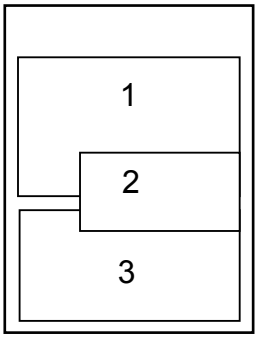
M. S. SWAMINATHAN RESEARCH FOUNDATION

2007-2008
EIGHTEENTH ANNUAL REPORT

CENTRE FOR RESEARCH ON SUSTAINABLE AGRICULTURAL AND RURAL DEVELOPMENT, CHENNAI



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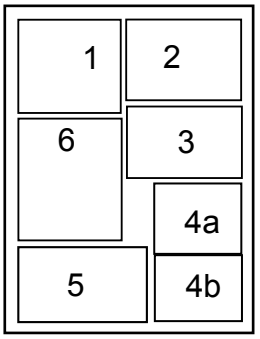
2. Mushroom training programme for tribal community members in progress

3. Training Centre for tribal men and women at CAbC Kalpetta, built with generous contribution from the Japanese Government



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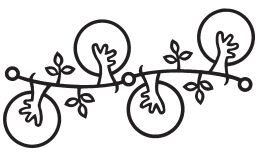
Eighteenth Annual Report
2007-2008



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; msswami@mssrf.res.in

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Chairman's Introduction

MSSRF at 20

The seed of the idea to set up an autonomous, non-profit and public good research institution was sown in my mind in 1970 by Prof C V Raman when he stayed with us for a couple of days at the Indian Agricultural Research Institute, New Delhi, where I was then the Director. Before leaving, Prof Raman told me that when I retired I should set up an autonomous, non-governmental research institution, which would provide young researchers a home for creative and socially relevant work. An opportunity for converting this idea into reality came when I received the first World Food Prize in Washington in 1987. The first task I undertook -on my return from Los Banos in the Philippines, where I headed the International Rice Research Institute for six years, was to develop a Trust Deed to establish a research institution devoted to imparting a pro-nature, pro-poor, pro-woman and pro-sustainable livelihood orientation to technology development and dissemination. The late Dr Manibhai Desai, founder of the Bharatiya Agro-industries Foundation (BAIF), which he established at the instance of Mahatma Gandhi, kindly helped to prepare the deed. On his suggestion, the Trust was named M S Swaminathan Research Foundation (MSSRF), and was registered on 17 May 1988 at New Delhi, with Prof V L Chopra, Prof V K Ramachandran and myself as the founder trustees. The year 2008 marks the 20th anniversary of the founding of MSSRF and hence, I would like to record a few facts about its growth.

While I was President of the World Conservation Union (IUCN) from –1984 to 1990, I had observed that scientific work on integrated coastal zone management was poor and as a consequence, precious mangrove wetlands were getting degraded. I considered this particularly unfortunate in the context of a potential rise in sea level as a consequence of global warming and climate change. I therefore felt that MSSRF should be located in a coastal area, where research on Coastal Systems could be initiated on the lines of Farming System Research (FSR). In 1989, the Government of Karnataka, then headed by the late Shri Ramkrishna Hegde, kindly offered me 5 ha of land and other facilities in the campus of the University of Agricultural Sciences, Bangalore, to establish MSSRF. At the same time, the Government of Tamil Nadu headed by Dr M Karunanidhi also offered land and other facilities in the Taramani Institutional Area of Chennai. I decided to accept the kind invitation of Chief Minister Dr M Karunanidhi and establish MSSRF at Chennai, due to its location on the coast. Further, Tamil Nadu has over 1,000 km of shoreline.

The scientific work of MSSRF began in June 1989, using facilities kindly provided by the Indian Institute of Technology, Chennai. A lecture I delivered at an international conference convened by the Government of Japan in Tokyo in September 1989 on the topic 'Anticipatory and Participatory Research to meet the Challenge of Sea Level Rise', led the Government of Japan to provide funds to MSSRF through the International Tropical Timber Organisation

(ITTO) to initiate a mangrove conservation strategy in the Asia-Pacific Region. This support helped to organise a survey of the status of mangrove wetlands in this region in 1991, and an International Training Programme in 1992 on mangrove ecosystem conservation and sustainable management. At this programme attended by twenty candidates from twelve countries, the participants prepared a Charter for Mangroves for their respective countries. MSSRF also assisted in the establishment of an International Society for Mangrove Ecosystem (ISME) with me as Founder-President and with its headquarters at Okinawa, Japan. A Mangrove Ecosystem Information Service (MEIS) was also started and a comprehensive international database on mangrove wetlands was compiled.

The Department of Biotechnology, Government of India, also extended support from 1990 onwards for establishing a Mangrove Genetic Resource Centre at Pichavaram, Tamil Nadu, and for initiating research on identification of the genes conferring tolerance to sea water in mangrove species, with a view to transferring them through recombinant DNA technology to rice and other crops of importance to coastal agriculturists. Thus began the twin strategy of MSSRF in relation to mangrove wetlands, namely conservation and sustainable and equitable use, as well as their use as donors of genes for salinity tolerance. At the same time, research was started on the integrated management of the coastal zone involving attention to capture and culture fisheries as well as coastal forestry and agro-forestry. MSSRF soon gained an international reputation as the "centre of origin" of new findings in the area of sustainable mangrove wetland conservation and regeneration and stable coastal agriculture, and received the **Blue Planet Prize** in Tokyo in 1996, becoming the only institution in Asia to be chosen for this pre-eminent international prize in the area of environment protection.

Another significant event in early 1990 was the organisation of the Second International Keystone Dialogue on Plant Genetic Resources. The Chennai Consensus arrived at on this occasion by the participants drawn from government, private, academic, and intergovernmental sectors, paved the way for resolving issues relating to access and benefit sharing, leading to the finalisation of the Global Biodiversity Convention adopted at the Earth Summit at Rio de Janeiro in 1992.

At the national level, MSSRF prepared in 1996 the first draft of an integrated Act to accord concurrent recognition to the rights of both breeders and farmers. Thus was born the Plant Variety Protection and Farmers' Rights Act of 2001. Similarly MSSRF contributed an early draft of the Biodiversity Act, which provided Panchayats pride of place in the conservation and sustainable and equitable use of biodiversity and proposed the establishment of local level Biodiversity Heritage Sites, such as Sacred Groves. Currently, MSSRF is assisting in the development of a National Biotechnology Regulatory Bill, which will enable the safe and responsible use of biotechnology, based on a transparent and credible process of risk-benefit assessment.

Over the years, MSSRF has been invited by both Tamil Nadu and other State Governments and the Government of India to prepare strategies for achieving specific goals such as Nutrition Secure Tamil Nadu, mitigating agrarian distress in the Kuttanad and Idukki districts of Kerala, and a rice revolution strategy for Assam. While presenting the State Budget for 1996, the Chief Minister Dr M Karunanidhi, made the following statement:

"வயிற்றுக்கு சோறிட வேண்டும் - இங்கு
வாழும் மனிதருக் கெல்லாம்
பயிற்றிப் பலகல்வி தந்து - இந்தப்
பாரை உயர்த்திட வேண்டும்"

- மகாகவி பாரதியார்

Feed the people
Who are hungry
Educate the people
To uplift the World ....

