F: 41 to 45 per cent). In village meetings, the major discussions were on planning for conservation and large-scale cultivation of local varieties, management of village resources, proper implementation of government schemes, training needs, infrastructure development, and arrangement of agricultural inputs, health of children and women and social issues. Residential trainings were organised for the leaders on community mobilisation and resource management.

Village Developmental Fund

Each household can be a member of the Village Development Fund (VDF) by paying a monthly contribution ranging from Rs 5/- to Rs 20/-. During the year under report, Rs. 142184/- was collected and deposited in the bank. An analysis of the utilisation of village funds indicated that around 50 per cent was utilised on agriculture, 30 per cent on social and cultural ceremonies and the rest on health and income-generation activities.

Panchabati Grama Unnayan Samiti

The sum of Rs 300000/- received as interest this year from the deposit of the Equator Initiative Award (2002) money was used by PGUS to carry out different need-based village activities. The major requirements were for pond renovation, fish farming, conservation and promotion of rice landraces, and training and capacity building on agricultural practices. The main activities taken up by PGUS were demonstrations and expansion of area under cultivation of landraces, deriving benefits from entitlements, and creating awareness and exposure visits.

Kalinga Kalajeera Dhan Utpadak Samabaya Ltd.

Kalinga Kalajeera Dhan Utpadak Samabaya, Ltd. (KKDUS), the cooperative set up in 2007-08 by involving all the *Kalajeera* growing farmers of 27 villages of 3 blocks, is functioning satisfactorily. This year 687 qtl of *Kalajeera* paddy was procured from 98 farmers of 22 villages, and stored at community storage at Chenndiajhilligaon, Kundura and MSSRF, Jeypore. The society has sold 350 qntl of *Kalajeera* rice packed in attractive polythene packets. ORMAS has supported this society (through a revolving fund of Rs.12 lakh to procure paddy. With help of the *Kalajeera* sale funds, land was released from the *sahukar* (money lender), *pucca* houses with asbestos roofs were built, tea shops and grocery shops were established, tractors, motor bikes and mobile phones were purchased, and further, children of farmers could be sent for higher studies.

Women Self-Help Groups

During the year under report, all the 31 SHGs formed by MSSRF conducted monthly meetings to decide on monthly contributions by the members, availing of loans from banks, need-based loan distribution, value addition, training needs as well as to resolve group conflicts. The loans were used basically to meet agriculture wages, purchase of agricultural implements, petty trading, collection of tamarind and cashew nut, preparation of value-added products and vegetable cultivation. Six WSHGs were fully

engaged in the preparation of a variety of value-added products from rice for local sales and 2 residential trainings were imparted to the SHG members from 12 villages on products like *murrukku (nadi)*, *chuda* mixture, *dosa* powder mix, etc., and on cash transactions. It is found that the most profitable value-added product from rice is *dosa* powder, the profit being double compared to other products. The profit from the value-added products was utilised to purchase major raw materials such as *Machhakanta* and *Haladichudi* grains, as also utensils and sarees. There is a demand for a processing-cum-sales centre where the groups can work together and maintain product quality.

WSHGs repaid 40 per cent of the loan amount and established healthy relations with financial as well as government line departments. (**Table 2.5**)

Table 2. 5 ***Particulars of Women SHGs of NAIP operational villages (2011 – 12)***

Number of villages	12
Number of SHGs	31
Total no. of members	384
Savings (2011 – 12)	Rs. 36690.00
Total amount in bank	Rs. 927200.00
Total amount taken as loans from bank	Rs. 683000.00
Repayment of loans by groups	Rs. 261645.00
Balance amount in bank	Rs. 724950.00
Number of SHGS linked to banks	12
Linkages established	Banks, agriculture department, local market

203.3 Other activities

Four exhibitions were organised at village level, State level, zonal level and national level during the reporting period. The exhibition at village level was conducted in Nuaguda village in collaboration with NBPGR base centre at CRRI in March 2012, to collect information about different traditional crops and varieties along with assemblage of seed samples.

MSSRF participated in the State level PARAB exhibition held in Koraput district, the national level exhibition at KIIT College, Bhubaneswar and in the Eastern Zone regional agriculture fair. The main focus of these exhibitions were on the landraces available in the region, improved agro-techniques for enhancing yields, value addition, judicious use of natural resources, especially in watershed areas, career development opportunities provided through the IGNOU-MSSRF Community College and familiarising the visitors about the various initiatives of the Centre.

The monthly agriculture magazine in Odiya, *Krushaka Bandhu Annapurna*, was distributed in 10 villages to create awareness on agricultural practices of various crops.

Linkages were established with government line departments, NGOs, CBOs and financial institutions for deriving various entitlements to the farmers worth Rs. 1 lakh.

203.4 Globally Important Agricultural Heritage System

Koraput district has the distinction of being the first site in India to be declared as a Globally

Important Agricultural Heritage System. Rayela Muduli of Boliguda village and Chandra Pradhani of Nuaguda village represented the tribal communities of Koraput district to receive the award from the Prime Minister of India on 3 January 2012 at Bhubaneswar, in the presence of the Chief Minister of Odisha. On 6 February 2012, 17 Farmers (10 female and 7 male) from 13 villages of Boipariguda, Jeypore and Kundura block were felicitated at a function conducted at the MSSRF Centre. A press meet was conducted on that day for media publicity. Members of PGUS and KKDUS also participated. Seven village-level consultations were conducted in 3 community development blocks of Koraput during the month of February. A total of 432 farmers (M: 246, F: 186) were oriented about GIAHS and their views sought to develop an action plan for conservation of the traditional plant genetic resources of the region.

203.5 Tribal medicinal plant garden

The *ex situ* medicinal plant conservation garden at Jeypore serves as a repository of various genetic stocks of the region and functions as a living gene bank for the Bhatra, Bhumia, Bonda, Gadaba, Ganda, Kandha, Koya, Paroja and Saora tribal families. Seven new tree species were added during the year, taking the number of species conserved to 354. At present, 116 tree species, 91 shrubs, 102 herbs, 39 creepers and 6 other plants are conserved. A total of 28,000 seedlings of 14 commonly used medicinal plant species were raised and distributed to interested farm families, institutions and NGOs in Koraput district. Projects were undertaken in 18 schools on *ex situ* conservation of medicinal plants and their usages. Forty-two schools from 2 districts used seedlings from this garden to develop school herbal gardens. Eighteen medicinal plant species were supplied to traditional healers (*desari*) for herbal formulations by the community. There were 700 visitors to the garden during the year. Linkages were established with The Odisha Forestry Sector Development Project, Jeypore College of Pharmacy and the district forest department.

Sub Programme Area 204

Community Gene Bank

DUS characterisation was undertaken and paddy germplasm was stored in the MSSRF Gene Bank.

The Community Gene Bank (CGB) has developed a format to document traditional knowledge systems with respect to paddy, highlighting the information associated with biotic and abiotic stresses, and has had it translated into the regional languages Odiya and Malayalam. This format is used at the time of survey and collection of paddy varieties in Odisha; at Wayanad, this format was widely circulated to the farmers.

CGB is focusing on the collection of local landraces and farmers' varieties of cereals, millets and niger from Koraput, Rayagada, Nawarangpur and Kalahandi. The survey at Koraput district covering 14 blocks, 226 gram panchayats and 1131 villages has been

completed. At Rayagada district, the survey covered 11 blocks, 155 gram panchayats and 1711 villages, resulting in the collection of 84 paddy varieties, 23 millet varieties and 1 niger variety. This has been subjected to germination test and processed for field DUS characterisation trial. The survey has just started in Nawarangpur district.

Conducting DUS characterisation of varieties

The field trial on distinctiveness, uniformity and stability testing has been taken up on paddy on 30 plants/ parts of 30 plants divided among 3 replications; assessment of uniformity was made on 10 plants per replication on the plant as a whole, based on visual assessment. The assessment of distinctiveness was carried out on the characteristics such as basal leaf sheath colour, time of heading, stems length, decorticated grain length, decorticated grain shape, decorticated grain colour and decorticated grain aroma. These were also taken into consideration for grouping of the varieties. Observations were recorded on different growth stages: starting from the emergence of first leaf through coleoptile, booting stage, emergence of inflorescence, milky stage development, dough development, and spike let ripening stage, etc. A total of 135 varieties have been subjected to trial under the crop season.

Registration of farmers' varieties

In association with farmers' groups as well as farmers' associations, MSSRF has identified a number of farmers' varieties of paddy for filing registration with the PPV&FR Authority. A separate meeting will be convened with farmers both at Wayanad as well as in Jeypore to finalise the filing of applications. Once the registration is accepted and notified by the Authority after thorough verification of all parameters specified in the application, the following benefits can be availed by farmers: to save, use, exchange; to register farmer's variety; to receive equitable benefit sharing; to receive reward and recognition; to get adequate seeds of registered varieties; to claim and receive compensation for underperformance of registered variety; to seek consent of farmer; non-cognisance of innocent infringement committed by farmers; and to get exclusion from paying fees.

Training programme on the legislation of PPV&FRA

CGB organised two training programmes at Koraput to create awareness and capacity building of the farmers on the legislation of PPV&FRA. In June 2011, one-day programme was organised at MSSRF, Jeypore, for 40 representatives from various NGOs as well as village officials from Koraput district. The second meeting was organised for three days for farmers in September 2011. Out of the 45 farmers from 9 blocks of Koraput district who participated in the training, 18 farmers have been identified as the resource persons for the next level of training to be organised at their village level. These 18 farmers also serve as trainers to spread the awareness of the legislation. Further, 8 village-level training programmes were

organised in Bisipur (Nandapur block); Dubmaguda (Dasmanpur block); Pakjhola (Semiliguda block); Tentuliguda (Semiliguda block); Kendar (Koraput block) Umuri (Koraput block); Kankadaguda (Jeypore block), and Arnna (Lamtaput block) to spread and create awareness on the legislation. Overall, there were 300 participants ranging in age from 25 to 60, including both men and women.

Sub Programme 205

Biodiversity Policies and Management

India's position paper on Green Economy for Rio+20 Summit

The Ministry of Environment and Forests (MoEF), Government of India, commissioned MSSRF to develop a position paper entitled "India's National Position on the Issue of Green Economy in the Context of Sustainable Development and Poverty Reduction" to be presented at the United Nations Conference on Sustainable Development Rio+20 at Rio de Janeiro in June 2012. Consequently, an inter-disciplinary team consisting of members drawn from the food security, climate change and biodiversity programmes of MSSRF was set up to formulate the document.

The team participated in three inter-ministerial working group meetings organised by MoEF for collating views from the Ministries of Agriculture, Fisheries and Animal Husbandry, Public Distribution System, Fertilizers, Petroleum, and External Affairs. A consultation on poverty reduction, food security and green economy was organised in MSSRF in August 2011 and the inputs were forwarded to MoEF. A conference on Rio+20 was held in MSSRF in February 2012.

People's Biodiversity Register

The People's Biodiversity Register (PBR) was translated into Tamil and reviewed by the Tamil Nadu Biodiversity Board (TNBB). One thousand copies were printed and handed over to the National Biodiversity Authority (NBA). The booklet was released in Madurai by the Minister for Environment and Forests, Tamil Nadu, in a meeting organised by the National Biodiversity Authority.

Biodiversity management committees

MSSRF is involved in the establishment of Biodiversity Management Committees (BMCs) at block level, involving village panchayats in five locations in Tamil Nadu. A meeting of panchayat leaders of Kolli Hills was conducted in May 2012, which will be followed up by forming a BMC.

On invitation from the Karnataka Biodiversity Board, a field visit to Nallur and GKVK Biodiversity Heritage Sites near Bengaluru was made in October 2011 to provide inputs for developing an ecotourism plan.

Family farms

The Biodiversity team was assigned the task of developing a concept note and detailed outline for conducting a study-cum-advocacy on family farms as a part of the UN

International Year of Family Farming 2014. The team identified critical parameters that characterise family farms: land, labour, crops and livestock. A selection of family farms belonging to different categories would be made for detailed studies and documentation. The outputs of the study would be used to highlight the contribution of family farms to the food security of the country. The team integrated the Family Farm concept proposed by the FAO and the National Commission on Farmers (2006) to suggest a range of options such as livestock keepers (cattle, sheep, goat, pigs, ducks, chicken), fisherfolk (traditional, trawler keepers and inland fisherfolk), landless agricultural labourers, landed small farmers (rain-fed and irrigated; subsistence oriented and market oriented), women farmers, tribal farmers (shifting cultivators, rain-fed farmers, irrigated farmers, home garden keepers), non-timber forest produce (NTFP) collectors, pastoralists (migrants – cattle, sheep, duck), plantation labourers (industry-based and small holder based – tea, coffee, rubber), urban farmers (keepers of milch animals and pigs and peri-urban vegetable farmers).

Proximate analysis of rice landraces

In order to strengthen and take forward the leads obtained in the research related to landraces, the nutrient composition of the landraces and traditional varieties have been taken up for analysis. Literature indicated that a large variation exists in the amylose and protein content among landraces and traditional varieties. This factor highlighted the importance of selection of varieties with maximum bioavailability of amylose and protein and micronutrients for utilisation in crop improvement. So far a total of 48 landraces have been collected and studied for their physical parameters: length and breadth of grain and kernel, colour of the husk, colour and physical character of the kernel, 100 grain weight. In collaboration with the Biotechnology group of MSSRF, the landraces are being subjected to proximate analysis. The emerging information would be relevant and critical for the identification and grouping of landraces from the perspective of nutrition. Based on the results, MSRRF Jeypore will organise follow-up programmes involving primary producers for marketing and consumption of better quality rice with higher nutritional value.

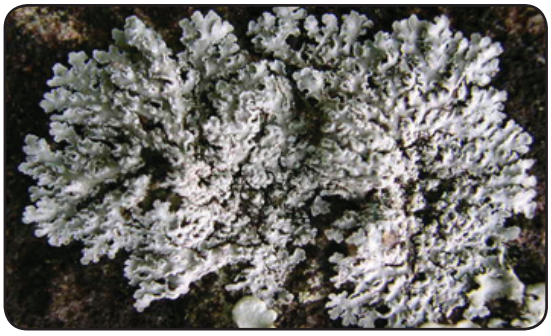
Contribution to eco-agriculture database

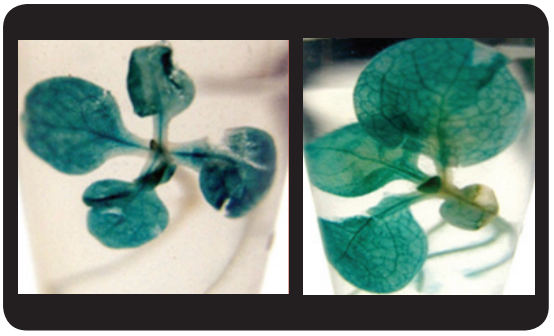
MSSRF participated in the Eco-agriculture Workshop on Ecosystems for Landscapes, Nature and People at Nairobi in February 2012. MSSRF has committed to provide information on case studies on eco-agriculture practices in India Traditional agricultural practices of the Apatanis tribals in Arunachal Pradesh is as an example of eco-agriculture. Information on the Apatanis was collected from various web sources and uploaded into the eco-agriculture database accessible only to members. Information on four other eco-agriculture cases is being collected for submission to the database.

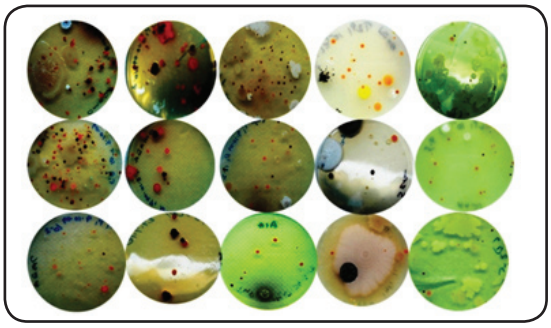
Programme Area 300

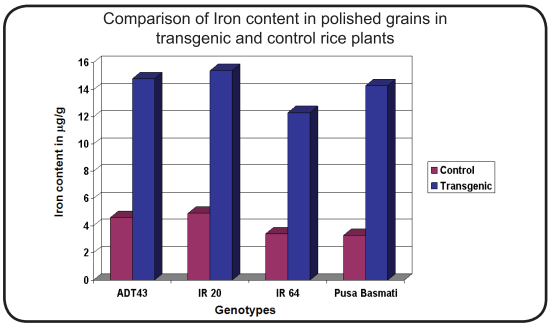
BIOTECHNOLOGY

Low-cost mass propagation protocols were developed for ginger, turmeric and pepper. Two new genes for transcription factors, induced under salt stress, have been cloned and characterised. Deletion studies of the promoter regions, their expression and localisation, response to salt and abiotic stress factors, enhancement of nutritional quality and introgression studies were undertaken for generating novel genetic combinations. Eight Syzygium RET species were selected for developing clonal propagation protocols and bioprospecting. Germplasm collection, multi-location trials and screening for high yields and oil content in J. curcas were undertaken in Odisha and Tamil Nadu. The bioprospecting programme on lichen and plant compounds generated 11 compounds of which 4 were novel molecules. Four novel Vibrio spp. were reported. A novel genus from the root nodules of chickpea has been isolated and named Cizobacter lividus.









Biotechnological tools for identification and characterisation of novel genes, molecules and organisms for agricultural and therapeutic implications

Programme Area 300

Biotechnology

The Biotechnology programme uses modern tools to identify genes that address the problem of abiotic stresses resulting in decreased plant productivity. Towards this, a number of genes in the enzymatic oxidative pathway, transcription factors, osmolyte accumulators, antiporters as well as promoter elements of genes reported in abiotic stresses have been isolated and characterised and some of them have been transformed into local varieties of rice. Screening of the transgenic lines show that overexpression of these genes confers tolerance to abiotic stresses, as compared to untransformed, control plants. Localisation of these expressed genes has furthered our understanding of plant responses to stress. Current focus area is to screen traditional varieties for enhanced nutrient traits and identify abiotic stress pathway genes using the marker-assisted breeding approach. The bioprospecting programme for isolating novel compounds and molecules from lichen and select plant species has made remarkable inroads in identifying anti-bacterial and anti-cancer molecules with very encouraging leads. The microbial genetic and functional diversity of the mangrove-associated rhizobacteria for enhanced crop productivity (mainly paddy) in the coastal areas is another important area of study. Plant tissue culture of select rare and endangered tree (RET) species as also multilocation *Jatropha* trials and establishment of *Jatropha* conservation gardens have been one of the focus areas of the programme. The outreach activities via DNA Clubs and vacation training programmes for school children are part of the capacity-building component of the programme.

Sub Programme Area 301

Ecological Restoration and Ecosystem Monitoring

301.1 Production and demonstration of high quality planting materials of *Jatropha curcas,* multilocation trials and conservation

MSSRF is one of the key partners in the National Network Programme on *Jatropha curcas* (bio-fuel plant species). As part of the network, MSSRF has collected a large number of accessions from different regions of Tamil Nadu. The major objective of the network is to identify the elite germplasm showing high yield as well as high oil content. Large-scale propagation and supplying elite saplings to farmers and for national-level multi-location field evaluation, as well as developing suitable agronomic practices for better yields are among the major activities being undertaken in this programme.

A genetic garden of *Jatropha curcas* has been established at Kudankulam, Tamil Nadu, with 234 accessions (distinct plant varieties) and 7 of these accessions were selected for progeny trials. Based on the performance of different descriptive parameters, seed samples were collected regularly and yield

parameter analysis of individual accessions was documented. Local climate adaptability by the accessions and critical irrigation practices helped in attaining a profusion of branches in the current year (48-135 – a 20 per cent increase compared to last year). The plants in the genetic garden have a good canopy with increased branches which is one of the indications for an increase in yields.

The Department of Biotechnology (DBT), Government of India, selected MSSRF 77 (NBPGR Acc. No 555381) *Jatropha* accession for conducting multilocation trials in dry lands of North India. About 3 kg of seed material was collected and submitted to DBT for these trials. The above accession has already demonstrated a yield of up to 1.5-2 kg seed per tree during field trials under dry land conditions in North India.

Half-sib progeny trials at Kudankulam

In *Jatropha curcas*, a genetic improvement programme is on, to develop stable, high-yielding varieties/hybrids, including intra- and inter-specific crosses, by the partnering institutions. Half-sib progeny trials are being conducted to compare the phenotypic traits of siblings that share one parent with other sibling groups. Earlier, MSSRF had provided some of its high-yielding accessions for half-sib progeny development by partner institutions. DBT supplied 20 half-sib progenies for trials and evaluation to MSSRF. Data on plant height, number of branches, canopy diameter and seed yield are to be collected for each progeny, using Random Block design, for evaluation.

The first pruning of the 2-year-old half-sib progenies under trial was made in June-July 2011. After pruning, the six-month data showed that the sibling HNB 3 had the lowest survival rate, i.e., 62 per cent, whereas MSSRF 7 had 96 per cent survival. HNB 2 measured an average of 45.1 cm in height (least), whereas NBRI 4 had an average height of 109 cm (maximum). The lowest average collar diameter was observed in HNB 2 with 12.2 cm whereas MSSRF 7 had a maximum diameter of 22.8 cm. It was observed that HNB 2 developed only 6 branches (least) and NBRI 3 developed 29 branches (maximum). MSSRF 7 showed an average canopy diameter of 85.2 cm followed by NBRI 2, 3, 4 and Biotech, HNB 2, 3, 4. HNB 2 sibling with 9 plants/block produced 17 fruits with 51 seeds (least) and MSSRF 7 with 9 plants/ block produced 298 fruits this year with 884 seeds (maximum). The average weight of seeds was 375 mg in HNB 2 (least) and 547 mg in MSSRF 7 (maximum).

Multilocation trials conducted on J. curcas accessions in Tamil Nadu and Odisha

In Tamil Nadu, the *Jatropha* accessions which were received from the national network partners were planted in Vadakkankulam, Tirunelveli district, according to approved design and treatment schedules and the trials included agronomic (19 accessions), multi-locational (95 accessions) and silviculture (2 accessions), which are now in the second year. Under silviculture trials, the first pruning for this year was carried out in July 2011 and the data on regeneration after pruning is currently being recorded.

In Odisha, during the year, field trials of accessions were conducted in 30 acres of land at Uduluguda and Chilliguda villages under the Kundura block of Koraput district. Data on growth parameters such as plant height, mortality, canopy, stem diameter, number of branches, flowering, fruiting as well as disease incidence were recorded. NPK and biofertilisers were applied 6 times and 3 times, respectively, in the agronomic trial. Of the 19 accessions, NBPGR Acc. No IC 555381 showed highest percentage of seed yield.

Analysis of variance for agronomic trials on Jatropha, Odisha

Analysis of variance of the agronomic trials showed that the differences between treatments are not significant for survival rates, fruiting and plant height. However, such differences were significant for the number of flowering branches.

It is found that the number of flowering branches was significantly low when treated with only bio-fertilisers or along with irrigation. These treatments are on par with the control where neither fertilisers nor irrigation was given. The number of flowering branches was significantly low at T1 which had 3 irrigations per month without any fertiliser application. And with inorganic fertilisers under irrigation, there was a significant increase in the number of flowering branches.

From the results of the first year it can be seen that with the application of 20 g urea, 60 g single super phosphate and 16 g potassium nitrate per plant given in two batches accompanied with three irrigations per month, T5 produced the best result as far as the number of flowering branches are concerned.

Conservation and resource maintenance of Jatropha germplasm

In Tamil Nadu, the seed germination test of *Jatropa* accessions was carried out at the Vadakkankulam and Kudankulam sites. These accessions include 234 from MSSRF and 268 from the network partners. In 150 accessions the germination rate ranged between 0 and 9 per cent and in 118 accessions it was 10 to 72 per cent. Only one accession (number 566104) showed 100 per cent germination, whereas 80 per cent of MSSRF accessions showed 25 to 80 per cent germination.

In Odisha, *Jatropha curcas* germplasm was established in 8 acres of land at Bandhiguda village under the Kundura block of Koraput district. A total of 560 accessions was obtained from 6 Jatropha micro-mission centres located across India viz., MSSRF, Chennai (234 accessions), CST, Hissar (86), PDKV, Akola (37), HFRI, Shimla (53), NBRI, Lucknow (44) and other centres (106). A total of 11000 seedlings of 560 accessions was raised in polybags with a mixture of soil, vermicompost and sand in 40:20:40 ratio. Seeds were treated first with fresh water followed by *Trichoderma* before sowing in the polybags. The average germination rate was 38 per cent, 234 germplasm from MSSRF gave 64 per cent germination, whereas 326 germplasm from other centres gave only 12 per cent germination. Therefore, only 2466 plants from 274 accessions (out of 560) were

available for planting. These were planted in blocks of 9 plants each, at a spacing of 3 m x 3 m. Another set of 351 plants raised from cuttings from 39 accessions received from Biotech Park, Lucknow, was similarly planted in another block, taking the total accessions to 313 with 2817 plants. Periodic irrigation was given to the plantation. Data were recorded on survival rate and growth parameters such as plant height, collar diameter, crown spread, flowering and fruiting and are being analysed. No pest attack was noticed this year.

301.2 Mass propagation of economically important plant species

During the current year, mass propagation protocols were initiated for the development for *Zingiber officinalis* (ginger) and *Curcuma longa* (turmeric) to develop disease-free planting materials for farmers. All experimental materials were collected from disease-free mother stocks in Koraput district, Odisha and Erode district, Tamil Nadu. Two RET medicinal plants of Eastern Ghats region, namely, *Mesua ferrae* and *Saraca asoca* were selected for *in vitro* clonal propagation. The aim of this activity is to propagate these RET plants on a large scale and to make available disease-free quality planting materials to the lab-to-land programme for large-scale plantation.

During the year, *Piper longum* was selected on priority on the basis of its market potential and demand for quality planting material by farmers. Nodal explants were cultured with different hormonal combinations with Murashige and Skoog (MS) medium. When the explants were cultured on MS medium supplemented with different concentrations (0.5-2.0 ppm) of 6-benzyl-amino purine (BAP) and kinetin, the synergistic effect induced adventitious shoots from nodal explants. When the nodal explants were treated with 1 ppm of BAP and 0.5 ppm of kinetin, callus was formed. After 10-14 days of callus sub-culture initiation, greenish white shoot buds were observed. The auxiliary shoot buds were formed from nodal explants without hormone on MS medium in two weeks. Optimum growth regulator concentrations for shoot induction were found to be 3 ppm of BAP with 2.5 ppm of kinetin. The roots were formed within 20 days of sub-cultured plants without any hormones. Shoot formation was obtained in nodal explants of *Piper longum* cultured on semisolid MS media supplemented with various concentrations of BAP and KN. A total of 300 *in vitro* rooted saplings of *Piper longum* was transferred to the hardening chamber.

Micropropagation of elite Jatropha curcas

Effect of different carbon sources on regeneration potential of *J. curcas* was studied for increased rooting. Higher concentration of sucrose was found to be more suited for regeneration of *J. curcas*. During the current year, 75 *in vitro* rooted plants from uninodal explants were ready for hardening. Hardened plants would be field transferred during September 2012.

Various seed treatments were tried to enhance the germination percentage of *J.*

curcas. The results showed that soaking the seeds overnight increased the germination percentage up to 95 per cent. Effect of different hormones and vitamins in rooting behaviour of cuttings increased (67 per cent) as compared to the previous year. The results showed that vitamins play a significant role in rooting *J. curcas*.

301.3 Mass propagation for saving the RET plant species

Several saplings of RET species obtained from CAbC, Wayanad are being maintained at the MSSRF, Chennai nursery garden for *in vitro* studies. During the year, RET species such as *Syzygium benthamianum, S. mundagam, S. occidentalis*, *Cynometra beddomei* and *Aglaia malabarica* were obtained from CAbC and the *in vitro* induction of callus was achieved. Several antioxidants were used to overcome phenolics in the medium and 45-day-old sub-cultured calli showed whitish brown colour and callus proliferation is underway. Uninodal explants of *Cynometra beddomei* and *Aglaia malabarica* showed initial bud break and further sub-culture increased shoot (3.4±0.13) break from basal nodes of *in vitro* explants. Presence of phenolics inhibited growth of *in vitro* shoots during elongation period and citric acid was added to the medium for moderate growth of *in vitro* shoots and elongation (2.7±0.21cm). *Further in vitro production of metabolites from RET Syzygium species using hairy root and elicitation is under progress.* Essential oil from leaf, bark and fruit were isolated from the 8 species and chemical profiles were obtained by using GC-MS. All compounds were identified by NIST library. Almost all essential oils have unique chemical characters yielding rich *sesquiterpenes.* Screening for antioxidant and antimicrobial properties of these essential oils is currently in progress, to identify potential bio-molecules.

Sub Programme Area 302

Genetic Enhancement

302.1 Rice bio-fortification with enhanced iron and zinc in high-yielding rice cultivars through marker-assisted breeding and transgenic approaches

The crop biofortification programme was initiated in 2005 with 3 crop-specific programmes on rice, wheat and maize. The participating institutions were MSSRF as lead institution and TNAU, IGAU and UAS-Bangaluru as partner institutions. The approach on biofortification was to screen the natural germplasm resources (varieties, landraces, breeding lines) from the rice-growing areas, to undertake marker-assisted breeding and development of mapping populations, and to employ the transgenic approach for accumulation, transport and bioavailability of micronutrient.

During Phase I of the programme, procedures for precise estimation of iron and zinc concentration in grains were standardised using atomic absorption spectrometer and 2, 2-dipyridylyl agent. More than 3500 rice accessions, including about 252 rice landraces of Chhattisgarh collection known for high-

grain nutritive value, about 100 popular rice cultivars and about 650 advanced breeding lines developed through various breeding populations, have been screened. Low genetic variations for grain iron (Fe) levels were observed compared to that of grain zinc (Zn) contents. About 14 genotypes have been identified with high Zn content in polished grains ranging from 26 ppm to 32 ppm. Sixty rice genotypes including advance breeding lines, lines selected based on previous screening for micronutrient content and those belonging to diverse genetic backgrounds were selected and phenotyped for grain micronutrient content. Molecular markers for genes associated with iron uptake, transport and accumulation have been designed.

Transformation with *ferritin* gene from *Avicennia marina* was carried out with the gene construct with endosperm-specific promoter using co-transformation protocol for generating marker-free transgenic rice plants. Estimation of iron content in polished grains showed a two-and-half fold increase in the transgenic plants. Three transgenic pure lines were selected from the transgenic plants developed in *indica* rice varieties using the *ferritin* gene isolated from the mangroves. They have been introgressed into IR 64, ADT 43 and white Ponni rice varieties. Both foreground and background selections were carried out in BC3F1 generation showing 99 per cent phenotypic similarity with the recipient parents. Eight ASD16 events were generated using particle bombardment and 86 ASD16 events were generated using *Agrobacterium*-mediated transformation. All plants were demonstrated to be positive for all the transgenes (*ferritin*, GUS and *hpt*) as well as in western blot analysis.

Based on the above results, Phase II of the programme has been approved by the Department of Biotechnology, Government of India with the inclusion of the Directorate of Rice Research, Hyderabad as another partner. The broad objectives of this programme will be:

- assessing the levels of micro-nutrient contents (especially Zn) among rice genotypes already identified during Phase I in different agro-climatic conditions.
- assessing the effect of external (soil and foliar) application of zinc on grain micro-nutrient contents in high and low zinc rice genotypes.
- marker-assisted breeding for enhanced micronutrient contents in rice.
- multilocation evaluation of introgresssed transgenic *ferritin* rice lines of adapted genetic background (IR20, IR 64, White Ponni, ADT 43) developed in Phase I, and screening of transgenic ASD16 lines expressing Am *ferritin* for grain iron contents developed in Phase I and their introgression to popular varieties.
- functional genomics for identification of novel transporter genes involved in grain loading for Fe/Zn contents from diverse plant sources, viz., minor millets and *Amaranthus*.

Isolation and characterisation of an iron deficiency-responsive cis-acting element binding factor1 (IDEF1) from wild rice Porteresia coarctata

Porteresia coarctata is a tetraploid wild relative of rice that occupies mangrove wetlands where soil salinity and availability of soil iron are two of the determining factors of its growth and survival. The response of *P. coarctata* plants to the combined effect of salt and iron deficiency treatments was studied through isolation and characterisation of IDEF1 transcription factor cDNA and monitoring the level of its transcripts. PcIDEF1 had a predicted molecular mass of 38.1 kDa and was shorter by 15 amino acids when compared to OsIDEF1, to which it showed highest homology. GFP-tagged PcIDEF1 protein was localised inside the nucleus in transgenic tobacco and the purified PcIDEF1 protein specifically bound to DNA fragment containing IDE1 element, suggesting its role in transcription of iron deficiency response related genes. Transcript expression of PcIDEF1 was influenced by the addition of salt in iron-deficient medium and was differentially regulated in *P. coarctata* leaves and roots. Results from the study suggest that IDEF1 transcription factors in *P. coarctata* are different from OsIDEF1 reported from closely-related *Oryza sativa*, both at sequence and functional levels.

PcIDEF1 gene was transformed to *indica* variety of rice (IR 64) by *Agrobacterium*-mediated transformation. Three lines were regenerated from transformation, among which one line showed the presence of PcIDEF1 gene, confirmed by TAIL PCR. Further analyses of transgenic lines for copy number are under way.

302.2 Localisation studies of *Am244* (GFP fusion driven by native promoter) expression through confocal microscopy in tobacco

The salinity tolerance of the mangrove, *Avicennia marina*, is a consequence of water use efficiency, balancing carbon gain, water loss and ion uptake. *Am244*, a salinity induced gene from *A. marina*, encodes a protein that belongs to the *upf0057* family and localises to the plasma membrane. *Am244* expression is up-regulated in leaves and roots of *A. marina* under salinity.

Confocal microscopy was used to analyse *GFP-Am244* (*Am244* promoter) expression in tobacco under basal/sub-lethal stress (25 mM NaCl). In the leaf, basal expression is seen in guard cells and inner phloem. With stress, expression in guard cells increases, and is seen additionally in mesophyll cells, outer phloem, cortical tissues and trichomes. In the stem, basal expression is visible in the inner phloem, enhanced with stress and seen additionally in the outer phloem and cortical tissues. In the root, *Am244* is highly expressed and seen in the phloem, inner/ outer cortical tissues, expression being enhanced further with stress. With salinity, lines PPG1 and PPG3 show more chlorophyll retention (70-80 per cent) as compared to non-transgenic control (50-60 per cent).

Tissue-specific expression of MUG activity (*Am244* promoter) under basal as well as salinity stress conditions (25 mM, 150 mM and 200 mM NaCl) was examined. In leaf and stem tissues, at 24 hours of salinity stress, a salt concentration dependent increase in MUG activity was observed that increased further on the fifth day of experiment. Withdrawal of salt lead to a drop in MUG activity in the leaf and stem tissues, maximal at 150mM for the leaf and dropping as a function of the salt concentration in the stem. In the roots, maximal MUG activity was seen with 150 mM NaCl at 24 hours and on the fifth day. Withdrawal of salt brings about an increase in MUG activity as a function of the salt concentration.

302.3 Characterisation of MYB1 transcription factor from mangrove plant *Avicennia marina*

Molecular analysis of AmMYB1 transgenic rice

MYB transcription factor genes play important roles in developmental and various other processes in plants. The functional characterisation of *AmMYB1*, a single-repeat MYB transcription factor isolated from the salt-tolerant mangrove tree *Avicennia marina* was carried out. *AmMYB1* cDNA was 1046 bp in length with an open reading frame of 783 bp, encoding 260 amino acids. In the current year, MYB1 gene from *Avicennia marina* was transformed to rice (*indica* rice, IR64) by *Agrobacterium*-mediated transformation and presence of the transgene was confirmed using PCR. To further confirm the copy number and stable integration of *AmMYB1* in transgenic rice, Southern blotting analysis was carried out. Three transgenic lines (L4, L8, L11) were chosen along with untransformed plant for Southern analysis. The genomic DNA was extracted with CTAB buffer and purified using phenol: chloroform. Total genomic DNA from the transformants and control plants were digested with *Bam*H1 and transferred to a nylon membrane. Hybridisation was carried out using *AmMYB1* specific 3'UTR probe at 42°C. Results from the Southern hybridisation analysis revealed that there was a faint band only in transgenic line 8 and no band was observed in other lines. Transgenic line (L8) was forwarded to T1 generation and segregation analysis for *AmMYB1* transgene is being carried out presently.

Transactivation assay of AmMYB1

Transcription factors are known to function by activating stress responsive genes in plants under stress conditions. *In vivo* analysis using yeast cells are well demonstrated to identify transactivation ability of transcription factors. To analyse transactivation ability of *AmMYB1*, complete and partial regions of *AmMYB1* encoding sequence were amplified and cloned in pGBKT7 vector (Clontech), fused with the GAL4 DNA binding domain (DBD) coding region, under the control of the ADH1 promoter. The yeast strain AH109 harboring the *HIS3* and *LacZ* reporter genes were transformed independently with the recombinant plasmids to identify their ability to activate transcription of the marker *HIS3* gene controlled by the GAL4 upstream activation sequence and their ability to promote yeast growth in the

absence of histidine. Transformants were selected on synthetic dropout (SD) media lacking tryptophan (SD-Trp). *HIS3* activity was assessed by conducting a viability test on a histidine-lacking medium. *LacZ* activity was tested by performing the galactosidase filter lift assay according to the manufacturer's instructions (Clontech). The results showed that yeast transformants expressing full *AmMYB1* protein could survive on histidine-lacking medium whereas the region containing only N-terminal sequence (containing 160 amino acids) and the empty vector could not. β-galactosidase activity was also examined for the marker *LacZ* gene expression. The *LacZ* activity of each yeast transformant was similar to the *HIS3* activity. These results indicate that *AmMYB1*, as reported in the case of several other transcription factors, exhibits transactivation activity and its activation domain is located in the C-terminal region rich in both proline and acidic amino acids (Asp and Glu).

302.4 Isolation and characterisation of AmRZFP1 (RING zinc finger) gene from *Avicennia marina*

Zinc fingers are autonomously folded protein domains in which cysteine and histidine residues are used to coordinate one or more zinc ions. Zinc finger proteins participate in the regulation of many aspects of growth and development in eukaryotic organisms. Zinc finger domains are also implicated in protein–protein interactions. One example is the LIM domain that is constituted by two distinct zinc fingers and is found in proteins with diverse functions. Another domain that has been thought to be involved in protein–protein interactions is the RING finger (Really Interesting New Gene) domain containing proteins which are widely found in different organisms. Despite being widely distributed and present in gene products, which play major roles during cell growth and differentiation, the molecular function of the RING finger domain has not yet been well established. It has been inferred that the structure of RING may vary according to the sequences surrounding it, thereby suggesting that this zinc finger might carry out diverse molecular functions. The isolation and characterisation of a zinc finger gene from the mangrove tree *A. marina* that encodes a protein containing a RING-H2 zinc finger motif has been carried out. Transcript profiling studies revealed that RING zinc finger genes have upregulated by various abiotic stresses such as NaCl and abscicic acid (ABA) and the AmRZFP1 gene was also found to be developmentally regulated. Full-length ORF of AmRZFP1 gene was cloned into pET32a expression system and purified as thio-redoxin fusion protein. NAC domain coding region was cloned into pGEX4T1 expression system and purified as GST fusion protein. Approximately 5 µg of recombinant AmRZFP1 and AmNAC1 was incubated in protein binding buffer for 1 hour at room temperature with optimal concentration $ZnCl_2$. To this 250 µl of GST-resin was added and incubated at 4 °C for 1 hour. The GST beads were then washed with ice-cold PBS thrice and then the proteins were eluted with glutathione elution buffer and analysed using SDS-PAGE.

The protein samples were then transferred to the nylon membrane using semi-dry transfer method and probed using monoclonal anti-his antibodies. The western blotting results confirmed the protein-protein interaction between AmRZFP1 and AmNAC1. The amino acid sequence analysis using bioinformatics tools revealed a putative transmembrane domain as well a RING domain. Since there is an interaction between AmNAC1 and AmRZFP1, the latter protein may localised into nucleus or into membrane due to the presence of transmembrane domain. To confirm the sub-cellular localisation of AmRZFP1 protein, a fusion construct with GFP fusion protein was done. Further studies are underway to confirm the sub-cellular localisation.

The 5' upstream region of AmRZFP1 gene contains a large number of light responsive elements. Most of the well-characterised RING finger proteins like COP1 and CIP8 are also known to be involved in light responses. To analyse the role of AmRZFP1 gene under light stress, one-month-old seedlings of *A. marina* plants were subjected to light stress and total RNA isolation was done. Northern blotting analyses are under progress.

302.5 Genetic engineering of *Brassica juncea* for enhanced phytoremediation

Phytoremediation is a relatively new technology that uses plants (accumulators of pollutants such as heavy metals) for the remediation of heavy metals from the soil. It is an inexpensive technology, the main strategies of which include phytostabilisation and accumulation. Plants like *Brassica juncea*, *Thlaspi caerulescens* are said to be hyper accumulators as they can accumulate the pollutants into their tissues. Phytoremediation efficiency of plants can be substantially improved using genetic engineering technologies. Overexpression of genes whose protein products are involved in metal uptake, transport, and sequestration, have opened up new possibilities in phytoremediation.

Metallothioneins and phytochelatins are thought to sequester excess amounts of certain metal ion. Metallothioneins are low molecular weight (4-8 kDa) polypeptides rich in cysteine residues (25-33 per cent). These residues in metallothionein form thiol bonds with metal ions to scavenge toxic heavy metals (cadmium, mercury, etc.), to store biologically essential metals (copper and zinc) and to regulate metal dependent processes essential to cellular pathways and thus play a major role in heavy metal detoxification.

Brassica juncea was successfully transformed with *PjMT1* (metallothionein gene isolated from *Prosopis juliflora*) under CaMV promoter using hypocotyls as explant. GUS was used as the reporter gene and the antibiotic Hygromycin as selectable marker. Putative transgenics were analysed for the presence of the transgene via PCR. The transgenic lines are currently in the T2 generation. Screening for homozygous single copy lines is underway.

Isolation of heavy metal transporters

Heavy metal transporters are also involved in metal detoxification. In order to further enhance its phytoremediaion potential, a heavy metal transporter gene was also isolated

from *Prosopis juliflora*. Pyramiding involves stacking multiple genes resulting in the simultaneous expression of more than one gene in a variety. This would in turn improve the efficiency of the plant, leading to the development of a better hyper-accumulator. Pyramiding of metallothionein and heavy metal transporter genes in *Brassica juncea* would further enhance the phytoremediation potential of *Brassica juncea.*

The full length cDNA and ORF sequence was isolated from the stress-induced *Prosopis juliflora* cDNA library using pDNR forward and reverse primers. The heavy metal transporter ORF was cloned into pET28a and pET32a in the BamH1 and Hind111 sites of expression vectors and checked for proper protein folding. The ORF of the heavy metal transporter (*Pj*HMT ORF) was cloned in Hind111 and BamH1 sites of yeast expression vector pYES2. Yeast complementation studies will be later done as a part of characterisation of the gene. The *Pj*HMT cDNA was cloned into pCAMBIA1301 in BamH1 and Sac1 site under CamV35S promoter and later transformed to the model plant tobacco (*Nicotiana tabacum* cv. petit havana). The presence of the gene was confirmed by PCR analysis and GUS staining. Further gene characterisation and analysis are underway.

302.6 Glycine betaine accumulating genes of a mangrove halophyte, *Suaeda maritima*: RNA expression and rice transformation

Glycine betaine is a non-ionic solute that confers osmotic tolerance in most plant species, particularly members of the spinach family. It is considered to be one of the best osmolytes. *Suaeda maritima* is a halophyte growing in the Pichavaram mangroves, which accumulates glycine betaine and codes for the 3 genes involved in the pathway: 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. Gene pyramiding of these enzymes in crop plants would help them tide over drought as well as soil salinity.

Full-length cDNAs of all the three genes had already been isolated. Also, protein expression of *Sm*CMO and *Sm*BADH cDNAs was completed using a bacterial system. The cDNAs were cloned in specific vectors for rice transformation studies. In the current year, expression of *Sm*PEAMT at the protein level was performed using bacterial expression system. The cDNA of *Sm*PEAMT was cloned into pET32a vector that was used for protein expression studies. The vector with *Sm*PEAMT was then introduced into a strain of *E. coli* BL-21. After growing the cells overnight, they were subjected to IPTG which induces protein expression of the cDNA (in pET32a). An aliquot of cells were harvested every hour up to 3 hours and the cells were lysed and the total protein in the lysate was analysed on a protein gel. *Sm*PEAMT protein induction

was observed in the lysates taken at different intervals.

RNA expression analysis of all the 3 cDNAs was performed using real-time PCR. *Suaeda maritima* seedlings were raised from seeds collected in Pichavaram in November 2011. Two-month-old *Suaeda maritima* plants were subjected to 200 mM NaCl treatment. Whole shoots of the plants were harvested at the end of the second and fourth days and after 2 weeks, as per standard protocols. The RNA expression levels were compared with that of *S. maritima* control plants grown without salt treatment. Confirmation of the results is under way, using another set of *S. maritima* plants (biological replicate).

This year, *Sm*CMO and *Sm*BADH were cloned into pCAMBIA1301, an expression vector that can be introduced into plants. The vector containing both CMO and BADH was transformed into rice (IR64) through *Agrobacterium.* About 60 lines were obtained after transformation, among which 3 rice lines showed the presence of both CMO and BADH cDNAs when analysed by PCR.

Future work is focused on experiments to confirm the presence of *Sm*CMO and *Sm*BADH (Southern analysis) in the rice lines analysed by PCR. Also characterisation studies for the introduced cDNAs will be performed. RNA expression studies would be performed for *S. maritima* biological replicate and transformation of rice would be carried out with the vector containing PEAMT along with that of CMO and BADH.

302.7 Characterisation of *NHX1* from *Porteresia coarctata*

NHX antiporters are membrane proteins that mediate cation and proton exchanges across vacuolar membranes. They play a key role in the sequestration of sodium ion (Na^+) into vacuoles to avert ion toxicity in the cytosol of plants under salinity stress.

Transformation of PcNHX1 into indica rice

NHX1 gene was isolated from *Porteresia coarctata*, which is a halophytic wild grass. It has mechanisms for tolerating high salt concentrations. *NHX1* gene was cloned under its promoter in pCAMBIA 1301. The construct was mobilised into local *indica* rice cultivar IR64 by *Agrobacterium*-mediated transformation using embryogenic calli as an explant. Twenty transgenic lines were obtained using Hygromycin as resistance marker. PCR was done using gene specific and Hygromycin primers. All the 20 lines are found to be Hygromycin-positive. There was no amplification in gene specific primer.

Southern analysis of transgenic plants

PcNHX1- transformed putative transgenic lines (L1, L3, L4 and L5) were analysed by Southern blotting. Genomic DNA of transgenic plants was extracted by CTAB method. Twenty μg of genomic DNA was digested with *EcoR*1 enzyme and the digested DNA was transferred to nylon membrane by capillary method. Southern hybridisation was carried out using *NOS-PcNHX1* 3' UTR probe. Faint bands

were detected in all the 4 transgenic plants. Further, T_0 seeds of the transgenic plants were germinated in medium containing Hygromycin (60μg/ml) and seedlings of T_1 plants were transferred to the greenhouse for raising subsequent generations. PCR and Southern analysis will be carried out for segregation analysis.

Retrogene of PcNHX1 in *Porteresia coarctata*

Retrogenes originate via the reverse transcription of mature messenger RNAs from parental source genes and are therefore usually devoid of introns. Knowledge of retrogenes in plants is so far limited compared to that in animals. In plants, alcohol dehydrogenase-derived retrogenes from *Brassicaceae* family have been reported. Retrogenes are found to be abundant in rice. Eighty per cent of retrogenes reported from rice and poplar have structural and evolutionary functions.

To identify retrogene of *PcNHX1*, PCR was done using *Porteresia coarctata* genomic DNA with *PcNHX1* specific primers. Multiple bands were obtained and one of the band sizes is similar to *PcNHX1* cDNA. To identify that band, PCR was done using a combination of primers designed across exon junctions, and it was inferred that there is a copy of the *PcNHX1* cDNA inserted in the *P. coarctata* genome. The bands were cloned into T-vector and sequenced, and 1,334bp of retrogene was isolated and was found to be identical with the *PcNHX1* cDNA with a 11 bp insertion equivalent to part of 11th intron of *PcNHX1* genomic clone. The upstream region of the *PcNHX1* retrogene isolation and characterisation will be done to decipher its function.

302.8 Characterisation of *PcHKT* from *Porteresia coarctata* and its transformation into rice

In 2010-2011, the GFP-HKT construct (N-terminal) was cloned in pCAMBIA 1301 (pGFP-HKT) and transformed into tobacco by *Agrobacterium*-mediated transformation. Eleven explants were selected on Hygromycin. Of these, 5 were found to be PCR positive as well as GUS positive. Fluorescence as observed by confocal microscopy was patchy and not consistently seen in the same lines and found to occur in both the cytoplasm and nucleus, contrary to previous reports of HKT localisation to the plasma membrane. A C-terminal GFP-tagged *PcHKT* was assembled by SOEing and cloned in pCAMBIA 1301 (*PcHKT-pGFP*) in the XbaI and BamHI sites. Tobacco cv. *Petit Havana* was transformed with this construct by *Agrobacterium*-mediated transformation and currently explants on Hygromycin are being selected.

Isolation of the PcHKT promoter

Identification of gene promoters which have a cell-type specific pattern will provide an opportunity to express genes in specific cells. For this, isolation of the native promoter of *PcHKT* was carried out last year using a *Porteresia coarctata* BAC clone (Oc_Ba_0027O13 and 0043B05; Arizona Genomics Institute) and primers designed based on the

O. sativa OsHKT 1, 5 promoter sequence as well as nested primers based on the isolated *PcHKT* cDNA sequence. In the first step, a fragment of approximately 450 bp was obtained and that was cloned and sequenced. It was found to have a 100 bp sequence overlap (identity) with the *PcHKT* cDNA isolated previously and an additional 316 bp of additional upstream sequence. BLAST analysis revealed a high identity with the 5' UTR and promoter region of *Pokkali* HKT. In a second round of genome walking using *P. coarctata* genomic DNA (Sau3A adaptor ligated DNA) and nested primers designed based on the additional 316 bp sequence information, 1. 1 Kb fragment was obtained which was cloned and sequenced.

Cloning of the PcHKT ORF in a Xenopus expression vector

Xenopus laevis oocyte provides a powerful system for the expression and characterisation of plant membrane transport proteins. The *PcHKT* ORF was cloned in the the *X. laevis* oocyte expression vector pT7TS in the BglII and SpeI sites. The C-terminal PcHKT-GFP fusion was also coned in the same sites of the BglII and SpeI pT7TS vector.

Transformation of PcHKT into rice

PcHKT was cloned under the transcriptional control of the maize ubiquitin promoter in pSF20 (pSF20-HKT) in the BamHI / KpnI sites. *PcHKT* was also cloned under the transcriptional control of the native *indica* rice (Nona Bokra) *OsKHT 1, 5* promoter. The transformation of pSF20-HKT and pSF-NB-PcHKT into *indica* rice (IR64) has been initiated and the infected calli are in selection medium.

302.9 Genetic engineering of sugarcane for abiotic stress tolerance through fructan biosynthesis

Fructan biosynthesis with the 1-sucrose: sucrose fructosyl transferase and the 1- fructan: fructan fructosyl transferase genes from *Cichorium intybus* L. have been carried out. The sugarcane transgenics could contribute positively to agriculture and bring about value addition to the crop as fructans are known to be low calorie sweeteners with therapeutic value.

Isolation and cloning of the fructan genes from Cichorium intybus

The 2 fructan genes encoding the sucrose: sucrose 1 fructosyl transferase (1-CSST) and the fructan:fructan 1 fructosyl transferase enzymes 1-CFFT were isolated from *Cichorium intybus* and their sequences were found to differ (97 per cent and 95 per cent, respectively) with those of the same species available in the NCBI Genbank. This may suggest a difference in the local isolate. The 1-CFFT gene differed in a stretch of 5 amino acids that were found to be identical with another genus of the same family. The sequences of the 2 isolated genes 1-CSST and 1-CFFT were submitted in the Genbank (JQ346799 and JQ346800 respectively). Engineering these genes for expression *in planta* would determine their function and potential.

Fructan gene expression

The CSST and CFFT genes cloned in pET32a expression vector were mobilised into BL-21 *E. coli*, and on induction gave the thioredoxin fusion proteins of the expected size (>90kDa).

Cloning of fructan genes in binary vectors and plant transformation

The 2 fructan genes have been engineered into pCAMBIA, pRI101-AN and pRI101-ON vectors separately and together for optimal gene expression. The transformation of sugarcane and tobacco has been carried out. The putative tobacco transgenics have been confirmed by PCR and will be analysed further for transgene expression. The sugarcane-infected calli are at the regeneration stage in selection. The transformation of tobacco as a test crop may be the best way to assess the engineered gene expression and its function in a short span of time as sugarcane is a comparatively slow crop system, though an ideal target crop in terms of engineering abiotic stress tolerance and for value-addition.

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

Red rot disease is a serious problem for sugarcane growers and sugar-producing industries. Studies on molecular level interaction between sugarcane (*Saccharum officinarum* L.) and *Colletrichum falcatum* may reveal the genes responsible for defence mechanism in the host. The gene-for-gene hypothesis is an established model for studying host-pathogen interaction in flax, arabidopsis, rice and also in sugarcane. However, in sugarcane several resistant and susceptible varieties interact with a number of pathotypes of *C. falcatum* in the field. Construction of subtraction suppression hybridisation library between Red rot-resistant and Red rot-susceptible sugarcane varieties using *Colletotrichum falcatum* purified or crude elicitor will give some good candidate genes for defensive mechanism.

To identify differentially induced elicitor-responsive gene during sugarcane – *C. falcatum*, sugarcane suspension cells were raised from embryogenic calli of CoC 671 (susceptible variety) and Co 93009 (resistant variety). Callus culture from both varieties were established using second or third whorls of sugarcane leaves in 2.5 per cent MS medium supplemented with 3mg/l 2,4-dichlorophenoxyacetic acid concentration and 10 per cent coconut water.

Friable embryogenic calli were used to initiate suspension cells of sugarcane CoC 671 and Co 93009. Medium for sugarcane suspension cells were formulated according to Ho & Vasil, with slight modifications. Callus of both varieties were inoculated in MS medium with 3mg/l 2, 4-D and 5 per cent coconut water to get uniform suspension cells. Suspension cells were kept in incubator shaker (120 rpm) at 25°C (±2°C). Total RNA isolation from suspension cells of both varieties was isolated.

302.11 Prospecting novel genes from lichen species

The main focus of this study is to carry out transcriptome (total set of transcripts in a given organism) analysis of *Roccella montagnei* to get an insight into the molecular mechanisms responsible for biological functions unique to this group of organisms, especially stress response and secondary metabolism.

A cDNA library from the natural thallus of *R. montagnei* was constructed and 2000 clones with a cDNA insert size of more than 400bp were randomly selected and EST sequencing (Expressed Sequence Tags) was carried out. Putative functions were assigned to these ESTs based on TBLASTX search results and functional annotation. Genes whose functions could be predicted from such annotation were classified according to biological roles and biochemical functions into 16 categories such as primary metabolism, secondary metabolism, membrane transport, signal transduction, etc. The ESTs showing similarity to previously uncharacterised genes (unknown) formed the largest (28 per cent) category. Important genes classified under the secondary metabolism category include 3-ketoacyl-(acyl-carrier-protein) reductase, Sphinganine hydroxylase, Acyl-CoA synthetases, Acetyl-CoA acetyltransferase, Acyl carrier protein, Acyl-protein synthetase, Asparagine Synthase B, Flavin reductase, 2-keto-4-pentenoate hydratase/2-oxohepta-3-ene-1,7-dioic acid hydratase, Thiazole biosynthetic enzyme Hydroxyquinol 1,2-dioxygenase (1,2-HQD), etc. Several genes functioning in oxidative stress tolerance such as Glutathion S-Transferase (GST), Thioredoxin (TRX), Aldehyde dehydrogenase, Arsenite-resistance protein 2 (ARS2), Copper-zinc superoxide dismutase, Glutaredoxin, Heat-shock protein hsp1, Cyanate hydratase, etc., were also found in the sequenced portion of the library.

ESTs corresponding to different genes/parts of the same gene were assembled into contigs using the CAP3 programme, resulting in 195 contigs and 432 singlets, constituting 627 unigenes.

One of the cDNAs coding for a Glutathione S-transferase (*Rocm*GSTI) was selected for further characterisation. The *Rocm*GSTI cDNA is 970 bp in length with an ORF of 639 bp, coding for a protein of 212 amino acids. Phylogenetic analysis of *Rocm*GSTI with other fungal GSTs revealed that *Rocm*GSTI is significantly different from them and can be considered a unique type of fungal GST. *Rocm*GSTI protein was overexpressed in *E. coli* BL 21 DE3 cells as part of pET 28a expression vector. High induction of the protein was observed in recombinant cells after the first hour of IPTG induction. The Glutathione S-transferase and Glutathione peroxidise activities of transformed and untransformed *E. coli* were assayed and it was revealed that recombinant *E. coli* has higher GST activity compared to control cells after IPTG induction. The ability of transformed and untransformed *E. coli* cells to survive under salt and cadmium stress was analysed, and it was found that *Rocm*GSTI protein overexpression

improves salt and cadmium stress tolerance in transformed *E. coli* cells.

The study has been successful in identifying many genes involved in stress tolerance and secondary metabolism in *R. montagnei.* The results from this study will facilitate in developing a database of *R. montagnei* genetic information and would serve as a source of novel and significant genes for future research programmes.

302.12 Identification of genes involved in the seed oil biosynthesis pathway from the biodiesel plant *Jatropha curcas*

India imports crude oil for 70 per cent of its needs. With frequent increases in fuel prices, the search for an alternative to fossil fuel has become inevitable. *Jatropha* is seen as one such alternative. Hence, research on *Jatropha curcas*, an oilseed plant, has become an important area in the field of bioenergy. The seeds contain more than 30 per cent oil by weight. In order to improve oil yield it is important to understand the regulation of oil biosynthesis in its seeds. Oil yield is a quantitative and complex trait, controlled by various factors like the genotype of the plant, environment and proper agronomic practices. Here the emphasis was on mining the genes that regulate the synthesis of oil by carrying out large-scale expressed tag (EST) sequencing of seed-specific cDNA library that was specific for mid-maturation stage of seed development. A total of 3700 EST sequences was obtained by the end of 2010. Software used for EST analysis has been freely available online. Vector contamination was removed using a tool known as 'Vecscreen' from NCBI; Gene annotation was done using blast2go (http://www.blast2go.com/b2ghome). Most of the hits showed similarities with *Ricinus communis* (castor), another high oil-yielding plant. Contig analysis was done using ESTpiper (http://casestpiper.cas.unt.edu/estpiper/) wherein 78 per cent were singleton sequences and the other 22 per cent were contigs. All these sequences were submitted to the NCBI database and made accessible online (Accession Nos: JK610133 to JK613645). Furthermore, Northern Analysis was done for a few genes selected from the EST sequences to find out expression levels in the seed stages, roots and leaves. Fructose 1.6 bisphosphate (a key enzyme in the glycolysis metabolic pathway) showed highest levels of expression in the third seed stage while there was expression in leaves in the first seed stage. Oleosin (oil body) was more in the third seed stage and was found to be in the form of 2 isoforms. Sucrose Synthase (SuSy) gene expression was found in all seed stages and in leaves and very faintly in root. Finally, expression of senescence-associated protein levels was equal in all stages. A few more genes related to the oil biosynthetic pathway need to be screened using Northern blots.

Sucrose Synthase (SuSy) is the key enzyme which breaks down carbohydrates accumulated through photosynthesis in seeds in the initial stages and diverts the products (glucose and fructose) towards oil as the seeds mature. With the partial information obtained from *Jatropha*

curcas ESTs, SuSy full length cDNA was isolated and protein expression was studied in a bacterial system during the beginning of 2011. In order to study the *in planta* expression of this gene, tobacco (*Nicotiana tabacum*) was used as a model plant. SuSy was cloned into pCAMBIA1301 expression vector with CaMV35S promoter. *Agrobacterium*-mediated transformation was used to introduce SuSy into tobacco using leaf disc method. Nineteen plantlets were grown in 2 per cent MS medium using Hygromycin as the selection marker. The transformed plants were later transferred to pots with vermiculite. The presence of SuSy in the transformed tobacco plants was confirmed by performing a PCR after isolating the genomic DNA. Sixteen out of 19 plants showed the presence of SuSy in the PCR. Southern analysis to find the copy number of the gene integration could not be performed due to certain constraints. Hence, seeds from a few of these positive lines were collected and forwarded to the next generation. Further analysis will be done using the next generation seeds. Along with this another cassette was made with a seed-specific promoter, curcin, replacing the CaMV promoter. This is to enhance the efficiency of SuSy as more of this enzyme would be directed to the seed. The same procedure was used for transforming this construct into tobacco. Around 30 plants were raised and genomic DNA was analysed for the presence of both curcin promoter and SuSy. None of the plants were positive for presence of both genes together. In order to ascertain the value of *Jatropha curcas* SuSy in the metabolic engineering of oil biosynthesis, future work would also focus on the analysis of transgenic tobacco for seed oil quantity and quality as reflected by fatty acid profile.

302.13 Pyramiding genes in the oxidative stress tolerance pathway

Antioxidant enzymes play a very crucial role in conferring abiotic stress tolerance and SOD (superoxide dismutase) is the first enzyme in the enzymatic oxidative pathway. APX (ascorbate peroxidise) also acts in a similar manner as SOD. MDAR (monodehydroascorbate reductase) is part of the ascorbate glutathione pathway and is reported to be upregulated with salinity. Thus, pyramiding of these 3 genes was undertaken to study the tolerance levels to abiotic stresses. F2 generation lines containing the 3 genes, AmSOD, AmMDAR and AmAPX, in rice are being screened for tolerance to salinity and drought. Hydroponic assays at 150 mM NaCl and pot experiments for drought stress with multiple rounds of water withdrawal revealed tolerance as compared to control, untransformed plants. Comparative studies among the transgenics with single genes and those with pyramiding are being analysed for better efficacy to tolerate abiotic stresses.

Sub Programme Area 303

Bioprospecting

Currently in India, lichens and medicinal plants are collected indiscriminately and exported raw. The bioprospecting research work by MSSRF, which has already demonstrated that some of the species of medicinal plants and lichens occurring in mangroves and in the

Western and Eastern Ghats have important biomolecules with therapeutic value, opens new avenues to explore the potentialities of these organisms. This programme aims in adding value to the bioresources and establishing alternative protocols for the generation of key molecules using relevant biotechnologies, thereby leading to the conservation and sustainable utilisation of these resources.

303.1 Establishment of lichen cultures

Lichen-forming fungi are unique organisms, producing a great variety of pharmaceutically-relevant metabolites which includes antibiotics, antimycobacterial, antiviral, anti-inflammatory, analgesic, antipyretic, antiproliferative and cytotoxic activities. However, only very limited numbers of lichen substances have been screened for their therapeutic potential, mainly due to difficulties encountered in identification of the species and collection of bulk quantities, low quantity of compounds within the organisms, lack of protocols for the biosynthesis of molecules in desired quantity, and lack of bioprospecting partnerships to screen these molecules for their pharmaceutical potential.

MSSRF has established culture protocols for optimum biomass production and secondary compound synthesis through lichen whole thallus, fungal (mycobiont) and photosynthetic partners of 35 lichen species with modifications of the culture conditions for the production of novel compounds. The lichen whole thallus cultures showed 3 different patterns of the biosynthesis of secondary compounds: Species showing secondary compounds similar to that of the natural thallus, species biosynthesised additional secondary compounds compared to the natural thallus, and species biosynthesised totally novel secondary compounds.

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

The national network programme on lichens was set up by the Department of Biotechnology (DBT), Government of India, during the year under report. MSSRF coordinates this national network and partners with the Agharkar Research Institute (ARI), Pune and the National Botanical Research Institute (NBRI), Lucknow for establishing lichen collections, as well as the culture and biosynthesis of compounds. The Cancer Institute, Chennai, the Tuberculosis Research Institute, Chennai, and the Pharmacognosy Laboratory, NBRI are bioprospecting partners and the Phytochemistry Laboratory of NBRI and the Indian Institute of Technology-Madras, Chennai are involved in characterising the compounds.

The key objectives of this network programme on lichen bioprospecting are:

- Establishment of lichen culture repositories for germplasm conservation and for the biosynthesis of secondary compounds
- Bioprospecting the secondary compounds of lichen species: screening for anti-cancer, anti-tuberculosis, and hepato-

protective, which includes consolidating the ongoing lead molecules towards product development, screening of the available lead molecules to other targets with suitable partners, screening new lichen species based on ethno botany literature for specific targets, and secondary compound characterisation and compound library development

- Genetic characterisation / fingerprinting of key lichen species
- Database development of selected lichens

The network has already started the collection of selected species and establishing culture protocols for these species for the biosynthesis of the secondary compounds.

303.3 Screening the secondary compounds of plants and lichens for their pharmaceutical relevance against cancer and tuberculosis

The search for potential molecules from bioresources as drugs against cancer and tuberculosis is a thrust area of medical research involving multi-institutional laboratories. MSSRF collaborates with the Cancer Institute, the Tuberculosis Research Centre, and Indian Institute of Technology-Madras, all located in Chennai, in this important research.

Screening compounds against cancer

MSSRF is involved in the generation of known and novel molecules from medicinal plants and lichen species through culture. The Cancer Institute is involved in the anti- cancer screening of the compounds in different cell lines using cell proliferation assay. The NCI H460, MCF-7 and SNB-19 cancer cell lines were used for the preliminary screening of the compounds. The compounds that show significant anti-cancer activity in the preliminary screenings will be screened against 30 different cancer cell lines that were procured from the National Centre for Cell Science **(**NCCS), Pune and the National Cancer Institute (NCI), Bethesda (USA) and maintained with appropriate medium.

Screening compounds against tuberculosis

The Tuberculosis Research Centre screens secondary compounds extracted from lichen and plants for their anti-tuberculosis properties, in seven different tuberculosis strains including multi-drug resistant strains.

303.4 Screening of plant extracts for anti-cancer and anti-tuberculosis activities

The compound isolated from *Plumbago zeylanica* shows significant cytotoxicity in the preliminary anti-cancer screenings, and hence the molecule was further purified and crystallised. The chemical characterisation of this molecule is underway. It was reported earlier that the compounds isolated from *Excoecaria agallocha* — a mangrove tree — showed significant cytotoxicity against 28 cancer cell lines with a LD50 value of 8000 g/kg body weight in animals (nude mice). In the toxicity experiments, many animals developed diarrhoea and blindness and some even died;

hence, this molecule was not prospected further.

303.5 Screening lichen compounds against tuberculosis

Last year 100 per cent mortality of *Mycobacterium tuberculosis* was reported by the compound isolated from the mycobiont cultures of *Trypethelium eluteriae* in all the strains tested, including the multi-drug resistant (MDR) (rifampicin and isoniazid) TB strains with a minimum inhibitory concentration (MIC) at 0.1 mg/ml concentration. This year, some of these experiments were repeated to confirm the vigour of the molecule. Further studies were also carried out on the effect of the compound on *M. tuberculosis* (H37Rv) infected macrophages. The effect of the compound on *M. tuberculosis* (H37Rv) infected THP1 cell line (Human acute monocytic leukemia cell line) macrophages indicated a reduced *in vitro* growth of *M. tuberculosis* after macrophage infection; the compound was also found to be safe on human macrophage cell lines.

Sub Programme Area 304

Microbial Diversity

The focus continued in understanding the genetic and functional diversity of the denitrifies, *Micromonospora* and acly homoserine lactone (AHL) producing Gram-negative bacteria from the mangrove ecosystems and the role of plant growth promoting bacteria in alleviating salinity stress in finger millets from the agri-ecosystems.

304.1 Bioprospecting for microbes from the mangrove ecosystem

Understanding the microbial diversity of this ecosystem has so far proved that this ecological niche harbours a large number of novel microbes which needs to be explored. The diversity of the unculturable microbes associated with the mangroves was determined by denaturing gradient gel electrophoresis (DGGE), a metagenomic tool capable of separating unrelated DNAs based on the differences in their sequences and GC contents.

Genetic and functional diversity of genus Micromonospora isolated from rhizosphere region of Avicennia marina and Rhizophora mucronata of mangrove ecosystem

A total of 326 *Micromonospora* strains were isolated from the rhizosphere soil samples of *Rhizophora mucronata* and *Avicennia marina* of two different mangrove ecosystems, Pichavaram and Devipattinam. Of the 326 isolates, 203 strains were from Pichavaram and 123 strains from Devipattinam. The *Micromonospora* are known producers of secondary metabolites of pharmaceutical and agricultural importance. These strains were screened for the presence of polyketide synthase (PKS) and non-ribosomal polyketide synthase (NRPS) genes, the key genes involved in secondary metabolite production. Degenerated primers were designed for amplification of an approximately 700 bp segment encoding the β-ketoacyl synthase (KS) domain of bacterial modular type I

PKS genes. Among the total isolates, 283 *Micromonospor*a harboured type I PKS and 296 strains harboured type II and 254 strains harboured the NRPS genes, indicating that these strains may be efficient producers of secondary metabolites. Further, the genetic diversity of *Micromonospora* isolated from the mangrove was analysed by BOX-PCR profiling. The BOX profile showed a high genetic variation within these *Micromonospora* isolates; clustering based on Pearson's coefficient and UPGMA algorithm at 50 per cent similarity index yielded 204 clusters containing 1 to 8 strains in each cluster with significant genetic variation. Phylogenetic analysis of these strains is under progress.

Diversity of denitrifying bacteria harbouring nitrous oxide reductase (NosZ) gene from the mangrove ecosystem

This study focuses on assessing the diversity of denitrifying bacteria, particularly the organisms that harbor the nitrous oxide reductase gene from the mangrove ecosystem, by using culture-dependent methods. The current research focus is on screening the denitrifiers for their potential in the degradation of aromatic hydrocarbons like benzene, toluene, ethyl-benzene and xylene, (BTEX) which are commonly found as groundwater contaminants. The denitrifiers were identified based on the presence of denitrifying marker genes such as nitrite reductase (*nirS*) and nitrous oxide reductase (*nosZ*). A total of 931 bacteria have been screened, out of which 56 were found to be denitrifiers. Some of the denitrifying strains were characterised and identified as *Pseudomonas* (MSSRF191), *Labrenzia* (MSSRF261), *Vibrio* (MSSRF180), *Bacillus* (MSSRF67), and *Halomonas* (MSSRF176) based on 16S rDNA sequence analysis and biochemical test. Among these strains, *Halomonas* sp. were tested for their efficiency to degrade benzene by enriching the culture in LB broth and then inoculating in minimal Davis broth medium amended with benzene (1per cent) and incubated for 5-7 days. After incubation the total RNA was isolated, and then subjected to c-DNA AFLP analysis for identifying the genes that are being overexpressed and responsible for degradation. The differentially expressed genes were eluted and sequenced which showed that some of the genes linked to the metabolic pathway of benzene degradation were present; this confirms the ability of the organism to degrade benzene.

Quorum-sensing among gram-negative bacteria

The AHL molecules were extracted from the culture filtrates (CF) of 10 AHL producers coded MSSRF M29; MSSRF M41; MSSRF R56; MSSRF R73; MSSRF R123; MSSRF M30; MSSRF M46; MSSRF R85; MSSRF R124 and MSSRF R54 and analysed by thin layer chromatography (TLC) using C18 reverse phase TLC plates. The presence of C6-HSL and C4-HSL were identified in all the 10 strains screened. Further, these strains were identified based on the 16S rDNA sequence analysis as *Pseudomonas chlororaphis* (MSSRFC15), *P. plecoglossicida* (MSSRF1), *P. aeruginosa* (MSSRF41), *Serratia marcescens* (MSSRF38),

Aeromonas veronii (MSSRF44), *A. hydrophila* (MSSRF30), *Pantoea ananatis* (MSSRFR54), *Brevibacillus laterosporus* (MSSRFM46), *Rahanella aquatalis* (MSSRFR123) and *Enterobacter* sp. (MSSRFR32).

The AHL regulated phenotypes such as exopolysaccharide production and biofilm formation in all six Pantoea strains. The *Pantoea* spp. are known to cause infections in a wide range of crops, and hence the pathogenecity of the *P. ananatis* (MSSRFR54) strains was checked in different crops such as paddy, onion and carrot. The strains failed to show any infection symptoms but elicited a hypertensive response in tobacco leaves. Further, the AHL synthase gene (EanI) was amplified using gene specific primers and a partial sequence of about 300 bp was found to have a 90 per cent similarity with the AHL synthase gene of *P. ananatis* SK-1.

Quorum quenchers

Quorum-quenching is a mechanism by which the bacterial cell-to-cell communication is blocked by the production of certain signal molecules by Gram-positive bacteria. In the present study, about 50 *Bacillus* spp. isolated from the mangrove ecosystem were screened for the production of AHL lactonase enzyme, a quencher of AHL molecule using aiiA primers; only 3 positives were identified which showed positive amplification with the specific primers. The organism was identified as *Bacillus thuringiensis* which showed 99 per cent sequence similarity to *B. thuringiensis* (ATCC 10792T). The 750bp aiiA gene was sequenced and confirmed as aiiA lactonase which showed a 99 per cent identity to aiiA lactonase gene of *B. thuringiensis* (aiiA-B22).

304.3 Screening for biomolecules from micro-organisms collected from different ecological niches

Among the 25,000 isolates screened by high infectivity throughput screening (HITS) as part of the National Bioresource Development Board (NBDB) project, the following 3-star hits were recorded: anti-cancer activity (146); anti-diabetic (893); anti-inflammatory (382); and anti-infectivity (273). One of the major challenges faced was the revivability of the cultures, as only 50-55 per cent of the cultures could be revived. This problem is currently being addressed by a project supported by DBT on the optimisation of the medium for the growth and storage of mangrove microbes and identification of the PKS genes from 3-star active cultures.

304.4 Microbes for biotic and abiotic stress attenuation in agriculture crops

Finger millet, *Eleusine coracana* L., is a staple food in Asia and Africa. In India, it is cultivated in Tamil Nadu, Andhra Pradesh, Odisha, Bihar, Maharashtra, Karnataka, Gujarat, Uttaranchal and Himachal Pradesh. The significance of finger millet as therapeutic diet and baby food is increasing, and hence it is important to protect the plant health and enhance its production in adverse stress conditions such as drought and salinity. Plant-growth promoting bacteria (PGPB) are known to alleviate both biotic and abiotic stress and enhance production in different crops. In this

study, 3 isolates of *Bacillus* spp. and 2 isolates of *Pseudomonas* spp. capable of alleviating salt stress and enhancing the growth in finger millet under salt stress were identified. The PGPB-treated plants showed enhanced root growth and accumulated low amounts of Na^+ and K^+ ions compared to the non-treated plants under 200 mM salt stress. The *Bacillus* and *Pseudomonas* treated plants showed lower percentage of electrolyte leakage and cell damage (15-30 per cent) compared to the salt-stressed non-PGPB treated plants. The accumulation of transcripts in PGPB treated and non-treated plants helps to understand the mechanism of stress tolerance mediated by the *Bacillus* sp. The cDNA subtraction library showed the regulation of many transcripts under salt stress in response to the *Bacillus* sp. treatment. Among them, the putative MYC 2 transcription factor and putative HKT transporter are important transcripts which minimise cell damage and protect plant health under salt stress. Construction of cDNA libraries is under progress to understand the molecular mechanism of the plant microbe interaction between *Bacillus* spp. and finger millet under salt stress.

304.5 Novel genus *Cizobacter lividus* gen. nov., sp.nov., a nitrogen fixing bacteria isolated from root nodules of chick pea (*Cicer arietinum*)

The taxonomic position of the strain MSSRFBL 1, isolated from root nodules of chickpea cultivated in Kannivadi in the Dindigul district of Tamil Nadu, was determined. The strain MSSRFBL1 is a Gram-negative, non-motile, aerobic nitrogen-fixing bacteria. Comparative 16S rRNA sequence analysis showed MSSRFBL1 shared 97.5 per cent similarity with *Ensifer adharens*, 97.2 per cent with *Agrobacterium tumefaciens* TJYJ, 97.1 per cent similarity with *Ensifer americanum* and 97.0 per cent similarity with *Ensifer kostiensis*. Phylogenetic analysis based on 16S rRNA clearly showed that strain MSSRFBL1 formed a distinct lineage within the family *Rhizobiaceae* by clustering between the lineage defined by the genera *Ensifer* and *Mycoplan*a. Sequence analysis of the house keeping genes *recA*, *dnaK*, *thrC* proved that the strain MSSRFBL 1 does not belong to the genus *Ensifer*, *Agrobacterium* and *Rhizobium*.

Programme Area 400

ECOTECHNOLOGY

Work under the Bioindustrial Watershed Project with a community-managed approach for sustainable management of natural resources in Tamil Nadu and Odisha was recognised and rewarded by the Ministry of Water Resources. The Biocentre in Puducherry, restructured after the extensive damage caused by cyclone Thane in December 2011, has been rechristened as Biovillage Resource Centre. A new research project on climate-resilient agriculture has been initiated in semi-arid regions of Tamil Nadu and Puducherry with support from ICAR. Experiments relating to biological control of mealy bug and mass multiplication of biopesticides and testing them in the field were the focus of the land-lab-land linkage programme.

Rural Systems Research: Integrating conservation of natural resources with livelihoods. Illupur Watershed received the National Water Augmentation Award.

Programme Area 400

Ecotechnology

The overall mandate of the JRD Tata Ecotechnology Centre is operationalisation of the holistic and human-centered biovillage concept through technology assessment (on-farm, off-farm and non-farm), development and demystification of technologies, dissemination through demonstrations, and facilitation for wider adoption through extension in various agro-ecological regions. Appropriate forward and backward linkages are facilitated to provide a synergistic effect. The restructuring of a few projects was undertaken to strengthen the efficiency and effectiveness of the JRD Centre.

This year saw a few milestones being achieved in some of the projects. The bio-industrial watershed project (BIWS), with its community-managed approach for sustainable management of natural resources, was recognised and rewarded by the Ministry of Water Resources, Government of India. One of the BIWS sites at Koraput district in Odisha — the Tolla watershed site — was awarded the *Rashtriya Jal Puraskar* (National Water Award) for 2010 with a citation and a cash prize of Rs. 10 lakh, while another BIWS site at Pudukottai district, Tamil Nadu — the Upper Vellar watershed — was honoured with the *Bhoomijal Samvardhan Puraskar* (Groundwater Augmentation Award) for 2010 with a citation and a cash prize of Rs. 1 lakh.

The Biocentre of the biovillage project at Puducherry was restructured and rehabilitated after cyclone *Thane* in December 2011 caused extensive damages to land and infrastructure. The community banking services supported by Asia Initiatives has also been restructured, in accordance with the recent FCRA policy of the Government of India. An assessment of the various grass-roots institutions is being commissioned, which would provide a strategic direction to strengthen and sustain them as well as build sustainable and replicable models. Leveraging and establishing linkages with multi-stakeholders has enhanced the community's capacity and strengthened the empowerment process on a rights-based approach in addressing their livelihood security.

The year also enabled the JRD Centre to develop new linkages and funding. A new initiative has been agreed upon between OCP Foundation, Morocco, and MSSRF to end protein hunger by augmenting the production and consumption of legumes. The Indian Council for Agriculture Research (ICAR), Government of India, is supporting a new and strategic research project on climate-resilient agriculture by addressing issues of climate change and variability. As part of its CSR programme, the Hindustan Petroleum Corporation (HPCL) has come forward to assist BIWS in constructing community-managed water harvesting structures. The Department of Biotechnology (DBT) is supporting a project on integrated farming systems (IFS), and the Department of Science and Technology (DST)

is sponsoring a research project on producing and testing liquid fertilisers. The Asia Initiatives group as well as nationalised banks and financial institutions continue with their timely and critical micro-credit funding support.

Sub Programme Area 401

Coastal Regions

The report on Kaveripoompattinam has been shifted to Programme Area 100 (Coastal Systems Research), and can be found under Sub Programme Area 105.

401.1 Kendrapara

The Kendrapara biovillage project, initiated in 2002, continues to blend sustainable natural resource management with livelihood security and women's empowerment through a participatory approach with the village community and other stakeholders.

Aquaculture-based integrated farming system

The aquaculture-based integrated farming system (AqIFS) model farm established on 1 ha at Manitiri village in 2004 has been replicated by 67 farmers across the district, and the AqIFS Farm School run by WSHGs has trained individuals from nearby villages. As the project area experiences regular drought and floods, a pond system with elevated dykes was planned for water harvesting to demonstrate the utilisation of farm resources in an integrated manner. The water harvested and stored in the pond is also used for raising a nursery that enables the farmers to go in for early transplantation over 110 acres. The yield from such practices has been 15 to 20 per cent higher than conventional methods adopted by other farmers, who raise the paddy seedlings after the onset of rains. This year, the net profit from the farm was Rs. 40285/-. The project has demonstrated that net income from the AqIFS farm is nearly 4 times higher than the existing practice of cultivating paddy on 1 ha of land.

As an extension of AqIFS activities, composite fish culture was promoted among the farmers and SHG members utilising the existing small and medium ponds. This year two more ponds were brought under pisciculture, taking the total to 14 ponds covering an area of 10.45 acres with a net income of Rs. 225940/- from the harvested fishes. This activity is supported by the Fisheries Department, which extends subsidies for excavation of new ponds and renovation of old ponds and also supplies fingerlings.

The project has established a vocational training centre in 2011 at Madhusagar in the campus of a residential school. The centre provides training in the area of micro enterprises to SHG members, agriculture and allied activities to the farming community, and vocational training and demonstrations to the school students on agriculture, horticulture, dairy, poultry, biodiversity issues, etc. The school programme is structured in such a manner that not only is hands-on training provided, the students are also exposed to an understanding of the dynamics of inter-relationship between

the farm and the surrounding environment, within the broad scope of MSSRF's concept of 'Every Child a Scientist'. The students are also members of the DNA/Eco Club activities of the Foundation.

The farm activities at the training centre include rice cultivation, vegetables, fruits and flower production, pulse and oil seed production, poultry, ducks, agro-forestry plantation, dairy development, fishery, bee-keeping, mushroom production, etc. The farm, dairy and poultry products are supplied to the residential school at a subsidised rate to supplement the students' diets.

Vocational training imparted to SHG members this year was on incense and candle sticks, phenyl preparation, food preservation, sunflower cultivation, IPM, INM, soil testing and seed treatment. The centre also conducted awareness and training programmes, such as tree plantation, biodiversity and computer literacy. During the year the gross value of the farm products was Rs. 72540/-. Fifty per cent of this is saved in a revolving fund for sustaining the activities of the centre.

Agroforestry

This year 1500 tree saplings were distributed to 118 farm families in villages. The produce of these trees will be of multiple use, like fruits, firewood and house-building materials.

System of Rice Intensification

The success of the System of Rice Intensification (SRI) method of rice cultivation and its demonstration and replication within the project area has helped the District Agriculture Department taking forward this programme across the district by providing necessary support and inputs through their Compact Area Programme, wherein they have supplied seeds, bio-fertilisers, weedicides, pesticides, micro-nutrients and agricultural implements to the farmers.

The State Agriculture Department through the Agricultural Technology Management Agency (ATMA), implemented a programme under Rashtriya Krishi Vikas Yojana (RKVY) titled 'Bringing Green Revolution to Eastern India' during this year in 4 blocks of the district. MSSRF was the NGO partner for providing training to the farmers in Mahakalpada block. Under this programme, MSSRF trained 1233 farmers covering 1000 ha in line planting. Farmers were able to get an increased yield of 15-20 per cent through this method. Within the project site, 252 farmers adopted SRI method, covering 62.5 ha and got an average yield of 61.20 qtl/ha.

Sunflower cultivation

A total of 500 ha was covered under this programme, with 22 ha (85 farmers) in the project area with an average yield of 14.70 qtl/ha.

Poultry rearing

During the year, 7000 chicks were sold to 323 individuals, who were able to get a profit of Rs. 2250/- on an average. Sixteen SHGs have also taken up poultry rearing as a group enterprise with a minimum of 100 birds with credit support from the Community Banking Project and other

Banks. They have also been provided training by the State Veterinary Department and KVK, which are now promoting poultry rearing in the district.

Backyard kitchen gardens

Currently backyard kitchen garden activities are practised by more than 434 families in the project area who cultivate about 20 different vegetables. MSSRF has linked the farmers to the State Horticulture Department and KVK for quality vegetable seeds and seedlings at subsidised rates. This year the Horticulture Department has also supplied 12000 packets of vegetable seeds (mini kits), micronutrients, bio-fertilisers and pesticides at 90 per cent subsidy through their Horticulture Mission programme. The average household profit from the backyard kitchen garden is approximately Rs. 2000/- per annum.

Mushroom cultivation

Forty SHG members cultivated mushrooms on a commercial scale and made a net profit of Rs. 12000/- per annum. Mushroom cultivation continues to be practised by some individual women SHG members in the project area and in the neighbouring villages with the support of the State Horticulture Department, which provides spawns and market linkages.

Grass-roots institutions

Grass-roots institutions, such as SHGs and Farmers' Clubs, continue to function under 3 clusters, one for each gram panchayat. There are 81 SHGs and 2 Farmers' Clubs with 1213 women and men members. Of these, 21 SHGs have availed credit facilities from MSSRF's Community Bank and from nationalised Banks for taking up income-generating activities.

The SHG members have taken the lead to train other SHGs of their villages and in nearby villages.

Village Knowledge Centre

This year the Village Knowledge Centre (VKC) has trained 42 WSHG members and 77 children. Regular programmes, such as health camps, sanitation awareness, child nutritional programme and enterprise development, have been arranged. Twenty-four students have undergone computer training from the Madhusagar Bidyapita centre during the year.

Training and capacity building

During the year, 3288 trainee days were completed, with resource persons from KVK, District Horticulture Department, District Agriculture Department, etc. In addition to the 1233 farmers trained in line planting of rice under the 'Bringing Green Revolution to Eastern India' programme, 1900 farmers were trained through MSSRF in seed treatment of paddy and groundnut.

401.2 Puducherry

The biovillage programme in Puducherry has two integrating components, which address concurrently the issues of resources and rural poverty: the Biocentre, which continues to be the hub of the biovillage programme, and extension activities, which include the Innuyir

Grama Sangam and various capacity-building activities.

Biocentre

To reinforce the goal of the biovillage programme, the Biocentre has been rechristened as Biovillage Resource Centre (BVRC), integrating components like ICT. The Centre has been redesigned in consultation with the community and demonstration units like the integrated farming system model, fodder grass plots, nutrition garden, livestock and floriculture have been rejuvenated. To integrate more such replicable models, a new cow shed was built to aid in vermicompost production and processing, and a mushroom spawn production and biocontrol labs were established during the reporting year.

One of the major setbacks has been the damage caused by cyclone *Thane* in December 2011, during which more than 40 trees and some of the buildings of the demonstration unit were damaged. The recovery and reconstruction process has been completed.

The income earned from the various units was quite significant compared to last year. The veterinary clinic was able to provide paid services to more than 20 surrounding villages. A livestock helpline service is being successfully implemented this year. The objectives of establishing the Biocentre is not only to develop and demonstrate various technologies but also facilitate in replicating them in the nearby villages. Fodder grass plots, vermicompost, livestock and floriculture were replicated in 5 villages covering about 50 farmers in each village. Many farmers, WSHG members, government officials, schoolchildren and others visited the Biocentre.

Extension activities

Innuyir Grama Sangam – Women's Federation

Innuyir Grama Sangam has a membership of 3261 women of 252 SHGs from 52 villages. Trainings and capacity-building exercises have been imparted for strengthening the grass-roots institution for independent functioning and management as also for long-term sustainability. Grading by Banks for credit linkages, trainings, monitoring and evaluation through animators are regular features of the Federation.

Community banking

During this year, the Cwommunity Bank has been able to provide loans to 122 members to the tune of Rs. 19.63 lakh for scaling up or initiating income-generation activities (IGAs). Through nationalised Banks (SBI and Indian Bank), additional credit of Rs. 141.56 lakh was facilitated for 552 SHG members. Credit has been utilised to improve existing income-generation activities or initiate a new livelihood activity. Besides, the loans have also been used to rebuild the houses destroyed by cyclone *Thane* which wreaked havoc on coastal areas like Puducherry and have been utilised too for education and other domestic needs or in building up assets.

The total funds available with the Biovillage Council (BVC) Community Bank have increased from Rs. 24188/- to Rs. 170552/- in 5 years.