- Subramania Bharatiyar

To fulfill this dream of Mahakavi Bharatiyar, this Government will launch a new "Hunger Free Area Programme" with an aim to eradicate poverty-induced hunger. *A number of schemes are already under implementation to alleviate poverty and to cater to the nutrition requirements of different groups of the population. Gaps in this coverage will be identified which can then be specifically targeted under the Hunger Free Area Programme. Provision has been made in the Budget for preparing a detailed strategy to implement this programme in association with Dr M S Swaminathan".*

From the beginning, professional and financial integrity and accountability to donors have remained the bottom line of MSSRF's work culture. This has been established by the presentation of Annual Reports on 7th August of each year (starting in 1990), getting accounts audited on time, prompt reporting on FCRA returns and 35 (I) (ii) submissions under the Income Tax Act, and sending audited utilisation certificates to all donors, regularly.

In addition to strategic, anticipatory and participatory research, MSSRF has laid stress on human resource development from its inception. Forty-two scholars have so far taken their Ph.D degree from Madras and Osmania Universities on the basis of the research done at MSSRF, and fifteen more students are currently in various stages of their Ph.D thesis work. Offering opportunities for professional growth for scientists has been another goal of MSSRF. As a result, many of the former MSSRF staff were selected for senior international positions as well as important scientific positions in government and non-government institutions. Several scientists have received important awards and recognition. For example, Dr Ajay Parida was the recipient of Prof Umakant Sinha Memorial Award by the Indian Science Congress Association, B M Birla Science Prize for Biology of the B M Birla Science Foundation, Hyderabad, National Biosciences Award, and has been an Elected Fellow of the National Academy of Agricultural Science, New Delhi and National Academy of Sciences, Allahabad. Dr Sudha Nair was awarded the Prof B D Tilak Lecture Award by Prof B D Tilak Scientific Research and Education Trust, Pune and Drs Lakshmi and Sudha Nair received the National Women Bioscientist Award of the Department of Biotechnology, Ministry of Science and Technology, New Delhi.

MSSRF's efforts in education and human resource development have not only been in the area of post-graduate education, but also in the field of children's education, from the earliest years onwards.

The project ACCESS (Action for Child Care and Education Services and Strategies) which ran throughout the nineties, focused on the under-sixes, a much neglected and vulnerable group in development in the country as a whole. One of the major achievements of this project was setting up and nurturing of FORCES, a network of

institutions concerned with the care and development of the young child. When the project closed in 2001, the significant outcomes were summed up as follows in a post-project review:

- "Forces (Forum for Creche and Child Care Services) at both the national and state levels (Tamil Nadu) now leading in the advocacy and policy lobbying fields in Early Child Development (ECD), following a smooth transition of leadership
- An ECD trainers' network in Tamil Nadu, today an effective group of ECD professionals concerned with training and curriculum development
- A National Task Force committed to, and at present working on, the development of quality rating tools in ECD for multiple purposes
- An extensive and catalogued collection of resources and training materials in ECD in print, audio, and video (now digitalised), and
- A group of mature and motivated young professionals well-placed in several developmental fields".

Taking only the first four outcomes, it is satisfying to note that the network has continued to develop and strengthen these activities, though MSSRF is no longer the leader, with continued nurture and support from MSSRF, though now in a different capacity. This approach is a conscious policy in keeping with the title given to the review, **As the Salt in the Sea**, an indication that the concerns and attitudes underlying the work should in future permeate the entire work pattern and culture, without necessarily being identifiable as a separate identity. That this has happened, at least to some extent, is the best indicator of success.

Among other major initiatives for children, mention may be made of the Touch and Smell Garden for visually impaired children, Genome Clubs for introducing school children to the significance of scientific advances in the area of biodiversity and biotechnology and the **Every Child A Scientist** programme for imparting scientific literacy and awareness among children. These programmes have stimulated the development of large national programmes such as the DNA Clubs sponsored by the Department of Biotechnology, Government of India in schools in several parts of the country.

A similar trajectory can be seen in the case of women's issues. In the first few years, work involving or relating to women was largely within the confines of the area labeled **Reaching the Unreached.** Soon however, realising that this might be a narrow and self-defeating approach, and that such negative profiling of women may not advance their cause, it was decided to move to the broader perspective of gender, especially in relation to development. A decision was taken to set up a resource centre in Gender and Development, to mainstream gender concerns within the Foundation. This stimulated research on gender issues in various fields in which the Foundation was working, as well as helping to introduce concerns about gender equity across the board, and has led to a number of publications and training materials, in print and video, over the years. The Ford Foundation established in 2002 a chair on Women and Food Security to promote studies on the role of women in conservation, cultivation, consumption and commerce.

Most outstanding among the achievements have been the research and development efforts on gender issues in relation to biodiversity. Starting from the publication of the book, **Gender Issues**

in Biodiversity Management in 1997, the first of its kind world-wide, which stimulated more such studies globally, there have been a series of studies and publications drawing attention to women's contribution to biodiversity conservation and management. MSSRF was also the first to draw attention to the comparative neglect of women's IPR in the path-breaking legislations on biodiversity, and continues to battle for a more inclusive approach to the dissemination of science and technology. In order to assist young women professionals to take to a career in biotechnology, MSSRF assisted the Government of Tamil Nadu and the Department of Biotechnology, Government of India, in setting up India's first and only (so far) Womens' Biotechnology Park at Siruseri village near Chennai.

Looking back over the past 20 years, mention may be made of some major scientific and socially significant contributions (the examples are illustrative and not exhaustive).

- In the area of mangrove research, over 1,475 ha of degraded mangrove forests were restored at 6 sites in Tamil Nadu, Andhra Pradesh and Orissa. Over 6.8 million saplings were planted by 5,240 families drawn from 33 Village Mangrove Councils. This is the largest community mangrove forest restoration programme ever undertaken in the country. Mangrove Atlases have been prepared for Tamil Nadu, Andhra Pradesh and Orissa.
- Maps prepared by MSSRF using remote sensing pictures reveal that the mangrove area in Tamil Nadu increased to 4,050 ha in 2006 from 2,100 ha in 1993. After the tsunami of December 26, 2004, community interest in mangrove and non-mangrove bio-shields grew and about 55 ha in Tamil Nadu and 60 ha in Andhra Pradesh have since been covered with bio-shields, which will help to reduce the fury of seawater intrusion in coastal areas during cyclones and tsunami.
- The Community Agro-biodiversity programme of MSSRF is unique in the sense that it has triggered the formation of gene, seed, grain and water banks at the village level, thereby helping to link all parts of the production, consumption and marketing chain in a mutually reinforcing manner. The field gene bank helps to revitalise the *in situ* on-farm conservation traditions of local communities. This community agro-biodiversity conservation and sustainable and equitable use system won for the tribal families of Koraput in Orissa the **Equator Initiative Award** at the UN Conference on Sustainable Development held at Johannesburg in 2002, and the first **Genome Saviour Award** of the Protection of Plant Variety and Farmers' Rights Authority of India in 2007.
- Infrastructure for community conservation of agro-biodiversity has been created at Kalpetta, Wayanad, Kerala, in land donated by my family and at Jeypore, Koraput district, Orissa, on land kindly provided by the Government of Orissa. The MSSRF Centre at Koraput has been named after late Mr Biju Patnaik, in recognition of his unique contributions to building modern Orissa. The Kalpetta Centre has promoted local level food security by organising the cultivation of a wide range of tubers, which can be appropriately referred to as "life saving crops". In both Wayanad and Koraput, rice varieties with medicinal properties, such as *Navara* in Kerala, or excellent culinary properties, such as *Kalajeera* in Koraput have been promoted to link conservation and

commercialisation in a symbiotic manner. The improved *Kalajeera* strain developed through participatory breeding with tribal families has been named *Kalinga Kalajeera*. Similar work is in progress in Kolli Hills in Tamil Nadu with reference to millets belonging to the genera *Panicum, Paspalum, Setaria, Eleucine* and other under-utilised millets and pulses. Participatory breeding is the pathway adopted by MSSRF to improve the productivity and profitability of underutilised crops. MSSRF's work on underutilised or "orphan" crops, has led to a wider understanding of the need to diversify the grain components of our food security system and to introduce such nutritious crops in the Public Distribution System (PDS) and school noon meal programmes.

- The movement for saving biodiversity to save lives and livelihoods will gain momentum only if local communities see this as a sustainable method of ending the prevailing dichotomy between the prosperity of nature and the poverty of the people. For this purpose, MSSRF has initiated a Biovalley Programme in Orissa -biodiversity-rich watersheds where appropriate linkages among bio-resources, biotechnology and business (micro-enterprises supported by micro-credit) can be achieved. This programme will be essentially managed by tribal women and men and will be serviced by the Biju Patnaik Medicinal Plants Garden and Research Centre at Jeypore.
- In order to assist farm and rural women and men to get benefits from the provisions of the Plant Variety and Farmers' Rights and Biodiversity Acts, a Community Gene Bank and herbarium have been established at MSSRF, Chennai. This is a unique facility for helping farmers and primary conservers to get recognition and reward from the Gene and Biodiversity Funds. Also, training programmes are held for Panchayati Raj leaders.
- In the area of Biotechnology, MSSRF's policy is to bring about appropriate combinations of mendelian, molecular and participatory breeding. The areas chosen for attention over 18 years ago, **namely tolerance to salinity and drought, have become most relevant in the emerging era of global climate change, sea-level rise and reduced precipitation**. The scientifically innovative and socially relevant work carried out by the Biotechnology team had led to MSSRF being designated as a **Centre of Excellence** by the Department of Biotechnology. In 1990, MSSRF initiated anticipatory and strategic research for developing genetic material for resistance/ tolerance to abiotic stresses like salinity and drought in important food plants. The aim of this research is the development of novel genetic combinations for use in participatory breeding programmes with farming families. Thus, MSSRF functions as a pre-breeding centre and works together with farm families in the development of strains possessing resistance to salinity/ drought. *Avicennia marina* and *Porteresia coarctata* were chosen as donors for tolerance to coastal salinity, and *Prosopis juliflora* was used for identifying genes for drought resistance. So far about 50 full-length genes and many partial sequences have been isolated for abiotic stress tolerance.
- The Review Committee on Genetic Manipulation, Government of India, approved limited field trials of three transgenic rice lines during 2004–05 and 2005–06. Large-scale sequencing and functional genomic approach have also been adopted in

Prosopis juliflora. Thus, a new chapter in breeding strains of rice, mustard and pulses has been opened up, thanks to transgenic technology. *This is the first time in the world that a mangrove species has been used as a donor of salinity tolerance, and a species widely regarded as a tenacious weed, i.e, Prosopis juliflora, has been mobilised for providing genes for drought tolerance.* The *Outlook* magazine (18 July 2005) listed this piece of research carried out by a young team of scientists of MSSRF among the ten most important pieces of scientific work carried out in India during 1995-2005, which can change our lives for the better.

- Other programmes like bio-prospecting, bio-remediation and micro-propagation are also making good progress. In addition, the production and demonstration of high quality planting material of *Jatropha curcas* is paving the way for launching science-based bio-fuel programmes. Conservation of eighty rare, endangered and threatened (RET) plants has been undertaken in a holistic manner from collection to propagation and to rehabilitation in natural habitats, and training the local people and scientists in the methodology. Reproducible *in vitro* propagation protocols have been developed for a number of RET species (viz. *Casearia rubescens, Ceropegia bulbosa, Ceropegia jaini, Crotalaria longipes, Frerea indica, kaempferia galanga, Myxopyrum serratulum, Piper barberi, Rauvolfia micrantha, Rauvolfia tetraphylla, Syzygium travancorium* and *Uraria picta*). *In vitro* protocols have also been developed for valuable and economically important species like *Aegle marmelos, Bacopa monnieri, Curculigo orchioides, Eupatorium triplinerve, Gymnema sylvestre, Hemidesmus indicus, Jatropha curcas, Sauropus androgynus, Tinospora cordifolia, Tylophora indica.* The group has also developed vegetative and micropropagation protocols for a number of mangrove species, and successfully transferred them into mangrove forest areas in Tamil Nadu and Puducherry, with the active participation of SHGs and forest officials, with appropriate training. The isolation, purification and characterisation of bioactive molecules from the mangrove ecosystem, against *Helicoverpa armigera* and an array of bacterial human pathogens have resulted in a number of biopesticide formulations possessing anti-pest and anti-microbial principles.
- The lichen group at MSSRF has made excellent progress during the last few years, working on diverse aspects of lichens viz: lichen diversity and ecology, bioprospecting for secondary compounds, lichen culture and molecular studies on lichens. Several lichen species have been identified, which can serve as bioindicators to monitor environmental pollution. Site-specific protocols to quantify data on lichen diversity and its distribution, ecosystem characteristics and pollution have been developed. Culture protocols for fungal, algal and whole thallus culture for twenty-two lichen species have been established to produce the bioactive secondary compounds *in-vitro*. Currently, three novel bioactive compounds which show potentiality against cancer and tuberculosis have been isolated and characterised. Databases on lichen species with appropriate images have been developed to spread awareness among scholars and scientists. MSSRF maintains a lichen reference collection with more than 3,000 specimens.
- Under the annual inter-disciplinary dialogue series of MSSRF, organised under the generic

title, "New Technologies – Reaching the Unreached", the first one in 1990 related to biotechnology. This led to the organisation of Biovillages, initially in Puducherry and later in Tamil Nadu, Orissa and other places. Biovillages aim to generate opportunities for skilled employment both in the on-farm and off-farm sectors of the rural economy, based on local bio-resources. At the same time, they strive to conserve and enhance the natural resources endowment of the village. The Biovillage model of sustainable rural development is based on "ecotechnologies" resulting from appropriate blends of traditional ecological prudence and frontier science. Hence, it has attracted international attention and the concept is spreading in neighbouring countries.