Asia Initiatives collaboration

An amount of Rs. 3.36 lakh was received from Dr. Mayuri (ETOSE) through Asia Initiatives to develop the sanitary napkin production unit in Puducherry. A detailed planning exercise is being carried out with the community, private agencies and government for marketing. Asia Initiatives has come forward to support the tailoring skills of WSHG members with a grant of Rs. 4.4 lakh. The Singapore chapter of Asia Initiatives has also envisaged keen interest in supporting the micro-credit programmes.

Trainings

During the last year, 138 training days were organised for the SHG members, SHG leaders, cluster level leaders, government departments, other NGOs and stakeholders. The highlight was that 42 such training days were given by the BVC master trainers. **Table 4.1** illustrates the training details.

Networking

Partnerships were built with small and marginal farmers, government departments like Agriculture, Horticulture and Forest, academic and research institutes like Tamil Nadu Agricultural University (TNAU), Krishi Vigyan Kendra, veterinary colleges, medical colleges, State units like PONLAIT, PASIC, nationalised Banks, NABARD, DRDA, Sankara Nethralaya, Fish Farmers Development Agency, REAP, various NGOs and others for technical and financial support towards various activities. Each stakeholder has significantly contributed in accessing various entitlements, government schemes and micro credit.

Funds leveraged

BVRC also plays a major role in networking and alliance building with Banks, NGOs, academic and research institutions, corporate sectors, donor agencies and policy makers. This year, a sum of Rs. 4.73 lakh was dovetailed from

Table 4.1 ***Training programmes at the Biocentre***

Training programmes	Training days	Total no. trained	Women	Men
Leadership development, SHG capacity building, conflicts management	32	960	938	22
Micro-enterprise development programme (MEDP)	53	190	190	-
Farmers field school and *uzhavar mandram*	6	126	102	24
BVC federation, community banking	12	240	240	-
IGA training to other NGOs	3	76	62	14
Orientation on biovillage model to government departments, NGO officials, bankers, students of national and international universities	32	480	158	322
Total	**138**	**2072**	**1690**	**382**

government departments: seed kits worth Rs. 0.11 lakh for backyard kitchen garden, Rs.0.24 lakh for the 10 cents fodder scheme, Rs. 0.90 lakh for goat rearing with subsidy for 15 members. NABARD supported with a grant of Rs.3.48 lakh towards a one-day awareness programme and micro-enterprise development program. NABARD also sponsored Rs.20000/- towards a meeting to deliberate on the way forward for the CBO with the participation of key stakeholders and IGS leaders.

Reaching out

A video documentary "New Voices and New Leaders" on the biovillage programme and its impact on the lives of the women in Puducherry was filmed by an intern from the SBI programme.

Bio-industrial watershed project

The bioindustrial watershed project supported by the Jamsetji Tata Trust and implemented in 5 agro-ecological regions covering 4 States has successfully completed its five-year term (2007-2012). The project has been commended by the evaluation team and has been granted an extension of 18 months as a bridging phase.

The bio-industrial watershed programme (BIWS) at Villupuram (Nallavur watershed, Karasanur panchayat) is implemented in the Vanur block and, this year, has expanded to 8 villages within the watershed boundary.

Land and water management

The community initiative to construct a well to cater to the irrigation requirements of 40 farmers that had been abandoned earlier due to practical difficulties was successfully completed this year. The revival of the construction of the Purakoil well was possible with intense discussion and planning with the community, ensuring participation. A 7-member team was set up for implementation of the work. Sustainability was ensured by the 40 benefiting farmers contributing a total of Rs. 48000, with each individual beneficiary's contribution based on the size of his landholding. With a budget of Rs.6.33 lakh, 12.48 acres of land could be brought under cultivation, and, importantly, two acres of permanent fallow land could be converted. Farmers can now go in for 2 crops: paddy followed by onion and vegetables, leading to an increased net cultivable area.

With a surface area of 70 acres, the Periya Eri (big tank) is the only source of irrigation for paddy cultivation for many farmers. However, for the last two decades, the two sluices and one weir had not been repaired, though its capacity to store runoff water has been good. The farmers lost their paddy crops during the flowering stage without the necessary critical water. With a budget of Rs. 91000/- and a contribution in kind from the panchayat to the tune of Rs. 10000/-, repair of the two sluices and weir was executed by the BIWS Committee. With equitable water-sharing measures in place, tail-end farmers also could get water. Over a 120 farmers could get assured irrigation for at least one crop and domestic and cattle needs for water could also be met.

The Perumalkulam tank located at Tiruvalluvar Nagar, the Dalit colony of Karasanur, had been renovated at the beginning of the project, leading to good recharge of the wells in the area. However, due to long neglect, most of the crumbling wells had silted up, resulting in low water storage. This year, 12 such wells belonging to Dalit farmers were taken up for renovation through the CSR project of HPCL. With each farmer contributing Rs.25,000/-, which has been deposited in the Bank for future maintenance, the 12 wells were renovated at a project cost of Rs. 12,00,000/- and already the farmers are reaping the benefits of assured water for irrigation.

A total of 90 soil samplings were collected from Karasanur and Thazuthali villages covering both wet and dry lands and based on the soil analysis, soil health cards were distributed to 90 farmers. 31 farmers undertook summer ploughing on 45 acres, while 28 farmers took up green manure application.

Sustainable farming systems

Thirty-eight farmers adopted SRI cultivation on 35.85 acres, getting a total production of 81 tonnes, with a minimum of 2025 kg and maximum of 2625 kg/acre. With initial steps to form the farmers' producer group through the support of the Training of Trainers (ToT) programme, 59 farmers holding a land extent of 56.75 acres (who were grouped into 4 subgroups) have adopted SRI cultivation.

Based on the participatory technology development approach, varietal trials were conducted on two varieties of paddy: CO-R (50), a medium slender variety, moderately resistant to blast, blight and rice tungro virus and ADT 49, a medium slender, white rice, moderately resistant to blast, sheath rot, sheath blight under artificial conditions and resistant to leaf folder and brown spot under field conditions. The grain yield obtained from CO-R (50) was 2.5 tonnes/acre, though the estimated yield was 2.88 tonnes /acre. The grain yield obtained from ADT 49 was 2.75 tonnes /acre as against the estimated yield of 3.86 tonnes/acre.

Turmeric has been cultivated on small landholdings, especially in upland areas, with open well irrigation. To revive and encourage its cultivation, a turmeric farmers' group with 14 members has been formed. They have been trained in cultivation practices and supported with a revolving fund of Rs.69,000/-.

The local Muttlur onion variety was raised on 17 acres by 27 farmers, with a total production of 45.2 tonnes. This year, an improved onion variety CO-ON-5 was introduced on 21 acres. The average yield increased to 3.6 to 4 tonnes/ acre with the improved CO-ON-5 variety, with 25 farmers adopting it on 20.25 acres, the farmers realising an income of Rs.8, 000/acre.

To support the onion farmers' group, a market survey has been completed to assess the local and export market. As a result, farmers were motivated to sell their produce directly with the formation of an ad hoc committee in the onion farmer's group, as the rate quoted by the traders fluctuated between Rs.750/- to Rs.1200/- for an 80 kg bag.

A farmer group raised groundnut varieties (JLR and JR) on 15 acres with support from MSSRF. The average yield of groundnut was 880 kg/acre. Fifteen farmers raised blackgram varieties T-9 and Nirmal-7 on 15 acres with an average yield of 475 kg/acre.

Technology and knowledge dissemination

The Karasanur VKC distributed IEC material on Muttlur onion to 41 farmers. As a pilot initiative, 15 farmers were enrolled for the voice message initiative; 25 more farmers have joined in taking note of its usefulness. As an introduction, 50 numbers of the community newspaper have been circulated in the area. A complete household survey is being undertaken. Over 100 students have accessed the VKC for learning basic computers and over 35 farmers come in regularly to read the newspaper, with the women's group using the facility to understand accounting practices.

Six members have attended a 2-week skills training programme on jute bag making at the Biocentre, conducted by NABARD, Puducherry. Five FFS programmes were completed, along with TOT farmers, for 55 paddy farmers (4 groups). The representatives from each group facilitated monitoring/training the group members on raised bed nurseries, seed treatment, IPM, INM, water management, weed management, etc.

Livelihoods

As a non-farm enterprise, a 7-member women's team was trained to upgrade their tailoring skills and they produced attractive bags from eco-friendly materials like *kalamkari.* With an initial support of Rs.30000/- for capital, the group has found success slowly through various market linkages with outlets in Chennai and elsewhere.

Off-farm efforts like dairy and goat rearing by individuals and groups is going on. On the dairy front, linkages that are more competitive are being explored.

Community institution building and networking

As part of bringing more individuals under organic SRI cultivation, farmers were motivated to form cluster/basin-wise groups. During this year, a farmers' producer group comprising 4 subgroups with 58 farmers has been formed at Karasanur while at Thazuthali, 3 groups have been formed.

As an initial step, an exposure visit was arranged to the Dharapuram, Oddanchatram and Erode markets for turmeric and onion farmers from the project villages, for them to understand the market demand for various varieties.

At Karasanur village, 9 new Women Self-Help Groups have been formed, taking the total number of MSSRF-facilitated WSHGs to 11. A majority of the women have been enrolled into the groups. A village-level federation has been formed comprising 11 SHGs. The loans given to the groups are now returned to the federation, which in turn circulates it to other needy groups/individuals.

Leverage and convergence

During the reporting year, Rs.150000/- was mobilised from the Indian Bank, Perumbakkam, as direct credit linkage for Annai Theresa SHG. The project leveraged Rs.82000/- for SRI kits and bio-fertilisers from the Agriculture Department. Rs.37, 000/- has been mobilised from the Agriculture Department for renovating paddy storage bins, with each farmer receiving Rs.1000/-. Fifty paddy farmers were able to get flood relief compensation from the Agriculture Department while 14 received relief compensation of Rs. 9000/- from the Horticulture Department. Nearly 60 paddy farmers have been enrolled for the paddy crop insurance scheme. The project linked up with the Animal Husbandry Department of Nemili for conducting a veterinary health camp and 159 cattle have been vaccinated.

Sub Programme Area 402

Semi-Arid Regions

402.1 Kannivadi

Strengthening the intra-site convergence among the different activities to achieve the overall goal of enhancing livelihood security through science- and technology-based pathways for sustainable use of the resource base (natural and human) was the priority during the year in Kannivadi.

Non-farm and off-farm livelihoods

The Kulumai SHG Federation consists of 185 groups with 2450 members, of which 94 per cent are women; most of the members are agricultural labourers and small farm holders. During this year, Kulumai Federation facilitated multiple livelihoods among its members. It provided services, such as technical, micro-financial and business development for off-farm and non-farm activities. Apart from multiple livelihoods, the Federation made possible processes related to nutritional security, sanitation, health, functional literacy, legal awareness on rights, entitlements and domestic violence, etc., for member households using its social capital. Need- and objective-based institutional linkages were facilitated with financial, academic, marketing and civil societies. Assessments on the impact of the programme at member- and group-level were completed. Using the assessment results, a strategic plan workshop for the Federation will be conducted to revisit its objectives, approaches and target themes.

Creating access to non-farm and off-farm technologies for women

Women group members were trained on using the fermenter to produce liquid formulations of *T. viride* carrier-based forms of *Verticillium leccani*, *Metarrihizium* and *Bacillus* subtilis. The production procedures were stabilised at the unit level by the group members.

The decentralised country chick production model has been customised with 20 birds with 4 production cycles in a year, with forward and backward linkages established for credit and technical inputs for buying young chicks, necessary feeds and antibiotics, as also opening up markets. The up-scaling strategy

was discussed with 118 members and the first set of training has been completed. Similarly, a model for backyard goat rearing, with 6 (5 does and 1 buck) animals, was designed and tested with one group, with technical inputs on feed and disease management. The process for strengthening the linkages is on going.

Capacity-building programmes were organised to improve feed efficiency and disease management to the members who have availed loans for dairy management. During this year, 460 women members availed loans and underwent credit-specific learning on dairy management; systems for village-level collective selling of milk and buying of inputs were developed. To further upscale and promote the self-replication of these enterprises, credit-specific learning is being mainstreamed in the Federation. Necessary learning materials on the production of 19 different bio inputs, country chick production and goat rearing have been developed in the local language, incorporating the innovative experiences of users based on available local resources.

Business development services

The Kulumai Livelihood Promotion Cell strengthened its business development services to its members by extending support on technology, input and output, and finance. Multiple market links have been adopted as a strategy and around 5000 farmers (80 per cent small and marginal farmers and 20 per cent big farmers) purchased the products. Production details include:

- 2500 kg of *Trichoderma viride*
- 900 kg of *Paeciliomyces* (Bionematicide)
- 528 kg of *Beauveria*
- 1700 kg of *Pseudomonas fluorescens,*
- 500 kg of *Bacillus*,
- 9000 kg of biofertilisers,
- 2000 kg of VAM,
- 500 cc of *Trichogramma*,
- 1800 packets of NT
- 800 bottles of *Cryptolaemus* and *Scymnus*

The annual turnover of the handmade paper unit was Rs 3.2 lakh and it generated 2400 labour days. The external audit has been completed for the business transaction and internal audit done for enterprise activities at the group level. During this year, one women's group received training and financial support of Rs 1.72 lakh from the Department of Sericulture to improve the infrastructure in the production unit and Rs 1.15 lakh to establish selling points for the products from NABARD under the rural mart scheme.

Micro financial services

The annual general body meeting of the Kulumai Federation was convened during July 2011; it passed the financial report for the year 2010-11 and approved the annual plan for 2011-12. Regular monthly meetings of the executive committee and 4 cluster meetings were organised. The external audit for 154 groups was completed which

helped the members to improve their group functioning process. On the financial side, self-sustainability helped the institution to meet 90 per cent of its annual expenses. Right now, it is availing external support to upgrade the staff's skills and ability to work on the diversified interventions.

Other services

Two legal awareness progammes was organised for the women leaders and a cell has been established by the Federation to provide further necessary support on need basis. So far, 212 women participated in the programme and 8 have availed the facility. Two health camps were carried out, in which 365 women members participated. Issues related to low body mass index (BMI), anaemia and unhygienic personal care practices, poor awareness on nutrition, etc., were taken up. As a first step towards this, nutritional literacy was carried out for 250 women members linked to their own nutrition status, especially anaemia and BMI. This motivated the members to take part in the programme and facilitated the design of household resource-based nutritional gardens. Each member participated in 3 classroom trainings, 1 field-level demonstration and 1 exposure visit to learn from practitioners. Post- intervention appraisal was carried out to assess the rate of adoption, which shows that nearly 190 members appropriated the design and species composition.

On-farm livelihoods

Reddiyarchatram Sustainable Agriculture Producers Company Limited (RSAPCOL), a farmers' producer company (FPC) registered in 2010, currently has 892 shareholders (72 per cent are men and 28 per cent are women) who are organised into 58 groups. Ten of the company's shareholders are members of the block level ATMA project management committee. Two farmers (one woman and one man) and have received the 'Best Farmer Award' for their innovative cultivation practices in paddy and tomato this year. With regard to financial self-sustainability, the institution is currently able to meet 25 per cent of its annual expenses and the rest is being leveraged from project support.

Under input services, 453 farmers availed services worth Rs 9 lakh on seeds, bio-inputs, micro nutrients and pesticides. On technical services, field-based advisories were given to 1186 farmers (76 per cent men and 24 per cent women) and 89 farmers were facilitated to do soil testing and practise test-based nutrient management. One FFS programme on maize, supported by the Department of Agriculture, was completed in which 20 men and 10 women participated. Demonstrations were carried out on precision farming in banana, pest and disease management in cotton, micronutrient management in maize, cotton, vegetables and pepper, integrated pest management in coconut, control of obnoxious weeds like parthenium, etc. Sixty master trainers and 847 farmers (492 women and 355 men) were trained on seed production technologies of three crops, with learning content through a Trainers of Training programme supported by TNAU. Twenty-six farmers (22 men and 4 women) were linked to government schemes

worth Rs 3.8 lakh; while this has been lower than previous years, it has been mainly due to the limited number of schemes extended by the government.

Under the life-long learning (L3) programme, emphasis was on credit-specific learning on technical issues through print-based courses through S*eithisolai*, web-based learning and voicemails. *Seithisolai* continues to reach 3000 farmers in the region. Each issue covers one lesson and 3 lessons constitute one module. During the year, 3 modules relating to principles and processes associated with seed production technology, livestock management, and specific seed production technologies for chickpea, lablab and paddy were covered. A total number of 2611 farmers (1041 women and 1570 men) gave their feedback and more than 30 groups discussed the content in their monthly meetings. Dynamic information as well as need-based information is regularly updated on the website: www.l3farmerstamilnadu.com. Fifteen case studies in video form were recorded on using specific production technologies to promote farmer-to-farmer learning and have been uploaded. On an average, 260 members browse the website in a month and efforts are being taken to promote its use in the villages through VKCs. About 212 granules (simple question-and-answer-based content suited for one-minute voice mode) were developed and 312 farmers have been using such mobile-based learning.

Efforts were taken to upscale the L3 initiatives among NGOs in the region with the support of commercial Banks and NABARD. Initially, 5 NGOs with 2500 members were trained to focus on credit-specific learning, with credit support being provided through Banks. Currently, 5 more potential NGOs have been selected to go through a similar approach and an orientation meeting has been organised.

Under financial services, 233 farmers (203 men and 30 women) were linked to banks this year for individual loans totalling Rs 58.25 lakh, and 6 farmers availed Rs 70,000/ from RSAPCOL. Under market linkages, a loan of Rs. 6 lakh was received from NABARD under the UPNRM (Umbrella Programme on Natural Resources Management) scheme and market links for maize and pepper were facilitated. The total transaction under this service was Rs 15 lakh. Farmers have been sensitised to sell quality products to meet the market and have developed a reliable supply base in an organised manner, starting from group, village and region. Thirty-five acres of maize and 50 acres of pepper were cultivated by 120 farmers, and RSAPCOL facilitated this service for other products too. The other major advantage was that it helped to reduce the actors in the supply chain — mostly commission agents or middlemen — which ensured correct weighment and on-the-spot payment to the farmers; profits of 20 per cent increase in maize and 15 per cent in pepper have been realised. Thirteen new farmers' clubs have been formed this year under NABARD and 2 of these are women-specific clubs. Orientation and advanced level trainings have been completed by these clubs, the focus

being on common property management and gender issues.

Discussions on risk reduction services, i.e., insurance for crops, animals and personal life cover led to 233 shareholders availing life insurance, 235 members subscribing to cattle insurance and only 5 farmers went in for insurance towards banana crop. RSAPCOL collaborated with TANUVAS in carrying out a participatory field study on the effect of supplemental mineral mixtures to enhance utilisation of nutrients in feed/fodder. Sixty-seven farmers (48 women and 19 men) participated in the study and TANUVAS is analysing the results, which will be shared with the farmers.

Community Knowledge Centres

The access to information and knowledge management is facilitated through 11 VKCs in the region focusing on entitlement schemes, improving quality of life, enhancing capabilities, strengthening livelihoods and physical infrastructure and services. A combination of modern ICTs like print, web and mobile phones (voicemail-based) is used. VKCs linked 159 men and 242 women with different schemes of the government, mostly related to social security (old age pension, widow pension, etc.) and PDS for a value of Rs. 5.3 lakh. Four training-cum-awareness programmes on women and child health were organised and 498 nutritional gardens were set up which have been regularly monitored and given need-based advisories, especially on pest management. In collaboration with the SHG federation and the Farmers' Producer Company (FPC), two veterinary camps (general camp and special camp for foot and mouth disease) were facilitated and 270 and 240 animals, respectively, were treated An ophthalmic camp through Aravind Hospitals as well as environmental awareness programmes with school children were other activities.

VKCs regularly provide ICT-enabled functional literacy to illiterate women and men; computer training is also being provided to children and youth. While promoting functional literacy, the Centres organised 44 village-level awareness meetings, reaching 402 adults (75 men and 327 women). Towards this, 271 generic learning contents were prepared in a gender-sensitive manner.

Under the strengthening livelihoods component, VKCs provided need-based local information like market prices, input prices, weather forecasts, agriculture and livestock advisories, etc. Integrated agro advisories have been regularly developed in English and Tamil and disseminated as part of the agro-meteorological field unit of Kannivadi. This has been uploaded on to the website of India Meteorological Department. Yield forecasting for rice and maize was undertaken in 5 districts (pre-sowing, flowering and pre-harvesting phases); statistical analysis using crop yield data considering four weather variables (maximum and minimum temperature, rainfall, morning and evening relative humidity) simultaneously was carried out. Long-term weather conditions (1985-2011) and historical crop yield data (1985-2010) were utilised in the model. This technique included the

development of suitable weather indices based on weekly weather data of both *kharif* and *rabi* seasons, which were substituted in the regression equation to develop crop yield forecasts.

In the current year, 114 gender-differentiated need assessment meetings were carried out among different sections of the community. A total of 11298 men and 10691 women accessed the Centres, of which 6 are located in exclusive Dalit hamlets/colonies.

Discussions have been on going regarding the sustainability of the Centres, but the progress is slow. The executive committees of the two grass-roots institutions have agreed to look into the issues to evolve village-based strategies.

Community banking

The release of the first instalment amount of Rs.379500/- from Asia Initiatives to RSAPCOL towards infrastructure support in Kannivadi is under process.

402.2 Pudukottai

The Bio-Industrial Watershed Programme (BIWS) in Pudukottai, Tamil Nadu is being implemented in the Ennai, Thalinji and Kadavampatti panchayats of Illupur taluk in Pudukottai district.

Land and water management

MSSRF's efforts to conserve water and soil through various measures by ensuring participation, equity and sustainability has been recognised by the Ministry of Water Resources, Government of India, and the project has been awarded the Groundwater Augmentation Award for the southern region.

Karunkulam rain-fed tank rehabilitation

With a command area of 17 acres, the Karankulam tank is the only source of irrigation for 49 farming families living in the Keela Ennai and Ennai panchayats. The work of desilting and deepening of the tank, construction of weir and repairing of a sluice was undertaken following the norms of participation, planning and contributions, with the Water Users' Association mobilising Rs.55000/- as contribution. The completed work has helped in increasing the waterspread area by about 6280m^2**.** The increased water storage has helped to reduce the water-lifting cost of Rs.21600/- which the farmers would have had to bear for pumping out water from the tank. The agricultural yield has now been enhanced from 20 bags/acre (340 bags/17 acres) to 25 bags/acre (425 bags/17 acre), as the farmers are able to transplant on time with adequate water availability. In economic terms, the Karunkulam farmers earned an additional income of Rs.81000/- per annum from an increased yield of 5.5 tonnes. As the result of partial modernisation, each farmer earned an additional income of about Rs.6 030/-.

Thattankudi agriculture open well

A common agriculture well was planned for 16 Dalit families of Thattankudi who were forced to leave their meagre landholdings fallow due to lack of water and migrate to distant places in search of livelihoods. With the excavation

of the well completed, a demonstration plot on 70 cents has been developed as an integrated farm with over 400 horticulture and forest tree species. Intercropping with vegetables and pulses will ensure income and food security. The community is also being encouraged to cultivate kitchen gardens to cater to their food and nutrition needs.

Thiruvennakulam rain-fed tank rehabilitation

The water users of Thiruvennakulam approached MSSRF to rehabilitate the tank in their village; with a waterspread area of 42 acres, it could not be used to sufficiently irrigate 47 acres of land belonging to 41 farmers because of the damaged weir, broken sluice and accumulation of silt. The users, being mostly small and marginal farmers belonging to the SC community, agreed to form a Water Users' Association and contributed 10 per cent of the total project cost of Rs.600000/-. Work on rehabilitating this tank is in process, with the community cleaning up the bunds and the repair work of the sluice and weir reaching completion.

Soil analysis

A total of 678 soil samples and 55 water samples have been collected over a period of 5 years from various habitations of the BIWS area. All the collected soil samples were sent to the lab at MSSRF, Chennai for analysis. This year, 192 soil samples from this site were analysed for physical and chemical properties and organic carbon. A total of 191 soil health cards were distributed in 2012.

Sustainable farming systems

Three critical farming issues affecting agricultural productivity in paddy were identified, with hypotheses framed for the participatory technology development (PTD) process: a) poor plant growth due to acidity of soil and whether application of organic inputs can support in maintaining the pH between 4.9 to 5.9 due to aeration and moisture; b) the scarcity of water in the critical period of planting and if SRI can help the farmers with one cultivation with the water available in their respective tanks; and c) the indiscriminate use of inorganics, which can be stemmed with the local production of bio-inputs using available biomass, as beneficial insects are not eliminated. The external agency Kudumbam has been working with the project staff and community for two seasons from 2010 to facilitate this PTD process. This year, 4 Training of Trainers and 6 Farmers Field School programmes were conducted in 4 villages — Neivaipatti, Thalinji, Keela Ennai and Pattiyan Street. At all the sites, an average of 6 classes was conducted with 18 trainers. Demonstrations of organic input preparation and SRI technology were held regularly.

The FFS farmers also practised organic rice cultivation through SRI methods in an area of 20 cents to 1 acre in their fields, which helped the farmers to be more conversant with the technologies they learnt in the FFS classes. They were trained and helped to collect data on cultivation expenses, yield and income, and document the same in the farm registers. The data were analysed and conclusions drawn. The FFS farmers were also evaluated by

resource persons from Kudumbam. Of the 105 farmers trained, 31 lead farmers have been identified as trainers, who are now conversant with the effects of climate change and are knowledgeable in sustainable agricultural practices/technologies and in adaptation strategies.

Varietal trial

During the focused group discussions with the farmers, the rain-fed paddy farmers voiced their concern about the loss of crop due to climate variations, especially due to poor or nil rainfall in the months of December and January. To overcome this, a drought-resistant paddy variety that could withstand drought during the critical crop stage was identified in consultation with the Aduthurai Rice Research Institute and the Anna 4 rice variety, released in 2011, was introduced in the area. The farmers were trained in biometric observations, mainly to observe and record the performance of the variety with regard to productivity, drought tolerance and duration. On a pilot basis, 4 farmers cultivated Anna 4 on 2 acres. The results were encouraging, as the harvest was good, though the monsoon failed and there were no rain spells during December and January. An evaluation of the Anna 4 paddy variety showed that productivity was on the higher side with 3.5 tonnes/ha, the plant was erect with no lodging, it was drought tolerant, suitable for September-October sowing and milled well, with less broken rice.

Technology and knowledge dissemination

The Village Knowledge Centre co-ordinated the PTD process in Thalinji. It also conducted 18 health camps and 2 animal health camps. Eleven persons (including 5 women) received certificates in basic computer education and of the total 127 illiterates in the village, 86 achieved the status of neo literates. The VKC supported 176 (including 51 women) access their entitlements.

Under the VKC Committee management this year, the total net profit through custom hiring of farm equipment was Rs.34400/-.

Livelihoods

Animal rearing, especially dairy, has been identified as an important off-farm livelihood in this area. Towards this, 3 milk collection centres have been established at Thalinji, Ennai and Meyiagoundanpatti, where nearly 100 women sell milk in bulk with a tie-up with Krishna Dairy for skill development and technical support. The business is managed by Komatha Milk Producers Association, which is the business wing of the Rural Women Entrepreneur Federation (RWEF). Training and orientation for the staff of the milk collection centre was organised to reinforce the objective of the dairy unit and to enable them to understand the organisational structure for effective business management.

The streamlining of the milk collection centre and market tie-up has helped the women being paid a fair price and on time; the impact of this can be assessed by the fact that in a month, RWEF has a turnover of over Rs.94000/- and deals with 5549 lts.

This year, the project facilitated credit support to 42 women towards purchase of milch

animals and 36 women for sheep rearing. The women have been trained in animal health and feed management, with RWEF playing an integral role in the process.

Towards integrating horticulture with livestock and water harvesting, 20 Dalit families in the Pudukottai NICRA project area received dairy loans. A common well was dug to provide water for their 20 acres of rain-fed lands. Horticulture plants were supplied from the Department and the water-harvesting structure was set up with funds from HPCL, while the intercropping with blackgram and staff support is from the ICAR project. This model will be replicated in other farmer's fields, covering about 50 acres in the ensuing season.

Community institution building and networking

Initial work towards federating the SHGs in the BIWS area has resulted in the Rural Women Entrepreneur Federation, a structure consisting of 24 WSHGs with a membership of 344 women, operating in space provided by the Ennai panchayat at Meiyagoundanpatti. RWEF has a revolving loan capital of Rs.1274000/- and a monthly income of Rs.12000/- from revolving loans. This amount is augmented through the sale of milk and cattle feed. The Federation in its initial stage has identified two enterprises — milk and gem cutting — for collective production and marketing with technical, credit and market support for its members.

RWEF is also supporting 15 women from Thattankudi and Neivaipatti hamlets to establish nutrition gardens in their backyards.

Agri-producer organisation

With the aim of bringing around 300 farmers into an agri-producer organisation to take advantage of collective marketing, an initial value analysis of paddy and pulse supply chains was conducted by an external agency, ALC from Hyderabad. As a first step, village-level orientations are being carried out and so far, 10 villages have been covered with an enrolment of 120 members.

The agri-producer organisation has embarked on a mission to convert temporary fallow land into productive land and has initiated model farms of 10 acres by planting diverse tree crops, pulses and vegetables.

A total of 98 men and 497 women have undergone capacity-building training this year in a wide variety of areas like SRI, vermicompost, operation of SHGs, varied micro-enterprises, soil and water conservation techniques, etc.

Convergence and leverage

The BIWS project continues to leverage and converge with relevant line departments. This year it has leveraged Rs.267340/- from the State Agriculture Engineering, Agriculture, Forest and Horticulture Departments as well as from other sources. The rehabilitation of various water-harvesting structures has been made possible, apart from the project funds, with the community contributing 6 per cent and the Agricultural Engineering Department 31 per cent of the total work.

Sub Programme Area 403

Hill Regions

403.1 Koraput

The bio-industrial watershed programme (BIWS) in Jeypore, Koraput, is implemented in the Tolla watershed area comprising 7 villages.

Land and water management

The Ministry of Water Resources, Government of India has recognised MSSRF's work in conserving water and soil through various measures that ensure participation, equity and sustainability with the conferment of the National Water Award (2010).

Several water management measures were undertaken this year. The water-harvesting structure constructed at Boliguda covered 658 sq.m, with 46 acres of catchment area. A total of 22 small and marginal farmers were able to cultivate paddy and vegetables, and an additional 30 were able to use it for domestic purposes. Though the seepage was high in the first season because of it being a new structure, the farmers were able to irrigate their crops despite the low rainfall of 1069 mm from the south-west monsoon. The work generated 1184 work days, with the community contributing labour worth Rs. 20280/-.

A farm pond of dimension 50'x50'x8' was constructed in Tolla village servicing 2.85 acres land belonging to 3 farmers. This has ensured 20 per cent increase in productivity with assured irrigation facility. The farmers contributed Rs. 2100/- and the project spent Rs. 16560/-, with 184 workdays.

A defunct community tank was renovated at the cost of Rs. 37427/- with community participation and contribution equivalent to Rs. 3600/-. The water storage capacity of the tank has increased to 1860 cu.m and in addition, groundwater has been recharged in the downstream wells. There has been an increase in moisture content too. The farmers could cultivate paddy, millets and vegetables (onion and tomato) on 7 acres during the *rabi* season. Four acres of fallow land were brought into cultivation with assured irrigation for *kharif* planting. The farmers also took up pisciculture, getting an additional income of Rs. 3000/- .

During the year, 9 open wells were constructed with a labour contribution of 42 workdays per well by 23 farmers. As a result, 29 acres of land were brought into cultivation of vegetables like chilli, brinjal, spine gourd, pumpkin, onion, etc. Not only has the food security of the community increased through domestic consumption, an additional income of Rs.1500/- to 2000/- has accrued through the sale of the vegetables. Currently all the wells have water even during the summer. A GIS-based map has been developed, projecting irrigation through wells and its intended benefits.

As the Tolla watershed area has an undulating topography, field bunding and contour bunding with turfing were taken up as a soil conservation measure on 4 acres belonging to a farmer from Pukaguda village. He was able to successfully cultivate *ragi* (finger millet) on 2 acres and niger

in the remaining 2 acres, obtaining an yield of 4.5 quintals of *ragi* and 215 kg of niger.

This year, compartmental field bunding was completed on 20.70 acres, helping 11 farmers. A total of 856 workdays was generated and 58 acres of wasteland could be brought into cultivation in the *kharif* season. Millets, maize, horsegram, niger and vegetables were cultivated, bringing an increased income of Rs. 3500/- to 5000/- per acre.

Contour trenches were introduced as a soil conservation measure in the village of Pukaguda. Trenches of 20 ft x 3 ft x 3 ft were dug in two rows in a staggered manner; and during the year, 22 trenches were completed covering 8.9 of acres land benefiting 13 farmers generating 70 days of employment.

Four rock-filled check dams were constructed, benefiting 14 farmers covering 12 acres and generating 47 days of employment. About 2 acres of land that had been affected by severe erosion was also brought into cultivation with millets in the *kharif* season, with the farmers seeing an increase in income by Rs.3000/- per acre.

Summer ploughing to minimise the weeds and harmful insects continued this year with 91 farmers working on 158 acres, using bullocks and tractors.

A total of 393 soil samples were collected from 130 farmers and tested for soil nutrients; soil health cards were simultaneously developed and recommendations provided to the farmers, based on the analysis carried out.

As part of wasteland reclamation measures and avenue plantation, 4000.saplings of *Simarouba*, *Peltophorum*, *Neem*, *Pongamia*, *Samanea saman*, *Cassia siamea*, *Gliricidia*, etc., were planted in the watershed region. With a survival rate of over 80 per cent, the efforts at re-greening the area has been successful.

Sustainable farming systems

Groundnut cultivation is now an on-going activity, with 90 farmers cultivating it on 102 acres in Tolla and Boliguda villages. With an average yield of 7 quintals/acre and a selling price of Rs. 30/- to 38/- per kg, farmers are getting a return of Rs. 22000/- per acre, realising a net profit of Rs. 10000/- per acre. A buy-back agreement of groundnut seeds with the Seed Corporation of the Government of Odisha was set up and seed production with breeder's seeds has been introduced on 32 acres of land, covering 34 farmers of Boliguda village. Since the State Seed Corporation purchased these seeds, the farmers were able to get a higher price as compared to local market sales, leading to tripling of income.

Hybrid maize (*CP-818, Juari*) introduced on 8 acres in 2009 increased to 52 acres in the *kharif* season with 42 farmers being involved. This year, as result of a demonstration of cultivation of *Juari* hybrid maize on 5 acres with participation of Tolla and Maliguda farmers, a yield of 30,000 cobs/acre was obtained as also an income of Rs. 15000/- to 17000/-acre through the sale of green cobs in the local markets.

Pipla cultivation has increased from 3 acres (5 farmers) to 16 acres (16 farmers), with an income increase from Rs. 20000/- to 150000/- per acre. Value-chain analysis of *pipla* from production (farm-level) to market was conducted. The project promoted cultivation of intercrops like papaya, chilli, cucurbits, root crops, beans, etc., during the gestation time to sustain the lean period.

Introduction of improved *ragi* varieties like Neelachal and GPU resulted in significant yield increase from 1.5 to 4.5 qtl/acre and an income enhancement between Rs. 1500/- to 2000/- per acre. Through seed exchange with local varieties as well as farmer-to-farmer exchange, the area covered with improved *ragi* varieties has gone up to 82 acres from the initial meagre 8 acres.

The cultivation of pulses like blackgram, greengram and Bengal gram is being promoted among small and marginal farmers; the acreage under pulses presently has increased from 5 acres to 25 acres in Tolla and from 2 acres to 6 acres in Boliguda. In addition, seed production of blackgram and greengram of *Prasad* and *JB* varieties was taken up in 40 acres in Tolla and Bebartaguda. The yield of blackgram and greengram ranged from 3-4 qtl/acre, which were sold at Rs. 38/- kg in the local weekly market.

Mixed cultivation of vegetables, such as cauliflower, cabbage, potato, chilli, brinjal, spine gourd, etc., continues to be successful, with 50 farmers working on 72 acres of land and obtaining additional income of Rs. 10000/- to 15000/- per acre. The farmers of Maliguda village have adopted such mixed vegetable cropping and have enhanced their income significantly, mainly during the *rabi* season.

Use of the drum seeder for paddy line sowing has helped in increasing the yield to 9-11 quintals/acre, particularly on the high lands; earlier, the conventional method could yield only 6-7 qtl/acre.

To reduce labour cost and drudgery, farm equipment like hand-operated paddy winnowers (11), hand compression sprayers (3), hand-operated groundnut decorticators (2), water pumps and garden tools (5) were purchased for farmers groups with a 50 per cent subsidy from the Agriculture Department.

Technology dissemination

Pamphlets on the cultivation of millets, maize, groundnut and *pipla* were printed in Odiya and distributed to farmers and also displayed at VKC Tolla for information dissemination. Posters on cultivation packages and techniques of various crops were also displayed at VKC. Video documentation was completed on soil and water harvesting, conservation measures and vegetable cultivation. A total of 35 schoolchildren of Tolla and Bebartaguda take tuition classes at VKC in the evening hours regularly.

Livelihoods

Backyard poultry farming was introduced mainly for the poor and landless community of the watershed area, with the Banaraja breed identified as the most suitable. With an

investment of Rs.55/-, the farmers could sell the live birds at Rs. 400/- to 500/- making a profit of about Rs.400/- per bird.

Goat and sheep rearing were taken up during the year by 108 members from 9 SHGs, with 324 sheep and 46 goats bought by the members. This activity has helped the families to obtain additional income to the tune of Rs. 3000/- to Rs.4000/- per family /year from a unit size of 4-5 animals.

The collection, value addition and marketing of non-timber forest produce saw a big jump this year. The tamarind collection and marketing unit increased its membership from 11 to 87. With a tie-up with the Forest Department for marketing, each member is able to get an additional income of Rs. 2500/- to 5000/- every season. The sal (*Shorea robusta*) flower collection unit has also seen an increase in members from 18 to 30, who were able to get an additional income of Rs. 300/- to 500/- person during the season. Similarly, membership of the *kendu* (*Diospyros melonoxylon*) leaf collection group has gone up from 86 to 106; for a seasonal activity of 10 to 20 days in a year, the increase in income has been Rs. 2000/- to 3000/- per person. Fourteen SHG members are engaged in the collection, grading, processing and marketing of cashewnut for 30 to 40 days in a season and get an additional income of Rs. 6000/- to 9000/- per season. Training was provided to 79 individuals in the collection, grading, processing, value addition and marketing of wild mango. As a result, their income has doubled from Rs. 500/- to 1000/- per person in a season. Fifty per cent of the mangoes are used for domestic consumption.

Thirty women are involved in making plates by stitching together leaves of *Siali* (*Bauhini vahlii*); a local market tie-up at Boipariguda was organised by the project and they are able to get an additional Rs.8000/-.

The main objective of the community unit engaged in producing mushroom spawn is to supply quality spawn of paddy straw and oyster mushroom to the tribal farmers, entrepreneurs and SHGs at affordable prices. The technical knowhow on mushroom spawn production was obtained from the Centre for Tropical Mushroom Research and Training (CTMRT) of the Orissa University of Agriculture & Technology (OUAT), Bhubaneswar. A tribal belonging to the Kandha community was trained in the production of spawn using the facilities available at the Centre. A total of 800 bottles of paddy straw and oyster spawn were produced during the year on a pilot basis and supplied to more than 18 farmers across 7 villages for commercial production of mushroom at the village level. Each bottle of spawn was sold at Rs. 10/- on a no-loss no-profit basis, with an accrual of Rs.6000/-. A mushroom production shed was constructed at MSSRF, Jeypore to evaluate the performance of the spawn and to demonstrate the commercial cultivation of paddy straw and oyster mushrooms. A process is on to establish a low-cost mushroom spawn production unit in tribal villages in the Jeypore region.

In collaboration with the State Fisheries Department, 8000 fingerlings were introduced (Catla catla, silver carp, grass carp, bhakur,

etc.) in the water bodies of the area and fish worth Rs 25000/- was sold in the markets, apart from domestic consumption. Seven SHG members have been facilitated to take up vegetable vending and now they are getting a regular income of Rs. 2000/- a month. As an off-farm activity, tailoring classes were conducted for 20 school dropouts; now the trained youth are able to earn Rs. 200/- to 300/- a day during the weekly market days.

Community institution building and networking

A farmers' cooperative is being formed according to the by-laws of the Odisha Co-operative Act 2001 with 162 farmers from 6 villages as members. The initial survey has been completed. Five groups have been registered as Farmers' Clubs with the objective of providing easy access to crop loans at minimum interest, financial support for infrastructure development, support for training, exposure and financial support for office management from NABARD. Thirteen women SHGs consisting of 152 members have been formed with initial credit and savings activity and appropriate livelihood support. Training has been provided for conducting regular monthly meetings, maintenance of books and records, and timely repayment of loans. A District Advisory Committee has been set up in the Tolla watershed area, and it has met twice so far.

Leverage and convergence

The BIWS project has leveraged funds to the tune of Rs.95.33 lakh for soil and moisture conservation measures and Rs.63.70 lakh for infrastructure development besides subsidies of Rs. 4.20 lakh to the SHGs.

Sub Programme Area 404

Land-Lab-Land Linkages

The IPM laboratory at Chennai focused on the following:

- Biological control of citrus mealy bug *Planococcus citri*, using entomopathogens, *Lecanicillium lecanii* and *Metarhizium anisopliae* and botanicals
- Production and quality control of entomopathogenic fungi, *Beauveria bassiana* using different grains
- Mass multiplication of biologicals (egg parasitoid, predators and entomopathogens)
- Effects of organic amendments on paddy soil health
- In-depth soil analysis to check physical, chemical and biological properties
- Training programmes on INM and IPM to the farmers in the target sites

Biological control of citrus mealy bug using entomopathogens and botanicals

The citrus mealy bug, *Planococcus citri* is a polyphagous insect which causes severe damage in citrus, cocoa, coffee, grapevine, etc., and has developed resistance to a major group of chemical insecticides. Though there is a wide array of strategies to manage the

pest, entomopathogens are highly preferred due to their specificity, less effect on useful insects, no harmful effects on humans, other vertebrates and the environment. Hence in the present study, experiments have been carried out to elucidate the insecticidal properties of *L. lecanii*, *M. anisopliae*, neem, Pon Neem (pongam and neem) and extracts of *Morinda citrifolia* under laboratory conditions.

The third instar larvae of *P. citri* were tested with 4 different concentrations of *L. lecanii* and *M. anisopliae*. The larval mortality (per cent), larval length (cm) and larval weight (mg) were recorded. The recorded data revealed that all treatments resulted in low population than the untreated control.

Lecanicillium lecanii

Larval mortality: Among the 4 concentrations tested in this study, the highest mortality was noticed in 10^{-4} spores/ml with 40 per cent at 72 hours after treatment, which was followed by 10^{-8} spores/ml with 36.7 per cent. However, mortality was the least in untreated control with 3.3 per cent. The resulting death occurred since the hyphae bodies spread throughout the insect and obtained nutrients leading to the death of the host by starvation.

Larval length and weight: Larval length was more or less similar in all the treatments, which ranged between 0.23-0.25 cm and for the control, it was 0.25 cm throughout. Reduction in the larval weight was observed at 72 hours after treatment, and ranged between 2.33-2.5 mg except in control, which showed the highest, 0.26 mg.

Invasion of the fungi: In order to confirm the death of the mealy bugs because of the fungal attack on their surfaces, 3 to 4 cadavers of the infected mealy bugs were transferred and inoculated into PDA medium. After 4 days, growth of *L. lecanii* throughout the petri plate confirmed its infestation.

Metarhizium anisopliae

Larval mortality: Bioassay against *P. citri* revealed least mortality in 10^{-2} spores/ml (10 per cent) after 48 hours, while the highest mortality was observed in 10^{-4} spores/ml, with 46.7 per cent mortality 72 hours after treatment.

Larval length and weight: There were no significant difference in lengths, which ranged between 0.18 and 0.22 cm and those in control recorded the highest with 0.25 cm. However, their weights showed some notable reductions to as low as 2.36 mg at 10^{-8} spores/ml after 72 hours of treatment.