- In order to intensify research on ecotechnologies, the JRD Tata Ecotechnology Centre was set up in 1996 with support from the Sir Dorabji Tata Trust. The building of this Centre was inaugurated in 1998 by the late Shri K R Narayanan, the then President of India. The work of this centre was evaluated by Drs Manjul Bajaj and S C Rajshekar in 2008. The team concluded that *"the Centre's work has led to the mobilisation and creation of many vibrant, articulate and well-run self-help groups and community based organisations. Given that the Centre staff comes mostly from a technical background and that most project sites are modestly staffed with a team of 3-5 members, this is considered a very significant and commendable achievement".*

It will be appropriate to highlight a few of the contributions of this centre.

- More than 10 grassroot institutions have been nurtured over the last decade and two of them are also functioning as micro-finance institutions. The Community Learning Centre (CLC) approach of the Centre is recognised as a best practice by UNESCO in promoting functional literacy - currently 17 are under operation and in four of the villages 100% functional literacy level is nearing achievement. A community managed B-class weather station is a successful model – being replicated in three more sites. IMD (Indian Meteorological Department) has recognised this model and wants to link it with VKC (Village Knowledge Centres) for dissemination. Annual business transactions of 567 SHGs across the sites covering 8,505 households stand at about Rs. 13.47 crore through bank credit and business. Twelve SHG women members have been elected as Panchayat leaders.

- The Microbiology group at the centre has established a niche in the research and development of biological software; new enterprise options have been demystified in the area of biological software production and value addition to the existing ones have helped in better market access. Over the years the work carried out has paid significant attention to land-lab-land continuum and this is also one of the lead groups working on a polyphasic approach to understand the role of microbes and in harnessing them for sustainable agricultural practices in the area of INM and IPM. Seven novel micro-organisms have been proposed and many more are in the pipeline. During 2006-07, these units produced more than 28,600 kg of biological software *(T. viridae, Pseudomonas fluorescens, Azospirillum, Phosphobacter and VAM)*. In addition, these units have also produced *Tricho* cards. The production process of *Beauveria bassiana and*

Paeciloymyces lilacinus has been standardised and will be now tested for production by the units.

- Following the tsunami of December 26, 2004, the Centre steered agronomic rehabilitation strategies through participatory field demonstrations by promoting soil reclamation processes, introduced water management techniques, livestock integrated farming systems (IFS), promoted community seed bank concept to conserve the local land races, and identified alternative options for improving the livelihood of the fisher men / women. MoUs have been facilitated with several business and management schools to develop assured and remunerative market linkages. The partners include banks, corporates and international networks like Eco-agriculture Network and the Commonwealth of Learning.
- The JRD Tata Ecotechnology Centre is also setting up thematically focused institutional facilities in specific locations like the 'Fish For All Research and Training Centre' at Poompuhar, one of the tsunami affected sites. This Centre will function as a training and demonstration centre for fisher men / women (marine inland, mechanised, artisan, non-traditional fishermen; fish vendors, fishing labourers, fisher women) on a learning-by-doing model to help in strengthening and diversifying the existing livelihoods and identifying alternative livelihoods for the resource poor and add value to the chain from capture / culture to consumption. A Mentoring and Capacity Building Centre for SHGs has been established at Pillayarkuppam village in Puducherry. On an average, 28,000 trainee days are spent in a year on capacity building. Many of the trained women SHG members and farmers have evolved into local resource persons and grassroot institutions facilitate horizontal transfer of knowledge during training programmes.
- The Centre has now shifted from the small-project-mode approach to large-multi-site umbrella projects like the *bio-industrial* watersheds project and the *climate management initiatives*. The strategy in the bio-industrial watershed approach is to augment the local agro-eco-systems, adding value to the available resources and enhance livelihoods through suitable technological interventions, selecting micro-watershed as the unit for action research and development and with a human-centric approach. The main focus areas include Integrated Natural Resources Management, especially soil and water management; crop diversification and productivity enhancement; post-harvest value addition and market linkages and promoting bio-industries and input services in five sites. Two of the sites are being implemented in partnership with the Punjab Agricultural University, Ludhiana and the Jawaharlal Nehru Krishi Viswa Vidyalaya, Jabalpur. This project also involves partnership with the Ohio State University, USA.
- The "Vulnerability Assessment & Enhancing Adaptive Capacity to Climate Change in Semi-arid regions of India" (V&A) project focuses on securing the livelihoods of rural poor and vulnerable communities by promoting appropriate adaptation measures and coping strategies related to agriculture, water, livestock and rural energy. The project is being implemented in Udaipur district of Rajasthan and Mehbubnagar district of Andhra Pradesh. The project has helped to enhance people's adaptive capacities to manage the adverse effects of climate change through strategic capacity building

programmes, technical advice and improvement of existing best practices with community' participation. The V&A project has also helped to take stock of the different training modules used by the extension services to update knowledge in existing delivery systems and incorporate information about climate science and best adaptation practices. The V&A project is being implemented in association with non-governmental and State Government agencies, with financial support from the Swiss Agency for Development Cooperation. The results obtained under this project will provide useful inputs in the implementation of the Missions on Water, Sustainable Agriculture and Energy Use Efficiency envisaged under the National Action Plan for Climate Change. The work on climate change related issues is being strengthened under a collaborative project coordinated by the University of Edinburgh, UK.

- The report on Measures of Impact of Science and Technology on Agriculture and Rural Development in India, that was brought out in 2007 with support from the office of the Principal Scientific Advisor to the Government of India, highlighted the significant achievements under public good research in the country. The follow-up study on designing technology delivery systems for mitigating agrarian distress areas is expected to develop an action plan for an effective technology delivery mechanism at the grassroot level.
- In the area of Food Security, the major contribution is the preparation of Food Insecurity Atlases of Rural and Urban India and an Atlas on the Sustainability of Food Security. The Rural Food Insecurity Atlas has been updated and will be published soon. All these Atlases have been prepared with financial and technical support from the World Food Programme. In 2000, MSSRF launched the **Mission 2007: Towards a Hunger Free India** in order to achieve substantial progress by 2007 in eliminating chronic, hidden and transient hunger. Commending this programme, Shri Atal Bihari Vajpayee, the then Prime Minister of India, stated: *the sacred mission of a "Hunger Free India" needs the cooperative efforts of the Central and State Governments, local self-government bodies, non-governmental organisations, international agencies, and - above all, our citizens. We can indeed banish hunger from our country in a short time. Let us resolve today to make this mission substantially successful by 2007, which will mark the sixtieth anniversary of our independence.*
- MSSRF has promoted Community Food Security Systems involving the revitalisation of earlier food traditions, which included a wide range of cereals, millets, legumes and tubers and the establishment of Community Food Banks. As regards micronutrient malnutrition, emphasis has been placed on introducing horticultural remedies to nutritional maladies.
- MSSRF is the coordinating centre for a project supported by the International Fund for Agriculture Development (IFAD) for saving genetic resources of underutilised crops. This project has led to promoting a movement for saving dying crops and dying wisdom. Also, the establishment of feed and fodder banks has been promoted in areas like Ladakh, where precious animals like the Pashmina goat face starvation during the severe winter months.

- In the agrarian distress "hot-spot" regions of Vidarbha in Maharashtra, steps have been taken to empower women farmers to take to low-risk agriculture. This programme titled *Mahila Kisan Shashaktikaran Pariyojana* is helping to bring a new life of hope and cheer to women farmers in general, and widows of those who have taken their lives, in particular. Continuing the education of children is another priority in areas affected either by natural calamities or economic disasters.

- Bridging the urban-rural digital divide is an important goal of the Information, Education and Communication (IEC) Programme. The Annual inter-disciplinary Dialogue in 1992 was on Information Technology. At this Dialogue, the concept of Village Knowledge Centres (VKC) was developed to achieve knowledge and skill empowerment in rural areas, using the tools of the new information and communication technologies like the Internet. The setting up of VKCs started in 1998 in villages in Puducherry. Connectivity, content creation, capacity building, care and management of the VKC and linking knowledge with application received concurrent attention. To make a difference in the lives of rural women and men, the content must be location-specific, dynamic and demand-driven. Also, the community should have a sense of ownership of the VKC to ensure its sustainability. Encouraged by the success of VKCs and the introduction by the Indian Space Research Organisation (ISRO) of Village Resource Centres (VRCs) with satellite connectivity, the Jamsetji Tata National Virtual Academy for Rural Prosperity (NVA) was launched in 2003. The Fellows of the Academy are rural women and men who have mastered ICT applications. There are now over 1,000 Fellows of the Academy drawn from all parts of the country as well as from Afghanistan, Philippines, Nepal, Kenya, Nigeria and Sri Lanka. Addressing the first Convocation of the NVA, the former President of India, Dr A P J Abdul Kalam mentioned in 2004 that the *"Academy is a Celebration of Rural India's Core Competence"*. NVA fosters the integrated application of the Internet, cable TV, community radio and the cell phone. The last mile and the last person connectivity is achieved through the Internet – cell phone synergy.

- In 2004, MSSRF launched *Mission 2007: Every Village a Knowledge Centre*, in order to take the power and benefits of ICT to every village in the country. A National Alliance consisting of several hundred partners was formed for this purpose. In 2007, on the occasion of the 60th anniversary of India's Independence, the partners of Mission 2007 decided to continue the programme in the form of *Grameen Gyan Abhiyan (GGA)*, with the Secretariat located in NVA. GGA has encouraged a wide variety of ICT models, such as the community based public good model of MSSRF, government-initiated models like Akshaya, e-Seva, ISRO's VRC, Bhoomi, and Common Service Centres (CSC), as well entrepreneur-led models like Drishtee, n-Logue, Rural BPOs and Tarahat and corporate sector models like ITC's e-chaupal, and mobile based models like IFFCO's mobile services, QUALCOMM's Fisher Friend Mobile Application, m-Krishi etc. The NVA serves as an umbrella organisation for this rich variety of initiatives, all designed to bridge the digital and gender divides and thereby ensure inclusiveness in access to ICT. Some of the Fellows of NVA participated in and delivered lectures at the

World Summits on Information Society held in Geneva and Tunis.

- A Jamsetji Tata Training School (JTS) is being set up to provide opportunities for a lifelong upgrading of the professional skills of NVA Fellows. At the same time JTS will offer placement services for large national programmes like Government of India's CSCs and ITCs e-chaupals. The contributions of MSSRF in the field of ICT for rural prosperity have received recognition both from leading scientific journals like *Nature (UK)* and *Scientific American (USA)*, and from other sources like the Stockholm Challenge Award and the Motorola Gold Award.
- Another important institutional device for linking science and society through the mass media was the establishment of the *The Hindu Media Resource Centre (HMRC)* in 1998. This centre has sponsored numerous dialogues and lectures on topics of public and political concern like genetically modified organisms, climate change, water saving and sharing and ecotechnology. The HMRC also helps to train young media personnel in various aspects of science communication.
- The MSSRF Library is rich in books and publications relating to environment protection and sustainable development. The library has a CD-Rom section, which is extensively used by scholars from all over the country.
- The work carried out by the organisation has resulted in several publications in the form of papers in peer reviewed international journals with high impact factor, books, monographs, publications and presentations at both international and national conferences, workshops and consultations.

From a small beginning in 1988, MSSRF has grown over the past 20 years into an effective inter-disciplinary organisation concentrating in areas where there are gaps in ongoing research, education and extension. Special attention has been given to technology delivery systems resulting in institutional innovations like biovillages, village knowledge centres and community food and water security systems through local level gene, seed, grain and water banks. The infrastructure developed at Chennai serves as the hub of a network of research centres located at Kalpetta, Wayanad, Kerala; Jeypore, Koraput, Orissa; Puducherry and Poompuhar, Tamil Nadu, all having their own buildings and field facilities. As and when funds become available, research and training facilities for an Integrated Coastal Zone Management Centre will be created at Chidambaram on land already purchased by MSSRF.

The work carried out so far and that described in this Report would not have been possible without the financial support and technical suggestions of the following:

- Central and State Government Departments and Institutions
- National, bilateral and multilateral donors
- Individual donors both in India and abroad and groups of donors like the Friends of MSSRF in Tokyo, and the Friends of Swaminathan, Australia (FOSA)
- A large number of eminent scientists who have generously given their time to serve on various advisory and steering committees
- Above all, rural and tribal women and men whose infectious enthusiasm for the adoption of socially and environmentally relevant technologies has provided the necessary stimulus and motivation for symbiotic

scientist – farmer partnerships at all the locations where MSSRF scientists are working.

Good scientists, and not just good looking buildings, alone can help to build a great scientific institution. MSSRF has been fortunate in this respect from its very beginning, as the scientists, scholars, administrative and accounting personnel and field staff have shown a combination of professional excellence and social commitment. We owe a deep debt of gratitude to them for making MSSRF what it is today – a leading research organisation in the world in the area of science for inclusive rural happiness.

Thanks are also due to the Executive Directors of MSSRF – Prof P C Kesavan (1999-2003), Dr M Velayutham (2003-2007) and Shri Achyut M Gokhale (October 2007 onwards) for their dedicated stewardship of the organisation. Above all, we are indebted to the Trustees of MSSRF, who have given generously their valuable time and rich experience and expertise for setting goals and standards and providing policy oversight to the work of the organisation. Recently, Dr K Kanungo, a distinguished and devoted past Trustee passed away. He was a pillar of strength to MSSRF in its formative years and was widely admired and respected both by staff and students for his wit and wisdom. Our sincere condolence goes to Smt Meera Kanungo and their son, Dr Shivraj Kanungo and other members of the family. We also lost a few years ago Dr K N Shyamsundaram Nair, who not only served as a Trustee for 10 years, but also spearheaded the Biovillage programme in the early nineties.