Efficacy of botanicals on P. citri

Six botanical products, i.e., Vijay Neem, Neem Gold, Pon Neem, extracts of *M. citrifolia* in hexane, dichloromethane and petroleum, were tested. Each treatment was replicated thrice and the per cent mortality at 24 hours interval up to 3 days was recorded. Six per cent Pon Neem after 72 hours was the most effective treatment with 96.7 per cent mortality, followed by Neem Gold (800 ppm) with 56.7 per cent reduction. Dichloromethane, hexane and petroleum ether extracts of *M. citrifolia* showed little reduction in *P. citri* population. Four per cent petroleum ether extract and 8

per cent hexane extract showed 33.3 per cent mortality 48 hours after treatment.

Synergistic efficacy of fungus and botanicals

M. anisopliae and Pon Neem gave significant mortality in the mealy bug population. Hence, their synergistic activity was observed against *P. citri*. *M. anisopliae* at 2.5 x10^2 spores/ml plus 1.4 per cent Pon Neem gave 100 per cent mortality in 48 hours after treatment under laboratory conditions, which was followed by 2.5x10^2 spores/ml plus 1.6 per cent concentration.

Production and quality control of entomopathogenic fungi using different grains

The nutritional status of different grains used as substrate for the growth of *B. bassiana* was determined**.** Parameters like total sugar, reducing sugar, total protein and crude fibre content were analysed. From the results obtained, it was found that total sugar and reducing sugar were maximum in rice and minimum in finger millet. Protein and crude fibre were maximum in barley, followed by finger millet.

The present study was undertaken to examine the effect of the growth of *B. bassiana* on different grains (rice, barley and finger millet) soaked in hot and cold water. Fifty grams of different grains were washed and subjected to different soaking conditions for 10 minutes, after which the grains were air dried and autoclaved at 15psi for 1 hour. After cooling, 0.5 ml of 1.5 x 10^6 spores/ml concentration of spore suspension was inoculated. The fungus was allowed to grow in the grains for about 10-15 days. Qualitative and quantitative parameters like biomass (g), moisture content (per cent), conidia/ml, spore germination (per cent) and biochemical parameters like sugar, total reducing sugar, total phenol and total protein were then evaluated.

Among the different grains, the maximum biomass of fungal growth was noticed in rice soaked in hot water (29.45 g), followed by rice soaked in cold water (21.90 g), while it was least in finger millet soaked in cold water (0.76 g). From the results, it was observed that the variations between the treatments were significant. The maximum sporulation of fungus viz., conidia/ml, was seen in rice soaked in hot water (6 x 10^6) following the same pattern as that of biomass, while the minimum sporulation was recorded in finger millet (1 x 10^6). The moisture content was maximum in barley soaked in hot water (5.72 per cent) and minimum in rice (3.53 per cent). The results of spore germination were also found to follow the pattern of results obtained in conidia/ml, starting with the maximum in rice (43.6 per cent) and minimum in finger millet (20 per cent), with all other treatments as intermediate.

Mass multiplication of biologicals

The multiplication of egg parasitoid *Trichogramma chilonis* was continued for laboratory experiments. The promising entomopathogens viz., *Beauveria bassiana, Metarhizium anisopliae, Verticillium lecanii, Nomuraea rileyi* and *Paecilomyces lilacinus*

were also mass produced, using different locally-available low-cost substrates.

Soil analysis

In all, 398 soil samples from various field sites and headquarters — Puducherry (90), Pudukottai (192) and Kannivadi (115) — were analysed for physical, chemical properties and organic carbon. Liquid samples from MSSRF, Chennai were analysed for total N, P and K.

Training programmes on INM and IPM

In-depth training to women and men on IPM and eco-friendly management of pests and diseases in plantation crops was organised. The management of major and minor pests on paddy as well as an integrated approach to manage the pests was demonstrated. Setting up bird perches and preparation of botanical repellents were activities that were of interest to the farmers.

Sub Programme Area 405

Climate Change Initiatives

A new project supported by ICAR's National Initiative on Climate Resilient Agriculture (NICRA) on vulnerability assessment and evolving adaptation strategies for climate-resilient agriculture in semi-arid regions of Tamil Nadu and Puducherry was initiated in January 2012. It is being implemented in 3 villages in Puducherry and 5 villages in Pudukottai under the BIWS programme.

As the first step, training in participatory vulnerability and adaptive capacity has been conducted for the project staff. Vulnerability and adaptive capacity assessment methods and tools have been developed and tested in the field. Baseline surveys using interview schedules to understand the socio-economic conditions and agriculture practices including productivity among the farming community have been carried out.

The project villages were selected and farmers identified through awareness meetings. Five farmers' groups in Puducherry and 8 farmers' groups in Pudukottai were formed and linked to NABARD. Each group consists of 12-18 farmers on an average, of which about 25 per cent are women farmers. The Farmers Field School (FFS) approach was adopted with 40 farmers participating in the exercise. The trials in Puducherry began in March 2012 — rather delayed, as the farmers were agitated in not receiving relief compensation for crop loss suffered due to cyclone *Thane* in the previous season.

As earlier reported under **SPA 401.2 Puducherry** and **SPA 402.2 Pudukottai**, the rice varieties Anna 4, ADT 49 and CO (R) 50 were found to be drought tolerant and pest resistant. The farmers co-opted into this project have decided to continue with the 3 varieties in the next season with more farmers joining in over additional acreage.

Programme Area 500

FOOD SECURITY

There have been two important developments in the Food Security Programme Area. One was an integrated community-centered approach to address hunger- and malnutrition-related issues in the Koraput district of Odisha through volunteers from within the village community designated as Community Hunger Fighters. The other was an invitation from the Ministry of Rural Development, Government of India, to strengthen and expand the ongoing Mahila Kisan Sashaktikaran Pariyojana (Programme for the Empowerment of Women Farmers) in the Wardha and Yavatmal districts of Vidarbha.







Ensuring food and nutrition through skill and capacity development and empowerment of women farmers

Programme Area 500

Food Security

MSSRF's programme on food security has two major elements: community-based interventions and research. The former focuses on promoting household food security among the socially and economically deprived sections in society and the latter concentrates on developing research reports to provide a macro perspective of the country's food security concerns. Systematic assessment through research and analysis is an integral part of the work that helps to critically reflect on and strengthen community-based interventions.

The Food Security (FS) programme area activities are under the aegis of both the B. V. Rao Centre for Sustainable Food Security and the Ford Foundation Chair for Gender and Food Security. Pertaining to the activities of the Ford Chair, two advisory committee meetings were held in August 2011 and April 2012 to review the work and to guide the programmes forward. An analytical pharmacognosist, an expert in quality control of medicinal plants, including those used in the Ayurveda, Siddha and Unani systems of medicine and in developing standards for drugs prepared from them, has been inducted into the advisory committee. The discussions at these meetings related to three main areas: undertaking research on gender relations at the household level, The Healthy Child action research project and The Community Hunger Fighters' training programme. The suggestions that emerged during these discussions were useful in planning and implementing all activities. A participatory workshop was organised in January 2012 for the FS team members of Odisha to gain conceptual clarity on monitoring and evaluation, sustainability of projects and gender mainstreaming. The team did a critical appraisal of the work done so far from the sustainability and gender perspective angles and developed indicators for monitoring.

Sub Programme Area 501

Community-based Interventions

501.1 Maharashtra

Mahila Kisan Sashaktikaran Pariyojana (Programme for the Empowerment of Women Farmers), Vidarbha

The Ministry of Rural Development (MoRD) has accepted a proposal submitted by MSSRF to strengthen and expand the ongoing Mahila Kisan Sashaktikaran Pariyojana (MKSP) in the Wardha and Yavatmal districts of Vidarbha, for a period of three years, till November 2014.

MKSP has three focal themes: institution building, sustainable agriculture, and household food security. Facilitating access to eligible entitlements is a cross-cutting activity across these themes.

Institution building

During 2011-2012, new groups have been formed taking the total coverage to 90 women

farmers' groups and 1421 women farmers across 56 villages in Wardha and Yavatmal districts. Administrative and accounting skills have been imparted to the group members through a series of trainings. In addition to this, women farmers are trained on skills for engaging with officials and effecting linkages with line departments and other institutions. Awareness camps on different socio-political rights and issues are also an important part of capacity building. An indication of increased levels of awareness and empowerment among members has been the instance, during the Gram Sabha held in April 2012, of the women farmers' group from Amboda village raising the matter of non-issuance of job cards under MGNREGS,

The ultimate goal of the programme is to empower women farmers through creating an autonomous federation which will function independently to serve the needs of its members and enable them to get the benefit of all the schemes for improved farm and non-farm livelihoods. Towards this, 20 village-level awareness meetings and discussions were conducted at the group level on the need for a federation, the services that a federation can offer and the potential benefits of being part of a federation. In addition to this, 6 cluster-level orientation and discussion meetings (attended by 165 women farmers) on the roles and functions of a federation were organised.

Three *Mahila Melawa*s — forums where women farmers interact with one another and share experiences — have been conducted this year. A total of 442 women farmers representing different groups participated in the *Melawa*s. External resource persons with experience in the field of health, agriculture, local governance and social activism were invited to interact with the women farmers.

Induction of community resource persons (CRPs) and village resource persons (VRPs) into MKSP is seen as an important measure for the scaling up and sustainability of the programme. Identification of CRPs and VRPs were done in a participatory manner. For every 3 or 4 contiguous villages, one CRP has been identified while every village has one VRP. Eighteen CRPs and 56 VRPs have so far been identified. CRPs and VRPs are highly motivated, enterprising women farmers who receive intensive training in areas related to institution building, sustainable agriculture and food security. They are expected to share their knowledge, gained through the capacity-building exercises as well as practical experiences in field-level implementation of technologies, with other group members and act as catalysts of change and mentors in the project area. The experience they will gain over the years in grooming the women farmers' groups will help them emerge as leaders and office bearers of the proposed federation. Developing CRPs and VRPs is an important step towards making the programme sustainable.

Table 5.1 sets out the details of the institution building initiative.

Table 5.1 ***Institution building initiatives in MKSP, 2011-12***

Activity	No. of sessions	No. of farmers covered
Formation of women farmers' groups	27	447
Training on record keeping	26	438
Training on interface skills	6	132
Mahila Melawa	3	442
Awareness on local self-governance	18	546
Awareness and orientation on the importance of federation	26	445

Sustainable agriculture

Women farmers are trained on a host of sustainable agricultural practices, ranging from soil and water conservation and land preparation to post-harvest seed selection and storage, using different pedagogic methods like learning-by-doing and learning-by-seeing. Learning-by-doing involves training and demonstration on various components of sustainable agriculture: soil health management, soil and water conservation, promotion of low-cost external inputs for pest management, and crop nutrient management. Learning-by-seeing includes exposure to best practices in the field.

As in previous years, *Van bhojan* (community lunches) were organised in the fields of women farmers who have adopted some of the best practices advocated under sustainable agriculture. Van bhojans also serve as forums for raising common concerns and for general sharing of experiences.

A visit to the Regional Organic Farming Centre, Nagpur, was organised in January 2012 for the staff, community resource persons and members of women farmers' groups. The 31 women farmers who participated learnt about off-farm enterprises such as the manufacture of different kinds of bio-fertilisers, their benefits, the precautions to be adopted in using them, and where to source the mother culture.

Ninety-three members from 10 women farmers' groups went on an exposure trip organised by the Department of Agriculture to a progressive farmer's field, followed by a visit to a soybean processing unit and another establishment where vegetable cultivation is carried out in a greenhouse.

Cluster-level trainings were organised for 180 women farmers on seed management and integrated nutrient management at the fields of model farmers, Ramesh Sakharkhar and Subhash Sharma, at Bhilli and Tiwasa villages, respectively.

Soil testing was facilitated for 412 women farmers through collecting and sending soil samples for analysis to the soil test lab at the Panjabrao Deshmukh Krishi Vishwa Vidyalaya (PDKV), Akola and through mobilising the IFFCO mobile soil test van. Soil health cards with appropriate soil health management recommendations have been given to the women farmers. Further efforts are on to facilitate collective purchase of fertilisers (chemical and non-chemical) so that the right kinds of fertilisers are available in the right quantity at the right time during the crop

season. During April 2012, about 231 soil samples have been collected and sent for analysis.

Graded bunds have been built in the fields of 26 women farmers in 82 acres of land, with the longitudinal grade demarcated by external resource persons. Necessary implements for making the bunds were also made available to the farmers.

Knowledge connectivity has been facilitated through agro-met advisories (to plan weather-based farming decisions) and relevant information provided on market prices and crop management practices. Phone-in programmes and helplines are other interventions planned to help women farmers access expert advice on issues relating to their lives and livelihoods. This year, the mobile numbers of 187 women farmers have been added for receiving 2 voice messages per day. One phone-in-programme has been conducted during April 2012.

Necessary groundwork towards establishing a community training centre as well as a common facility centre has been carried out during the reporting period. Common facility centres are designed to serve as custom-hiring centres for basic agricultural implements, which have been identified through a survey conducted among the women farmers. Common facility centres are planned in Lonsawali village, Wardha taluk and Sonegaon Bai village in Deoli taluk. Space for establishing centres would be provided by members of the group who will be responsible for maintaining and administering the centres. Funds for building the community training centre have been sanctioned under the MPLAD scheme as proposed by Professor M. S. Swaminathan, in his capacity as Rajya Sabha MP.

Nineteen cattle vaccination camps, covering 2398 cattle, were organised at the village level with the support of the Veterinary Department in the project area.

Details of trainings and demonstrations provided during the past year is given in **Table 5.2**.

Table 5.2 ***Sustainable agriculture components in MKSP 2011-12***

Activity	Area/No. of sessions	Coverage
Training on soil and water conservation practices	7	269 women farmers
Demonstrations on soil sampling	55	All members in 55 villages
Demonstrations on composting	26	All members in 26 villages
Demonstrations on plant extract preparation	16	All members in 16 villages
Soil testing		643 women farmers
Graded bunds built on fields	82 acres	26 women farmers
Van bhojans	22	308 women farmers
Cattle vaccination camps	19	2398 cattle
Knowledge connectivity		187 women farmers
Exposure visits	3	304 women farmers

Household food and nutrition security

Food and nutrition security interventions were taken up with women farmers on the three dimensions of food security, namely, availability, access and absorption, on a life-cycle approach. Activities to facilitate access to food-based entitlements have also been taken up to ensure food security of women farmer households.

This year, 25 training and demonstration sessions on scientific kitchen garden layouts have been conducted across 25 villages. In addition to this, an exposure trip to an experimental farm of a local NGO was organised during January 2012, and participants learnt about different layouts of a good backyard kitchen garden, benefits of kitchen gardens, nutritional values of various vegetables, etc. During the reporting period, 318 women farmers across 38 villages had established backyard kitchen gardens.

To promote awareness about proper and healthy diets, some women farmers prepared delicacies from locally-available foodgrains. These were displayed and judged on the basis of their nutritive value.

The use of safe cooking appliances like smokeless *chulah*s and *sarai* cookers was demonstrated and access to these was facilitated. Fifty-five demonstrations on sarai cooker handling and usage have been taken up in 55 villages in the programme area and 14 women farmers have started using such cookers. Fourteen demonstrations, covering 264 women farmers, were conducted on smokeless chulahs where the use as well as making of the chulah was demonstrated; 16 women farmers use the smokeless chulah at home for cooking.

An important intervention under the food and nutrition security component of MKSP is facilitating access to health services. Health camps are organised with the help of Primary Health Centres and access to health insurance facilitated to women farmers. Village-level health camps (general health check-ups and screening for iron-deficiency anaemia and sickle cell anaemia) have been conducted in 45 out of the 55 project villages. A total number of 602 health insurance cards for concessional out-patient and in-patient services at Sewagram Medical College have been availed for the group members.

The MKSP experience has been documented in the form of a case study as well as a video documentary, capturing voices of empowerment from the field. The documentation was funded by the United Nations Office for Project Services, Switzerland. The case study was published in the Universitas Forum, an international open access journal *Journal on Human Development and International Cooperation* in the special issue on *Decentralization, Local Development and Women's Empowerment: Innovating Knowledge and Practice, 2012.* The video documentary was uploaded in YouTube.

A booklet on sustainable agriculture and brochures on soil and water conservation practices and seed management practices have been developed in Marathi.

The process of developing the web-based MIS system, where real time data will be uploaded, has been started. The monitoring indicators developed for the project will become part of the MIS and this can be used for regular input-output monitoring of the project at various levels.

The Kelapur Gram Panchayat awarded a token sum of Rs.101 to the Kelapur women farmers' group on 12 October 2011 in recognition of their work.

Table 5.3 sets out the household food and nutrition security initiatives of MKSP.

Table 5.3 ***Household food and nutrition security initiatives in MKSP 2011-12***

Activity	No/No of Sessions	No of Women Farmers Covered
Demonstrations on kitchen garden layout	25	324
Demonstrations on safe cooking appliances	55	676
Demonstrations on smokeless chulah	14	264
Diet displays	15	315
Health camps	45	537
Exposure visits	2	67
Facilitation for establishment of kitchen gardens	38 villages	318

Education support programme for children from farmer's suicide-affected families.

A total of 69 children from 38 families in Wardha and Yavatmal districts are being supported under the ongoing educational support programme. Of the 69 children, 10 are at the primary level, 20 at middle school, 29 at secondary level and 10 at higher secondary levels. The highlight of the programme during the last academic year was the admission of two students — Aishwarya from Tulajapur village in Wardha district and Avinash from Mangi village in Yavatmal district — to polytechnic courses after completing Class 10. *The Week* published a story about one of the scholarship students, Ganesh, which led to a philanthropist donating Rs. 8000/- to him with which he has set up a small grocery shop in his village. Using the contribution received from some individual members of Shiksha Mandal Society, Wardha, a copy of the special edition of the children's magazine brought out by *Sadhana*, Pune was sent to all 69 children currently being supported under this programme. Two students, Rushali Petkar and Kunda Petkar, who received support under this programme and who went ahead and completed a course in nursing have secured employment during 2011 in private hospitals in Nagpur and Pune, respectively. Every family that is covered under this programme is met individually by MSSRF staff. The purpose of the visit is to motivate the children and to ascertain that the scholarship funds are used properly. In addition to personal visits, staff members also maintain contact with the families through postcards.

501.2 Odisha

Community Hunger Fighters

Community Hunger Fighters (CHFs) are a cadre of community volunteers at the grass-

roots level mobilised to address hunger and malnutrition in their villages. The team comprises both men and women, with minimal or no literacy, selected by the village *palli* or Gram Sabha. The members underwent a residential and participatory training programme, spaced out in 3 sessions, the intervals enabling participants to go back and share their learning with their village community. Indicators for monitoring the actions taken up by the CHF were developed and the assessment of training impact included changes at the personal level of the volunteers as well as at the community and panchayat levels.

The content of the training included the extent and prevalence of endemic hunger and its causes; approaches for mitigation through agricultural remedies, income generation and access to entitlements with appropriate linkages with government departments; attention to personal hygiene and sanitation; child malnutrition status such as low birth weight, stunting and wasting; ICDS and other child nutrition initiatives. Social inequities low status of women and children and governance issues.

Five people each from five villages belonging to Banuaguda panchayat in Kundura block where MSSRF projects are being implemented, in order that the impact can be leveraged to the maximum, were selected for the first training programme held from October to December 2011. Among the 14 men and 11 women selected, there was a high representation of marginalised communities such as tribals, scheduled castes, and backward communities. The ages ranged from 26 to 40 years, and the men were more literate than the women, though two women from the SC community and one from the OBC category could read and write.

In the first module the participants were introduced to the concept of balanced diets, anthropometric, biochemical and functional measures of nutritional status, and the importance of personal hygiene and environmental sanitation. The training sessions were participatory, with songs and skits being developed on key messages identified by the participants. Through group exercises participants demonstrated how they would introduce nutrition concerns A method was evolved nutrition concerns in crop-cycle management in different agro-ecological regions and in home gardens. In the second module, the social barriers to good nutritional status were discussed, such as the low status of women, alcoholism, discrimination based on caste and class, and lack of community organisation. In the final module, the team visited some of the MSSRF sites to learn about various food- and nutrition-security initiatives such as the Gene-Seed-Grain Banks, watershed management techniques, agricultural production techniques, income-generation activities, child health and nutrition endeavours, and VKCs. Village-wise action plans were formulated and discussed and experiences shared in the valedictory session, attended by the Block Development Officer, panchayat and other village leaders.

The immediate impact of the training was the broadening of the perception of the participants regarding food and nutrition security (**Figures 5.1, 5.2 and 5.3**). Initially, participants had envisaged women (especially pregnant) and children to be the most vulnerable groups needing attention, with clean drinking water, food production, access to entitlements and income generation being the priority areas to be addressed for reducing hunger and malnutrition. In the second module, the concept was extended to include personal hygiene and sanitation, and livestock, hitherto considered to be an economic source, was added in the last one.

Prioritisation of Food Security Issues by CHFs

Figure 5.1 ***(Module 1)***

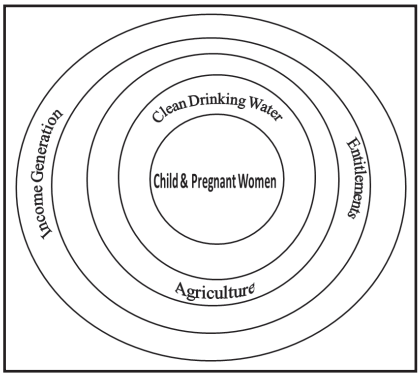


Figure 5.2 ***(Module 1I)***

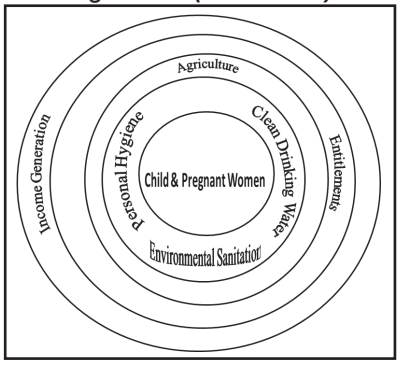
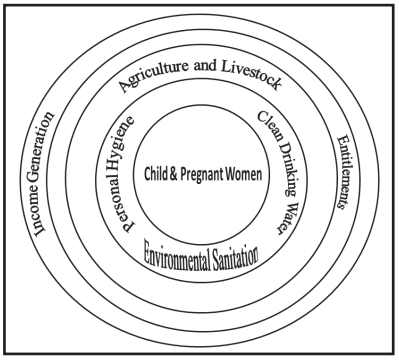


Figure 5.3 **(Module III)**



One of the prominent achievements of the training has been the practice of hygiene, such as washing hands before eating and after using toilets, by the entire household of 4 male CHFs and by some women CHFs, though they have not yet been able to influence their families to do so. Some members have become more socially active. The issues discussed during the training have been disseminated within their villages at harvest time, through SHG and village meetings, in tea shops and in personal conversations. An interesting outcome has been a play on child marriage, which is planned to be enacted in all the villages. The community hunger fighters have also been active in panchayat and ward elections and have assisted in drawing up plans for their village development. Officials have asked for the cooperation of the CHFs for planning and finalisation of government schemes.

Community Grain Banks

MSSRF's efforts over the last year have been to build up the capacities of the committee members of the Community Grain Banks. Programmes on record keeping and on management aspects were organised for

the management committee members of 7 Grain Banks established in 2010. Record maintenance is a major concern, and the identification of educated youth from the villages to be trained by MSSRF has been proposed. The sustainability of the Banks in the event of withdrawal of external support is another concern. At regular intervals, the committee members were facilitated to review the performance of the Banks and to present the status before the general body. In some villages, the committees decided to sell the excess grain and credit the sale proceeds to the village development fund. Last year, the Nuaguda Grain Bank sold 343 kg of rice, 350 kg of paddy and 30 kg of *ragi;* the Gunthaguda one sold 50 kg of rice and 40 kg. of *ragi;* and the Boliguda Bank sold 5 qtl of paddy. Analysing the household transaction of Grain Banks over the year it has been seen that, in general, 10 to 20 per cent of growth of grain stock is through interest collection. An analysis of grains borrowed indicates that, on an average, a household that has borrowed paddy has done so to the tune of 42 kg while a household that has borrowed rice has an outstanding of 18 kg, *ragi*, 6 kg and pulses, 4 kg. Further, during lean periods (July to September), 60 to 80 per cent of member households availed loans, while in other periods, it was 20 to 30 per cent.

In 2011, a film on Grain Banks has been produced and is being used in capacity building programmes organised by other organisations. MSSRF Grain Bank models are being replicated by organisations like LEPRA Society and PRASTUTEE in the tribal regions of Koraput. MSSRF acts as a resource organisation for these agencies and 8 training programmes were organised on the establishment and management of Grain Banks.

Gagad pila

Gagad pila in the Odia language means a healthy child and the intervention to improve the nutritional status of children below three years is gaining ground in the three villages of Bolliguda, Gunthaguda and Nuaguda.

The repeated incidences of illnesses among the children continued to cause concern. Respiratory tract infection (RTI) was the most common, followed by diarrhoea. Others, such as fever, stomach pain and vomiting, were only symptomatic of these two conditions. Most mothers used home remedies at first. When this did not yield results, alternative health options ranged from consulting the traditional health practitioner, anganwadi worker, ANMs, PHC, private doctors, the local exorcist, and even untrained and unauthorised personnel. Since the villagers placed great emphasis on herbal medicine, it was decided to train the traditional health practitioner and some health committee members on preparing medicines from locally available medicinal plants. An ayurvedic paediatrician was identified, who would provide training and guidance in the preparation and administration of the herbal preparations. The physician visited the villages, met the people and studied the catalogue on medicinal plants prepared by MSSRF. Formulations available and suitable for local conditions were selected. Two workshops

were conducted and the target groups were village health committee members (HCMs), traditional birth attendants (TBAs), traditional health care practitioners (THCPs) and mothers of children (0-3 years) from the 3 villages.

The first workshop — on management of respiratory tract illnesses through home remedies based on locally available plants — was conducted at the MSSRF site office at Jeypore on 14 November 2011. The ways of diagnosing a child's illness and its severity, care practices of children (starting from cutting of the umbilical cord after birth) and other protective measures to safeguard and maintain children's health were discussed. The resource person also talked about herbal drugs, their administration (dosage and frequency), acceptability and palatability. The preparation and use of *kasantaka churna* (for respiratory tract infections), *vasa baleha* paste (for cuts and bruises) and *sudhakar malam* (for skin diseases, scabies being the most prevalent) were demonstrated.

Table 5.4 sets out the list of ingredients used in *kasanthaka churna* for treatment of coughs and colds.

The workshop was followed by a health camp the next day. Even though several announcements had been made that the camp was to be a paediatric camp, adults, adolescents and the elderly thronged the camp. Gastritis was a common problem among adults. A total of 244 people (124 males and 120 females) were treated. There were 278 episodes of illnesses recorded since some had more than one ailment.

A follow up of 104 children (up to 12 years of age) a week after the health camp ascertained that 60 per cent had completed the course of herbal medicines. Ninety-five percent found the taste acceptable and the health status of 75 per cent had improved. Incidence of scabies was detected,

The second workshop — to discuss preventive (personal hygiene and sanitation) and curative aspects of health — was held from 17 to 19 December 2011 for 23 participants from the target groups. The topics discussed included:

- Causes of some common childhood ailments and ways of preventing them

Table 5.4 ***Ingredients used in kasanthaka churna***

Name of plants in different languages			Part of plant used in drug preparation
Sanskrit	**Odiya**	**Latin**	
Haritaki	Harida	Terminalia chebula	Fruit pericarp (de-seeded)
Bibhitaki	Bahada	Terminalia belerica	- do -
Amalaki	Anala	Embelica officinalis	- do -
Sunthi	Sunthi	Zingiber officinale	Rhizome
Pippali	Pipali	Piper longum	Fruit
Maricha	Golmarich	Piper nigrum	Fruit

Source: Baisagya Ratnavali, kasha chikitsha, sloka 43

Table 5. 5 ***Illnesses detected and treated during the health camp, November 2011***

Disease	No. of cases treated			
	Nuaguda	Boliduda	Gunthaguda	Total
Respiratory tract infections	6	15	31	52
Fever	3	9	7	19
Ear ache	3	5	0	8
Headache and giddiness	0	5	1	6
Scabies and other skin infections	27	19	27	73
General weakness	2	7	3	12
Arthritis	1	32	11	44
Anaemia	8	7	1	16
Gastritis	9	15	20	44
Menstrual disorders	3	0	0	3
Chicken pox	0	0	1	1
Total	**62**	**114**	**102**	**278**

- Issues of personal hygiene and environmental sanitation
- Home remedies commonly practised and their fine tuning
- Herbal preparations for skin diseases (especially scabies), worm infestation, fever, diarrhoea and adult gastric disorder
- Existing health facilities and their utilisation with specific reference to children.
- Evolution of an action plan for future use

The ayurvedic paediatrician confirmed that 80 per cent of the home remedies practised in the community were appropriate and needed only some minor changes. The participants decided that they would go ahead with the preparation and use of *kasanthaka churna* for treating RTI and have started the process. The quantity prepared, users, the dosage given, impact and cost of the medicines are being closely monitored and documented.

In February 2012, health committee members were taken on an exposure trip to panchayat villages near Berhampur to study the water and sanitation model promoted by the NGO Gram Vikas with the aim of introducing 100 per cent piped drinking water supply and individual toilets for all households in selected villages. Each village had a management committee consisting of three men and women. All households paid an initial membership fee of Rs 1000, and participated in the programme irrespective of caste or socio-economic status. The programme has had a positive impact on the quality of life of all participating villages, through reduction of water-borne diseases, improvement in personal hygiene and a clean environment. The activity also had the potential of bringing a village community together and acts as a tool for total social inclusion.

As there had been a break in the preparation of the nutritious porridge mix for children, which

is a good "bridge" food when complementary feeding begins after 6 months of age, it is now prepared in bulk by the HCMs and stored in the Grain Banks. The HCMs choose the member who is willing to prepare the mix and give her an advance for the procurement of the ingredients and wage compensation. An interesting development is that others besides children are also being given this mix as a health drink: a lactating mother with twins (60 days post-delivery) and a weak 7-year-old child were given the mix.

Despite these initiatives, the issue of childhood malnutrition and support to mothers did not figure in the village (*palli*) development meetings and largely remained as mothers' issues to be discussed at household level. Hence, in January 2012, the problems of sustainability, gender sensitisation and mainstreaming at the community level and impact assessment were discussed in a capacity-building programme for the project team. Following this, a capacity-building workshop for the health committee members was organised in March 2012. The objectives of the workshop were:

1. To sensitise participants about the low status of women in the household and community, the multiple roles they play and how it affects their health and nutritional status and that of their children.
2. To help participants reflect on how the practical and strategic needs of women may be met at the household and community level to reduce undernutrition in young children.
3. To raise the critical awareness of participants to the importance of having a well-organised village community for overall village development.
4. To help them reflect on their own village situation and evolve strategies for improving community participation for accessing entitlements.

Through role plays, discussions and group work, participants analysed the status given to men and women, their role in decision making at household and community levels, and participation in social and political activities. Participants agreed that women need to be paid wages equal to that of men for equity and empowerment. They agreed that the "power of change" for social transformation rested only with men, and that they should go back and sensitise their community to discuss women's and children's issues in meetings and to mobilise their own womenfolk for effective participation. Village-wise plans were made for improving social inclusion of women, water and sanitation facilities and raising governance issues, especially those of ICDS, at nodal and Gram Sabha meetings.

501.3 Tamil Nadu

Integration of food security component in MGR Nagar, Chidambaram

As reported last year, the assessment of household food and nutrition security undertaken in MGR Nagar, Chidambaram district, has led to several measures being taken to integrate the food security component in the village. To begin with, an evaluation of

the nutritional status of individuals as well as the level of access to various household entitlements relating to food, nutrition, health, drinking water and sanitation was made, using structured questionnaires and focus group discussions.

The census conducted by MSSRF in June 2011 showed that MGR Nagar comprised 132 households with a population of 492. Among this population, 260 (53 per cent) were male and 232 (47 per cent) were female. A total of 161 children (< 14 years) were counted, of which 92 were boys and 69 were girls.

The nutritional status of children was assessed using the indices of weight-for-age (underweight), height-for-age (stunting) and BMI-for-age. These indices were compared to the WHO growth chart and values below minus 2SD were determined as malnourished.

Table 5.6 shows the percentage of children below 5 years who were malnourished in MGR Nagar in 2011.

Table 5.6 ***Percentage of children below 5 years classified as malnourished, MGR Nagar***

Sex	Underweight	Stunted	Undernourished (BMI)
	Below 5 yrs	Below 5 yrs	Below 5 yrs
Boys	50.0	56.3	37.5
Girls	47.6	19.0	33.3
Total	48.6	35.1	35.1

Source: *Primary Survey, 2011; WHO Growth Chart, 2007*

Note: *Number of children below 5 years of age are 37 (21 girls and 16 boys); among children below 5 years, 12 out of 21 girls and 3 out of 16 boys were stunted, and 10 out of 21 girls and 7 out of 16 boys were underweight.*

The nutritional status of adults was assessed by calculating the body mass index. Among 155 females (excluding pregnant and lactating women), 45 (29 per cent) were suffering from chronic energy deficiency (CED), 16 (10 per cent) were overweight, 21 (14 per cent) were obese and 73 (47 per cent) were normal. Among 168 males, 55 (33 per cent) were suffering from CED, 12 (7 per cent) were overweight, 11 (7 per cent) were obese and 90 (54 per cent) belong to the normal category. Out of the 132 households, there were undernourished persons in 95 (72 per cent). Twenty-seven families had only undernourished children; 21 had only undernourished adults and 47 households had both undernourished adults and children.

The assessment of the status of nutrition security among children and adults in MGR Nagar indicates the deplorable situation that prevails here, not very different from the conditions facing the country at large. This calls for focused interventions if there is to be any improvement.

The measures adopted by MSSRF in this regard included facilitation of food security entitlements as well as creation of awareness on food security related issues.

- Nearly 25 households had lost their ration cards — so important to access subsidised foodgrains — during the tsunami of 2004 in which MGR Nagar was affected. Through active facilitation undertaken by MSSRF staff, 7 families have secured ration cards.

- An awareness programme on nutrition and health was organised (257 persons were screened) in October 2011 in collaboration with Department of Community Medicine, Raja Annamalai University, Chidambaram.
- Immunisation programmes for children and awareness programmes on anaemia for adolescent girls were organised with the support of the Primary Health Centre.
- As recommended by medical experts, iron supplements are being distributed since November 2011 to 105 women and 59 adolescent girls in the age group of 10-45 years through volunteers from the community, Further, all 132 households were given a kilogram each of multiple fortified salt enriched with vitamin A, vitamin B_{12}, iron, iodine, folic acid and zinc in January 2012. The cost involved in the initial supply of salt to all the families was borne entirely by the manufacturer, Sundar Nutritions, Chennai. In April 2012, 68 households purchased 274 kg of salt as per the agreement to pay a subsidised cost of Rs.5/kg against the MRP of Rs.18/kg.
- As it was found that the ICDS subcentre in the hamlet was functioning only partially, volunteers identified by the community were educated about the importance of monitoring the ICDS centre on a regular basis.
- Awareness programmes were organised for the community on issues such as safe drinking water, hygiene, nutrition, and toilet usage through talks, video clippings, etc. The majority of the households have difficulty in accessing safe drinking water and sanitation facilities. Discussions are on with the village panchayat for necessary action to improve drinking water and sanitation facilities in MGR Nagar.
- Awareness on the importance of vegetable consumption and the possibility of promotion of kitchen gardens was carried out in February 2012, in collaboration with the College of Agriculture, Chidambaram.

Sub Programme Area 502

Research

502.1. Action research

The Healthy Child Project was an action research undertaken to reduce undernutrition in young children. It tested the hypothesis that support to mothers of young children is an important variable in improving nutritional status and endeavoured to create a cadre of people who would espouse the cause of women and young children in the community. A survey was conducted in January 2011 to assess the impact of the intervention on complementary feeding, incidence of morbidity and nutritional status of children.

Considerable improvement in the quality of complementary feeding in the diets of children was noticed. Eighty-one per cent (81 per cent) of the children have three to four food groups in their diets as compared to 25 per cent during the baseline period (**Table 5.7**). With regard to morbidity, respiratory tract infections continue

to remain high, being 61 per cent in January 2008 and 64 per cent in January 2012. This is perhaps due to the smoke-filled huts without proper ventilation. The incidence is likely to come down once the villages start preparing and using the herbal remedies. However, adoption of smokeless *chulah*s would have to be encouraged and this would be taken up with the health committee.

Table 5.7 ***Changes in the diet quality of children (September 2008 - January 2011)***

No. of food groups in the diet	No. of children (2008)	No. of children (2012)
4 groups	0	17
3 groups	9	17
2 groups	21	6
1 Type	6	0
Total	**36**	**42**

The impact of improved sanitary practices like the village cleaning programmes, use of boiled water for young children and control of indiscriminate spitting seems to have paid off, since diarrhoeal infections have come down from 41 per cent in 2009 to 13 per cent in 2012 (**Table 5.8**). The attendant manifestations of viral infection such as fever, stomach pain and vomiting have also come down considerably, indicating that children in these villages have a better quality of life than before. However, an outbreak of scabies in children which was not there earlier is suggestive of a decline in the personal hygiene practices of adults. Scabies was detected in the health camp itself. This issue was discussed in the second workshop and it was found that during winter bathing was not done everyday and it is likely that clothes did not get dried in the sun properly and remained damp. The importance of keeping one's body and clothes clean was emphasised.

Table 5.8 ***Morbidity pattern in children***

Categories	September 2008 (n = 46)	January 2009 (n = 31)	January 2012 (n = 50)
Respiratory tract infections	24 (52%)	19 (61%)	32 (64%)
Fever	22	12	4
Stomach pain	1	1	2
Diarrhoea	9	13	4
	-	1 (dysentery)	-
Vomiting	-	4	-
Scabies	-	1	13

Note: *Conditions like diarrhoea and dysentery were usually accompanied with symptoms like stomach pain and vomiting.*

Using weight for age as the criterion, there has been a marginal improvement in the nutritional status of children in 3 years (**Table 5.9**). The considerable improvement in feeding practices and marginal improvement in health conditions have still not been translated into adequate anthropometric measurements. When comparing the baseline and final figures with that of Odisha and India, it is found that the figures are much higher in these tribal areas than for the rest of the country. Since weight as a measure of undernutrition is subject to fluctuations on a short term basis, stunting has also been chosen as an indicator for nutritional status improvement. Stunting signifies the adaptation of the body to a reduced food

Table 5.9 ***Nutritional status of children at baseline and after intervention***

Nutritional Status	September 2008 (n=39)	January 2012 (n=50)	Odisha*	India*
Underweight by age	25 (65%)	29 (58%)	44%	46%

** DRDA – Koraput, www.Koraput.nic.in*

intake. Stunting level was found to be 37 per cent. Impact on stunting would be measured at the end of the project period.

As an offshoot of the Healthy Child Action Research Project, another research study for developing a rating scale for assessing the complementary feeding behaviour of mothers was decided to be undertaken. Undernutrition peaks between 6 and 36 months, the time when complementary feeding begins. The interaction between the caregivers and children is a critical input in determining the child's interest in the food and participation in the feeding process. Hence this has to be studied carefully to be able to form programmatic guidelines in interventions. A preliminary review of literature was undertaken to know the work done in this area and identify already existing tools, if any.

While there are several studies highlighting poor feeding and hygienic practices, in general, as being the causal factors of undernutrition, there are comparatively fewer studies that have assessed complementary feeding behaviour of the mothers or caregivers and its impact on food intake and nutritional status of children. Experience with the measurement of psychosocial aspects of child feeding, such as maternal encouragement to eat and other aspects of caregiver-child interaction during feeding, is limited. Most studies till date have used structured observations to describe these complex interactions. Scales have been developed but most have not been validated. Experience with survey approaches is also scarce and it is probable that many aspects of psychosocial care will never be amenable to survey approaches.

As a first step, it was decided to record the actual feeding sessions of children at different age intervals and request a panel of experts to identify the dimensions to be included in the scale. With the help of ICDS staff, mothers with children in the ages one, one and a half, two, two and a half and three years were identified. After seeking permission and identifying the feeding routines of the children, a suitable date and time was chosen for videographing the child's feeding. This was edited and the video has been circulated to a selected panel of experts for viewing and feedback.

The Ford Chair along with the convenor of Tamil Nadu Forum for Creche and Childcare Services (TN-FORCES) and a representative of Public Health Resource Network (PHRN), New Delhi met the Health Secretary of Tamil Nadu to discuss the findings of the study done by them on the maternity entitlement scheme of Tamil Nadu. It was decided that a communication package with a set of key messages would be developed and disseminated to the common public through the health functionaries. The impact would be studied on IYCF (Infant and Young Child Feeding) practices and utilisation

of the maternity scheme in a given area. A set of messages have been developed and submitted to the Health Secretary and follow up continues.

Home gardens

Home gardens, found in many tribal households, are an important avenue of intervention for alleviating micro-nutrient malnutrition. A study conducted in Nuaguda, Gunthaguda and Bolliguda in 2006 highlighted the limited supply of vegetables, especially during off-season, disappearance of wild foods preferred by the tribals, water scarcity and need for gender-friendly technologies. Therefore, home gardens have been supported to increase the production and consumption of vegetables and fruits in the 3 villages since 2006. Monitoring of kitchen gardens has been undertaken with the help of a checklist to track the availability of different vegetables, intercultural operation, weed control, maintenance of the garden, insect and pest control, etc. Monthly village meetings were conducted to share the experiences of individual households in the maintenance of the gardens, benefits they obtained as well as constraints faced. One hundred and thirty-one home gardens, across the 3 hamlets, have been monitored on a monthly basis.

Out of 131 households, 98 had grown green leafy vegetables (GLV), 127 had grown root vegetables, 76 had other vegetables and 66 had fruit-bearing plants. Only 58 households have a combination of green leafy vegetables, root and other vegetables along with some fruit-bearing plants like lemon, guava, custard apple, etc.

Some key results for the period June to December 2011 are presented here:

- With regard to green leafy vegetables (GLV), 35 per cent households had one green leafy vegetable, 23 per cent had two green leafy vegetables, 12 per cent had three green leafy vegetables and 5 per cent had more than three green leafy vegetables.
- With regard to root vegetables, 24 per cent households had one root vegetable, 53 per cent had two root vegetables, 18 per cent had three root vegetables and 2 per cent had more than three root vegetables.
- With regard to other vegetables, 24 per cent households had one vegetable, 25 per cent had two vegetables, 18 per cent had three vegetables and 13 per cent had more than three vegetables.
- With regard to fruit-bearing plants, 30 per cent households had one type of fruit-bearing plant, 8 per cent each had two and three types of fruit plants and 4 per cent had more than three types of fruit plants.
- Most of the vegetables (80-90 per cent) were consumed and the excess was distributed to neighbours and relatives or sold. Vegetables were grown from the perspective of household food security and not so much for economic gain.
- Conditions influencing vegetable cultivation were availability of land, water and manpower.

- All households are aware about the importance of vegetables and grow a combination of green leafy vegetables, root and tubers and other vegetables and are self-sufficient in the matter of seeds.

The model kitchen garden which was established at the BPMPGRC campus in 2009 has been monitored and maintained properly with respect to weeding, cleaning, intercultural operation, watering, seasonal vegetable cultivation, etc. This year 6 varieties of sweet potatoes were collected from the Regional Centre of CTCRI, Bhubaneswar and were planted in the model kitchen garden. The productivity of each variety is being studied. Thereafter sweet potato will be incorporated into home gardens as a tuber crop. Around 450 farmers visited the garden and learnt about management and maintenance of home gardens. The garden consists of all the three types of vegetables and fruit-bearing plants which include 8 tree species (papaya, drumstick, banana, guava, curry leaf, tapioca, lemon, custard apple) along with seasonal vegetables, spices and pulses.

The Forest Food Plants Conservation Garden at BPMPGRC campus was established in 2009. This year 2 new species were collected and planted in the garden. Presently the garden consists of 70 species which includes 12 herbs, 14 shrubs, 29 tree species and 15 climbers. The plants species used as food consist of 13 tubers, 11 green leafy vegetables, 21 berries, 15 fruit-bearing plants, 3 edible flowers plants and 7 other plants used as food.

502.2. School Feeding Programme in India

An e-Report on the evolution and experiences of school-feeding programmes in the country as a whole as well as in the States of Tamil Nadu, Odisha, Andhra Pradesh and Puducherry was prepared and was brought out in August 2011, in collaboration with Partnership for Child Development, London. In addition to highlighting the role of the state in implementing mid-day meals as a social safety net for marginalised sections of the population, the document captures interesting innovations in the implementation of the scheme across the country.