The responsibility for compiling this report was borne by Dr Sudha Nair, Ms R V Bhavani and Dr Ajay Parida. The editing was done by Dr Nandhini Iyengar, while the printing was done by AMM Prints, Chennai. Our thanks are due to all of them for their efforts to ensure that the contents and the presentation meet with high standards of quality and user-friendliness.

In 1989, MSSRF started its research activities with three staff members, one of whom Dr N Parasuraman, still remains a committed and dynamic member of the MSSRF family. Today the staff strength has grown to 330 (185 scientific staff, 10 advisors, 135 technical, administrative, accounting and supporting staff). Looking ahead, it is important that MSSRF maintains its pioneering character and continues to develop and disseminate innovative methods of technological empowerment of rural families, like biovillages, biovalleys, village knowledge centres, pulses villages and community food and water security systems.

A pre-requisite for maintaining and enhancing its pioneering character is the ability to attract and retain creative scientists, filled with a desire to take our country to an era of bio-happiness resulting from the conversion of our rich bioresources into sustainable rural livelihood opportunities. This will call for a substantial endowment fund, the interest from which can assure job security to scientists having the capacity and urge to become transformational agents. I therefore wish to conclude this brief synoptic survey of the highlights of the journey from a Registrar's table in Ajmere Gate, New Delhi in May 1988 to the present day with a sincere thanks to all past and potential donors.

M S Swaminathan
28 July 2008

Programme Area 100

Coastal Systems Research

Establishment of community-based mangrove and non-mangrove bio-shield was achieved in 115 ha and people from 18 fishing villages participated in the process. Multilocation trials of identified Jatropha *accessions have been undertaken under the National Network Programme. Remote Sensing and GIS techniques were used for project planning and monitoring in resource mapping, bioshield, watershed and landuse.*

Sub Programme Area 101

Mangrove and non-mangrove coastal bioshield

Establishing mangrove and non-mangrove vegetation along the coastline with the participation of the community and other stakeholders is a part of community preparedness for the management of natural disasters in coastal areas. In 2006, the coastal bioshield programme was initiated in 11 villages and in the following year, two major projects with the objectives of establishing community-based mangrove and non-mangrove bioshields were started in Cuddalore, Pudukottai, Ramanathapuram and Tuticorin districts in Tamil Nadu (TN) and East Godavari and Krishna districts in Andhra Pradesh (AP).

101.1 Ecological Rehabilitation of the Coastal Areas of Pichavaram: Establishing Community-based Mangrove and other Coastal Vegetation as Bioshield

This project is being implemented in the Pichavaram region of Cuddalore district in three fishing hamlets namely, Muzhukkuthurai, MGR Thittu and Mudasalodai. Three islands, ranging from 3 to 32 ha are present in the backwater canals of these hamlets, and their sandy beaches were found to be suitable for establishing the bioshields. As the land is owned by the Revenue Department of the Government of TN, permission was sought from the District Collector, Cuddalore, and coconut and casuarina plantations were raised with the help of the fishing community. A Village Welfare Society (VWS) was organised in each village to carry out the activities. The structure of these societies is given in Figure 1.1.

The General Body (GB) of the VWS met regularly on the first two days of every month and during these meetings, the members of the VWS made presentations on income and expenditure, work completed during the previous months and issues that needed to be addressed. The GB facilitated the solving of major problems and also examined and approved the future plan of activities.

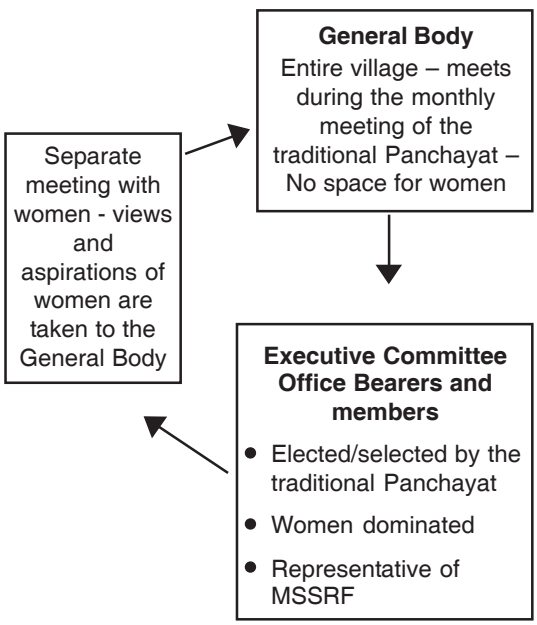

Fig.1.1 ***Organisational Structure of the Village Welfare Society formed in project hamlets in Pichavaram region***

It was observed that participation of women was comparatively low in GB meetings. This was mainly because of the discouragement by the traditional panchayat leaders, who strongly believe that women have no role to play in decision making at the community level. On the other hand, the level of participation of women in EC meetings was high both in terms of quantity and quality where they expressed their views strongly and actively participated in decision making and planning. It is planned to organise workshops to sensitise traditional leaders, women and youth on gender issues as well as on community participation to gradually bring gender equity in decision making at the community level

Mangrove bioshield: During 2006-2007, a mangrove bioshield was raised in 30 ha, comprising 25 ha in MGR Thittu and 5 ha in Mudasalodai. A total of 1,33,000 propagules (seedlings) were planted in these areas, consisting of 1,28,000 *Avicennia marina* seedlings and 5,000 *Rhizophora* species. This year, the VWS's were actively involved in the plantation and management of the seedlings, and the survival rate is 67 % for *Avicennia marina* and 80 % for *Rhizophora.* As a gap filling exercise 15,000 *Avicennia marina* seedlings were planted in December 2007.

This year the mangrove bioshield was extended to another 15 ha in MGR Thittu and Mudasoladai. In these 15 ha, 90,000 propagules including 31,000 *Rhizophora* and 59,000 *Avicennia marina* were planted in December 2007 and January 2008. The performance of the plantation is being monitored by group comprising members of the VWS and the project team.

Strengthening the mangrove plantation, which was taken up by the community in Mudasalodai before the project started, was completed during the year. The community had raised a mangrove plantation of *Rhizophora* and *Avicennia* parallel to the shoreline just opposite to the village, as a bioshield. During the tsunami, a large number of mechanized boats and debris were carried into this community plantation by the waves, causing heavy damage. Nearly 50 % of the plants and the bamboo fence erected around the plantation were uprooted or affected. The activities that were taken up to rehabilitate this tsunami-affected community mangrove plantation included replacement of dead trees with new well grown saplings, digging of canals in the plantation to provide more tidal flushing to the area and raising the bamboo fence around the plantation to prevent grazing by animals.

Sand dune restoration and stabilisation: All along the beach, small sand dunes of various heights, stretching 2,300 m in length and separating the village and the sea, were present before the tsunami. During the tsunami, the dunes located at a distance of 1,000 m were destroyed and these dunes were restored last year following traditional methods. Similarly, sand dunes that were partially degraded were also restored by heaping sand manually. This year, stabilisation of these restored dunes was taken up. As vegetation is the key factor in sand dune stability, a thorough study of the existing pattern of

vegetation in the dune complex was completed and based on the observations, *Ipomea pescaprae* and *Spinifex* sp were planted in the rehabilitated sand dunes.