Programme Area 600

INFORMATION, EDUCATION AND COMMUNICATION

The Jamsetji Tata National Virtual Academy focused on innovating and contextualising ICTs to provide a package of services incorporating end-to-end solutions to fisherfolk, farmers and entrepreneurs. Multiple technologies including web-based audio and video conferencing, GSM-based public address system, WLL-CUG and mobile applications have been harnessed to provide need-based information to VKC and non-VKC villages. A national consultation was organised to strengthen the Grameen Gyan Abhiyan network. Knowledge management systems have been developed and deployed for access of information, publications of MSSRF and contents in different forms. The web-based Open Access Archives has been initiated in the library.

Innovative use of ICT-based interventions for enhancing livelihoods of farming and fishing communities.

Programme Area 600

Information, Education and Communication

The prime focus of the Information Education and Communication (IEC) Programme Area is to build and strengthen the knowledge and capacity horizons of diversified key stakeholders, following the principle of last-mile last-person connectivity with pro-poor, pro-nature, pro-women approaches leading to the development of the community, primarily in the rural areas of India. The programme focuses on (a) reducing the gap between knowledge seekers and knowledge providers using various ICTs, aligning the focus of linking science with society; (b) establishing and maintaining a robust IT infrastructure for efficient communication within MSSRF; (c) maintaining an effective knowledge management system (KMS) capturing the knowledge generated across MSSRF that is accessible internally by the staff and externally by the public; (d) recognising and motivating grass-roots academicians by bestowing NVA fellowship awards; and (e) networking and building alliances with institutions and departments which are involved in information and knowledge dissemination, enabling replication and scaling up of various ICT models in India to trigger a knowledge revolution across rural India.

Sub Programme Area 601

Jamsetji Tata National Virtual Academy for Rural Prosperity

The mandate of the Jamsetji Tata National Virtual Academy for Rural Prosperity (NVA) is:

- to provide locale-specific, demand-driven content to address life and livelihood related issues of the rural populace.
- to build the capacity of the rural community, including the most vulnerable, in technical aspects that focus on enhancing their livelihoods.
- to recognise outstanding grass-roots academicians who have been change agents in bringing development to rural India.
- to enable virtual platform and connectivity to reach the last mile.
- to build alliances with key stakeholders across India for triggering a knowledge revolution.

NVA accomplishes all these through Village Resource Centres (VRCs) and Village Knowledge Centres (VKCs), National Virtual Academy Fellowships and Rural Knowledge Movement (Grameen Gyan Abhiyan). Content, capacity building, connectivity, coalition, care and management turn out to be the underpinning and cross-cutting elements for these components.

601.1 Village Resource Centres and Village Knowledge Centres

MSSRF's NVA has set up 16 VRCs and 73 VKCs across Tamil Nadu, Maharashtra, Andhra Pradesh, Odisha, Kerala and Puducherry. Of this, 12 VRCs and 63 VKCs are managed by a team of subject specialists and the remaining 4 VRCs and 10 VKCs are operated on a PAN MSSRF mode. In 2012-13, 3 VRCs and 5 VKCs are proposed to be set up under PAN MSSRF projects.

This year, the internal assessment of VRCs and VKCs indicated that they have made significant advancement in terms of both qualitative and quantitative results, thus establishing their effectiveness and efficiency. The kind of technical support and knowledge services rendered through content, capacity building and linkages to the rural populace highlighted significant presence in the areas of major livelihoods, such as agriculture, fisheries and animal husbandry, and subsequently in addressing developmental aspects like health, education and welfare measures. VRCs catered to 1743 villages, benefiting 77,692 rural folks, including 27,052 women and 50,640 men. This was made possible with the help of multiple partners, including public and private institutions as well as corporate entities. Various State and Central Government departments like DST and MKSP and other agencies like IDRC, IFFCO-IKSL, INCOIS, NETFISH, NABARD, JSW, NFDB, Indian Overseas Bank, State Bank of Mysore, The Neuberger Berman Foundation, Mahyco, Bharat Petroleum Company Limited and Qualcomm have been partners in the process. State-wise details of community outreach are given in **Table 6.1**.

Table 6.1 ***State-wise break-up of community outreach***

States	Villages	Total	Male	Female
Overall	**1743**	**77692**	**50640**	**27056**
Tamil Nadu	1243	50809	31250	19559
Maharashtra	422	14504	11079	3425
Puducherry	35	7343	4325	3018
Andhra Pradesh	21	2123	2123	0
Odisha	22	2913	1862	1051

NVA has followed a two-pronged approach to reach out to the rural community in the operational districts in the States of Tamil Nadu, Puducherry, Maharashtra, Odisha and Kerala. The model of VRC-VKC is still preferred by many as it has its own advantages. VRCs have in addition capitalised on emerging technologies like mobile applications as they have greater reach in rural areas and can bring larger benefits to the rural community to address their livelihood issues. Thus VRCs have demonstrated a virtual model of IEC, addressing the problems and needs of the rural community without relying on the structure of VKC. Using this virtual mode of operation, VRCs have reached 1667 villages with knowledge and information services.

601.2 Farmer Friend Programmes

ICT services

The on-going mobile-phone-based advisories through short text and voice messages in agriculture and animal husbandry to farmers in

Tamil Nadu, Puducherry and Maharashtra were extended to many new villages. The unique feature of such services is that they not only receive advisories on the crops of the region, weather forecasts and related topics, but also interact with experts through the helpline facilities made available in MSSRF, Chennai, and in the VRCs. During the year, 7480 voice messages and 843 short text messages were disseminated on a daily basis to 50,710 farmers in the local languages, such as Tamil in Tamil Nadu and Puducherry and Marathi in Maharashtra. A panel of 8 agriculture and 3 animal husbandry experts located virtually in these three States interacted directly with the farmers to provide solutions to their problems. The queries were either answered instantly or put on teleconference to the experts. In the reporting period, 7476 farmers have utilised the helpline facilities across the operating States. The queries related to agriculture included seed selection, varieties suitable to the region, soil nutrient enhancement, diseases and pest management, weather forecast and precautions, organic method of agriculture and market price information. Livestock care and management queries related to fodder cultivation, periodic vaccination, treatment of seasonal diseases (mainly mastitis, foot and mouth disease), skin rashes, and problems like infertility, reduced milk yield and stunted growth.

The VRCs are in partnership with agricultural and animal husbandry institutions, such as Krishi Vigyan Kendra, Soil and Water Management Research Institute, agriculture colleges, Veterinary Research and Training Institute, as well as individual experts to answer the queries of the farmers. Agriculture experts from MSSRF also attended the helpline.

WLL-CUG telephone-based audio-conferences of farmers sitting in the village talking to the agriculture and animal husbandry experts directly to get solutions have helped farmers adopt corrective measures to avoid risks and control damages in crops and livestock. Similarly, farmers were invited to the VRCs to have face-to-face video conferencing with experts on a regular basis.

The weekly theme-based phone-in programme conducted by MSSRF, Chennai and the VRCs in Tamil Nadu and Maharashtra was another initiative. Each phone-in programme pertains to a particular crop like paddy, coconut, cotton, sugarcane, vegetables, floriculture, fruit trees or livestock. On the whole, 114 phone-in programmes covering all the projects collaborated with IKSL, NABARD, MARG, etc., were conducted, in which 8910 questions from 1434 farmers were answered by the experts. All the phone-in programmes have been video-documented for further dissemination in VRCs and VKCs. Weekly quiz programmes have continued; this year 48 quiz programmes were conducted, in which 1008 farmers participated.

Exposure visits of farmers to KVK and to the fields of progressive farmers in Tamil Nadu and Maharashtra focused on demonstrations and discussions on cultivation practices of cotton, vegetables and pulses.

This reporting year, all the VRCs put together have conducted 119 programmes covering

2252 farmers (M: 1603, F: 649). Case studies have been documented on the benefits obtained from the information and knowledge services extended through various ICTs in these regions. **Table 6.2** sets out the details.

Training and awareness programmes

VRCs have conducted 65 training and 94 awareness programmes, benefiting 6448 (M: 4582, F: 1866) farmers by inviting subject experts from KVKs, agriculture colleges and research institutes and individual experts. The training programmes were on topics specific to the region, based on the needs of the farmers.

Odisha VRC conducted training programmes for a total of 922 participants (M: 533, F: 389) on topics, such as disease and pest management in paddy, SRI technique of paddy cultivation, bio-fertiliser preparation, care and management of livestock, value-added products from rice, legal aspects of PPV&FRA, quality seed production of minor millets, herbal home remedies and poultry management. Artificial insemination camps for livestock were conducted in Nuaguda, Assna and Kaudiaguda villages. In one camp covering 9 villages, 2785 cattle were vaccinated and 245 cattle were treated for various diseases. In the same camp, de-worming was done and vitamin A tablets distributed by the Department of Animal Husbandry. Artificial insemination carried out in two camps brought an outcome of 65 per cent success rate to 64 cattle.

Mobile soil- and water-testing laboratory

The mobile soil and water testing laboratory in the Thiruvaiyaru VRC in Tamil Nadu has instruments to test pH, electrical conductivity, macro-nutrients in the soil, such as nitrogen, potash and phosphorous, and hardness of water in terms of both cations and anions for determining the quality of irrigation water. Based on the hardness index of water, advisories were provided to improve the soil fertility for acidic and alkaline soils. During the year, the mobile laboratory visited 58 villages in Tamil Nadu and tested 1500 soil and 44 water samples of 1300 farmers. In Maharashtra, the soil samples were tested in the Agriculture College, Amaravati and Krushi Vigyan Kendra, Karda, in Washim district.

The scientists associated with the mobile laboratory conducted awareness programmes

Table 6.2 ***ICT initiatives in agriculture***

Programmes	Number	Male participants	Female participants	Total
Audio conferences	61	1046	236	1282
Video conferences	47	236	322	558
Exposure visits	11	128	58	186
Demonstrations of agricultural techniques	05	199	33	226
Total	**119**	**1603**	**649**	**2252**

in the villages on the importance of soil and water testing, role of macro and micro minerals in the growth of plants, and soil sample collection procedures. Twenty-nine awareness camps were conducted to train 1361 farmers (M: 943, F: 418) in soil sample collection procedures and norms. The unique feature of the service in the reporting year is that a centralised server-based data bank in a web-portal form has been developed for the repository of soil and water test reports. This data is used for monitoring the soil nutrient status of each farmer and based on it, a long-term soil health management and crop rotation is suggested. The logical retrieval of the data by village and district were is useful to analyse the trend in the soil nutrient pattern of the village or region.

Bharat Petroleum Company Limited, Mumbai has supported MSSRF in establishing two soil and irrigation water testing laboratories in Wardha and Yavatmal districts in the Vidarbha region of Maharashtra, with the primary objective of educating farmers on soil health management and providing recommendation of fertiliser dosages for the crops. In Wardha district, the laboratory has been established in the VRC in Waifad village and in Yavatmal district, it is located in the Savitri Jothirao College of Social Work. VRC staff members have conducted awareness programmes on the importance of soil testing and sample collection procedures in 5 villages in which about 150 women farmers participated and have collected 360 soil samples for testing in both the VRCs.

601.3 Fisher Friend Programmes

One of the thrust areas of NVA is to augment the Indian coastal marine fisheries sector in terms of technology, good practices and sustainability. Today small boat fisherfolk face a number of livelihood issues, such as unpredictable weather conditions, uncertainty in fish catch due to decline in stocks, spoilage of fish due to unhygienic packaging practices and transportation, lack of knowledge and skill in new fishing technologies and unsustainable fishing practices. In order to address these issues, the Fisher Friend programme has partnered with a number of organisations, such as the Indian National Centre for Ocean Information Services (INCOIS), National Fisheries Development Board (NFDB), Indian Coast Guard, NETFISH-MPEDA, State Fisheries Department, Tamil Nadu Marine Police, Central Marine Fisheries Research Institute (CMFRI), NABARD and Qualcomm, focussing on risk reduction, quality maintenance, marine bioresources conservation, value addition and capacity building in new fishing technologies.

Risk reduction and enhanced fish catch

Since 2009 the NVA has partnered with INCOIS to help fisherfolk in reducing risks and uncertainty by providing them with information on locale-specific potential fishing zones, forecasts on sea wave height, wind speed and its direction and high wave alerts. Besides early warning, the goal is to upgrade the standard of current fishing practices by encouraging fisherfolk to move from traditional methods of

fishing to modern ICT-based precision fishing. NVA has been using various ICTs, such as vernacular short text and voice messages on mobile phones, helpline services, electronic display boards, GSM-based public address systems, notice boards in VKCs, as also training of master trainers in the villages to disseminate information on a daily basis.

Every day around 5000 fisherfolk in 101 villages across 10 districts in Tamil Nadu, 21 villages across 2 districts in Andhra Pradesh and 13 villages in Puducherry receive potential fishing zone information, early warning and sea state forecasts through mobile phones enabling them to make smart decisions that are focused on safe and productive fishing.

24/7 helpline services to fisherfolk

MSSRF in partnership with INCOIS has launched helpline services for fisherfolk, a first of its kind in the country. The helpline is a 24/7 service, where fisherfolk can contact the numbers 9282442312 and 9282442311 at any time of the day to get fisheries-related information, such as potential fishing zones, ocean state, early warning, marine conservation, fisheries schemes and entitlements, emergency relief etc. This reporting year, 2150 fisherfolk across Tamil Nadu, Puducherry and Andhra Pradesh have accessed the helpline services. During cyclone *Thane* in December 2011, NVA staff tracked the cyclone movement continuously for 24 hours and 350 fisherfolk used the helpline to get the status. Similarly, when the tsunami alert was raised in April 2012 due to the earthquake in Indonesia, the helpline was accessed by fisherfolk to get status of the tsunami and its possible impact on the Tamil Nadu coast. Officials of the Fisheries Department updated their warnings based on the advisory provided through the helpline service.

Sea safety and security

The Fisher Friend programme has partnered with the Indian Coast Guard to provide sea safety and security awareness to 610 fisherfolk from 14 fishing villages in Tamil Nadu. Feedback from fisherfolk on Coast Guard services and community interaction programmes were presented to the regional headquarters of the Indian Coast Guard for follow up.

Marine conservation and sustainable fisheries

In order to address the issue of marine conservation, NVA has adopted a two-pronged strategy targeting fisherfolk as well as their children. The focus has been on educating fisherfolk in fishing net mesh size regulations, importance of brooders, maintenance of cleanliness and hygiene in coastal areas, as well as the conservation of endangered species, coral reefs and mangroves. A series of awareness programmes with the support of NETFISH were conducted in 7 villages in which 997 fisherfolk participated. Similarly, 450 students from two schools in Seruthur and Vizhundamavadi fishing villages have been sensitised on various aspects of marine conservation through a series of competitions and awareness programmes.

Capacity and skill building

A series of capacity-building programmes have been conducted in partnership with NFDB and NETFISH to equip rural fisherfolk with information focusing on various aspects of fishing, viz., fish quality management, both on shore and on sea, for getting good returns from the catch, Global Positioning System (GPS) including basics of navigation, operation of GPS, maintenance of equipment and practical navigation exercises to reach fishing grounds reducing time and fuel. One of the biggest safety issues faced by rural fisherfolk is the failure of fishing vessel engines on the high seas. Cut away from the rest of the world, this can result in being adrift for a number of days and even loss of life. Thus, training on diesel engine mechanisms, maintenance and basic repairs including the basics of outboard diesel engines, dis-assembling and assembling of engines, etc. was given to them.

Table 6.3 ***Fisherfolk trained on need-based skills***

Topics	Participants		Villages covered
	Male	Female	
Quality control - on shore	1549	715	24
Quality control - on sea	113	-	8
Sustainable fisheries	960	37	7
Sea safety measures	454	156	14
GPS training	148	-	10
Trouble shooting diesel engines	140	-	9
Dry fish quality management	-	150	-
Total	**3364**	**1058**	**72**

Phone-in programmes

In the phone-in programmes, each month a key issue based on the queries received in the helpline is chosen and a suitable expert is identified to address the issue. Topics, such as marine conservation, sea safety measures, fish value-addition, seaweed culture, GPS, MPEDA schemes, first-aid tips and insurance schemes for fisherfolk, have been addressed by experts from CMFRI, MPEDA, Indian Coast Guard, MSSRF and United Insurance Company. In all, 11 phone-in programmes were conducted during which 461 fisherfolk interacted directly with the experts

Publications and training manuals

Apart from training and capacity-building initiatives at field level, 4 training manuals have been published in the local language for the fisherfolk and distributed through the VRC/VKC network. Entitlements book for fisherfolk and seasonal-based fish catch calendar for 39 coastal villages in Tamil Nadu and Puducherry are the other publications brought out this year.

Shore-to-shore approach to fisheries extension services

The shore-to-shore approach forms the cornerstone of NVA's Fisher Friend programme, with the fishermen being supported in every step from the time they leave the shore to the time they return to land. Every day the fishermen decide on venturing out to sea based on the weather forecast, wave and wind speeds provided through mobile phones. The next step is to get a good catch in the most cost

effective manner, for which the fisherfolk are provided with information on potential fishing zones based on satellite remote sensing data — precise coordinates, direction and bearings enabling them to reach the spot directly reducing search time and fuel expenses while at the same time having an assured catch. In order to ensure safe fishing, the fisherfolk are trained on sea safety measures, first-aid practices and trouble shooting for diesel engines, including a series of on-board and on-shore trainings to ensure quality control. Thus the fishermen return safely to shore with a good catch that is hygienic, resulting in increased revenue.

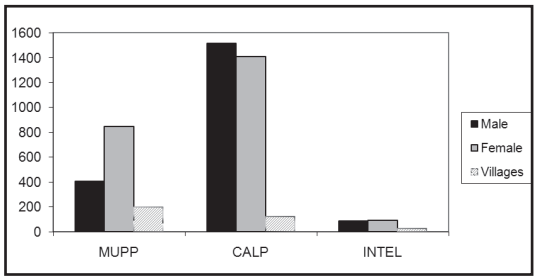
However, market forces play a role in fixing the price for the catch (always lower than anticipated) and many times the species are of the type that fetches low price in the local market. NVA has trained fisherwomen in adding value to low quality fish to increase revenue.

601.4 Education

Regular programmes of Microsoft Unlimited Potential Programme (MUPP), Intel Learn Programme (ILP) and Computer Aided Learning Programme (CALP) along with computer hardware training have been given to the rural community, especially to the children in all the VRCs.

The data presented in **Figure 6.1** represents that of all the VRCs, including Odisha. The gender disaggregated data of the training organised on ICT-based curricula shows that girls outnumbered boys, except in CALP. All

Figure 6.1 ***No. of persons equipped through ICT-based curricula***



the students who underwent the MUPP course got jobs in the IT sector.

Career counselling is another major programme through which 921 students, including 515 girls, obtained guidance from an expert panel integrating different disciplines in choosing higher education options, based on the career avenues across different fields in Tamil Nadu. In Maharashtra and Puducherry, spoken English courses were designed and imparted by two SBI Fellows by which 39 students learnt to speak the language. Twenty-nine vocational courses on Hardware and Photoshop were organised in Tamil Nadu VRCs. As part of academic research, 43 students from different universities and colleges have been placed in VKC villages to research rural development and extension activities.

Table 6.4 gives details of education-related services.

Ten Students of RMK Engineering College, Chennai who were placed in the Informatics division in Chennai have developed a web-based Management Information System for the NVA programme with a data bank of 10 VRC and VKC activities.

Table 6.4 ***Education-related services provided in VRCs and VKCs***

Education services	Total	Male	Female
Career counselling	921	406	515
Spoken English course – SBI Fellow	39	18	21
Vocational – Hardware & Photoshop	29	26	3
Students' placement	43	26	17
Total	**1032**	**476**	**556**

MSSRF-IGNOU Community College

In the MSSRF-IGNOU Community College in Odisha, the courses offered during the year were: Bachelors Preparatory Programme (BPP), Certificate in Computer Application (CIC), Certificate in Watershed Management (WSC), Certificate in Propagation, Cultivation of Horticultural Crops (CPCHP), and Associate Degree Programme (ADP).

As a part of "education for livelihood", the College introduced the sponsored programme of training tribal youths under the SCA-TSP scheme of the Integrated Tribal Development Agency (ITDA); 30 tribal students sponsored by ITDA Malkangiri were trained in horticulture, grafting and gardening. After completion of the training, the students were engaged by the district authority of Malkangiri in horticulture/ plantation work in the region. The students of CPCHP programme were sent on exposure visits to successful nurseries and plantations in other States. The College conducted seminars, workshops and various competitions to enhance personality development and communication skills of the students. The successful initiatives of this Community College were shared with the other IGNOU Community Colleges to improve their functioning.

Enrolment of students in various courses is presented in **Table 6.5**.

Collaboration with academic institutions

Thangatchimadam VRC in Rameshwaram district has been recognised as the study centre by the Tamil Nadu Open University and Kings Catering College, Ramanathapuram, for distribution and collection of application forms for joining the courses offered by them. The Tamil Nadu Open University has permitted the conducting of a Beautician Course in the VRC and provided study books for the students.

Table 6.5 ***Statistics of students at IGNOU Community College, Odisha***

IGNOU –	SC			ST			OBC			General			Total		
Programme	M	F	T	M	F	T	M	F	T	M	F	T	Male	Female	Total
BPP	46	16	62	36	24	60	11	12	23	25	12	37	118	64	182
CIC	18	11	29	16	9	25	4	5	9	30	28	58	68	53	121
WSC	4	0	4	3	1	4	0	3	3	4	0	4	11	4	15
PCHC	17	0	17	44	0	44	-	-	-	3	0	3	64	0	64
ADP	7	4	11	6	4	10	5	3	8	9	4	13	27	15	42

During this year, 60 candidates (F: 40 & M: 20) have completed the course. Sathak Trust in Keelakarai near Ramanathapuram has collaborated with Thangatchimadam VRC to conduct short-term training programmes for village youth and fishermen on diesel engine mechanism, welding and computer hardware. During the process, Sathak Trust has serviced 5 fishing boats free of cost. Sathak Trust and Nehru Yuvak Kendra brought 100 students from Gujarat, Maharashtra, Andhra Pradesh and Karnataka to visit Thangatchimadam VRC.

ADM College for Women in Nagapattinam, affiliated to Bharatidasan University, Tiruchirapalli, has collaborated with the Nagapattinam VRC for developing and conducting a 30-hour short-term certificate course in sea food preparation. The course is proposed to be started from June 2012. The College has also proposed that the VRC should offer the same training course to undergraduate and postgraduate students as part of enhancing their entrepreneurial capacity.

VRC as resource organisation

Nagapattinam VRC has been recognised as a resource organisation by various agencies such as the District Collectorate for training on hygienic handling of marine resources supported by IFAD; by KVK, Nagapattinam as a resource agency for conducting gender training programmes to the extension officials of the Government Departments supported by NABARD and by the Fisheries Department of Nagapattinam district for conducting training on leadership skills, sea safety measures and soft skills development to fisherfolk of the district. A member of the Nagapattinam VRC is a member of the Programme Monitoring and Review Committee in the NABARD-supported project in the district being implemented by Central Institute of Brackishwater Aquaculture (CIBA), Chennai.

601.5 Health

The health services extended by VRCs and VKCs focused on general health care, women's reproductive health and ophthalmic care. Altogether, the VRCs in Tamil Nadu, Puducherry and Maharashtra conducted 32 health camps in 32 villages in collaboration with the local hospitals benefiting 4117 (M: 1527, F: 2590) members. In Odisha VRC, an ophthalmology camp was conducted and free medicines were distributed, and 14 patients who attended the camp were further treated in hospitals.

601.6 Civic and social welfare services to rural communities

VRCs and VKCs disseminate information on civic services/facilities, government entitlements and schemes covering widow and old age pensions, health insurance, income and community certificates, family ration cards, voter identification cards and so forth. In total, 1061 people, including 728 men and 233 women benefited from such services through VRCs and VKCs.

Odisha VRC facilitated several services, such as subsidised loans for SHGs, procurement

of quality fodder maize seeds free of cost, construction of houses, educational support and aid to tribal students, post-natal care, family planning programmes, farm pond construction and drought compensation. The total worth of benefits realised by the community through these programmes amounted to Rs. 907000/-, comprising loans of Rs. 3 lakh to SHGs, Rs. 366000 to 52 farmers, Rs. 150000 to 11 tribal students, Rs.46000 to 18 women and Rs.45000 to 12 families.

601.7 Micro-enterprises training

Training on income-generation programmes have been provided by VRCs in Tamil Nadu, Maharashtra and Odisha. In Tamil Nadu and Maharashtra, 198 members (194 women and 4 men) were trained on small-enterprise initiatives like tailoring, value-added banana products, amla and soya bean products and artificial jewellery making. In the Odisha VRC, sewing and tailoring classes were conducted for 22 school dropout girls and boys. Six students successfully completed the course and are now offering tailoring services as one group in the village.

601.8 Community newspaper

The bi-monthly Community Newspaper (CNP) that provides locale-specific, pro-active and demand-responsive information to the rural community is circulated not only in the VKC villages but also in the non-VKC villages, to a wide range of readers including line departments and NGOs. The details of readership and circulation are given in **Table 6.6**. Over the past 5 years, CNP has been circulated free of cost to different target groups. In this reporting year, CNP has been made available to the rural community on subscription basis with a small cost to contribute towards self-sustenance of the paper. NVA is in the process of registering the community newspaper under the Newspapers and Magazines Act.

Table 6.6 ***Readership and circulation details of community newspaper***

CNP details	Number
No. of readers	2900
No. of subscribers	1259
Subscription collected (in Rs.)	38115
No. of villages covered	311
No. of districts covered	17

601.9 Jamsetji Tata National Virtual Academy Fellows

Since its inception in 2005, NVA has identified rural men and women every year for the award of NVA Fellowships. The Fellowship award does not carry any monetary benefit but is a recognition of their knowledge and committed services to the rural community. The selected NVA Fellows are provided with relevant training to build on their existing skills. One such effort has been to involve the NVA fellows from Tamil Nadu and Puducherry in the phone-in programmes. In all, 6 programmes were conducted during the year in which 333 members including 97 women from different parts of Tamil Nadu and Puducherry participated, which also includes other community members based on the reference given by the Fellows. A brainstorming session was held among the NVA staff to evolve

strategies to engage the Fellows on a continuous basis for strengthening their existing capacity and introducing additional skills. As a part of this, a quarterly newsletter is being developed for circulation among NVA Fellows in the regional vernaculars.

Nomination has been invited to select NVA Fellows for the 8th convocation to be held later this year. So far about 200 nominations have been received from 12 States including the North Eastern States. The process of selecting NVA Fellows through peer review committees in the respective regions is underway.

601.10 Grameen Gyan Abhiyan

Grameen Gyan Abhiyan (GGA) continues to facilitate national and regional events related to ICT enabled rural developmental activities and thereby engage partners across India to deliberate on issues related to knowledge revolution, technology transfer, content, capacity building, etc. The partners include research and academic institutions, government departments, corporate sector and civil society organisations.

GGA partners were invited to demonstrate their mobile-based technological innovations during the Mobile Plus International Conference on "Inclusive Growth through Mobile Applications" organised by MSSRF in September 2011, in collaboration with the International Institute for Information Design (IIID) and Indian Institute of Technology, Bombay (IITB).

In order to strengthen the GGA network and to evolve strategies for the way forward, a meeting was held at the national level with core partners on 24 May 2012. An important agenda of the meeting was to constitute a steering committee for GGA to take forward the initiatives and links with strategic institutions and government departments. A separate website http://www.mission2007.in has been created under the mssrf.org domain in which the profiles of the partners, publications by the GGA secretariat and events are shared for the benefit of the partners.

601.11. Knowledge Management System – Website of MSSRF

Knowledge Management System (KMS) has become an important and integral part of MSSRF, both for internal use for research and improvement and for external users. Organisational experience and research findings are shared in the KMS which is in the public domain. The four KMS websites — MSSRF organisational website, Jamsetji Tata National Virtual Academy (NVA), MSSRF Multi-media Resource Centre and Rural Knowledge Movement (Grameen Gyan Abhiyan) — are hosted through a common domain for public view.

The MSSRF website (www.mssrg.org) contains information on the work being done by 6 Programme Areas across 6 States in the country. Publications, learning tools and photos of activities are available in the respective PA sections.

The Jamsetji Tata National Virtual Academy website covers VRC and VKC locations and activities, government announcements,

education, animal husbandry, micro-enterprises, health, fisheries, agriculture, soil testing and women self-help groups. Content updating and uploading is a continuous process and 443 contents have been added in these topics in the website this year.

Two separate website-based data banks have been created for farmers' soil health cards and daily information disseminated to fisherfolk. These two are sub-domains in the NVA website. The farmers' soil health card website is a data bank of 3500 soil and 120 water test results and fertiliser recommendations made. The website can be accessed by the public and has an option to retrieve data using logical parameters both village and district wise. The village and district wise test results can be analysed logically for each parameter like pH, electrical conductivity, available nitrogen, available potash and available phosphorus. The farmers may be advised accordingly on appropriate measures to improve soil fertility. The soil health card of individual farmers can be printed from the website itself.

The fisherfolk website has daily recordings in the data bank on potential fishing zones, wind speed, weather, wave height as recorded for each district in Tamil Nadu and Puducherry. The location-wise data can be retrieved for analysis. The website has a counter to count the visitors and the pages visited. The annual counter had 16,555 first-time visitors and 17,881 unique visitors who visited 31,720 pages. Out of the total visitors, 1326 visitors have revisited the website pages quite often.

MSSRF Multi-media Resource Centre's website is a repository of audio and video documents of the training / awareness programmes, phone-in programmes conducted for the farmers and the fisherfolk, and conferences conducted in the Foundation as well as of photographs of important events.

The website of the Rural Knowledge Movement (Grameen Gyan Abhiyan) contains detailed profiles of each of the partners and their contact addresses. The expertise of each institution is described for the visitor. This website has been visited by 3561 new visitors and 3969 repeated visitors. In all, 10,862 pages have been visited by the users.

601.12. Utilisation – Focused Evaluation (U-FE)

The U-FE process is continuing with the six teams from 4 Programme Areas — Food Security, Biodiversity, Biotechnology and Information, Education and Communication — constituted to work on 6 selected topics devising an evaluation design each. A simulation exercise was carried out to refine the data collection tools designed by each team. Periodical training programmes were organised for the members during each phase to strengthen their evaluation capacity on the subsequent steps of U-FE. So far this year, 3 training programmes have been organised focusing on evaluation design, method of developing both qualitative and quantitative data collection tools, analysis and interpretation against key evaluation questions, and evaluation use and evaluation

report writing. Besides training, the teams have had several sittings with their members to spur further progress of the work. All the teams excluding one have completed the studies covering the entire process of utilisation-focused evaluation and prepared the reports. It was found that the entire process of this capacity building exercise has helped to build a new skill set among staff to conduct utility-based evaluations of the projects / programmes in the Foundation.

601.13. Overall impact of the Programme Area

Knowledge connectivity to the rural community using various ICTs under the IEC Programme Area of MSSRF is a decade old programme. NVA has undertaken an assessment in a few areas to understand the level of impacts. Some of the findings are reported here.

Community management

A systematic approach has been developed with the participation of the VKC village community from the beginning to own and manage the VKC up to the point now where the VKC Management Committee (VKCMC) has been strengthened and facilitated to look into both the activity and financial sustainability points of view. An assessment conducted among VKCMC members indicated that in 42 out of 52 VKCs (81 per cent) the members are developing quarterly plans, conducting regular meetings, assessing and addressing the needs of the community and monitoring the VKCs, with minimal support from the respective VRCs. In terms of membership in the committee, 65 per cent of VKC management committees have 30 per cent representation of women. Out of 52 VKCs, in 42 VKCs women members participate in the management committee meetings and attempt to involve themselves in the discussions, while women in the remaining 10 VKCs fall under the average and below average categories. Financially, all VKCs put together have generated Rs. 269884/- as sustainability fund (collected from MUPP, INTEL, CNP subscription, soil testing fees, printouts and internet browsing) and also mobilised resources enabling infrastructure development this year. VKCMCs are meeting the electricity bill and internet connectivity charges in some places.

Fisher Friend programme

NVA commissioned two studies during the year to assess the impact of the Fisher Friend programme in Tamil Nadu and Puducherry. One was on “Market study to measure the economic benefit of potential fishing zone and ocean state forecast information to the fisherfolks” and the other on “Role of VRCs in bringing knowledge empowerment among fishing communities”. Stratified random and purposive sampling methods were used; the sampling size of market study was 292 and the knowledge empowerment study was 225. The study revealed that the initiatives of VRC-VKCs has brought behavioral changes among fisherfolk and yielded the following key findings:

Hygienic handling of fishes: Ninety-four per cent of the respondents follow the practice of using ice, of which 78 per cent use ice in the

proposed ratio of 1:1. Only 6 per cent are not using ice because of a very short fishing time, not far off the shore.

Decision making: On the whole, 76 per cent of fisherfolk use VRC information as a source for early warning, of which 93 per cent are using the information for making decisions, such as venturing into the sea, changing the time of fishing, protecting their crafts and nets, etc. The forecast and other relevant information enabled 70 per cent of fishers not to venture into the sea during warning days, 10 per cent of fishers to change the position of the boat anchoring, 8 per cent of fishers reduce boat and net damage and 6 per cent to determine the number of crew in the boat for fishing.

Economic development: Altogether 60 per cent of fisherfolk who utilised the PFZ data indicated that they got increased catch compared to the average regular catch. Seventy per cent of fisherfolk who used PFZ data indicated that there was an increase in net income between Rs. 1000-10000, per catch while 22 per cent enumerated an increased income level above Rs. 25000/- per catch.

Farmer Friend programme

Similarly, farmers who have been supported with information and knowledge in agriculture and animal husbandry management have acknowledged that they have benefited from the timely information and linkage services provided. The voice message advisory and helpline services have helped them to interact with the experts and get solutions to their problems. The number of farmers who accessed the helpline has increased from 380 to 680 in the past year. The thematic phone-in programme has had good response from the farmers. The participation of 984 farmers this year in the programme, posing around 2000 questions in agriculture and animal husbandry to experts, is ample evidence of the demand for the programme and the benefit that it has created.

The exposure visit of 20 farmers to a progressive farmer's field who is practising organic farming in Yavatmal district in Maharashtra has resulted in 4 farmers also taking to organic farming and benefiting from the quality produce and income.

Education: Seventy case studies collected across 5 VRCs from MUPP participants reflected positive changes in them: 66.6 per cent of the women and 32 per cent of the men got employment as data entry operators, computer teachers, in printing and photo studios, and their income ranged between Rs. 2000/- and 8000/-. It is significant to note that the income enabled 33.3 per cent of the women and 8 per cent of the men to meet household expenses, while 6.6 per cent of the women and 16 per cent of the men used it for pursuing higher education, 35.5 per cent of the women and 28 per cent of the men in computer-related programmes. About 62.2 per cent of the women and 52 per cent of the men pointed out that their self-confidence and self-esteem have enhanced.

Sub Programme Area 602

Informatics Division

Informatics Division takes care of management of the technological applications and computer systems in the Foundation, purchase of computer peripherals and equipment for all Programme Areas, intranet and internet services as well as catering to the technological requirements of VRCs and VKCs. As part of the technical infrastructure improvement in MSSRF, bandwidth of internet was enhanced from 6Mpbs to 8MPbs, Spam filter, Barracuda UTM 300, for blocking spam and virus enabled, the Chennai campus made wi-fi enabled and a platform of web-based video / audio conferencing facilities made available for senior staff meetings and project / programme level meetings across regional offices and field sites.

Informatics Division extended its technical support to VRCs and VKCs in terms of maintaining and updating computer systems, internet connectivity, technical infrastructure, including GSM-based public address system, wireless local loop based closed-user group (WLL-CUG) network telephone and wireless broadband connection. The team has provided technical infrastructure for conducting web-based video and audio conferencing, settings for conducting weekly phone-in programmes with the farmers and fisherfolk, sending short text and voice messages, providing hardware and computer maintenance training to VRC staff and VKC Knowledge Workers. In addition to this, with the support of the SBI-sponsored Fellow, it has designed an application of interactive voice recognition (IVR) for accessing audio advisories of the day by farmers through their mobile phones.

It supported 3 international conferences conducted in the Foundation with live video broadcasting of the programmes, 17 counselling programmes for the IGNOU course on sustainable agriculture, 52 video-conferencing interactions between VRCs and Chennai office, including 6 with high-level delegates, and sending voice messages to 55810 farmers, fisherfolk and women SHGs on a daily basis from Chennai, during the reporting year.

Sub Programme Area 603

The Hindu Media Resource Centre

Every year *The Hindu* Media Resource Centre (*TH*MRC) organises public forums and millennium lectures. This year there were eminent resource persons from different parts of the world who participated in the activities.

Public forum

A public forum on “Challenges to Ensuring Food and Nutrition Security” was organised at the Foundation on 19 March 2012, coinciding with the inception workshop of the project on Leveraging Agriculture for Nutrition in South Asia (LANSA). The forum drew on eminent academics and researchers, who had come

to participate in the workshop, to reach out to the larger public on issues of food and nutrition security in South Asia. The session was conducted in the form of a panel discussion chaired and moderated by Professor M. S. Swaminathan. The panellists were Stuart Gillespie, Senior Research Fellow, IFPRI and CEO, Transform Nutrition Research Programme Consortium, Geneva; Mahabub Hossain, Executive Director, BRAC, Dhaka; Bhavani Shankar, Professor of International Agriculture, Food and Health, Centre for Environment, Development and Policy, London; Haris Gazdar, Senior Researcher, Collective for Social Science Research, Lahore; and Madhura Swaminathan, Professor, Sociological Research Unit, Indian Statistical Institute, Kolkata. Following short presentations by each panellist, the session was thrown open for questions from the audience. About 150 people comprising MSSRF staff, representatives from LANSA partner organisations, students, media and the general public participated.

Millennium lectures

Two Millennium lectures were organised by *The Hindu* Media Resource Centre this year. The Millennium lecture on "Nature-based Solutions" was delivered by Dr. Julia Marton-Lefèvre, Director General of the International Union for Conservation of Nature (IUCN) on 21 November 2011**.** In her talk, Dr. Marton-Lefèvre said that IUCN was working on developing specific guidance on what type of intervention could (or should not) be considered as a nature-based solution. It must, for example, bring biodiversity and livelihood benefits, be cost-effective and replicable, and respect and reinforce communities' rights over natural resources. Giving examples of successful nature-based interventions, she said the IUCN and its member, Winrock International India, were working with forest-dependent local communities in the region between the Simlipal Tiger Reserve and the surrounding hills in Odisha, where forests contribute about 25 per cent of the average income, mostly through non-timber forest produce, to turn natural resources into assets for livelihoods. Another IUCN-led initiative was 'Mangroves for the Future' that deployed a nature-based solution by linking ecosystems to climate change and food security. Dr. Marton-Lefevre raised a major governance issue: how to share the use and benefits derived from natural resources, especially since ecosystems do not recognise national boundaries. India and Bangladesh had a trans-boundary initiative – Ecosystems for Life – aimed at a greater understanding of the water issues in the river basin shared by the two countries.

Dr. Pedro Medrano, Director, New York Liason Office and Regional Director for Latin America and the Caribbean, UN World Food Programme, delivered the Millennium lecture on "Achieving the Goal of Sustainable Food and Nutrition Security" on 4 April 2012. Dr. Medrano pointed out that there are major challenges to achieving sustainable food and nutrition security. The biggest challenge, and the events that can set us back the furthest in achieving sustainable development, is the increasingly complex and frequent nature of

emergencies and natural disasters. Without food and nutrition security, we cannot achieve sustainable development. Key food-based safety nets can build this resilience and contribute to sustainable food and nutrition security. According to the World Bank, school feeding can supply 10 per cent of household expenditure for each child who participates, and even more when schoolchildren are given take home rations for their families. School feeding increases school attendance, cognition, educational achievement and gender equality among children. Policies and programmes should be directed to the specific needs of women and smallholder farmers. Food-for-work or asset programmes can provide incentives for the poor to engage in conservation activities and environmental protection.

Special lecture

A special lecture on "Biotechnology for Crop Improvement" was delivered by Dr. Gurdev Khush, renowned rice breeder who has played a key role in the development of more than 300 innovative rice strains and World Food Prize Laureate, on 28 February 2012. He endorsed that genetically-modified (GM) foods are safe and environmentally sustainable.

Sub Programme Area 604

The Every Child a Scientist Programme

The Every Child a Scientist (ECAS) programme commenced in Chennai in August 2002 to ignite young minds on the challenges facing the environment and to sensitise students on the need for protecting the environment. At present, this programme is concentrating on schools in Zones 9 and 10 of Chennai Corporation and a few other schools in the neighbourhood. Opportunities are provided for students to learn about recycling wastes, vermicomposting, composting, water conservation, health and hygiene, etc., through lectures, multimedia tools and demonstrations. The students engage in hands-on science activities. With continuous support from the Joint Commissioner for Education and Zonal Supervisors, this programme has completed a decade with approximately 4000 students having being trained so far.

About 280 students benefited from this programme during the reporting year. The students presented projects on different topics and expressed their ideas in the form of assignments, charts and models. Competitions were conducted regularly and students were taught to make video projects on several topics.

On Science Day, 28 February 2012, students made a model of an eco-friendly village. On 29 February, the students went on an exposure visit to Modern Bakery at Kanagam to understand the different steps involved in making bread, which was an enriching experience.

Touch and Smell Garden

The Touch and Smell Garden is a unique way of helping visually impaired people experience the joy of nature and learn by exploration

through the senses of touch and smell. Children from schools for the blind, visually-impaired adults from various NGOS, visually-impaired computer trainees from the National Institute of the Visually Handicapped (NIVH), Poonamallee, as also other school and college students regularly visit the garden.

DNA Clubs

Odisha

DNA Clubs have been established in 9 schools in 9 different districts of the State. During the year, 484 students (289 boys and 195 girls) and nine teachers participated in the programmes. Twenty-nine guest lectures were delivered on topics, such as bioresources, conservation of biodiversity, environment, climate change, endangered animals and biotechnology. During the year, hands-on training sessions, numbering 37, were conducted on vermicomposting, nursery raising, seed germination, medicinal plant garden development, low-cost poly houses, mushroom cultivation, rice cultivation, poultry farming, vegetable cultivation and herbarium preparation. Twenty-nine laboratory experiments were conducted on subjects like mitosis and meiosis, pond water testing, estimating pH of soil and study of microbial colony. Various competitions like essays, debates, quizzes, posters were conducted in all the 9 schools. *Vanmahostav* (tree plantation week) was observed in all the schools, where massive avenue plantations were taken up. National Science Day, World Environment Day, World Ozone Day, World Science Day, etc. were organised in the 9 schools with the participation of DNA Club student members. Some schools took out awareness rallies on contemporary issues related to bioresources. Students were taught about blood grouping and all the DNA Club student members were mapped for blood groups.

A 3-day DNA Club festival was conducted from in February 2012 at MSSRF, Jeypore, involving 43 students (22 boys and 21 girls) from all the 9 DNA Club schools. World Earth day was celebrated on 22 April 2012 with the theme “Every day is an Earth day”. Children’s Day was celebrated in 5 DNA Club schools: Swami Vivekananda Vidya Mandir, Umerkote; Braja Mohan Meher High School, Bhawanipatna; Madhu Sagar Vidya Pitha, Kendrapara; S.A.I.E.Centre, Rayagada and S.A.S.N., Kundra.

A group exposure visit to Nayagarh district was organised in October 2011, involving 58 students and 13 teachers from 5 DNA Club schools. A visit was also made to SAMBHAV, a NGO working on natural resources management in the Kesharpur Reserve Forest to orient students about community conservation of forest areas, and to the Sericulture Research Station, deer park and watershed reservoir. DNA Club of Koraput visited the Sericulture Research Station, forest plant nursery, agricultural farm, Coffee Board and Krishi Vigyan Kendra located in the district. In March 2012, Braja Mohan High School in Kalahandi district organised an exposure visit of 59 students with 2 teachers to Ramakrishna Mission, Bhawanipatna, to orient students about organic agriculture, sustainable, poultry

farming, dairy, conservation of medicinal plants, etc.

Fourteen students (6 boys and 8 girls) and 4 teachers from 5 DNA Club schools participated in the Third Indian Youth Science Congress at New Delhi in November 2011.

Green Dream, the annual magazine on the activities of the DNA Club programme in Odisha, was published during the reporting year.