Multispecies non-mangrove bioshield: During the year, 800 saplings of *Calophyllum inophyllum* (Pinnai), *Pongamia glabra* (Punnai) and *Cocus nucifera* (Coconut) were planted in 1.5 ha as a non-mangrove bioshield as they are capable of growing in sandy soil and tolerate salinity. The VWS appointed two families to take care of watering and protecting this non-mangrove bioshield. Good ground water is available in the sand dune, which is being utilised for watering the plants. A similar bioshield was established in a vacant plot located between MGR Thittu hamlet and the adjoining backwater canal.

In Madavamedu village, located about 6 km south of Pichavaram, a model non-mangrove bioshield is being developed. This model comprises small sand dunes on the seaward side followed by multispecies non-mangrove vegetation on the landward side. For uninterrupted coastal ecological process, a gap of about 50 m is left between the sea and the sand dune. The height and breadth of the sand dune, which was about 2.5 m and 8 m respectively when it was formed in 2006, has changed considerably now due to ecological process. Now the height of the dune is only about 1.8 m but the breadth has increased to about 12 m. The dune was stabilised by planting sand binders such as *Ipomea pescaprae* and *Spinifex.* A local NGO planted palm trees on the top of the sand dunes, which are also growing well. In this multispecies non-mangrove bioshield 450 saplings of *Pongamia,* 300 saplings of coconut and 100 saplings of neem were planted. Unlike the neem, the other two species are surviving well; all the dead neem plants have been replaced with *Pongamia*. In addition, other species such as *Thespesia* and casuarina have also been planted. Table 1.1 shows the survival and growth performance of plantations in various non-mangrove bioshields.

Livelihood support: Last year, it was reported that in all the project villages, a four-wheeler was provided to fish-vending women to reduce their drudgery in transporting fish to the markets, as well as to improve their income by transporting good quality fish in time. The vehicles were managed by a team of women selected by the fish vendors. Monitoring and

Table 1.1 ***Survival and growth performance of tree species planted in non-mangrove bioshields in the Pichavaram region***

Bioshield site	***Pongamia***		***Calophyllum***		**Coconut**	
	Survival %	Height - cm	Survival %	Height - cm	Survival %	Height - cm
MGR Thittu / Beach	68	92	80	98	95	148
MGR Thittu / Village	88	198	85	82	98	120
Madavamedu / Beach	82	198	-	-	97	181

analysis of the performance of the vehicles during the year indicated that in all the project villages, considerable profit was earned in the first six months by operating the vehicle. Subsequently, the profit margin gradually declined because of reduced landings in MGR Thittu and Muzhukkuthurai, as fishers preferred landings in Mudasalodai fishing harbour to reduce transportation costs. As a result, the number of women involved in fish vending in MGR Thittu and Mudasalodai also decreased, which led to loss in the operation of the vehicles. To earn a profit, the vehicles of MGR Thittu and Muzhukkuthurai were used for long distance transport, and both the vehicles were involved in accidents, affecting their operation. The current status is that in MGR Thittu the vehicle is being used for local trips within and around the village and no profit is being made in this operation. Hence, the VWS is taking steps to lease the vehicle to private transport companies on a monthly rent. In Muzhukkuthurai, the vehicle has already been leased to a private fish marketing agency for a monthly rent of Rs 4,500. It is expected that this arrangement would earn a profit of about Rs 30,000 per year which will be shared with the women SHGs.

Analysis of livelihood option: A short study was commissioned to assess the livelihood situation in MGR Thittu and Muzhukkuthurai villages. The objectives of this study were to make a thorough analysis of the livelihood strategies followed in the two villages; identify various interventions and methodologies that would strengthen the existing business activities and livelihood strategies and increase the net profitability from these activities; identify potential alternative income generating activities that could be taken up by the community on a sustainable and environment-friendly basis and determine methods to link mangrove and non-mangrove bioshields with the livelihood security of the community and institutionalise this linkage.

The methodology followed in the study involved a SWOT analysis of the various assets in the villages that could be better used by the villagers themselves for generating income and increasing net profitability; role play among the villagers as to why an income generating activity should or should not be taken up and preliminary cost-benefit analysis of each of the identified activities.

The main findings of this study revealed that open sea fishing and deep sea fishing are the major income generating activities, which are monopolised by men; small-scale fishing is carried out in the backwater canals both by men and women; and fish auctioneering, fish vending and dry fish manufacturing and selling are the income generating activities taken up exclusively by women. The study also indicated that to increase the net profitability from existing fishing and fish related business activities, three approaches and methodologies could be adopted. They include exploration of new market areas and appointment of new agents to fetch remunerative prices, modernisation of fishing practices without damaging stock, and use of wireless communication, to increase the income; use of bio-diesel, preventive maintenance of boats and nets, use of buoys and LED devices to prevent damage to nets

by boats, improved fish preservation techniques etc., to reduce expenses; insurance, daily savings, investments in other non-fish related business activities, bank accounts with ATM facilities for easier cash withdrawals, improved communication facilities through mobile phones, broadband internet connections for VKCs to obtain and analyse market related information etc., to cover risks.

In addition to the above, the study also revealed new business opportunities that village youth and entrepreneurs could take up on an individual or collective basis for sustainable livelihood. These include preventive maintenance and repair of emergency lamps, batteries, FRP boats, outboard engines and accessories; establishment of processed prawn and fish processing units for powder, dehydrated meal and pickles; fish meal unit for poultry and fish feed; spawner (female) trading unit; establishment of community organised trading units (on the lines of the one established at Annankovil by SIFFS), eco-tourism; joy manual boat ride in the back waters; installing a chain of eateries along the beach; water sports in the backwaters and the open sea; establishment of a fish chilling unit, ice plant, and a unit for mud crab fattening in the backwaters.

All these new employment opportunities were identified by the community with the help of an external facilitator and during the coming year follow up action will be taken.

Training: A one-day training programme was organised to orient fishers, leaders and members of women SHGs and youth on what should be done to increase income from the fishing and other business activities. This training programme was conducted by an external consultant and 26 persons participated. A one-day training programme including an exposure visit to Integrated Mangrove Fishery Farming System (IMFFS) was conducted for the leaders, members, women and youth of the Muzhukkuthurai and MGR Thittu villages. In this farming system, fish, prawn and crab culture is integrated with mangrove plantation. Some of the youth in MGR Thittu are now interested in starting their own IMFF farms. An exposure visit to Kuthambakkam model village was also conducted for the President and ward members of Killai Panchayat to which the project hamlets are attached. The Trust for Village Self Governance operating with its base in Kuthambakkam, provided the necessary inputs to motivate the Panchayat leaders to take steps for self-governance. This Trust expressed its willingness to provide training on the role of the Panchayat in disaster preparedness and mitigation, which will be organised in the coming year.

Exposure visits to mangrove and non-mangrove bioshields developed at MGR Thittu and the IMFFS were conducted for members of Pondicherry Multipurpose Social Service Society, Puducherry, and for three batches of second year B.Sc (Agriculture) students of Annamalai University. Three one-day orientation programmes on community participation in bioshield development and management were conducted for M.Sc (Social Work) students of Annamalai University.