Kerala

DNA Club activities were implemented in 8 schools in 8 districts of Kerala, with the support of the Department of Biotechnology, Government of India. The major activities included 20 invited lectures, 4 exposure visits, 10 scientific experiments, and a few audio visual shows on biodiversity and nature. DNA Clubs created awareness and ran a campaign on a plastics-free campus, and also established medicinal gardens and vermicompost units in selected schools.

Vacation training programmes

A 17-day vacation training programme (VTP-2012) was organised for students in Kerala who had appeared for the Class X examination in 2012. VTP-2012 was inaugurated by Ms. Jayalakshmi, Minister for the Welfare of Scheduled Tribes and Youth Affairs, Government of Kerala, on 27 April. As many as 30 students from different parts of the State, selected through a competitive process, took part in the training. The programme focused on topics relating to biodiversity conservation and the applications of biotechnology in agriculture and food security.

In Odisha, a 15-day vacation training programme on bioresources and biotechnology was organised from 20 April to 4 May 2012, in which 32 Standard X students from 23 schools belonging to 21 districts participated.

Sub Programme Area 605

Library and Information Services

In this reporting year, 226 books have been added to the MSSRF Library's existing collection of 17491 books. In addition, it has 382 CDs on various topics, 140 journals, 2824 bound journals and 194 newspaper clippings for the year 2011-2012.

The Library provided digests of information downloaded from the Internet and rendered alert services, such as current awareness services, selective dissemination of information, article alert services, document delivery, publication and distribution services, reprographic services and newsletter alert services. These alert services are tailor-made to the requirements of individual researchers at MSSRF.

During the year 525 students from national and international universities have accessed the library services.

Programme Area 700

WORKSHOPS, CONFERENCES, PARTNERSHIPS AND INSTITUTIONAL INITIATIVES

Three international conferences as well as inception meetings of three new projects were among the key events organised during the year. Partnerships with the banking and corporate sectors under their CSR projects saw the launch of new initiatives and strengthening of ongoing programmes. Gender, building up of grass-roots institutions and development training and capacity reinforcement were taken up as cross-functional activities cutting across Programme Areas to bring more focus and consolidation.







Imparting farmer-centric training programmes through farm schools and sharing knowledge and experiences through national, regional and international meetings, consultations

Programme Area 700

Workshops, Conferences, Partnerships and Institutional Initiatives

Sub Programme Area 701

Workshops and Conferences

International Conference on Mangroves for Coastal Area Management, 7-10 August 2011, Chennai

To commemorate the International Year of Forestry, an International Conference on Mangroves for Coastal Area Management was organised by MSSRF in collaboration with Mangroves for the Future (MFF) and the Society for Integrated Coastal Zone Management (SICOM), Ministry of Environment and Forests (MoEF), Government of India.

The Conference endeavoured to act as a platform for meeting and sharing issues, concerns, successful experiences and finding the way ahead by bringing together organisations and individuals working in the areas of mangroves and coastal management. Scientists, researchers, conservation experts, managers and policy makers from India and abroad deliberated on the current status of mangroves in selected countries, community-centred management initiatives and innovative programmes to enhance the livelihood security of mangrove communities. The Conference also discussed and identified future research areas and policy interventions in the conservation and sustainable use of mangrove wetlands and their resources.

A total of 121 delegates (25 women and 96 men) from six countries — India, Sri Lanka, Bangladesh, Thailand, Vietnam and the UK — participated in the Conference. The participants from India comprised scientists, forest managers, NGO representatives and policy makers from the 8 coastal states of Tamil Nadu, Andhra Pradesh, Odisha, West Bengal, Kerala, Karnataka, Maharashtra and Gujarat and from MoEF, Government of India. The recommendations of the Conference were forwarded to MoEF for further action.

Launch of the IFAD-EU Project on Under-utilised Crops, 5-6 September 2011, Chennai

A project on reinforcing the resilience of poor rural communities in the face of food insecurity, poverty and climate change through on-farm conservation of local agrobiodiversity funded jointly by the International Fund for Agricultural Development (IFAD) and the European Union (EU) and internationally co-ordinated by Bioversity International, was launched with three India partners, namely, MSSRF, Gene Campaign and Action for Social Advancement (ASA). Dr. Stefano Padulosi, Senior Scientist, Dr Adam Drucker, Senior Economist and Dr Prem Narain Mathur, South Asia Coordinator and Senior Scientist, all from Bioversity International, Dr Suman Sahai, Gene Campaign; Dr Ashis Mandal, Director,

ASA; Dr. Gigi Manicad, Oxfam-Netherlands; and Dr. Ajay Parida, Dr. S. Bala Ravi and Dr. Oliver King, all from MSSRF, participated. The work plan for the first year was discussed and approved.

Inception Meeting of the Aus-Aid – CSIRO-funded Project on Seasonal Forecasting and Food Security, 6 -7 September 2011, Chennai

Representatives from the Commonwealth Scientific and Industrial Research Organisation (Australia's national science agency), the South Australian Research and Development Institute (SARDI), MSSRF, Tamil Nadu Agricultural University, India Meteorological Department, Sri Lankan Department of Meteorology, and the University of Peradeniya, Sri Lanka, participated in a meeting to discuss the implementation framework and other details concerning the project on Seasonal Forecasting and Food Security. As a follow-up to this inception meeting and as a capacity-building activity under the project, a workshop on Decision Analysis was held at Hyderabad on 2-3 May 2012. Dr. Peter Hayman, Principal Scientist, Climate Applications, SARDI facilitated the interactive workshop, bringing in various stakeholder perspectives on how farming decisions are made with available forecasts.

Mobile Plus: International Conference on Inclusive Growth through Mobile Applications, 15-16 September 2011, Chennai

The International Institute for Information Design (IIID), the Indian Institute of Technology, Bombay (IITB) and MSSRF jointly organised Mobile Plus: International Conference on Inclusive Growth through Mobile Applications. The issues addressed included information design challenges for bringing relevant content via mobile phones to people who would otherwise have no access to such information, methods of exchange and interaction to promote inclusive growth, and aspects of communication that are appropriate and understandable in order to empower people and support socio-economic development. There were more than 150 participants from seven different countries. Representatives from the Prime Minister's Scientific Advisory Committee and the Department of Information Technology, Government of India, also participated.

Progress Review of the Project on Food Security with Regional Staple Foodgrains, 26-30 September 2011, Jeypore

A review meeting of the project on enhancing food security of rural families through production, processing and value addition of regional staple foodgrains in India was attended by the project staff from the partner institutions — University of Agricultural Sciences, Dharwad (UAS-D), Himalayan Environmental Studies and Conservation Organisation (HESCO), Dehradun, Faculty of Agricultural and Environmental Sciences, McGill University and MSSRF. The International Development Research Centre (IDRC) was represented by Dr Sara Ahmed from the India Office and Dr Kevin Tiessen from Ottawa. The team visited the project site in Kundra,

the field experiments under progress, the grain-processing centre and the value-addition activities of the women SHGs. An important side event was an exhibition of several millet-based value-added products being commercialised by the three Indian partners.

Regional Training Programme on Plant Genetic Resources and Seeds: Strengthening Community Resilience, 31 October-18 November 2011, Jeypore and Chennai

The focus of the training programme was on climate change, agrobiodiversity, community empowerment and resilience, conservation strategies, CBM methodology and practices, participatory learning and action research, multi-stakeholder processes and social learning, genetic resources and climate change policy frameworks. The programme paid special attention to participatory and multi-stakeholder approaches, and placed CBM into local, national and international conservation and climate change policy contexts.

The training programme was designed for professionals who aim to promote the conservation and use of plant genetic resources for agriculture and link this with climate change adaptation. The 14 participants were from various countries, such as Cote d' Ivore, Ecuador, Ethiopia, Ghana, Guatemala, Nigeria, Norway, Serbia, Sudan, and Zambia, drawn from political, public, civil, research, education and development organisations. It was funded and organised by Wageningen University Centre for Development Innovation, the Centre for Genetic Resources, the Netherlands, in collaboration with MSSRF. The first part of the programme on participatory approaches in genetic resource management was held at Jeypore, followed by the second half on plant genetic resource policies at Chennai. The training included case studies. excursions and fieldwork.

Third Youth Science Congress, 3-5 November 2011, New Delhi

The third Youth Science Congress on Youth and Agenda 21: Shaping a Sustainable Future was organised by MSSRF in collaboration with Rajiv Gandhi National Institute of Youth Development, SRM University, National Bureau of Plant Genetic Resources and Vishwa Yuva Kendra to provide a national-level forum for young research scholars and students.

The Conference was inaugurated by Shri Ajay Maken, Union Minister of State for Youth Affairs & Sports. Dr. S. Ayyappan, Director General, ICAR, also spoke. All panel discussions veered around lack of awareness on various opportunities for youth and motivated the young student delegates to think beyond their textbooks and curriculum. The session on improving education in schools and colleges dwelt at length on learning beyond what is taught in formal schools and colleges. The 4 parallel sessions saw enthusiastic participation, with approximately 20 presentations by students from different universities in the country. Forty posters were produced along the lines of the parallel sessions.

Training Programme on Climate Risk Management at the Local Level, 21-24 November 2011, Chennai

Under the Climate Change Programme initiative, a training session was organised on Climate Risk Management at the Local Level for 31 participants from Tamil Nadu, Kerala and Odisha. The objectives were to assess/ understand climate risks in selected sites and associated local adaptation measures; to train a cadre of Master Trainers in local-level climate risk management; and to impart training for Climate Risk Managers at the community level on a pilot basis on weather-based farming.

The training sessions focused on a general overview of climate change, its impact on various livelihood sectors like agriculture, water, livestock and forestry with specific modules on risk assessment, and contingency plans and alternative cropping strategies at the local level. An interactive session helped the participants understand practical issues. The final day was exclusively devoted to hands-on experience in the field, looking at how weather information is scientifically gathered through agro-meteorological equipment and disseminated through ICT.

Workshop on Clima-Adapt, 24 April 2012, Chennai

A new project has been funded by the Norwegian Embassy in India called Clima Adapt. The project partners include the Norwegian Institute for Agricultural and Environmental Research, MSSRF, the Tamil Nadu Agricultural University, Water Resources Organisation, Irrigation Management Training Institute (Tamil Nadu), the Water and Land Management Training and Research Institute (WALAMTARI) and the International Water Management Institute (IWMI) from Andhra Pradesh. The various work plan packages, site selection criteria, reporting schedules and institutional structures linked to the project were discussed at length in the workshop.

Conference on Rio +20: Green Economy and Inclusive Growth. *Fresh Solutions to Asia's Urgent Development Problems*, 3-7 May 2012, Chennai

The conference Rio +20: Green Economy and Inclusive Growth. *Fresh Solutions to Asia's Urgent Development Problems* organised by MSSRF and the Ramon Magsaysay Award Foundation (RMAF) was attended by 14 Magsaysay laureates across Asia. The RMAF Trustees, well-known environmentalist Mr. Anil Joshi from Uttarakhand and academics and researchers from Chennai also participated.

A draft platform for Rio +20 that was drawn up identified the following priority issues in Asia:

- Rapidly increasing rate of environmental degradation compounded by climate change
- Persistent mass poverty, hunger and malnutrition
- Increasing social disparities leading to heightened social tensions

The Laureates committed to collectively pursue the following actions:

- Develop, articulate and staunchly advocate at national and local levels, alternative development models that mobilise Asia's poor communities, and especially its women, in the search for new ideas and local technologies to solve problems.
- Collate and faithfully disseminate a Body of Practice where holistic, successful models in building community-based and community-owned solutions nurtured by transformational leaders can be systematically replicated in Asian societies.
- Consistently champion the intrinsic creative ability of Asia's poor to address their needs from the ground up so that, in the recognition of their efforts, they may be further empowered, inspired and may take pride in themselves and their work.

The Magsaysay Award recipients who attended the Conference were Angel Alcala (The Philippines), A.T. Ariyaratne (Sri Lanka), Jockin Arputham (India), Chandi Prasad Bhatt (India), Ela Bhatt (India), Harish Hande (India), Juaini Hasanain (Indonesia), Mahesh Mehta (India), Tri Mumpuni (Indonesia), Antonio Oposa, Jr. (The Philippines), Aruna Roy (India), P. Sainath (India), M. S. Swaminathan (India) and Yu Xiaogang (China).

Visit of Shri Naveen Patnaik, Chief Minister of Odisha, 10 May 2012, Chennai

A meeting was organised in connection with the visit of Shri Naveen Patnaik, Chief Minister of Odisha, to the Foundation. An exhibition highlighting MSSRF's work in Odisha was put up on the occasion. Dr. Ajay Parida made a brief presentation on MSSRF's work under different Programme Areas and highlighted the activities undertaken in Odisha. Following discussion about some of the work, the group was linked with MSSRF's centre in Jeypore via video conference for interaction with village community members who had gathered there. Shri Patnaik asked them about the operation of some of the government schemes like maternity benefits and bicycles for high-school girls.

MKSP Participatory Monitoring Workshop, 14-16 May 2012, Wardha

In January 2012, a detailed result-based monitoring plan was drawn up for MKSP in a 4-day workshop in Chennai attended by all staff members involved in the implementation of the programme. Following this, a participatory monitoring workshop was organised in Wardha with representatives of women farmer groups to evolve a monitoring and evaluation framework from the perspective of the women farmers themselves. Twenty-six women farmers participated and evolved indicators for assessing the effectiveness of the programme.

Second Review of the Project on Food Security with Regional Staple Foodgrains, 14-16 May 2012, Chennai

The meeting successfully reviewed the progress achieved by the project. In view of the crop season of the current year extending up to November-December, a no-cost extension of

the project up to March 2013 and organisation of a valedictory national conference on regional staple crops were recommended.

Brainstorming Workshop on Addressing Household Level Food and Nutrition Security for Tribal Areas, 24-25 May 2012, Chennai

Organised in collaboration with Vigyan Prasar (Department of Science and Technology), this workshop was attended by 25 experts from different States of India including scientists, government officials, nutritionists, academicians, technical managers, implementing agencies and NGO representatives. The focus of the discussions was on food and nutrition security issues in tribal areas and on identifying gaps and future strategies to reach out to the target group through science and technology. The presentations highlighted the prevailing nutrition scenario among tribal communities in India with focus on NFHS and NNMB data; studies conducted among tribal communities; community-based food and nutrition security interventions; technologies available to address household food and nutrition security; factors affecting tribal food and nutrition diversity; role of government agencies, research organisations and institutions in addressing tribal food and nutrition security; the need for region-based nutrition education/resource materials to improve household food and nutrition security among tribal communities. After detailed presentations, deliberations and brainstorming sessions, research topics and IEC strategies were identified and the recommendations generated were compiled.

Sub Programme Area 702

Partnerships

Support from the banking and corporate sectors under their CSR initiatives has enabled MSSRF to undertake many innovative projects. While many of these find mention under different PAs, these are highlighted in a consolidated manner in this section.

702.1 MSSRF-IOB Farm Schools

The National Commission on Farmers (2004-06) constituted by the Government of India under the chairmanship of Professor M. S. Swaminathan had made many practical suggestions for revitalising the lives and livelihood of farming communities . One of the recommendations was to set up Farm Schools based on the method of learning-by-doing.

In a country where agriculture is a major activity, there are unfortunately very few farmers who have shown the way to make farming more attractive and rewarding. Such farms that are successful are “centres of learning”, managed by farm families taking into account proper management of natural resources, judicious use of water, adoption of new and improved cultivation methods, innovative farm management, adequate access to credit facilities and need-based processing and market linkages. These farms have been able to show that, if properly managed, taking up

agriculture can be attractive as a viable career option.

With support from and in partnership with Indian Overseas Bank, MSSRF has taken the initiative in identifying progressive and leading farmers in 5 agro-ecological zones with distinct agricultural practices. These farmers have been provided with adequate facilities for undertaking the establishment and operationalisation of Farm Schools.

The key features of the Farm Schools are:

- They are to be set up in the field of outstanding farmers and winners of nationally-recognised awards.
- They must be operated by progressive farmers, extension functionaries or experts belonging to government or non-government sectors.
- They must set up front-line demonstrations focusing on integrated crop management including field preparation, seed treatment, IPM, INM, etc.
- The trainees in the Farm Schools would be from farming communities in nearby villages.

Farm schools have been established in the farms of Eldho Baby of Pozuthana gram panchayat, Wayanad district, Kerala; Gobinda Ghiuria of Nuaguda village, Lima panchayat, Koraput district, Odisha; Kalaiselvan and Pasupathi Kalaiselvan, Kannivadi, Dindigul district, Tamil Nadu; Kalaivani Rajendran, Pasupathikovil panchayat, Thanjavur district, Tamil Nadu; and Suresh Pawde of Takarkheda village, Wardha district, Maharashtra. These six admirable farmers have established residential facilities for men and women from neighbouring villages to spend time in their farms to understand the innovative practices they follow and to share their knowledge and experience.

702.2 Partnership project with HPCL

Hindustan Petroleum Corporation Ltd (HPCL), Mumbai has supported MSSRF under its CSR initiative with a small initial grant to augment water security in two of the BIWS sites — Nallavur watershed (Karasanur panchayat, Villupuram, Tamil Nadu) and Upper Vellar watershed (Illupur taluk, Pudukottai, Tamil Nadu). At Karsanur, 12 small and marginal farmers belonging to the Dalit community were helped to renovate their open wells which were not able to store enough water due to siltation, forcing the farmers to leave their meagre landholdings fallow. With the renovation completed, the wells are already seeing an increased storage of water and the farmers are eagerly looking forward to convert their fallow land to productive use. With assured irrigation, they can now cultivate a second crop also, adding to their income and food security. At Illupur, two rain-fed tanks were renovated and two sluices and a weir repaired, in addition to excavating a community agri-open well. Rehabilitation of the tanks has the potential to support nearly 90 farmers owning 80 acres of land in accessing assured irrigation. The agri open well catering to the needs of 16 Dalit women farmers has helped them make their hitherto fallow land productive, where they are

enthusiastically raising horticulture trees. The HPCL team from Mumbai visited both the sites recently to observe the progress and to interact with the stakeholders and were impressed that their support has been able to make positive impact on the poorest sections of the Indian agriculture community.

702.3 Collaboration with BPCL

BPCL has sanctioned the establishment of two soil- and water-testing laboratories, one in Waifad VRC in Wardha district and another in Yavatmal VRC. The primary objective of these testing laboratories is to educate farmers on the importance of soil testing and soil health management as well as to provide correct advice on fertiliser use and application. Awareness programmes have been conducted in 5 villages on the importance of soil testing and sample collection procedures, involving more than 150 farmers. A total of 360 soil samples have been tested. Regular village meetings are being conducted with the help of soil scientists and experts in answering the queries of the farmers.

702.4 Support from Pratiksha Trust

Pratiksha Trust, Bangaluru, has supported MSSRF in diverse activities.

1. A Technology assessment, development and dissemination centre has been established in Puducherry. The main focus of this centre is to demonstrate additional avenues of income generation that would supplement the income farmers obtain from their regular agriculture practices. The Centre demonstrates a basket of technologies, such as integrated farming systems, nutrition gardens, floriculture, horticulture, livestock, fodder grass and legumes, mushroom spawn production, biocontrol inputs, vermicomposting, pisciculture, animal clinics and 24-hour helpline services. A rural energy centre is also being set up in the Biocentre at Puducherry for awareness creation and demonstration of low-cost energy options. Rehabilitation of some of the demonstration units damaged by cyclone *Thane* was also undertaken. The demonstration units are now functioning normally to their full capacity. Some of the successful outputs have been in the replication of some demonstration units in the nearby villages, benefiting more than 300 women. The helpline service and the animal clinic have so far reached more than 20 villages, servicing about 500 animals. Vermicompost demonstration was held in 10 villages.

2. Assessing the genetic diversity of nutritionally important species was undertaken in order to identify nutritionally-enriched genotypes, such as *Moringa oleifera*. Study of the genetic diversity in *Moringa oleifera* for the development of genetically-distinct germplasm and conservation has been undertaken. The accessions were assessed for iron content and analysed for phenotypic differentiation based on seed character. The genetic diversity of 30 accessions of *Moringa oleifera,* collected from Odisha and Tamil Nadu, were analysed using SSR and AFLP

markers. Nutritional genomics studies have also been undertaken in order to understand the pattern of gene regulation and isolation of nutritionally-enriching genetic material.

3. Similar studies were also undertaken in the case of nutritious millet species. Millets encompass 10 genera and about 14 species and are generally referred to as "orphan crops". A great deal of morphological differences exists among the landraces of these millets owing to the various eco-geological regions they are grown in, making classification of these species confusing. A detailed study was undertaken to review the level of genetic divergence and to infer their phylogenetic relationships using molecular markers. Seven millet species that are grouped as minor millets, represented by 24 races and 106 accessions, were analysed for the level of diversity. These studies have helped to identify some of the distinct and location-specific genotypes.

4. Food and nutrition security are among the major concerns of the rural communities. MSSRF has initiated developing a cadre of Community Hunger Fighters (CHFs), starting with one man and one woman, from 20 villages in Koraput district. The CHFs are trained in addressing the major causes of malnutrition, i,e., availability, access and absorption of food (see details under SPA 501). Such CHF volunteers will work with ASHA workers belonging to the National Rural Health Mission and other relevant staff of government programmes such as MGNREGA to ensure that the numerous nutrition and health support schemes reach the unreached. CHFs are being trained to address issues of adequate nutrition for pregnant mothers, in order to ensure that the newborn child has adequate birth weight. A similar effort is being planned in the Vidarbha region of Maharashtra.

5. Awareness creation for bioresources and natural resources conservation were undertaken involving school students in Odisha and Kerala. The major objective was to inculcate the importance and relevance of bioresources conservation for environmental protection and preservation. More than 500 students from biodiversity hotspots were provided exposure visits to natural heritages sites, hands-on experience in identification and preservation of natural resources, and discussions with experts in the field. Two residential vacation training programmes, each of 3-weeks' duration, were conducted in Koraput and Wayanad, attended by 60 students.

702.5 Association with Mitsubishi Corporation

Since 2006, Mitsubishi Corporation has been supporting MSSRF's work with the tribal and rural communities in the Koraput region of Odisha under its CSR programme, beginning with the supply of 200 solar street lamps in 32 villages followed by the establishment of a residential Human Resources Development Centre at BPMPGRC, Jeypore. This Centre, with accommodation facilities for more than

60 people, is being extensively used for skill and capacity development of the rural and tribal communities, government and non-governmental agencies as well as for conducting several national, regional and international training programmes. Continued support from Mitsubishi Corporation is being utilised for natural resource management (soil, water, biodiversity), enhancement of on-farm and non-farm employment opportunities, value addition to primary producers, provision of community-level village development funds, and organisation of several awareness programmes in the area of food and nutrition security. The collaboration has enabled MSSRF to initiate and sustain activities in 25 villages of the region, covering a total population of 4095, involving 802 households, of which more than 600 households are below poverty line with 70 per cent belonging to tribal families. Major activities conducted during the year include off-season vegetable cultivation in 127 acres, establishment of 100 vermicompost units, aquaculture in 28 farm ponds and backyard poultry farming in 250 families. The support has led to increase in farm productivity as also increase in the number of working days. The promotion of backyard kitchen gardens has also helped the communities to enlarge their food basket through consumption of home-grown vegetables.

Sub Programme Area 703

Institutional Initiatives

A conscious process of institutionalising activities with relevance across the Programme Areas (PAs) has been initiated. The issues covered include gender mainstreaming, grass-roots institution building and development training and capacity building of staff and community.

703.1 Gender

The Gender Institutionalisation and Mainstreaming (GIM) group in MSSRF has been working since April 2010 in providing guidance and support for effective integration and mainstreaming of gender concerns in MSSRF interventions. The group was started with 10 members and evolved its course of action during the first year. Currently the group consists of an equal number of men and women totalling 18, representing all the PAs. Several workshops were organised during this reporting period to strengthen the knowledge, skill and capacity of the GIM group.

A proposal developed by the Coastal Systems Research team on the conservation and development of the Vedaranyam coastal zone based on Gandhian principles was the basis for a workshop organised during 17-18 June 2011 on integration of gender in the proposal by adopting the project- cycle approach . The workshop covered themes such as gender mainstreaming, integration of gender in the objectives and at the activity level, gender-sensitive implementation, monitoring and evaluation, and gender-responsive budget development.

A workshop on Gender, Power and Empowerment conducted on 14 July 2011 covered the subjects of gender and power

relations and translating empowerment frameworks to project planning.

A paper critiquing workshop was organised on 14 October 2011 with the objective of strengthening members' conceptual understanding on gender with regard to paper writing. As a pre-workshop assignment, 4 articles (categorised into 2 sections) and 1 review paper on gender were circulated. Members were requested to critically analyse a paper from each section and send their inputs. Detailed guidelines were provided for critiquing the paper.

An exercise on report writing was organised on 11 November 2011. Guidelines were given for writing a short report by taking one activity and discussing it. A clear outcome from the workshop was that the members need exclusive training on methodology to capture gendered outcomes.

Following these short-term workshops, a 5-day training programme was organised from 28 November to 2 December 2011 on Gender Equality and Social Empowerment in Agriculture and Rural Livelihoods with resource persons from IFAD. The main objective was to accelerate progress towards rural women's empowerment and economic security by enabling participants to better understand gender issues in agriculture, identify actions, initiatives and partnerships to strengthen their programmes and search for innovative ideas. The content was mostly based on the source book on *Gender, Agriculture and Rural Livelihoods* which has been developed jointly by the World Bank, FAO and IFAD. The themes covered during the workshop were: a general introduction to the concepts of sex and gender; the IFAD approach to gender, poverty and social targeting; checklists in use for gender and social targeting; thematic modules covering agriculture, livelihoods, food security and natural resources management; empowerment strategies through case studies; LFA and M&E; knowledge management and knowledge sharing; and follow-up plans. The most outstanding feature of the workshop was its process methodology which enabled the participants to engage with the content intensely and creatively through a rich variety of strategies and exercises, which themselves deserve to be compiled into a compendium of value to any trainer. The method allowed for flexibility to make changes in the plan in response to the expressed needs and interests of the participants, combined with rigour.

As a follow up, a one-day meeting was held on 17 Dec 2011 to integrate actions into quarterly work plans. Subsequently, the GIM members provided an initial orientation on gender and shared the proceedings of the IFAD-supported workshop with the field staff in respective locations.

Further, to strengthen the gender component in the initial stages of projects, a one-day training workshop was organised on social targeting: inclusion and exclusion. The importance of gender in relation to caste, class, age and other relevant variables were discussed along with sharing the strategies of social inclusion in their respective programmes.

Capacity building on gender at field level

A process has been initiated to gradually sensitise and involve all staff in all projects/ programmes by extending gender/social training to all field sites with the help of GIM members. The first field-level orientation on gender was carried out in Wardha from 16-20 April 2012 for the staff of the Food Security and IEC PAs working in the Vidarbha region. Twenty-six members (16 men and 10 women) participated in the programme, which was conducted in the local language with the support of an external resource person. The themes covered were gender and sex, origin of patriarchy, census definition, women's work, gender analysis, empowerment strategies, gender and violence, women's rights, government programmes for women in the State, social targeting with field-level exercises on gender analysis and follow-up plans for action. A similar programme was organised in the Jeypore field site from 20-24 May 2012 for 23 staff members, with two external resource persons. The themes covered were poverty and gender dynamics in the context of south Odisha, gender discrimination in tribal communities of Koraput region, workload of men and women among tribals, violence, gender, science and technology, social targeting, gender analysis, women's work (especially productive and reproductive work), social mobilisation and organisation, etc.

Apart from such capacity-building programmes, efforts were taken to extend necessary support for integrating gender in specific projects/ activities at the level of planning and appraisals, in partnership with concerned PA leaders. At the institutional level, to mainstream the social inclusion in all the programme interventions, effort has been initiated to develop guidelines for social inclusion.

703.2 Grass-roots institutions

Over the years, MSSRF has been facilitating the setting up of community-based grass-roots institutions across field sites to institutionalise interventions. Nine such institutions have been formed across sites till date. They have been registered under different legal forms, depending upon the context-specific objective.

In order to strengthen and mainstream the process, an initial assessment of each of these institutions was carried out. The assessment covered details such as membership profile, stated purpose (goals and objectives), registration details, activities list, spread and year-wise progress, operational guidelines including organisational/governance structure, participation of men and women in leadership positions, roles and responsibilities at different levels, period of rotation, frequency of meetings at different levels, nature of issues discussed, record maintenance, type of support given by MSSRF in terms of financial, technical, managerial and training, linkages with other institutions such as Banks, panchayats, government departments at local level, other groups and unions and political parties, services provided to MSSRF by them, infrastructure available, and planning and monitoring systems and organogram of the

institutions. The assessment reports indicate that the 9 institutions are at different levels of functioning and need to be strengthened further to institutionalise the Foundation's interventions and internalise development perspectives.

Subsequently, in-depth assessment is being initiated to study the progress, current status and impact of two SHG federations — Innuyir Grama Sangam, Pillayarkuppam, Puducherry and Kulumai Federation in Kannivadi, Dindigul district, Tamil Nadu. The assessment has been designed at 3 levels: member, group and federation. The assessment at the member level will look at the impact at the individual and family level on the socio-economic factors and the women-empowerment aspects. The expectations of the members from their groups and federations and their contribution to achieve these will also be understood. The assessment at the SHG level will assess the impact of the group on the members on different parameters, their ownership of the groups and the expectations of the members from the groups. The federation assessment will be done on following parameters: finance, governance and development and the impact on the members and their expectations.

Based on these assessments, a future search exercise involving the members, leaders, federation staff and MSSRF staff will be organised and a perspective plan for each federation for the next 5 years will be evolved jointly by all the stakeholders. The design and resource persons to support this exercise have been finalised. A major portion of the member and SHG level assessments has been completed in one of the federations. An orientation to the staff and leaders of the second federation regarding the assessment has been done. The exercise will be completed in the next 6 months in both the federations. A lot of learning for building grass-roots institutions would be one of the major outcomes of this exercise besides setting the agenda for the two grass-roots institutions involved.

703.3 Development training and capacity building

Training and capacity-building initiatives have been regularly taken up at different levels — staff, community and other stakeholders in development. In order to give more emphasis and thrust to these efforts, a new cross-functional area on training and capacity building was created within the Foundation during the year.

Capacity building is one of the crucial elements for achieving significant impact in development work. The human resources at all levels need to be equipped with the needed knowledge, skills and attitude to be able to bring about the desired changes in the lives and livelihoods of the poor communities that MSSRF is working with. Well-designed capacity building programmes will help the individuals and teams to work efficiently and help achieve the goals of the programmes/projects undertaken by them. Such capacity-building programmes along with other opportunities for ongoing professional development will help them to reach higher levels of performance and effectiveness in their work.

The community has a lot of potential and native wisdom from their own life experiences which can be used for their own development through creating learning opportunities and platforms. They can take charge of their own development and their communities through their organisations which are currently being promoted by the Foundation. To achieve this, it is important to build the capacity of the community members, field workers and staff working closely with them.

With this background, discussions were organised in 2 Staff Council meetings during the year in December 2011 and March 2012 to identify some of the important capacity-building areas at the institutional, staff and community level. The priority themes at each level have been identified and programmes related to them will be organised in the coming months. A combination of resource persons, both internal and external, will be used to conduct the trainings. Partnerships and collaborations will be forged with relevant resource institutions in addition to strengthening the existing ones. From among the prioritised areas, one that would benefit most of the staff will be taken up for action this year.

The areas prioritised at the institutional, staff and community levels are listed below.

Institution

- Induction programme for new staff on MSSRF's mission, vision and approach (HR and Admin policies, the Programme Areas/success stories)
- Shared understanding among the staff and PAs on common and cross-cutting themes like food security, climate change and gender mainstreaming, with mechanisms and methodology to incorporate the same in regular work
- Setting up an M&E system, how it needs to be institutionalised and the linkages between community– staff– region – programme – Foundation
- Interpersonal communication, team building. leadership training and labs

Staff

- Development orientation in working at the grass-roots, understanding of basic development concepts and equipping with basic tools for undertaking this work. Concepts include livelihoods, village study, social aspects of a village, PRA and resource mapping.
- Surveys of different types and methods of conducting, data collection, analysis and use
- Conceptual understanding and its application in baseline surveys and studies, impact studies, etc., participatory appraisal/ impact assessment methodologies
- Thematic appreciation for those with 1-3 years of experience to build their competence and skills in the theme they are working on, for e.g., watershed development
- Basic and advanced courses to cover major management concepts such as project management, financial management,

human resource development, setting up M&E systems and new areas such as results-based management, participatory impact assessment, social audit, appreciative inquiry

- Facilitation of learning journeys in small groups to select resource institutions for learning from their experiences and best practices, with specific predefined purposes such as microfinance, watershed, climate change adaptation, etc.
- Conceptual understanding about the different forms of community organisations and the know-how to build them up — federations, producer companies, watershed associations, village development committees
- Conflict resolution at community/village level
- Financial management and legal compliances for community institutions promoted and facilitated by MSSRF

Community

- Community capacity in accessing entitlements and getting a convergence of services from different sources
- Development literacy for community which can include topics like nutrition, health, education, legal, entitlements, gender, climate change, agro-bio diversity, etc., through appropriate learning materials
- Institution building – three modules: primer, management and future search exercise for field staff (and where required for leaders)
- Financial management and legal compliances for community institutions for community governance team
- Building the capacity of the local panchayat members to function more effectively

Trainings organised

A 2-day programme on leadership and team building was organised in March 2012 for a batch of 30 Staff Council members, including the Executive Director, with the support of an external resource person. Theatre techniques were used to provide experiential learning on team building and leadership. It put the participants in touch with their inherent capability to deliver excellence under pressure and change, with enjoyment and without stress. It generated good bonding, trust, communication with one another as well as a high degree of individual and team creativity. A deeper exploration of the process of leadership which enables the possibilities of teams to excel was also covered. A second programme will be organised for the remaining 30 members of the Staff Council shortly.

A 3-day programme on social mobilisation was organised for the staff of Jeypore Regional Centre in May 2012. It was coordinated by a 2-member team comprising one internal and one external resource person. The purpose was to provide an understanding of the key concepts of social mobilisation, the skills and attitudes needed for being an effective social mobiliser, the process and strategies to be followed in community mobilisation. It was attended by 23 members from the Jeypore team.

Programme Area 800

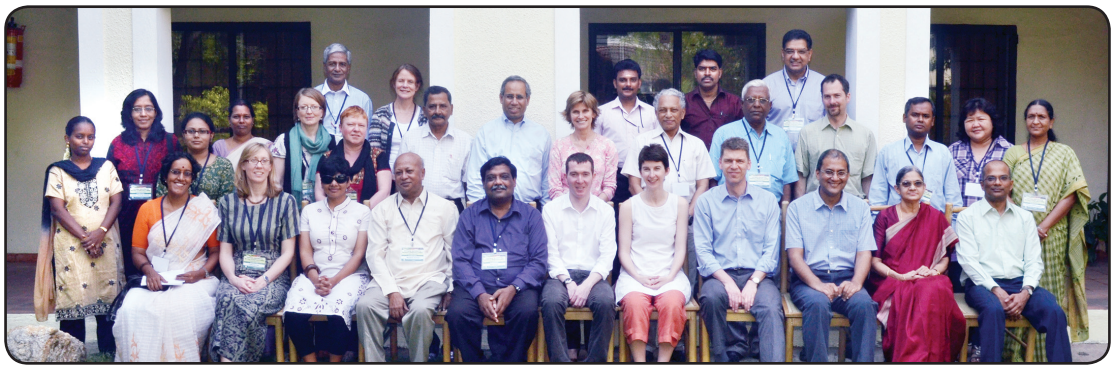
SPECIAL PROJECTS

Baseline surveys were undertaken and activities commenced in all the three project sites of a collaborative initiative on alleviating poverty and malnutrition in agro-biodiversity hotspots. Eight case studies were carried out across different States to understand the impact of bioenergy interventions. MSSRF is a partner in a number of multi-country collaborative projects. The inception workshop of one such project — on leveraging agriculture for nutrition in South Asia — was held in March 2012.









Reinforcing the resilience of poor rural communities in the face of food insecurity, poverty and climate change through on-farm conservation of local agrobiodiversity.

Programme Area 800

Special Projects

There are many ongoing projects that combine aspects of different Programme Areas and initiatives like food security, biodiversity and climate change. Many of these are also collaborative projects with multiple partners both from within the country and outside. These projects are presented in this section.

Sub Programme Area 801

Agrobiodiversity and Food Security

801.1 Alleviating poverty and malnutrition in agro-biodiversity hotspots

This collaborative research project supported by the International Development Research Centre (IDRC) and the Canadian International Development Agency (CIDA) is being implemented by MSSRF and the University of Alberta (UA), Canada, with the overall goal to identify processes that will help in leveraging agriculture for alleviating poverty and malnutrition among small farm families in 3 distinct agro-biodiversity hotspots in India (Jeypore in Koraput district of Odisha, Kolli Hills in Namakkal district of Tamil Nadu and Meenangadi in Wayanad district of Kerala). The project was inaugurated in May 2011 at a workshop jointly conducted by MSSRF and the University of Alberta. Along with representatives of both organisations and senior scientists and policy makers from institutions like the World Food Programme and Bioversity International, panchayat leaders from Kolli Hills and Wayanad also attended this workshop.

The burden of poverty and malnutrition in India, particularly in its rural areas, is very high. The majority of marginal and small farmers who constitute 82 per cent of India's 120 million farm families are poor. This research project aims at interventions based on farming systems as well as nutrition-sensitive farming in agro-biodiversity hotspots as important exit routes to rural poverty and malnutrition.

Thus, this project aims to understand through farmer participatory research concerns such as:

1. What are the main constraints and opportunities associated with production, income and food and nutrition security in agro-biodiversity hotspots?
2. To what extent can integrated farming and location-specific participatory on-farm and non-farm initiatives contribute to increased farm productivity and income?
3. Can nutritional maladies be addressed by remedies based on biodiversity, along with required mineral supplementation at individual, household and community levels?
4. How far can the equity and socio-economic status of rural women, who play critical roles in family nutrition, be strengthened by engaging them in planning and implementing nutrition interventions?

5. Can skill, technology and information empowerment of the communities bring a change in managing resources, production and the value chain?
6. How much of this research outcome can be replicable within and outside the regions?

The broad objectives of this project embedding gender equity, environmental health and sustainable development, include:

- Increasing farm productivity by promoting integrated and sustainable use of local crops and livestock, also involving under-utilised crops, vegetables and fruit trees
- Understanding the gender dimensions of poverty and enhancing the food and nutrition security at individual, household and community levels with a women-centric approach
- Enhancing diversified on- and off-farm livelihood options
- Need-based capacity building of farm families, involving panchayats, governmental, non-governmental and service-providing institutions
- Developing tools and processes, including ICT for information/knowledge management and policy advocacy

The project sites chosen have genetic diversity in one or more crops. Jeypore is notable for rice diversity, Kolli Hills for nutri-millets and Wayanad for yams. These project areas were identified involving the local panchayats and based on available secondary data on size of farm holding, extent of poverty and predominance of socio-economically disadvantaged groups (**Table 8.1**). The activities of the project involve 4004 households (HHs), spread across four panchayats and 34 villages.

The 4004 households include 2004 in Banuaguda and Dangarpaunsi panchayats covering 32 villages of Kundra block in Koraput, 1000 HHs in one village in Valappur panchayat in Kolli Hills, and 1000 HHs in two villages under Kolampetta in Meenangadi panchayat, Wayanad.

Initial meetings were conducted with panchayat representatives, community members, local officials and other community organisations

Table 8.1 ***Secondary data on project sites***

Particulars	Jeypore	Wayanad	Kolli Hills
Total area (ha)	2290	-	2105
Total households	2074	1026	1010
Population	9910	3496	3236
BPL HH %	76	65	90
SC %	20.5	11.0	0
ST %	43.0	18.0	99.6
Major crops	Rice, millets, maize, niger, vegetables	Rice, banana, pepper, coffee, arecanut, yams	Tapioca, rice, banana, coffee, pepper

Source: Various government departments

to explain about the project, its methodologies and benefits. Some of these meetings were focused on women to generate their interest and involvement.

Baseline surveys encompassing socio-economic details as well as farming systems of households and their nutritional status have been initiated. This involved a quick survey of all HHs, which assessed the farming systems, socio-economic status, productive and non-productive assets, gross income, cropping systems, roles of local crops, vegetables and fruit trees, crop-livestock integration, etc.

A high percentage of landless (31.5 per cent across locations) and high predominance of marginal and small farmers (92 per cent of the landed farmers) is notable in all locations (**Table 8.2**). Most of the landless belong to the SC and ST categories. Much of the land is owned by the male heads of the families. While ownership by women is limited to very few HHs, such ownership is more frequent in Wayanad. Joint ownership of land and house between husband and wife in Jeypore is rare and a good percentage of women landowners in Jeypore and Kolli Hills are widows, divorcees or deserted. More women owned houses than land in all locations (**Table 8.3**).

Major crops in each project site along with their relative land area are presented in **Figure 8.1**. The most important crop occupying the largest

Figure 8.1 ***Per cent of total area under major crops in each location***

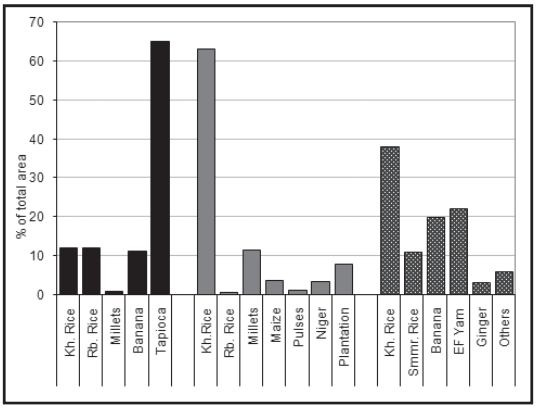


Table 8.2 ***Selected HHs and their landholdings***

Project Site	Total HHs	Land less	Marginal	Small	Semi-Med	Medi-um	Large
Holding size, ha	-	-	<1 ha	1-2 ha	2- 4 ha	4-10 ha	> 10 ha
Jeypore	2004	38	42	12	5.5	2	0.5
Kolli Hills	1000	17	63	16	3	0.7	0.2
Wayanad	1000	33	58	7.2	1	0.6	0.3

Table 8.3 ***Asset ownership of women***

Asset	Owned by Women (HH)			Owned Jointly (HH)		
	Kolli Hills	Jeypore	Wayanad	Kolli Hills	Jeypore	Wayanad
House	128	104	315	85	4	43
Land	101	38	368	83	0	58
Jewellery	546	917	811	27	33	49

area in Jeypore and Wayanad is rice, while it is tapioca in Kolli Hills. While rice is grown virtually only during *kharif* in Jeypore, it is grown during *rabi* and summer seasons in Kolli Hills and Wayanad. Rice in Jeypore is grown in three different areas — up-land, mid-land and low-land — the last offering the highest relative productivity. The major dry land crop in Jeypore is millets, while that in Kolli Hills is tapioca and banana. The other major dry land crops here are nutri-millets (finger and little millets), niger, maize and pulses. Banana and elephant foot yam (EFY) compete for space in the paddy lands of Wayanad. The yield of these crops as well as use of technology for their production is very low, particularly in dry land crops.

Commercial vegetable production by small farmers is being done in a small area in Jeypore during the post-monsoon season with lift irrigation from open wells. While consumption of vegetables is rare in Jeypore and Kolli Hills, it is relatively better in Wayanad, although the overall production and consumption is low. The survey showed the percentages of HHs consuming seasonal fruits and vegetables and livestock products to be very low in Jeypore and moderate in Wayanad, while a good share of HHs in Kolli Hills consumed seasonal fruits such as jackfruit and banana. The most commonly consumed seasonal fruit in Jeypore and Wayanad is mango.

Livestock rearing as an essential component of traditional agriculture is practised more by the small and marginal farmers. Livestock is also an important source of income for landless farmers. It is found that 32.5 per cent of farm families have either cows, oxen or buffaloes, which are reared either for milk or draught and 21.6 per cent of families have either goats or sheep, which are used for meeting cash needs. Backyard poultry is common among 34 per cent of families, while a few HHs also maintain broiler birds for meat. Ducks and pigs are also reared by some HHs, with differences across locations.

Disaggregated analysis of livestock and poultry between landed and landless famers showed that the landless have ownership of 21 per cent of cattle, 62 per cent of goats and sheep, 67 per cent of poultry and 90 per cent of pigs. Almost all pigs in Kolli Hills are owned by the landless families.

The existing level of food and nutrition security is being benchmarked by methods including anthropometric measurements and 24-hour recall. This is being assessed initially and periodically on certain sampled number of HHs in each location.

Community mobilisation for all inclusive participation is an important approach. The project area in each site is divided into a few convenient zones and farmers' clubs (FCs) — a grouping of local women and men farmers, including farmers doing leased cultivation — are promoted in each of these zones. Women members of these clubs and those from landless families are organised, on need basis, into SHGs, each having a specific mission, such as value chain, non-farm income generation activity, promotion

of drudgery-free technologies, etc. Members of the FC who are involved in participatory research are constituted as members of a Farmers' Research Group (FRG). All project interventions involving either women or both women and men, including training, other capacity building and support to mechanised farming practices, etc., are leveraged through the FC. Eight FCs have been formed and registered with NABARD in Jeypore and Kolli Hills. Three SHGs in Kolli Hills and one in Jeypore have been newly formed. Four previously existing SHGs were revitalised in Jeypore. At Wayanad, the project works with Kudumbasree, a chain of women SHGs being promoted by local institutions and the government of Kerala.

Increasing farm productivity

Multiple approaches are used to increase productivity of food and cash crops to make available more food and cash income at the household level. Three farmer participatory field trials are being tested in 2 of the project sites since August 2011. These are: variety evaluation of agronomically superior high yielding varieties of rice and tapioca in Kolli Hills and elephant foot yam (EFY) in Wayanad; and innovative tapioca-based intercrops under improved soil fertility management.

Five new varieties of rice and one widely-used local variety were chosen to address the yield limiting concern of the *rabi* rice crop. Important consideration to grain quality was given while choosing the new varieties as the entire production is consumed by the producers. These 6 varieties were laid out in 2 randomised block design (RBD). The local farmers were involved in evaluation of these trials to assess the comparative performance of all the varieties. Plot-wise yield data was collected and is being analysed for identifying better varieties having higher yield and acceptable grain quality with ability to escape/tolerate terminal moisture stress and rice bugs.

Tapioca is the major annual cash crop for all landed farmers in Kolli Hills. Its cultivation has been exclusively dependent on one variety (H-165) for several years. Because of repeated cultivation, the variety has become heavily infested with cassava mosaic virus (CMV) and mealy bug, both causing substantial yield decline. Therefore, two Farmers' Participatory Variety Trials (FPVTs) were established in August 2011 with 10 improved varieties identified as having resistance to CMV by the Central Tuber Crops Research Institute (CTCRI), Thiruvananthapuram, and one local variety in RBD having 3 replications.

Another important FPVT on tapioca is to study the benefit of balanced application of manure and fertilisers on crop yield and soil health as well as assessing the economic advantages of intercropping small millets and beans (*Dolichos*) with tapioca (variety H-165). The manurial and fertiliser applications are aimed at changing the practice of applying highly imbalanced fertiliser nutrients. This trial with 4 manurial/fertiliser schedules (main treatments) and 3 crop combinations (tapioca alone, tapioca + finger millet and tapioca + bean) as

sub-treatments have been planted in split-plot design with 4 replications. The experiment will be ready for harvest in July 2012.

Tuber crops, particularly the yam, *Diascorea sp* and elephant foot yam are common local crops in Wayanad. A local EFY variety, which allows early harvest, is used to raise a 6-month crop. CTCRI has selected a high-yielding EFY variety called *Padma* and this new variety and another high-yielding variety *Gajendra* were chosen along with the local variety for a variety evaluation in participation with farmers. The FPVT on EFY has 3 varieties and 2 manurial schedules in a RBD design. The trial was planted in March 2012 and results are expected in August 2012.

The World Agroforestry Centre (ICRAF), Nairobi, has reported successful use of the fertiliser tree in the Sub-Saharan African region to promote least input sustainable agriculture. Aiming to assess the advantage of fertiliser tree under Indian conditions, preparation has been initiated to conduct this study in Jeypore. Seeds of fertiliser tree obtained from ICRAF are raised in the nursery. They are to be transplanted in the main fields during June-July of 2012.

Enhancing food and nutrition security

Improvement of nutrition security at individual, household and community levels is being addressed through multiple interventions within nutrition-sensitive agriculture. This agriculture has components such as promoting home gardens to supply vegetables at household level, raising specific fruit trees to enhance access to nutritionally superior fruits, diversifying the food basket by promoting the production of all important local crops such as nutri-millets, yams, local pulses, vegetables and fruits, and conducting nutrition literacy to the families, particularly to women and children.

The first intervention has been the promotion of vegetable consumption through setting up home gardens. Considering the variable land availability to households in establishing home gardens close to their habitation, two types of gardens are being advocated: the structured home garden (STHG) and the unstructured home garden (USTHG). The STHG is laid out in an area of 1-3 cents (40-120 m^2) with 6-10 subplots for simultaneous cultivation of a variety of vegetables. These gardens follow a crop calendar for repeated year-round cultivation with suitable crop rotation, with priority given to locally preferred vegetables identified by women, as also greens and other nutritionally-appropriate vegetables. Due to local non-availability of seeds, quality seeds had to be supplied along with training to HHs on planting and maintaining the gardens with fencing to prevent scavenging fowls, goats, etc. The nutrition training provided to HHs having home gardens stressed on the importance of vegetables, particularly leafy and other nutrition-specific vegetables, to family health. So far 125 STHGs and 20 USTHGs have been established in the 3 project sites.

Orange-flesh sweet potato was introduced in Kolli Hills and in Wayanad with planting material received from CTCRI. This material

is being multiplied and distributed to farmers in these locations. Appropriate training of the community in cooking and using certain vegetables and using leafy vegetables in different recipes and on the importance of these vegetables in family nutrition, particularly with regard to young children, has been conducted. The intervention on diversification of the food basket by promoting consumption of local crops included multiplication of quality seeds of nutri-millets in Kolli Hills and Jeypore and planting material of a high-yielding variety of EFY in Wayanad. Initiatives for promotion of nutritionally-appropriate trees in the homestead such as papaya, drumstick, guava and gooseberry were undertaken in all the 3 project sites. Nurseries of these trees are raised at all locations for distribution of quality planting material to the community.

For conversion of home wastes to value-added manure for increasing the quality and quantity of vegetables as well as other crops, appropriate training has been provided to the HHs for vermicompost production and establishment of such units for use in vegetable cultivation. While these units are being provided to individual HHs in Kolli Hills, these are provided as group units in Jeypore.

Promotion of fish production by communities using the available public and private water bodies in all the project sites is being taken up as part of integrated nutrition intervention. A total of 122 water bodies having about 10,9193 m^2 waterspread area has been identified. Members of FCs have been formed into Pond Users' Groups (PUGs) to manage fish culture in common water bodies with the approval of panchayat officials and/or Block Development Officers in Kolli Hills and Wayanad and by leasing out the ponds through public auctions in Jeypore. Such PUGs included landless families and women farmers. Catla, rohu, grass carp and mrigal have been chosen for the polyculture in these ponds, depending on the water availability. The private fish pond owners and the public pond users' groups are trained on fish production and better management of ponds. The first phase stocking of fishlings has been completed in June 2012 and the final stocking is to be completed after the monsoons, when the water level will rise in all the ponds.

Promotion of local genetic diversity

While need-based introduction of improved varieties for higher productivity has been done in some crops, their local genetic diversity has been extensively assessed and conserved with community participation in Village Gene Seed Banks (VGSBs). Five such Banks have been established in Jeypore and 3 in Kolli Hills, through provision of land either gifted by some members of the community or purchased by community collective efforts. Some of the diversity belonging to rice and nutri-millets are being studied for their climate resilience and for drought tolerance as also tolerance to different biotic pressures. Characterisation of drought tolerance in finger millet, initially at greenhouse level and subsequently at molecular level, is being carried out by one of the post-graduate students of the University of Alberta (UA).

Additional income generation

While increased production of food through productivity enhancement would increase the accessibility to food and/or to increased cash income, additional income generation from on- and non-farm activities is important in the alleviation of poverty and malnutrition among small-farm or landless families. Hence the project scouted for different enterprise options such as livestock integration, value chain, apiculture, mushroom production, commercial production of value-added products from farm produces, etc. The economic benefits from collective primary processing, such as cleaning, sorting/grading and packaging, to reach high-end markets are being studied. Forty farmers of Kolli Hills, comprising 14 women and 26 men, have been organised for apiary under a cluster model with detailed training and support for honey production, processing and marketing.

Need-based training and capacity building

Many need-based trainings were conducted by the project staff and resource persons contracted from outside for building up the capacity of different groups of women and men farmers in different thematic areas. Twenty-eight trainings have been conducted on 11 thematic areas for 333 men and 292 women.

The VRC and VKC system developed by MSSRF is being used in all project sites for locale-specific information and technology dissemination and continuous empowerment of farmers and farm families. One VRC and VKC in the Meenangadi panchayat of Wayanad, one VRC at Semmedu and two VKCs in the Valappur panchayat of Kolli Hills, and one VRC in Jeypore and 3 VKCs in the Kundra block of Jeypore have been established, in space provided free of cost by the local panchayats.

The staff newly recruited under this project participated in a workshop in Chennai and in seminars conducted in the 3 project areas to understand the project objectives, concepts and methodologies, including all aspects of agriculture, home gardening, vermicomposting, design of field experiments, participatory rural appraisal and data building.

Regional, national and international dissemination

A dedicated website to disseminate project details, results and major outcomes has been jointly launched by the project scientists from UA and MSSRF. This website, currently under trial, is accessible at www.ua-mssrf.org.

Research studies by graduate students of UA

Engagement of graduate students from UA is one of the research collaborations between MSSRF and UA under this project. Six students are currently engaged in such studies on as many research areas under the guidance of the UA faculty with technical and logistical support from the project staff in MSSRF. The following studies are being undertaken by the research students of UA:

- Assessment of the non-financial determinants of technology adoption

- Use of mechanised flour mills by subsistence households
- Assessment of household and community level indicators that contribute to food insecurity and malnutrition
- Evaluation of local genetic diversity for understanding their climate resilience
- Assessment of nutritional status and food security
- Evaluation of cassava-based inter-cropping on food security and soil fertility

801.2 Enhancing food security of rural families through production, processing and value addition of regional staple foodgrains

Supported by IDRC and CIDA, this is a collaborative project involving MSSRF, the University of Agricultural Sciences, Dharwad, the Himalayan Environmental Sustainable Conservation Organisation, Dehradun, and McGill University, Montreal, Canada. The primary objective of this project is augmenting the food security of rural families through increasing production and consumption of local staple foodgrains, promoting their drudgery-free processing and enhancing income generation through value addition. The project activities under MSSRF are being implemented in 11 villages (6 villages in Kundra, Koraput district, Odisha and 5 villages in Kolli Hills, Namakkal district, Tamil Nadu).

The project aims to understand how far local crops could be leveraged to enhance food security through participatory research interventions which may increase productivity and production in a cost-effective manner, and how far other interventions could be brought in to build a value chain for increasing the income to the farm families while re-tooling the interventions to make them women-centric, including reduction of their drudgery in cultivation and post-harvest processing.

Entry-level community engagements were made through meetings at every village for assessing the constraints in millet production and clarifying the ways and means of addressing the constraints. These meetings identified the state of millet cultivation, problems causing low productivity, the level of profitability, crops competing with millets, the drudgery being faced by women in cultivation and post-harvest grain processing, the role of millets in the local food system and the community perception of the nutritional value of these grains.

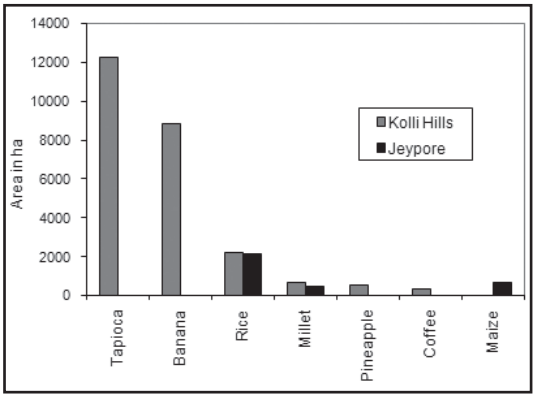
A benchmark survey was carried out in a sample of 100 HHs in Kolli Hills and 99 HHs in Kundra, using a survey instrument designed by the Indian partners. The data included household details, socio-economic status, landholdings, seed systems, millet farming practices, consumption patterns, constraints in millet cultivation, post-harvest processing, role of women/women's groups in nutri-millet cultivation, sources of drudgery, value chain and markets, community institutions in place, financial liability, etc. The survey revealed that the vast majority of the HHs in both locations — and more so in Kolli Hills — belonged to marginal and small landholding classes. The mean holding size was 1.55 ha in Kundra and

0.75 ha in Kolli Hills. A major share of dry land in Kolli Hills is planted under tapioca (54 per cent), coffee and black pepper (18 per cent), while nutri-millet had only 6.4 per cent of this land. The land share for millets in Kundra, on the other hand, was 60 per cent. Thus, while nutri-millet is the second major food crop in Kundra, it is only a marginal crop in Kolli Hills. Finger millet (FM) is the most predominant nutri-millet with little millet (LM) occupying a very small area in both locations. In Kolli Hills, under the new cropping pattern, tapioca, coffee and pepper are replacing nutri-millets. Moreover, ready availability of free rice from the public distribution system has decreased the need for growing food crops on land which could be more profitably deployed. In addition, the considerable drudgery associated with manual threshing and processing of nutri-millets, which are normally done by women, has discouraged the use of these grains.

FM is grown mostly as pure crop and about 30 per cent of the area is sown as mixed crop. More frequently used FM varieties were local landraces and GPU 48 (which is an improved variety introduced by another MSSRF project). The more common local varieties of FM are *Perungelvaragu, Sundangi kelvaragu* and *Sattai kelvaragu* in Kolli Hills, and *Dussarimandia, Telugumandia, Badamandia* and *Birimandia* in Kundra. About 75 per cent of farmers in Kundra had not heard of the improved varieties. Very few knew about the improved variety GPU 28 recently introduced by MSSRF. There was no improved variety of LM, and the common local varieties in Kolli Hills are *Thirigula samai*, *Mallai samai* and *Kattavetti samai*, and *Badasuan* in Kundra. The common crops used as intercrops are mustard, pigeon pea and maize in Kolli Hills and blackgram, pigeon pea and sorghum in Kundra. Unlike in Kolli Hills, 52 per cent of farmers in Kundra followed mixed cropping. In Kolli Hills; inter-cultivation of nutri-millet with tapioca was not known.

A positive outcome of continued retention of nutri-millet cultivation in highly marginal state in Kolli Hills is that it helps in on-farm conservation of many traditional varieties, although some of these varieties are under risk of extinction. An assessment of nutri-millet cultivation and yield of all crops in both locations (**Figure 8.2**) showed that the cultivation in Kundra is more primitive with yield almost one-fourth of national average. Farmers in both locations were following broadcast sowing in pure and mixed crop with high seed rate, low management with no or least external inputs. The pulses among the intercrops are important in terms of their

Figure 8.2 ***Average yield of major crops in Kolli Hills and Jeypore***



income and for contributing to improved household nutrition and soil health.

Therefore, addressing the low productivity of nutri-millets and their intercrops, mechanisation to minimise the drudgery associated with post-harvest processing and generation of additional income through value chain assumed importance in the project strategies for revitalising nutri-millet cultivation and accessing its nutritional benefits. Thus, the components of interventions chosen for implementation are: use of new high-yielding seeds, supply of quality seeds, shift from broadcast sowing to row planting with optimum seed rate, introduction of thinning of seedlings to regulate plant population, reasonable application of farmyard manures and/or fertilisers for sustained soil fertility, and introduction of weeding, inter-cultivation and nutrient top dressing.

Analysis of consumption patterns in both locations showed the principal role of rice, while 20 per cent of grain in Kundra and 8 per cent of grain in Kolli Hills were contributed by the nutri-millets (**Table 8.4**). While nearly 50 per cent of grain consumed in Kolli Hills is produced in personal farms, this share in Kundra was about 75 per cent. Thus, increased production strengthens the availability of food to the HHs in both locations. About 30-35 per cent of the finger millet consumed is used to prepare the traditional fermented beverage called *landa* in Kundra.

Studies on gender roles in millet cultivation, harvest and processing showed that women and men play joint roles in preparation of fields for sowing, transportation and application of manure, thinning, weeding, harvesting and transporting harvested material to homesteads, while women exclusively attend to threshing, grain cleaning, seed preparation, storage and grain processing. The most tedious among these operations are weeding, threshing and processing, which are largely or exclusively done by women. The women are found to

Table 8.4 ***Details of foodgrains being consumed per month by households***

Project Village	Rice, kg		Wheat, kg		Millet, kg**		Total Grains, kg	
	Kolli Hills	Kundra	Kolli Hills	Kundra	Kolli Hills	Kundra	Kolli Hills	Kundra
Thirupuli/ Kaudiaguda*	44.1	83.1	1.1	0	2.5	15.8	47.6	98.9
Padasolai/ Bhadraguda*	47.9	69.3	1.6	0	4.8	18.5	54.2	87.9
Sembothuvalau/ Pipalguda*	41.7	71.0	1.9	0	4.0	24.0	47.7	95.0
Puliyampatti/ Narakenduguda*	38. 9	71.1	0.5	0	1.9	17.6	41.3	88.6
Thuvarapallam/ Heruguda*	46.0	83.4	1.4	0	2.2	18.9	49.6	102.2
Chendiajhiligan*	x	81.1	-	0	-	19.6	-	100.7
Average	**43.76**	**76.5**	**0**	**1.3**	**3.98**	**19.1**	**48.1**	**95.6**

* *Villages of Kundra*

** *Includes Finger millet used to ferment traditional beverage (landa) in Kundra*

play marginal roles in decision making related to cultivation of millets, marketing of produce and handling of money earned.

As far as processing is concerned, the millets fall into two categories. In the first category is FM, which is largely consumed after milling directly to flour, which is a tedious process by using a stone grinder, which takes 2 women one hour for milling 1 kg of grain. All other millets fall in the second category, and they need to be first hulled to remove the hard seed coat. Traditionally, these grains are manually pounded using mortar and pestle, which is highly tiresome and exhausting. A nutri-millet huller is being developed to solve this issue.

The existing family income and its sources for men and women showed that the total income and the average wage income of the households in Kolli Hills far exceeds the respective incomes of Kundra farmers. In both locations, the wage income of women farmers from local agricultural employment was either on par with or higher than that of men farmers. The income from non-agricultural wages, on the other hand, was higher for men. The total agricultural income including crop and livestock was either on par with or higher than the total wage income. While most of the income earned by women is spent on the family together with the income contributed by the male member, only in a few households could the women manage some savings.

Women's share of assets and their control on resources have been mapped from both project villages. The summarised results are presented in **Table 8.5**

Productivity enhancement

Enhancement of nutri-millet productivity is being used as an important pathway to increase the availability of these grains for consumption. This project has deployed multiple participatory approaches to increase

Table 8.5 ***Frequency of women's ownership of land, other assets and income***

Particulars	Kolli Hills Villages		Kundra Villages	
	Frequency	% of HHs	Frequency	% of HHs
Ownership of land, either exclusively or jointly	19	19	7	7.1
Sources of income for women:				
a. Livestock (milk, animal wastes)	19	19	2	2
b. Income from marketed crops	4	4	8	8.1
c. Income from non–farm & self-employment	13	13	43	43.4
d. Earned agricultural wage	68	68	75	75.8
e. Income from value-added products	0	0	5	5
Women spending total income for family expenses	75	75	92	92.9
Contribution of headman & other earning men to home expenses	92	92	92	92.9
Savings of income-earning women	25	25	6	6.1
Average current savings (Rs/Year)	3156		2655	

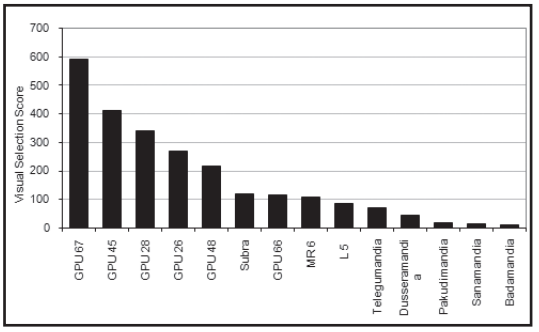
productivity. These approaches include farmer participatory seed selection, production and use of quality seeds of selected varieties, use of optimum seed rate, promoting the use of farmyard manure including homestead-produced vermicompost, balanced application of chemical fertilisers, shifting from broadcast sowing to seeding in rows using locally fabricated row marker tools, maintaining optimal plant population with timely thinning, and introduction of hand-operated Konoweeder for drudgery-free weeding and inter-cultivation, as well as training on the new practices.

Participatory variety selection

Farmer participatory variety selection (FPVS) is a method used by the project to facilitate identification of well-adapted high-yielding varieties by farmers from a bouquet of varieties, both traditional and improved, through a scientific method. Four FPVS trials were conducted, 2 in each location. The trials in Kundra had 18 varieties, comprising 5 local and 9 improved FM varieties and 1 local and 3 improved varieties of Little millet. The trials in Kolli Hills had 20 varieties, comprising 4 local and 8 improved FM varieties, 3 local and 2 improved Little millet varieties and 3 local Italian millet varieties. These varieties were planted in randomised block design with 3 replications in 2 villages, in each location.

Participatory variety selection was carried out involving 28 men and 19 women farmers in 2 trials in Kolli Hills and 44 men and 42 women farmers in another 2 trials in Kundra. Those varieties ranked as first and second by each farmer were quantified by assigning specific scores to generate the visual selection scores. Such a score on FM varieties generated from trials in Narkenduguda, Jeypore is presented in **Figure 8.3**. This shows the high farmer preference to new varieties over locally available varieties.

Figure 8.3 ***Aggregate Visual Selection of millet variation: Score offered by farmers in Jeypore***



Gender disaggregated analysis of this selection showed that the women farmers seem to have better precision in visual selection than men, although they tend to be more swayed by the colour of the grain. The most common reasons attributed by farmers for their selection were good panicle size, robust growth, higher panicle-bearing tillers, larger grain size, and medium or late maturity duration.

All varieties from these trials were separately harvested and the yield data statistically analysed. The varieties showed significant differences in yield at 0.01 per cent level of probability. The highest mean yield among FM was reported from GPU 67, followed by GPU 26 and GPU 66 in that order. Among the 5 local varieties of FM, *Telegumandia* and *Dusseramandia* had highest yield, which was 69 per cent less that that of GPU 67. In the

case of Little millet, the local variety *Badasuan* is found to be top ranking.

Yield enhancement trials

The improved agro-techniques in crop production were tested in farmer participatory demonstrations along with traditional practices of farmers in each location. A total of 102 trials were conducted at both locations in 15.4 ha area, comprising 44 demonstrations in 11.87 ha in Kundra and 58 demonstrations in 3.5 ha in Kolli Hills. The 44 demonstrations in Kundra included 23 demonstrations with pure crop of FM and 21 with FM-based intercrops. The 58 demonstrations in Kolli Hills included 35 millet-based demonstrations and 23 tapioca-based nutri-millet intercrops. The intercrops in both locations included Little millet, blackgram, sorghum, mustard and pigeon pea. Each of these demonstrations had twin plots of almost equal area, one for traditional or farmers' practice and the other for improved practice. Improved agronomic practices included optimum seed rate, row planting instead of broadcast sowing, modest application of farmyard manure and fertilisers, and thinning and weeding with inter-cultivation. All farmers, however, did not follow uniform practices either under improved agronomic practices or traditional practices. The variation was mostly in the quantity of manure and fertiliser applied and in overall crop care. However, comparison was made between the two systems of cultivation for yield and net income.

The results of 23 pure crop demonstrations in Kundra showed the improved practice led to 86 per cent increase in productivity with 796 kg/ha as mean yield of farmers' practice and 1481 kg/ha as mean yield of improved practice. The average net returns from both these systems was Rs 591/- per ha in the case of farmers' practice and nearly six-fold higher, Rs 3524/- per ha from improved practice.

The 21 finger millet-based intercrop demonstrations in Kundra had little millet, blackgram, sorghum and pigeon pea as different intercrops. Their yield comparison was made in FM yield equivalent. The average FM yield equivalent in the farmers' practice was 1150 kg/ha, while the same in the improved practice was 1822 kg/ha, a 58 per cent higher yield. In terms of net profit, the improved practice offered Rs 6581/- per ha, while the same from farmers' practice was Rs 3227/- per ha. The results from Kolli Hills followed a similar trend, although the differences between the farmers' practice and improved practice were narrower in view of the higher base productivity here. These results showed that the nutri-millet-based intercrop system offers higher income apart from nutritional and ecological advantages of crop diversity.

An important outcome from Kolli Hills was on the tapioca-based FM intercrop. These trials were conducted in plot sizes between 0.03 ha and 0.10 ha. The available data on millet yield showed that grain yield to the tune of 521 kg to 726 kg/ha was harvested from FM. The main crop, tapioca, will be ready for harvest during July-August 2012. The promising prospect of

creating co-existence between tapioca and the millet, which the former had displaced, is well demonstrated on technological and economical grounds.

Improved technology adoption

Selected women and men farmers from both locations were taken to the heartland of FM cultivation in Karnataka to expose them to the improved and intensive cultivation of this nutri-millet by the Kannada farmers in Ramanagara district. This visit provided great learning to the project site farmers on the yield being harvested in FM and the technologies and practices contributing to the same. The farmers from Kundra and Kolli Hills saw for the first time the use of seed drill, advantage of using optimum seed rate and application of modest rate of fertilisers, transplanting method and use of locally-made weeder called *kunte* for low-cost weeding. They were also exposed to the new millet production technologies being developed at the All India Coordinated Small Millet Research Project in the GKVK Campus in Bangaluru. These farmers on their return disseminated the learning to other farmers in their villages.

Vermicompost production and use

Vermicompost offers opportunities for low cost and high output farming with sustainable soil health in marginal dry lands where nutri-millets are normally grown. Hence, production and use of vermicompost has been promoted in both project locations. Eighty-seven individual units of 8'x 3'x 3' were established in Kolli Hills, while in Kundra the units were constructed in 10 clusters by groups of farmers.

Technology innovations for reduction of drudgery

The major sources of drudgery associated with millet cultivation, particularly faced by women, are operations such as weeding, threshing and grain processing.

In order to address the issue of drudgery involved in weeding, two types of row markers were designed; — the 1.6 m long nine-row marker suited to the plains of Jeypore and 1 m long six-row marker suited to the narrow terraced fields of Kolli Hills. Introduction of these markers has made row planting more popular among farmers. Row planting facilitated the introduction of the manually-operated Konoweeder, thereby saving women the drudgery of hand weeding. Weeding problems in nutri-millet-intercropped tapioca were addressed by designing a spade of 6 cm width instead of the 9 cm width, which is commonly-used for tapioca. The new spade is found most convenient by women for weeding the tapioca-nutri-millet intercrop.

Mechanical pulverisers were introduced to replace manually-operated stone grinders. These pulverisers operating on single phase 2 HP motors with throughput of 30 kg/hour are highly useful to women. These mills were entrusted with women SHGs who were trained in mill maintenance and account keeping. The extension of milling services has also led to more income. During this reporting period, 7 flour mills or pulverisers were established, 4 in Kundra and 3 in Kolli Hills.

Extension of women-centric farm-to-market value chain

Nutri-millets and associated local crops have important roles in enlarging the rural food basket with nutritional benefits. While there is already a body of traditional knowledge on the nutritional benefits of millets and other local crops, this was strengthened with specific nutritional literacy. In addition, building value chain on nutri-millets and empowering the village women and their SHGs towards this was undertaken, along with reduction in the drudgery associated with post-harvest processing of grain. A gender consultant was engaged to get inputs on mainstreaming gender concerns in these areas and other domains of nutri-millet production mandated under the project. The major recommendations provided by her to the two project locations are as follows:

1. Conduct research into and provide machinery/technology that can reduce drudgery and save women's time.
2. Consider availability of raw materials, regularity and surety of work, women's labour/time availability, profitability/returns, access to working capital for enhancing returns and control over the enterprise/ incomes therefrom, while designing value addition activities.
3. On market linkages, regularity of supplies, price and quality standards and scope of creating linkages with bulk buyers such as bakeries rather than the final consumer are to be studied.
4. Apart from the impacts of interventions on incomes and productivity, the implications for gendered labour contributions, decision-making, and control over both resources and allocations, need to be monitored. A focus on both the technical-material and social-symbolic dimensions are important to gauge the impacts of the project on the empowerment of rural women.
5. Ensure that drudgery reduction and labour saving technologies such as weeders, mills, etc. are controlled by women's groups.
6. Provide facilities for saving any cash surplus generated as a result of increased production and value addition.

Most of these recommendations have been addressed, and the remaining issues are under completion.

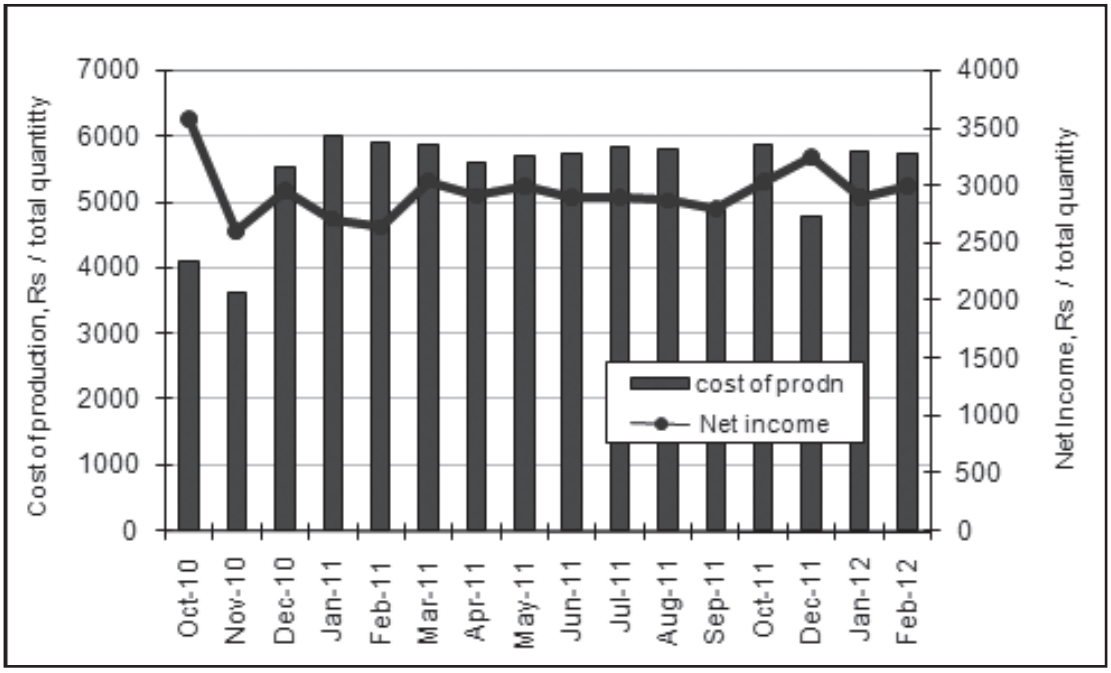
The activities of the millet value chain have been set up in multiple steps. First step was the village community identifying land for establishing the milling shed and contributing labour for its construction. Provision of mechanical grain processing unit was the next step. In the next step specialised training on value addition was provided to selected women members of SHGs at the University of Agricultural Sciences, Dharwad. This included hands-on training on making about a dozen value-added products from millets, as also on hygiene standards of products. The fourth step was further training on identifying some value-added products for commercial production, testing the targeted market with these products, and organising the infrastructure and capital required for

establishing the production. The fifth step involved testing and standardising consistency of product quality across production batches, designing product packaging and labeling, cost calculation and determination of market pricing. The sixth step, a very key one, was market network building, either local or distant, including engagement of commission agents/distributors with agreed profit sharing. These steps have been slowly built up, along with streamlined raw material procurement, account keeping and sharing of economic gains among members.

Five SHGs and one FC in Kolli Hills and Kundra took up value chain activities with varied levels of success. The products being commercialised are FM malt, *laddu*s made from FM and Italian millet and FM *murukku* (*chakkli*). Other products being commercialised are millet flour, *upma* mix, *bajji* mix, *payasam* (*kheer*) mix, and *rava* mix. A market outlet for bulk and retail sale of these products has been established in Kolli Hills managed by KHABCoFED. The Kolli Hills products have a registered brand name. As of now a limited retail market network has been established for some of the products within Tamil Nadu. These products have also been registered under relevant food products laws of the State.

One of the products with fair distribution is FM malt being produced by the Padasolai Farmers' Club together with Mullaimahalir Suyaudhavikuzhu, Padasolai (local WSHG). The malt production turnover during the last 18 months is presented in **Figure 8.4**. The restricted market reach is keeping the turnover

Figure 8.4 ***Cost of production of malt and net income***



stagnant at 90-100 kg/month. The FM *murukku* and *laddu are* being produced by WSHGs Iyyanar Porulathara Munnetra Sangam Thuvarappallam, and Kannimarmahalir Suyaudhavikuzhu, Sembuthuvalavu. The annual turnover of all millet value-added products achieved by KHABCoFED has been 2.896 tonnes for a total value of Rs. 245130/- and with a net income of Rs. 64498/-.

Nutrition education

Three important approaches have been used by the project to promote consumption of millets and other local nutritious crops. These are (i) increased availability of grain through increased productivity and area expansion, (ii) popularising acceptable value-added non-traditional recipes, and (iii) nutritional literacy on the health benefits of consuming nutri-millets.

A survey schedule was constructed to assess the nutrition knowledge, attitude to nutrition and nutrition practices of 70 HHs randomly chosen from Kundra and Kolli Hills. The results show fairly good awareness among households on the important roles of food, the need for cereals, pulses, milk and meat in the diet, and nutritional superiority of parboiled rice over raw rice and millet grains over other grains. Nutri-millet foods were considered to be better suited than rice or wheat for manual labour. The HHs attributed decreased production and consumption of millets to the availability of cheap or free rice through PDS and they welcomed inclusion of millets in PDS.

Thirty-one per cent of farmers in Kundra believe that continuous consumption of nutri-millets may cause joint pains while 46 per cent consider nutri-millets not appropriate for children. These are contrary to the perceptions among farmers in Kolli Hills. Families in both locations showed good understanding on the nutritional benefits of consuming locally available pulses (blackgram, greengram, pigeon pea and horsegram), although nutritious millets are not mixed with pulses in food preparation.

Nutrition awareness programmes were conducted in 7 schools in the area. Special lectures on the nutritional advantage of local foods including nutri-millets were given by the project staff. Essay writing and quiz competitions were conducted in these schools, at intra- and inter-school levels with prizes for winners. The theme of the quiz was “Health and balanced diet and role of nutri-millets in nutrition” and of essay writing, “The importance of nutritious millets in Kolli Hills”. While 150 students participated in the quiz, 159 students joined the essay writing competiton. The school-level winners were given incentive prizes and the inter-school winners were awarded at a public function.

Based on the feedback gained from the nutrition benchmark survey, an awareness programme was planned to improve the nutrition understanding, attitude and practices of women in the project villages. Resource persons identified from Home Sciences institutions were engaged to give nutrition literacy to women, children and men in every project village. This training was conducted with the help of food items, charts and interaction

on the practices of cooking and hygiene. These trainings also dealt with issues such as nutritional adequacy, feeding of children during first three years, importance of using locally available crops and fruits and vegetables, including green leafy vegetables.

Training and capacity building

Several trainings were organised within and outside villages on many thematic areas involving subject matter experts, wherever required. All these trainings covered 9 thematic areas across 63 training days and reached out to 1234 farmers (495 men and 739 women). The thematic areas included quality seed production, specialised training on value addition, vermicompost production and use, participatory seed selection, row seeding, inter cropping in rows, use of Konoweeder, value-added product packaging, account keeping, and nutrition.

801.3 Reinforcing the resilience of poor rural communities in the face of food insecurity, poverty and climate change through on-farm conservation of local agro-biodiversity

This project, located in India, Nepal and Bolivia, is supported by joint funding from IFAD and the European Union and internationally coordinated by Bioversity International, Rome. The Indian component is coordinated by MSSRF and also implemented jointly with Action for Social Advancement (ASA), Bhopal and Gene Campaign, New Delhi. It is implemented in Kolli Hills by MSSRF, in Mandla block of Mandla district of Madhya Pradesh by ASA and in some villages in Almora district of Uttarakhand by Gene Campaign.

The goal of this project is to facilitate more effective and sustainable use, management and conservation of local agro-biodiversity by communities and stakeholders, particularly in the context of food security, nutrition, income-generation potential and adaptation to climate change. The work programme addresses the following aspects:

- Developing and testing new methods and tools in participation with farmers and value chain actors aimed at enhancing capacities to sustainably conserve traditional crops and associated knowledge at the farm level
- Exploring ways of integrating the monitoring of diversity on-farm, along with use-enhancement goals, through inter-disciplinary and multi-sector approaches
- Promoting a more balanced complementary conservation agenda in national programmes, based on the need to combat genetic erosion and to meet the needs of agro-biodiversity users
- Providing useful findings to guide further research related to climate change and its impact on species and varieties deployed in local production systems

The project is working on three nutri-millets (Finger, Little and Italian millets) in Kolli Hills under MSSRF, Little and Kodo millets, lentil and pea in Mandla district under ASA, and Finger millet, Barnyard millet, Proso millet/

Foxtail millet, grain amaranth and buckwheat in Almora district under Gene Campaign.

The project was started in January 2012. Currently, the initial survey on genetic diversity in the mandated crops is underway.

Sub Programme Area 802

Climate Change and Bioenergy Initiatives

Currently, there are four projects under the climate change programme, with emphasis on action-research and capacity building. The primary focus is on community-based adaptation and the themes span a range of issues including climate risk management at the local level, bioenergy and per-urban agriculture.

802.1 Policy Innovation System for Clean Energy Security (PISCES)

During this year, the PISCES research project on bioenergy has conducted 8 case studies in Odisha, Nagaland, Karnataka, Tamil Nadu, Andhra Pradesh, Bihar and the Punjab, addressing the 3-way linkages between livelihoods, adaptation and bioenergy. The case studies represent a mix of agro-climatic zones and vary in terms of livelihood endowments, bioenergy feedstocks, and natural and social capitals.

Appropriate indicators were devised to understand the changes resulting from bioenergy interventions in the study area. For example, the indicator "CO_2 emission per unit of energy sold" measures CO_2 emission per unit of energy sold to the State grid and encompasses the emission from biomass combustion, transportation and handling. For the 7.5 MW power plant generating electricity from biomass in Muktsar, the Punjab, CO_2 emission per unit of electricity sold is 0.0077 tonnes per unit whereas the grid emission factor (Co_2 emission per unit of energy) is 0.83.

Besides examining the technologies put into use, the socio-economic and policy environment and its implications in the use of bioenergy as a livelihood resource has also been explored. The husk power system in Bihar is an excellent example of social entrepreneurship. In this initiative, rice husk is being utilised to produce electricity in kilowatt scale gasifiers. By establishing its own makeshift distribution and transmission lines, the initiative has set up an example of delivering power to people who do not receive grid power. Though several technological barriers still remain to be resolved, bioenergy has delivered power to people in need. The husk power system has been scaled up to 65 gasifier units in other regions of the State where paddy rice is the principal crop.

Agro-residues apart, bio-resources like flowered bamboos that are otherwise wasted are utilised to produce charcoal, proving vital for the subsistence agriculture and bamboo-centric livelihood system in Nagaland. In the charcoal-making initiative in Nagaland, bamboo having less economical use has created alternative employment. Charcoal

production technology has been streamlined and bulk selling routes have been defined by the Nagaland Bamboo Development Agency (NBDA). This has spurred use of local charcoal in place of natural charcoal and fuel wood. Bamboo has contributed in generating livelihood by engaging youth in bamboo craft, mat making and bamboo-based rural enterprises in Nagaland. Local youth have actively taken part in making charcoal a viable source of livelihood. A total of 650 youth members have already been benefited by the charcoal making initiative of NBDA.

Not all interventions of biomass and bioenergy have positive impact on livelihoods. The experiment of crop diversification by domesticating *Jatropha* in rain-fed agro-ecosystems has not yielded the expected results. On the other hand, at a time of declining profit from agricultural farming, tribal farmers of Rayagada district have undertaken *Jatropha curcus* plantation. Marginal farmers are worst hit as 66.9 per cent of farm income is being locked up in *Jatropha* cultivation. This is quite a significant reduction in income, considering the limited options they possess. The Net Present Value (NPV) of the 3-year old *Jatropha* plantation is negative with a loss of USD 38.9 per acre without seed yield. A negative NPV indicates that the project ought to be rejected as the cash flow is negative. The loss incurred from *Jatropha* has triggered dependence on forest resources. Small farmers have returned to traditional farming whereas big farmers having disposable landholdings have continued with *Jatropha*. Nevertheless, there is growing awareness among the farmers on the reduction of farm income and resultant strain on household budgets.

Biomass zoning

Biomass zoning and mapping exercises are underway in Tamil Nadu for 22 species (tree, plant and grass) which have bioenergy value. The mapping and zoning exercise takes into account the growth period, calorific value, agronomic management practices and economic value of the species besides other elements like the climate and edaphic factors of the given agro-climatic zones of the State. The zonation exercise would be a potential tool for decision makers in locating the potential source of biomass feedstock for various conversion processes. The zonation maps would assist in identifying sites suitable to grow specific biomass species and thereby aid the efforts in efficiently promoting energy from biomass in the State.

The local biomass demand has increased the income of families in the various study areas by about 10 to 20 per cent. Though there has been an increase in rice and cotton yields in certain States like the Punjab and Bihar, decrease in cultivation area and crop failure due to shift in monsoon and variability in temperature account for less feedstock production. Average paddy production in Odisha and Nagaland is less than the national average. Shift in weather parameters and poor management practices are, inter alia, principal factors for the low production rate.

Analysis of climate variability trends (parametric and non-parametric tests) as well as the

impact of climate variability on production of agricultural (paddy, cotton) and tree crops (eucalyptus, *Jatropha*, *Sesbania Sesban* and bamboo) have been carried out in the case study areas. The results point out that there is an increase of temperature over Muktsar in the Punjab (0.01 ^{0}C) and about 0.37-0.4°C increase in Coimbatore and Erode in Tamil Nadu. Increase in temperature has also been observed in Mokukchung and Kohima in Nagaland (0.30 and 0.31^{0}C). With respect to precipitation, there is a decreasing trend in Araria, western Champaran and Saran, case study areas of Bihar, Kohima, Mokukchung in Nagaland and Raygada in Odisha during the past few decades, whereas an increasing trend in rainfall is observed in Muktsar district of the Punjab, Coimbatore and Erode districts of Tamil Nadu and Mahbubnagar district of Andhra Pradesh. A documentary film has been made on the challenges and opportunities of bioenergy interventions.

The quantitative impact of bioenergy-related initiatives on the livelihoods of people in the case study areas has been quite substantial. The charcoal market system in Andhra Pradesh and Nagaland has increased energy access to 2000 households and about 150 small and medium enterprises. The beneficiaries of the energy initiatives have managed to establish charcoal marketing channels for bamboo in Nagaland and *Prosopis juliflora* in Andhra Pradesh.

About 5000 households (of which 2600 women) in the Punjab and Bihar have benefited from the shift in policy processes, which has enabled the commissioning of biomass-based power projects in the respective states. Feed-in tariff systems, renewable purchase obligations and other financial instruments have helped to change the renewable landscape.

The project team works closely with key players in Tamil Nadu, specifically with the nodal agency for energy, Tamilnadu Energy Development Agency (TEDA). A State-level policy working group has been formed, which will play a key role in discussing relevant issues and provide focus to bioenergy-related activities in Tamil Nadu.

The major limitation of the case studies is that the decentralised bioenergy projects are being implemented by various agencies and thus there is a lack of clear-cut baseline data. The quality of the data is also very varied. The size and capacity of the chosen power plants vary too, and hence the reach of the benefits cannot be compared and quantified.

With the successful completion of the first phase of the project, an 18-month extension has been approved by DFID. The extension period would exclusively focus on the completion of the bioenergy zoning map of Tamil Nadu as well as pilot testing of selective adaptation measures and influencing policy at different levels.

802.2 Mainstreaming adaptation to climate change in agriculture and water sectors

The objective of this research project is to construct an adaptation metric framework

based on the assessment of the factors that influence adaptation as well as act as barriers to adaptation, particularly with reference to the agriculture and water sectors. A two-way assessment process is envisaged to understand the perspectives, the farmers' perspectives as well as those of the policy makers. The adaptation metric framework is essentially conceived to monitor the progress in mainstreaming adaptation in sectoral policies.

In the first phase, a total of 150 farmers were interviewed in 5 selected districts from different agro-ecological zones of Tamil Nadu, namely, Kancheepuram, Ramanathapuram, Namakkal, Pudukottai and Dharmapuri. In order to develop adaptation metrics, 7 prominent adaptation measures which are mostly practised in the study region were selected: Micro-irrigation, rainwater harvesting, pest-resistant crops, bio-fertilisers, crop insurance, income diversification and community-based efforts. Analytical hierarchy process methodology and multi-criteria analysis methodology have been followed to develop adaptation metrics. Effectiveness, economic efficiency, individual and institutional compatibility, and flexibility and independent benefits are the 4 criteria chosen for analysis. The analysis and ranking of criteria indicate that 'effectiveness' is the major barrier (about 60 per cent of the respondents), which means most of the farmers lack understanding of adaptation options and how they could reduce potential impacts of climate change. Among the chosen adaptation measures, bio-fertiliser use (about 75 per cent) is recognised as an effective adaptation option. Variation in the rate of adoption of the adaptation measures is also being observed. The primary barriers listed include timely input supply (about 77 per cent), institutional support (68 per cent), extension-related information (66 per cent) and cost of technologies (52 per cent)

Apart from the farm-level analysis, the focus during this period has been on understanding the perspectives of policy makers and the various implications of agricultural policies in Tamil Nadu. Limitations of time and resources have led the study to zero-in on 2 specific adaptation-related policies, namely. micro irrigation and crop insurance (weather-based insurance), chosen based on the secondary data analysis of selective policies and in consultation with State- and district-level agricultural officers. The interview process covering 10 primary stakeholders and about 10 officers from State level to block and extension level has been completed; the impact of the two policies are being studied, specifically estimating the scale of reach of the chosen policy measures and the corresponding barriers. Since the policies have implications for the private sector, inputs from selected players has also been sought to provide a comprehensive understanding of the barriers and factors that affect the policies.

Climate risk management

A community-based approach to manage climate risks at the local level has been the cornerstone of MSSRF's climate change programme. A programme has been set up in order to improve the capacities of local

farmers to manage climate risks through methodical training in the assessment of local vulnerabilities arising out of climate-related risks and identifying appropriate adaptation strategies that suit local needs. Four representative areas covering different agro-ecological zones — coastal, hill regions, plains and irrigated areas — have been chosen for implementation of the programme. A 3-day Climate Risk Management training programme was conducted, involving 30 participants chosen from different areas. The training sessions included basics of climate change, impacts on specific sectors like agriculture and water, best practices and hands-on experience with agro-met services. A draft curriculum was put to test to understand the effectiveness of the programme. The feedback from the participants and the subsequent follow-up on the specific assignments provided to the participants are being used in shaping a set of dedicated modules. A strategic plan has been devised to carry forward the training programme to the four agro-ecological zones. A cadre of 20 people from each of the agro-ecological zones is expected to be trained under this programme in the first phase. The Ministry of Earth Sciences, Government of India is supporting this endeavour.

802.3 Assessment of climate change impacts on peri-urban agriculture: The case of Chennai city

This research study is part of the joint assessment initiative undertaken on behalf of the System for Analysis, Research, and Training (START) of the nine-city effort in South Asia and Africa to better understand linkages between peri-urban food production, urban food systems, and livelihoods in cities contending with climate change and rapid urbanisation. The assessment was designed to understand the trends related to climate variability and change, and ensuing impacts on agriculture, food security and livelihoods in the context of Chennai city and its peri-urban region. This assessment work is expected to inform State policy makers, city administration officials and other relevant stakeholders on critical emerging issues as well as make significant contributions to the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

A combination of primary data analysis, secondary data analysis, observed and projected trends in climate change scenarios for Chennai city and detailed literature reviews is being employed to understand the impact of climate change on the peri-urban regions of Chennai. The notified peri-urban region for this study includes the adjacent Kancheepuram and Thiruvallur districts. The primary focus is on the impact of climate change on agriculture and water in the study areas. Demographic changes, socio-economic changes, change in land-use patterns, change in water availability, growth patterns, food supply status including agricultural produce, fisheries and dairy remain the central focus of the study.

Sub Programme Area 803

Leveraging Agriculture for Nutrition in South Asia

MSSRF is the lead institution of a multi-country, multi-institutional Research Programme Consortium (RPC) working on the project Leveraging Agriculture for Nutrition in South Asia (LANSA). Funded by the Department for International Development (DFID), UK, the 6-year project commenced in February 2012 and is currently in the inception phase. The other partners of the consortium are: International Food Policy Research Institute (IFPRI), USA; Institute of Development Studies (IDS) and Leverhulme Centre for Integrated Research on Agriculture and Health (LCIRAH), UK; Bangladesh Rehabilitation Assistance Committee (BRAC), Bangladesh; and Collective for Social Science Research, Pakistan.

The three core research questions being addressed under LANSA are:

1. How can agriculture be provided with an enabling environment in which to leverage nutrition?
2. How can agriculture and agri-food chains be incentivised to be more pro-nutrition?
3. How can more pro-nutrition agricultural interventions be designed and implemented?

Running across the above are three cutting themes:

1. How can systems of innovation that better connect agriculture and nutrition be nurtured?
2. How can appropriate pro-nutrition agricultural policy frameworks for fragile and conflict-affected contexts be ensured?
3. Can we strengthen existing pathways to women's empowerment and identify new ones within the food system?

The LANSA consortium will promote collaboration among the South Asian countries of India, Pakistan, Bangladesh and Afghanistan, in research and development through frameworks for comparative analysis of agricultural and social systems with a view to develop insights into the agriculture and nutrition conundrum. It is expected that the outcome of the research undertaken by RPC will lead to transformational thinking and action by agriculture and nutrition stakeholders on what can be done to realise the potential of agriculture to address undernutrition in South Asia, shift of nutrition in the agriculture and agriculture-food systems agenda and an increased contribution by these sectors in accelerating reduction in poverty and undernutrition in the focal countries.

The inception workshop of the project was organised at MSSRF in March 2012. This was the first meeting of all the partners after the sanction of the project. DFID officials also participated. The first day of the workshop was devoted to detailed discussion on each of the research questions and cross-cutting themes, in the context of the agriculture-nutrition

situation in the LANSA focus countries. On the second day, the attention was on consortium management and governance issues, research uptake strategy and inception phase requirements.

Following the inception workshop, partners have started developing research ideas. An Inception Report has to be submitted to DFID in the last week of August 2012 and work is in progress. A detailed research framework, RPC management and governance structure and overview of research uptake, capacity building, gender mainstreaming and monitoring and evaluation strategies will form components of the Report. Following a review and assessment of the Inception Report, DFID is expected to give its approval within a period of two months for the commencement of the delivery phase of the project.

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Selvam, V. "Linking coastal livelihood and biodiversity". National Consultation Workshop on Coastal and Marine Biodiversity: Gaps, Challenges and Opportunities. Ministry of Environment and Forests, Government of India and Deutsche Gesellschaft für Internationale

Zusammenarbeit (GIZ). Gandhinagar. 11-12 April 2012.

Selvam, V. and L. Gnanappazham. "Conservation and management of coastal bioshields". National Workshop on Geospatial Technology for Coastal Resource Management. Indian Institute of Space Science and Technology. Thiruvananthapuram. 28-29 May 2012.

Selvarasu, T. and L. Krishnan. "Aquaculture-based integrated farming system in coastal region of Nagapattinam". 9th Indian Fisheries Forum. Chennai. 19-23 December 2011.

Selvarasu, T. and L. Krishnan. "Integrated approaches for agriculture productivity and sustainable livelihood enhancement in coastal region of Nagapattinam district". 99th Indian Science Congress. Bhubaneswar. 3-7 January 2012.

Selvarasu, T, and L. Krishnan. "A case study: Water management through low cost pedal pump". 99th Indian Science Congress. Bhubaneswar. 3-7 January 2012.

Senthilkumaran. S, "ICT and agriculture". The Latin American Association of Telecommunication Companies. Montevideo, Uruguay. 13-15 June 2011.

Singh, Navjot. "Conservation of elite *Jatropha* germplasm for energy security of India". 3rd Indian Youth Science Congress. New Delhi. 3-5 November 2011.

Sophia, J. D. "Mangrove and livelihoods: Livelihood challenges and opportunities for coastal women". International Conference on Mangrove for Coastal Management. MSSRF, Chennai. 7-9 August 2011.

Srinath, J. "Voice messages and SMS services through mobile phones for improving farming thereby ensuring livelihoods security of farming families in Tamil Nadu, India". Mobile Plus International Conference on Inclusive Growth through Mobile Application. MSSRF, Chennai. 15-17 September 2011.

Swain, S. "Conservation of ethno-medicinal plants by tribal people of South Odisha". Odisha Environment Congress. Bhubaneswar. 22-24 December 2011.

Swain, S. "Globally Important Agricultural Heritage System". National Seminar on New Frontiers in Plant Science Research for Sustainable Development. P.N. College, Khurda. 25-26 February 2012.

Swain, S. "Role of traditional agriculture in maintaining the agro biodiversity of Jeypore district". National Seminar on New Frontiers in Plant Science Research for Sustainable Development. P.N. College, Khurda. 25-26 February 2012.

Triveni, C. "Special inputs on technologies available to address household food and nutrition security for tribals – Role of government agencies, research organisations and institutions". Brainstorming Workshop on Addressing Household Level Food and Nutrition Security for Tribal Areas. Vigyan Prasar and MSSRF. Chennai. 24-25 May 2012.

Vishwanath, Ganga., V. R. Prabavathy and Sudha Nair. "AHL dependent QS homologous gene loci in *Rhizobacteria* isolated from paddy". International Conference of Regulatory Network Architecture in Bacteria (RNAB). SASTRA University, Thanjavur. 9-11 March 2012.

Participation in Training Programmes/ Workshops

Anabel, Nancy J. Annual Meeting of Community of Practice on Monitoring & Evaluation and Climate Change, PACT World and Rockefeller Foundation, Bangkok. 8-10 November 2011.

Anabel, Nancy J. National Consultation Workshop: Towards Arriving at a Roadmap for India Development Gateway (InDG). Hyderabad. 28 January 2012.

Anand, Jay. Namma Chennai– Ezhilmighu Chennai. FICCI, Chennai. 15 November 2011.

Anand, Jay. Energy and Fuel Users Association of India. FICCI, Chennai. 16 December 2011.

Anand, Jay. Second Asia-Pacific Climate Change Adaptation Forum. United Nations Conference Centre, Bangkok. 12-13 March 2012.

Anantha Krishnan, R. K. Conference on Biodiversity Conservation and Climate Change, The Institute of Minerals and Materials Technology, Bhubaneswar. 2-4 December 2011.

Anil Kumar, N. International Workshop on National Biodiversity Strategy and Action Plans. Global Launching of the United Nations Decade on Biodiversity 2011-2020. Kanazawa City, Japan. 18 December 2011.

Anil Kumar, N. The Second Global Conference of the International Partnership for the *Satoyama* Initiative: Strategy for Realising Societies in Harmony with Nature. The International Partnership for the Satoyama Initiative, World Agroforestry Centre, Nairobi, Kenya. 13-14 March 2012.

Anuradha, G. Course on Monitoring, Evaluation and Impact Assessment of Food and Nutrition Security, Wageningen UR Centre for Development Innovation, The Netherlands. 6-24 June 2011.

Anuradha, G. Training Course on Statistical and Demographic Data Analysis for Health Personnel, National Institute for Health and Family Welfare, New Delhi. 21-25 November 2011.

Ara, Sehnaz. Seed Fair, Nuaguda. National Bureau of Plant Genetic Resources, Cuttack. 23 March 2012.

Arivudai Nambi, A. Peri-Urban Agriculture – An Assessment Initiative in Collaboration with the International START Secretariat, Washington DC. Kathmandu. 16-19 August 2011.

Arivudai Nambi, A. Consultation to Improve Climate Forecasting to Enhance Food Security in Indian Ocean Rim Countries, CSIRO (Australia), Chennai. 6-7 September 2011.

Arivudai Nambi, A. Panellist for the Workshop on Sharing Experiences of Climate Change Action in Semi-Arid Regions of India – A Case Study of Bundelkhand Region, organised by Climate Change and Development, Global Programme Climate Change, The Swiss Agency for Development and Cooperation and Development Alternatives. Bhopal. 9 September 2011.

Arivudai Nambi, A. National Workshop on India's Second National Communication (SNC) to the UNFCCC. New Delhi. 20 September 2011.

Arivudai Nambi, A. 12th Plan Working Group on Climate Change. State Planning Board, Thiruvananthapuram. 30 September 2011.

Arivudai Nambi, A. Food, Agriculture and Rural Markets Systems (FARMS) Consultation on Climate Change Adaptation. India-USAID / FARMS, New Delhi. 18-19 October 2011.

Arivudai Nambi, A. Second National Research Conference on Climate Change. Centre for Science and Environment & IIT Delhi, New Delhi. 5-6 November 2011.

Arivudai Nambi, A. 2011. National Level Capacity Building Workshop on Promoting Eco-Agriculture for Sustainability and Climate Change Impacts Management. Department of Life Sciences. Mumbai University, Mumbai. 19-20 December 2011.

Arivudai Nambi, A. International Conference on Climate Change and CO_2 Management: Mitigation, Separation and Utilization. Anna University, Chennai. 2-3 February 2012.

Arivudai Nambi, A. Second Asia-Pacific Climate Change Adaptation Forum. United Nations Conference Centre, Bangkok, Thailand. 12-13 March 2012.

Arivudai Nambi, A. International Workshop on Climate Change in Agriculture: Adaptation and Mitigation Strategies. Gandhigram Rural Institute, Gandhigram. 21-23 March 2012.

Arivudai Nambi, A. Integrating Urban Climate Guidelines through Clean Technologies (RE&EE) at the State and City Level to Build Sustainable Low Carbon Cities. International Council for Local Environmental Initiatives & British High Commission, Chennai. 18 April 2012.

Arivudai Nambi, A. Workshop on Decision Analysis: Can Seasonal Climate Forecasts Improve Food Security in Indian Ocean Rim Countries in a Variable and Changing Climate? Commonwealth Scientific and Industrial Research Organisation (Australia), Hyderabad. 2-3 May 2012.

Badoghar, A. K. Eastern Regional Agricultural Fair. CRRI, Cuttack, 21-23 February 2012.

Badoghar, A. K. Seed Fair, Nuaguda. National Bureau of Plant Genetic Resources, Cuttack. 23 March 2012.

Chaudhury, S. S. National Training on Project Formulation, Risk Assessment. Scientific Report Writing & Presentation. IARI, New Delhi. 25 September -1 November 2011.

Chaudhury, S.S. National Workshop on Demonstrated Options for Improved Livelihood in Disadvantaged Areas of India. Indira Gandhi

Krishi Vishwavidyalaya, Raipur. 20-21 January 2012.

Chaudhury, S. S. Seed Fair, Nuaguda. National Bureau of Plant Genetic Resources, Cuttack. 23 March 2012.

Dash, Niranjan. Farmers-led Innovation Programme. Chaudhary Charan Singh Haryana Agricultural University, Hissar, Haryana. 23-24 December 2011.

Dhanya, C. S.. Training on Facilitation and Managerial Skills for Field Efficiency. Karl Kubel Institute for Development Education, Anaikkatti, Coimbatore. 14-18 September 2011.

Girija, D.S. First Working Group Meeting on Integrated Coastal Zone Management Pilot Site-Puducherry. Bay of Bengal Large Marine Ecosystem Project, Puducherry. 26 June 2011.

Gupta, R. K. Protective Agro-Textiles – Advantages and Future Prospects. Synthetic & Art Silk Mills' Research Association (SASMIRA), Ministry of Textiles, Government of India and Tamil Nadu Agriculture University, Coimbatore.7 June 2011.

Hopper, R. S. S. Global Food Security Forum. Rabat, Morocco. 7- 9 March 2012.

Hopper, R. S. S. Policy Dialogue on Building Climate Resilient Agriculture in India. ICRISAT & ICAR, NASC, New Delhi. 22 May 2012.

Jithin, M. M. Training on Plant Tissue Culture – Techniques and Applications. Centre for Plant Biotechnology and Molecular Biology, College of Horticulture, Kerala Agricultural University, Vellanikkara. 19-31 March 2012.

King, E. D. Israel Oliver. Global Conference on Women in Agriculture and Participating in the Innovation Market Place Exhibition, Global Conference on Women in Agriculture, New Delhi. 13-15 March 2012.

Kishor, Japtap. Workshop on Interventions for Women Empowerment in Cotton Areas of Maharashtra. UNDP, Pune. 13 October 2011.

Kumar, N. Training on Improved Agronomic Practices in Millets. University of Agricultural Sciences, Bangalore. Bengaluru. 7-9 November 2011.

Kumar, N. Master Training on Pepper Cultivation at Kolli Hills. Spices Board of India, Coimbatore. 22 November 2011.

Lenka, Kartik Charan. Conference on Biodiversity Conservation and Climate Change, IMMT, Bhubaneswar. 2–4 December 2011.

Lenka, Kartik Charan. Seed Fair, Nuaguda. National Bureau of Plant Genetic Resources, Cuttack. 23 March 2012.

Maity, B. K. District-level Workshop on Financial Inclusion and Literacy for NGOs. NABARD, Bhubaneshwar. 11 November 2011.

Manjula, M. Regional Workshop on Peri-urban Agriculture — An Assessment Initiative in Collaboration with the International START Secretariat–Washington DC. Kathmandu. 18-19 April 2011.

Manjula, M. Short Course on Agriculture in Transition: Analysis, Design and Management of Sustainable Farming Systems. Wageningen UR Centre for Development Innovation. The Netherlands. 9-25 May 2011.

Manjula, M. Workshop on Training in Successful Research Grants Application, Management, Academic Dissemination and Non-Academic Impact. Economic and Social Research Council - Department for International Development, New Delhi. 22-23 July 2011.

Manjula, M. Workshop on Urban-Peri-Urban Agriculture Assessment. United Nations Environment Programme (UNEP), Nairobi. 24-26 October 2011.

Mithunlal, S. Training Programme on Log-frame Integrated Project Proposal. Karl Kubel Institute for Development Education, Coimbatore. 7-9 February 2012.

Nagaraja, C. National Training Programme on Fish Health Management. Central Institute of Freshwater Aquaculture (ICAR), Bhubaneswar. 23-29 November 2011.

Nagarajan, R. The 26th Meeting of the National Natural Resources Management System Standing Committee on Bio Resources and Environment. Ministry of Environment and Forests, New Delhi. 17 February 2012.

Nagarajan, R. Workshop on Cloud Computing Technology. Amazon Web Services, Chennai. 21-22 March 2012.

Nagarajan, R. Technical Advisory Group Meeting of *National Natural Resource Management System* — Biosphere Reserve Project. G.B Pant Institute of Himalayan Environment and Development, Almora, Utharakhand. 10-11 April 2012.

Nagarajan, R. International Day for Biological Diversity. Biodiversity Authority of India and Ministry of Environment and Forests, Government of India. Chennai. May 2012.

Naik, J. Farmers-led Innovation Programme. Chaudhary Charan Singh Haryana Agricultural University, Hissar, Haryana. 23-24 December 2011.

Nampoothiri, K. U. K. National Colloquium on Media Education: Challenges. New Delhi. 26 November 2011.

Nampoothiri, K .U. K., Workshop and Conclave on Agriculture Agenda for Odisha Bhubaneswar. 24-25 February 2012.

Nayak, G. State-level Convention on Women Empowerment and Role of Mahila Santi Sena. Human Development Foundation & Unnayan, Bhubaneswar. 4-5 February 2012.

Nayak, T. R. Seminar on Dynamics of Chronic Poverty in Odisha. Central University Odisha, Bhubaneswar. 30 April 2012.

Parameswaran, Prajeesh. Training Course on Vegetation Science and Site Classification. TERI University, New Delhi. 5-23 October 2011.

Parasuraman, N. Third Agriculture Leadership Summit, *Indian Agriculture Research Institute,* New Delhi. 29-30 September 2011.

Parida, A. Global Food Security Forum, Rabat, Morocco. 7-11 March 2012.

Parida, P. K. Training on Micro-level Planning. Centre for Youth and Social Development -PrAYAS, Mundaguda, Boipariguda. 28-29 July 2011.

Parida, P. K. National Colloquium on Media Education: Challenges. New Delhi. 26 November 2011.

Patro, N. C. Eastern Regional Agricultural Fair. CRRI, Cuttack, 21-23 February 2012.

Raj, R. Meera. Training Programme on Log-frame Integrated Project Proposal. Karl Kubel Institute for Development Education, Coimbatore. 7-9 February 2012.

Rajkumar, R. Workshop on Centrally-sponsored Credit Schemes. NABARD, Thanjavur. 10 November 2011.

Ramasubramanian, R. Systematization for Learning and Monitoring & Evaluation of Demonstration Projects Workshop. Gesellschaft für Internationale Zusammenarbeit (GIZ), New Delhi. 16–17 November 2011.

Ramkumar, Vidyaa. Stakeholders Meeting. Ministry of Minority Affairs, Government of India, Puducherry. 22 November 2011.

Ramkumar, Vidyaa. Financial Inclusion Meet. Reserve Bank of India, Government of India, Puducherry. 22 December 2011.

Ramkumar, Vidyaa. Workshop on Agri Clinic & Agri Business Centre. Ministry of Agriculture, Government of India & MANAGE, Puducherry.12 January 2012.

Ramkumar, Vidyaa. NGOs Consultation Meet. Department of Social Welfare, Government of Puducherry, Puducherry. 3 February 2012.

Ramkumar, Vidyaa. Local Advisory Committee Meeting of INDSETI–Indian Bank Self Employment Training Institute, Puducherry. 4 March 2012

Ratha, Antarjyami. World Education Summit, IGNOU, New Delhi, 13-15 July 2011

Ravichandran, K. K. Workshop on Systematization for Learning and Monitoring Evaluation for Demonstration Projects. GIZ, New Delhi. 16-17 November 2011.

Rengalakshmi, R. Workshop on Urban Agriculture/Climate Change Assessment for the Joint EC/UNEP-funded Project Integrating Climate Change Mitigation and Adaptation in Development Planning, UNEP, Nairobi. 24-26 October 2011.

Rengalakshmi, R. Workshop on ICTs and Climate Change. University of Manchester and Association for Progressive Communications, Johannesburg. 22-25 January 2012.

Santhamurthy, P. Local Advisory Committee of Indian Bank Self-Employment Training Institute, Puducherry. 4 March 2012.

Selvam, V. Workshop on the Economics of Ecosystems and Biodiversity, Ministry of Environment and Forests (MoEF), Government of India and GIZ. Bhopal. 15-16 September 2011.

Selvam, V. Workshop on World Bank Assisted Integrated Coastal Zone Management Project-Phase II. The World Bank and Society for Integrated Coastal Zone Management (SICOM). New Delhi. 27 September 2011.

Senthilkumaran. S. India-Myanmar Collaboration in Establishing an Advanced Centre for Agricultural Research and Education (ACARE) in Yezin and Setting up of Rice Bio-Park at Model Integrated Farm. Nay Pyi Taw, Myanmar. 23-26 July, 2011.

Senthilkumaran. S. 5th Annual Review Meeting of Integrated Agromet Advisory Services. Agartala. 18-20 October 2011.

Senthilkumaran, S. Setting up of Knowledge Connectivity in SMART Village Programme in Malaysia, Malaysia. 8-16 November 2011.

Senthilkumaran. S. Implementation of Knowledge Connectivity Programme in India-Morocco. Food Legume Initiative, Morocco. 5-10 February 2012.

Shajahan, P. T. Training on Facilitation and Managerial Skills for Field Efficiency. Karl Kubel Institute for Development Education, Anaikkatti, Coimbatore. 14-18 September 2011.

Singh, Navjot and Bandana Padhan, UGC Sponsored National Seminar on New Frontiers in Plant Science Research for Sustainable Development. P.N. College, Khurda. 5 -26 February 2012.

Sivakumar, A. Workshop on Finance and Procurement. SICOM, New Delhi. 3-4 May 2012.

Sivan, V.V. Training on Facilitation and Managerial Skills for Field Efficiency. Karl Kubel Institute for Development Education, Anaikkatti, Coimbatore. 14-18 September 2011.

Sophia, J. D. Workshop among Indian Partners of the EU-India on Biotechnological Wastewater Treatments and Reuse in Agronomical Systems. Hyderabad. 28 October 2011.

Sophia, J. D. Workshop on Coastal Well-Being Methods. National Centre for Sustainable Coastal Management and University of Ulster, Ireland, Chennai. 14-18 November 2011.

Sophia, J. D. Workshop on Integrated Coastal Zone Management, SICOM and the World Bank, Goa. 21-24 February 2012.

Srinath, J. National Workshop on ICT in Agriculture through Virtual Extension Platform. E-Extension Department, Tamil Nadu Agricultural University, Coimbatore. 9-10 August 2011.

Srinath, J. National Consultation on MGNREGA, Reforming Agenda. Ministry of Rural Development and UNDP, New Delhi. 14 November 2011.

Srinath, J. National Training of Agromet Unit Staff of India Meteorological Department. Central Training Institute, Pashan, Pune. 13 February 2012.

Srinath, J. National Content Management Meet on Content Assessment and Planning for Improving Contents and Listeners. IFFCO Kisan Sanchar Limited and Fertilizer Marketing

Development Institute, Gurgaon. 22-23 March 2012.

Subbiah, Vijay, R. National Conference on E-Waste Management Using Biological Tools — An Eco-Friendly Approach. Centre for Environmental Research and Development and Loyola Institute of Frontier Energy, Loyola College, Chennai. 8-9 March 2012.

Swain, S. Odisha Environment Congress 2011. Regional Museum of National History, Bhubaneswar. 23-24 December 2011.

Swain, S. Celebration of National Science Day. Saraswati Vidya Mandir, National Aluminium Company, Damanjodi. 28 February 2012.

Velvizhi, S. First Working Group Meeting on Integrated Coastal Zone Management Pilot Site - Puducherry. Bay of Bengal Large Marine Ecosystem Project, Puducherry. 26 June 2011.

Velvizhi, S. Stakeholders Workshop on Impact of Climate Change on Coastal Aquaculture and Adaptations and Mitigations for Resilience in Nagapattinam District. Central Institute of Brackishwater Aquaculture, Nagapattinam. 25 July 2011.

Velvizhi. S. Workshop on Centrally-sponsored Credit Schemes. NABARD, Thanjavur. 10 November 2011.

Volga, V. R. Training Programme on Log-frame Integrated Project Proposal. Karl Kubel Institute for Development Education, Coimbatore. 7-9 February 2012.

Awards/Honours

Institutional

M. S. Swaminathan Research Foundation. 2012. National Water Award for 2010 for Tolla Watershed, Koraput District, Orissa. Ministry of Water Resources, Government of India, New Delhi.

M. S. Swaminathan Research Foundation. 2012. National Ground Water Augmentation Award for Illupur Watershed, Pudukottai District, Tamil Nadu. Ministry of Water Resources, Government of India, New Delhi.

Individual

George, Suja. 2011. DBT CREST (Cutting-edge Research Enhancement and Scientific Training) Award for Short Term Training in Plant Genomics, Transcriptomics, Metabolomics and Proteomics. Department of Plant Science, University of Illinois, USA.

George, Suja. 2012. Indo-US Research Fellowship, Department of Science and Technology, Government of India, New Delhi.

Harikrishnan, M. 2012. Deutscher Akademischer Austausch Dienst Fellowship, Germany. University of Bielfield, Bielefeld, Germany. June 2012 to September 2013.

Mohamed Bhilal, A. 2012. Mother Teresa Award, Tamil Nadu Federation Volunteers Association, Kanyakumari District, Tamil Nadu.

Nampoothiri, K. U. K. 2011. Member, Research Advisory Committee, Directorate of Cashew Research (ICAR), Puthur.

Padhan, B. 2011. Best Poster Award (2nd position). 3rd Indian Youth Science Congress, New Delhi.

Parasuraman, N. 2011. Member, Divisional Railway Users' Consultative Committee, Southern Railway, Chennai.

Parasuraman, N. 2011. Member, Agriculture Committee, Government of Chhattisgarh, Chhattisgarh.

Parasuraman, N. 2011. Karam Veer Puraskar, International Confederation of NGOs, New Delhi.

Parasuraman, N. 2011. Best Citizen of India Award, International Publishing House, New Delhi.

Parasuraman, N. 2011. Glory of Education Excellence Award, International Institute of Education and Management, New Delhi.

Parasuraman, N. 2012. Member, 12th Five Year Plan, Public Distribution System Committee, Government of Tamil Nadu, Chennai.

Parida, A. 2012. Prof. T. S. Sadasivan Memorial Lecture Award, Madras Science Foundation, Chennai.

Rout, S. S and N. C. Patro 2011. Best Poster Award. 3rd Indian Youth Science Congress, New Delhi.

Sreekirupa, R. 2011. Best Woman Award, Rotary Club of Ramnad, World Women's Day. Ramanathapuram.

Swain, S. 2011. Young Scientist Award, Department of Environment & Forests, Government of Odisha, Bhubaneswar.

Swain, S. 2012. Best Poster Award, Agriculture and Forestry Section, 99th Indian Science Congress, Bhubaneswar.

Swaminathan, M .S. 2011. Honorary Doctorate, Indian Institute of Technology, Kharagpur.

Swaminathan, M. S. 2011. Honorary Doctorate, Punjab University, Chandigarh.

Swaminathan, M. S. 2011. Member, National Advisory Council, Government of India, New Delhi.

Swaminathan, M. S. 2011. Willa S Cather Medal, University of Nebraska, Lincoln, USA.

Swaminathan, M. S. 2012, 5th Panampilly Prathibha Puraskar Award, Samskara Sahiti, the Art and Cultural Wing of the Kerala Pradesh Congress Committee, Thiruvananthapuram, Kerala.

Swaminathan, M. S. 2012. Honorary Doctorate, University of East Anglia, UK.

Swaminathan, M. S. 2012. Honorary Doctorate, Calicut University, Calicut.

Swaminathan, M. S. 2012. Deshikottama (Honorary Doctorate), Visva-Bharati, Santiniketan.

Velvizhi, S. 2011. Member – Board of Studies, Department of Zoology, Advisory Committee. A. Duraisamynadar Maragadavalliammal Women's College, Nagapattinam.

About the Foundation

The M.S. Swaminathan Research Foundation (MSSRF) was registered in 1988 as a non-profit Trust, 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 MSSRF.

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World Noni Research Foundation, Chennai

Friends of MSSRF - Asia Initiatives, Japan

Friends of Swaminathan, Australia (FOSA)

OCP Foundation, Morocco

The World Food Prize Foundation, Des Moines, USA

Wasser Fuer DicDribe, Switzerland

Programme Area 500: Food Security

B.V. Rao Endowment

Ministry of Rural Development, Government of India, New Delhi

Uttara Devi Endowment

Ford Foundation Chair Endowment

Friends of Swaminathan, Australia (FOSA)

Global Alliance for Improved Nutrition (GAIN), Switzerland

Imperial College of London, UK

United Nations Office for Project Services (UNOPS), Switzerland Operations Center

National	*International*
Programme Area 600: Information, Education and Communication	
Department of Science and Technology, Government of India, New Delhi	International Development Research Centre, Canada
IFFCO Kisan Sanchar Ltd, New Delhi	International Institute for Information Design (IIID), Vienna, Austria
Indian Institute of Technology Bombay, Mumbai	Telecentre.org Foundation, The Philippines
Indian National Centre for Ocean Information Service (INCOIS), Hyderabad	The Neuberger Berman Foundation, USA
JSW Steel Limited, Salem	
Madhyamam Daily, Kerala	
MARG Karaikal Port, Karaikal	
National Bank for Agriculture and Rural Development, Chennai	
Sasken Communication Technologies Ltd, Bangalore	
State Bank of Mysore, Chennai	
Qualcomm India, New Delhi	
Programme Area 700: Workshops, Conferences, Partnerships and Institutional Initiatives	
Agriculture Today, New Delhi	Food and Agricultural Organization of the United Nations (FAO), Rome
Bharat Petroleum Corporation Ltd	International Centre for Agricultural Research in the Dry Areas (ICARDA), Syria
Hindustan Petroleum Corporation Ltd	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad
Indian Overseas Bank, Chennai	Ramon Magsaysay Foundation, Philippines
Ministry of Environment and Forests, Government of India, New Delhi	

National	*International*
Project Director, ATMA, Kendrapara, Odisha	Royal Norwegian Embassy, New Delhi
Protection of Plant Varieties & Farmers' Rights Authority, Government of India, New Delhi	World Agroforestry Centre, Nairobi
Rajiv Gandhi National Institute of Youth Development, Sriperumbudur	
Science City, Chennai	
SRM University, Chennai	

Programme Area 800: Special Projects

Ministry of Earth Sciences, Government of India, New Delhi	African Centre for Technology Studies (ACTS), Nairobi
	Asia-Pacific Network (APN), Japan
	Bioversity International, Rome
	Canadian International Development Agency (CIDA), Canada
	Department for International Development (DFID), UK
	European Union, Brussels
	International Development Research Centre (IDRC), Canada
	International Fund for Agricultural Development (IFAD), Rome

List of Acronyms

ADP	Associate Degree Programme
APM	Alleviating Poverty and Malnutrition
ANM	Auxiliary Nurse Mid-wife
ARI	Agharkar Research Institute
ASA	Action for Social Advancement
ASHA	Accredited Social Health Activist
ATMA	Agricultural Technology Management Agency
BMC	Biodiversity Management Committee
BIWS	Bio-Industrial Watershed Programme
BMI	Body Mass Index
BPCL	Bharat Petroleum Corporation Limited
BPMPGRC	Biju Patnaik Medicinal Plants Garden and Research Centre
BRAC	Bangladesh Rural Advancement Committee
BVC	Biovillage Council
BVRC	Biovillage Resource Centre
CAbC	Community Agrobiodiversity Centre
CALP	Computer Aided Learning Programme
CBM	Community Biodiversity Management
CBO	Community Based Organisation
CED	Chronic Energy Deficiency
CGB	Community Gene Bank
CHF	Community Hunger Fighter
CIBA	Central Institute of Brackishwater Aquaculture
CIC	Certificate in Computer Application
CIDA	Canadian International Development Agency
CMFRI	Central Marine Fisheries Research Institute
CMV	Cassava Mosaic Virus
CNP	Community Newspaper
CPCHP	Certificate in Propagation, Cultivation of Horticultural Crops
CRP	Community Resource Person
CRRI	Central Rice Research Institute
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSR	Corporate Social Responsibility
CTCRI	Central Tuber Crops Research Institute
CTMRT	Centre for Tropical Mushroom Research and Training
CVC	Central Village Committee

DBT	Department of Biotechnology
DFID	Department for International Development
DPCL	Dhamra Port Company Limited
DRDA	District Rural Development Agency
DSMS	District Supply & Marketing Society
DST	Department of Science and Technology
ECAS	Every Child A Scientist
EFY	Elephant Foot Yam
EST	Expressed Sequence Tags
EU	European Union
FAO	Food and Agriculture Organisation
FARMS	Food, Agriculture and Rural Markets Systems
FCRA	Foreign Contribution (Regulation) Act 2010
FFS	Farm Field School
FM	Finger Millet
FPC	Farmers' Producer Company
FPU	Fish Processing Unit
FPVS	Farmer Participatory Variety Selection
FPVT	Farmer Participatory Variety Trials
FRG	Farmers' Research Group
FSN	Farming System for Nutrition
FYM	Farmyard Manure
GEC	Gujarat Ecological Commission
GGA	Grameen Gyan Abhiyan
GIAHS	Globally Important Agricultural Heritage System
GIM	Gender Institutionalisation and Mainstreaming
GIS	Geographic Information Systems
GIZ	Gesellschaft für Internationale Zusammenarbeit
GLV	Green Leafy Vegetables
GM	Genetically Modified
GPS	Global Positioning System
GSM	Global System of Mobile Technology
HCM	Health Committee Member
HESCO	Himalayan Environmental Studies and Conservation Organisation
HH	Households
HITS	High Infectivity Throughput Screening
HPCL	Hindustan Petroleum Corporation
HYV	High-Yielding Variety

ICAR	Indian Council for Agricultural Research
ICDS	Integrated Child Development Services
ICRAF	World Agroforestry Centre
ICT	Information and Communication Technology
ICZM	Integrated Coastal Zone Management
IDRC	International Development Research Centre
IDS	Institute of Development Studies
IFAD	International Fund for Agricultural Development
IFFCO	Indian Farmers' Fertiliser Cooperative Limited
IFPRI	International Food Policy Research Institute
IFS	Integrated Farming System
IGA	Income-Generation Activities
IGAU	Indira Gandhi Agricultural University
IGNOU	Indira Gandhi National Open University
IIC	Iwokrama International Centre for Rainforest Conservation and Development
IIID	International Institute for Information Design
IITB	Indian Institute of Technology, Bombay
IMFFS	Integrated Mangrove Fishery Farming System
INCOIS	Indian National Centre for Ocean Information Services
IPM	Integrated Pest Management
ITDA	Integrated Tribal Development Agency
IUCN	International Union for Conservation of Nature
IVR	Interactive Voice Recognition
IWMI	International Water Management Institute
IYCF	Infant and Young Child Feeding
KHABCoFED	Kolli Hills Agro-biodiversity Conservers' Federation
KKDUS	Kalinga Kalajeera Dhan Utpadak Samabaya Ltd.
KKRGCS	Kalinga Kalajeera Rice Growers' Cooperative Society
KMS	Knowledge Management System
KVK	Krishi Vigyan Kendra
LANSA	Leveraging Agriculture for Nutrition in South Asia
LCIRAH	Leverhulme Centre for Integrated Research on Agriculture and Health
LFA	Logical Framework Approach
M&E	Monitoring and Evaluation
MFF	Mangroves for the Future
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Scheme
MKSP	Mahila Kisan Sashaktikaran Pariyojana
MoEF	Ministry of Environment and Forests

MoRD	Ministry of Rural Development
MPEDA	Marine Products Export Development Authority
NABARD	National Bank for Agriculture and Rural Development
NASC	National Agricultural Science Centre
NBA	National Biodiversity Authority
NBDA	Nagaland Bamboo Development Agency
NBDB	National Bioresource Development Board
NBPGR	National Bureau of Plant Genetic Resources
NBRI	National Botanical Research Institute
NETFISH	Network for Fish Quality Management and Sustainable Fishing
NFDB	National Fisheries Development Board
NIVH	National Institute of the Visually Handicapped
NNMB	National Nutrition Monitoring Bureau
NNRMS	National Natural Resource Management System
NPK	Nitrogen, Phosphorus and Potassium
NTFP	Non-Timber Forest Produce
NVA	National Virtual Academy
OFSP	Orange Flesh Sweet Potato
ORMAS	Orissa Rural Development and Marketing Society
OUAT	Orissa University of Agriculture & Technology
PBR	People's Biodiversity Register
PDKV	Panjabrao Deshmukh Krishi Vishwa Vidyalaya
PDS	Public Distribution System
PGPB	Plant Growth Promoting Bacteria
PGR	Plant Genetic Resource
PGUS	Panchabati Grama Unnayan Samiti
PHRN	Public Health Resource Network
PPV&FRA	Protection of Plant Varieties & Farmers' Rights Authority
PTD	Participatory Technology Development
RBD	Randomised Block Design
REAP	Resource Efficient Agricultural Production
RET	Rare and Endangered Tree
RMAF	Ramon Magsaysay Award Foundation
RWEF	Rural Women Entrepreneur Federation
SARDI	South Australian Research and Development Institute
SCA-TSP	Special Central Assistance – Tribal Sub Plan
SHG	Self-Help Group
SICOM	Society for Integrated Coastal Zone Management

START	System for Analysis, Research, and Training
STHG	Structured Home Garden
TAGG	Thirupuli, Alathur, Gundur and Gundani
TANUVAS	Tamil Nadu Veterinary and Animal Sciences University
TBA	Traditional Birth Attendant
TEDA	Tamil Nadu Energy Development Agency
THCP	Traditional Health Care Practitioner
TN-FORCES	Tamil Nadu Forum for Creche and Childcare Services
TNAU	Tamil Nadu Agricultural University
TNBB	Tamil Nadu Biodiversity Board
UA	University of Alberta
UAS-B	University of Agricultural Sciences, Bangalore
UAS-D	University of Agricultural Sciences, Dharwad
U-FE	Utilisation – Focused Evaluation
UPNRM	Umbrella Programme on Natural Resources Management
UPOV	International Union for the Protection of New Varieties of Plants
USTHG	Unstructured Home Garden
VGSB	Village Gene-Seed Banks
VKC	Village Knowledge Centre
VKCMC	VKC Management Committee
VRC	Village Resource Centre
VRP	Village Resource Person
WALAMTARI	Water and Land Management Training and Research Institute
WARDA	Wayanad Agricultural & Rural Development Association
WEPIC	Western Ghats Endemic Plants Information Centre
WLL-CUG	Wireless Local Loop Based Closed-User Group
WSHG	Women's Self-Help Group

FINANCIAL STATEMENT 2011-12

M.S.SWAMINATHAN RESEARCH FOUNDATION

NO.6, THIRD CROSS ROAD,TARAMANI INSTITUTIONAL AREA, TARAMANI,CHENNAI 600 113

BALANCE SHEET AS AT 31ST MARCH 2012

Figs in Rs Lakhs

FOUNDATION

LIABILITIES	SCH	2011-2012 Rs.	2010-2011 Rs.	ASSETS	SCH	2011-2012 Rs.	2010-2011 Rs.
OWN FUNDS				OWN ASSETS			
CORPUS FUNDS	1	126.708	126.694	FIXED ASSETS	5	600.904	632.115
GENERAL FUND & OTHER FUNDS	2	2870.178	2817.699	INVESTMENTS	6	1331.640	2949.280
ENDOWMENT FUND	3	4378.824	4340.455	CURRENT ASSETS			
CURRENT LIABILITIES	9	64.805	249.012	CASH & BANK BALANCES	7	4873.744	3239.582
				ADVANCES	8	634.228	712.884
TOTAL [A]		**7440.516**	**7533.861**	**TOTAL [A]**		**7440.516**	**7533.861**

PROJECTS

LIABILITIES	SCH	2011-2012 Rs.	2010-2011 Rs.	ASSETS	SCH	2011-2012 Rs.	2010-2011 Rs.
PROJECT FUNDS & OBLIGATIONS	4	2382.071	1445.479	PROJECTS RECEIVABLES	4	507.974	375.675
CURRENT LIABILITIES	4	631.613	545.870				
				ADVANCES	4	270.695	278.528
				BANK BALANCES	4	2235.015	1337.145
TOTAL [B]		**3013.684**	**1991.348**	**TOTAL [B]**		**3013.684**	**1991.348**
GRAND TOTAL [A]+[B]		**10454.199**	**9525.209**	**GRAND TOTAL [A]+[B]**		**10454.199**	**9525.209**

Provisional(Unaudited)

M.S.SWAMINATHAN RESEARCH FOUNDATION

NO.6, THIRD CROSS ROAD,TARAMANI INSTITUTIONAL AREA, TARAMANI,CHENNAI 600 113

Figs in Rs Lakhs

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2012

EXPENDITURE	SCH	2011.2012 Rs.	2010.2011 Rs.	INCOME	SCH	2011.2012 Rs.	2010.2011 Rs.
ADMINISTRATIVE EXPENSES	12	370.080	429.759	INTEREST INCOME	10	515.587	449.017
ENDOWMENT EXPENSES	13	362.382	307.125	DONATION & OVERHEAD RECOVERIES	11	399.690	462.306
MEETINGS & OTHER RELATED EXPENSES	14	29.913	50.115				
DEPRECIATION		59.141	61.526				
10% OF ENDOWMENT INTEREST INCOME TRANSFERRED TO ENDOWMENT FUNDS		38.369	35.965				
EXCESS OF INCOME OVER EXPENDITURE FOR THE YEAR TRANSFERRED TO THE GENERAL FUND		55.392	62.798				
TOTAL		**915.276**	**947.288**	**TOTAL**		**915.276**	**911.323**

Provisional(Unaudited)

Address:
M. S. Swaminathan
Research Foundation
III Cross Road
Institutional Area
Taramani
Chennai 600 113, India