101.2 Strengthening Resilience of the Tsunami Affected Communities

This project, aims to reduce the vulnerability of the rural poor in coastal areas and is being implemented in India and Sri Lanka. In India it is being implemented in four sites namely, Vembar and Manamelkudi in TN and Kakinada and Sarlagundi in AP. A total number of 13 hamlets are covered under the project, four in Manamelkudi site and three each in the other three sites. Unlike other projects of MSSRF, this project is being implemented in three sites through grassroot NGOs. At the Vembar site in Tuticorin district in TN, the NGO People's Action for Development (PAD), which has been working in the Gulf of Mannar region for a long time, is associated with project implementation, whereas at the Manamelkudi site in Pudukkottai district, the Society for Participatory Research and Integrated Training (SPRIT) is implementing the project. In the case of AP, Praja Pragathi Seva Sangham (PPSS) is the partner at the Krishna site, while at the Kakinada site in East Godavari district MSSRF is directly implementing the project. The important components of this project are community mobilisation and organisation, mangrove and non-mangrove bioshield, VKC, and livelihood and community based disaster risk reduction. The results achieved in these components, except VKC, are given below, while the results achieved in VKC are presented under Programme Area 600.

Community mobilisation and organisation

Cultural programmes, orientation and exposure visits: In the seven project hamlets in TN, cultural programmes, orientation meetings and exposure visits were used as the tools to mobilise and organise the community. In Vembar, the cultural team of PAD conducted programmes, while in Manamelkudi, the SPRIT team conducted cultural shows. In these programmes, songs, skits, dances and mono-plays were used effectively to create awareness among the community about the aim and purpose of the project and its components. In the cultural shows, processes that would be followed in planning and implementing the project were also outlined. In the Manamelkudi site, cultural programmes were followed by orientation meetings, conducted for the traditional leaders, women and youth of the project hamlets and leaders and members of Panchayat Raj Institution (PRI) separately.

Exposure visits were also organised as a part of the strategy to mobilise and organise the community and facilitate people to gain first-hand knowledge from already established models of bioshield, VRC, VKC and livelihood programmes, and facilitate interaction between representatives of the project hamlets with the community that established successful models. In these exposure visits traditional leaders, women group leaders and members, young women and men and representatives of PRI from the project hamlets were given exposure to the Joint Mangrove Management (JMM) programme and bioshield programme implemented in Pichavaram area and VRC and VKC in Puducherry and Thangachimadam. Interactive presentations, field visits and interaction with the community were the tools

used for the exposure visits. Processes relating to PRA, formation of hamlet level institutions, identification of bioshield management units, and preparation of hamlet level plans were shared with the participants. In the bioshield component, types of bioshields, and the role of mangrove and non-mangrove vegetation and sand dunes in reducing the impact of disasters were explained with empirical and field based evidence. Details of techniques relating to the establishment of mangrove and non-mangrove bioshields and methods to link them with livelihood were provided and shown in the field. In the VRC and VKC component, processes relating to the establishment of VRC and VKC, need assessment, content creation and technical aspects relating to information and knowledge dissemination were explained to the participants. In these exposure visits, 107 women and 61 men participated. A similar process was followed in the case of the Krishna and Kakinada sites in AP. Representatives from the community, women's groups, youth and PRI were taken to the hamlets where JMM programmes were being implemented in the Godavari and Krishna mangroves. These exposure visits played a crucial role in motivating both the community and PRI members to participate actively in the project.

Village level institutions: In all the project hamlets a Village Level Institution (VLI) was formed to prepare, implement and monitor project activities in a participatory manner. It is called Village Development and Management Council (VDMC) in the project hamlets of Manamelkudi, Krishna and Kakinada sites, whereas it is called Village Development Committee in Vembar site. However, the organisational structure of the VLI is more or less similar in all the hamlets. It consists of a GB, which is the supreme body of the institution and takes all the decisions. In project hamlets in TN, one adult man and woman from the families living in that hamlet have been enrolled as members of the VLI, whereas in AP one adult man and woman from willing families are included as members. In all the project hamlets the GB of the VLI elected an EC which is the planning and implementing body. In the EC of various VLIs women have been given 30 to 60 % representation and representatives from PRI and MSSRF and partner NGOs are also included. The GB of the VLI meets regularly once a month in some villages, whereas in other villages a meeting is conducted once in three months. The EC of all the VLIs meets once a month. All the VLIs have a savings bank account in the nearby nationalised bank, which is being used for the transaction of project funds.

Participatory Rural Appraisal: PRA was extensively used to understand the socio-economic condition of the community living in the project hamlets, interdependency between natural resources and user communities and major concerns of the people relating to their socio-economic development, resource management, information flow, disaster management, etc. It was also used as a tool to develop rapport among stakeholders. The PRA documents the village history, social infrastructure, livelihood analysis, gender, VLI, bioshield mapping, information and knowledge, problems and intervention measures and micro-planning.

The major concerns identified in the project hamlets through PRA varied from over-exploitation of fish stock in the sea, lack of employment opportunity in the villages, quantity and quality of drinking water and lack of financial support to reclaim prawn farms into agricultural lands, to degraded mangrove ecosystem, lack of transport facility and lack of proper houses. In some of the hamlets, lack of credit facility and dependency on moneylenders were cited as major issues. In some other villages, the lack of a source of information on potential fishing zones, and the climate and prices for different kinds of fish markets were identified as the major concerns. These concerns formed the basis for the preparation of village level developmental plans.

Bioshield

Mangrove bioshield: In TN, the establishment of a mangrove bioshield was initiated during the year in Kattumavadi village at Manamelkudi site and Keezhavaipar village at Vembar site. Both the mangrove bioshields are being developed in unsurveyed mud flats and hence are not under the control of government departments. In taking up these lands for raising mangrove plantations, the PRI, in which the project hamlet is a part, played a key role. Representatives of these PRI were oriented to the project and taken for an exposure visit to Pichavaram, which made them gain in depth understanding of the role of mangroves in fishery development and in mitigating the impact of natural disasters such as cyclone and tsunami. They were also informed that disaster preparedness had now become the mandate of PRI and bioshield could be a part of the preparedness exercise. All these motivated the PRI to provide land for mangrove bioshield development. In this regard a resolution was passed in the *Gramsabha,* indicating that PRI is willing to raise mangrove plantations in the unsurveyed mud flats jointly with MSSRF and partner NGOs to protect the people from cyclones and other natural calamities. Since the resolution passed in the *Gramsabha* meeting is legally valid, the decision was taken as permission to raise a mangrove bioshield in the unsurveyed land.

Establishment of a bioshield was initiated in about 20 ha in Kattumavadi village and in about 30 ha in Keezhavaipar village. In these areas, the canal method, which was developed and tested during earlier JMM programmes, was followed to raise the mangrove plantation. A total of 2,25,000 propagules of *Avicennia marina* and 85,000 propagules of *Rhizophora* were planted in the mangrove bioshield sites during the year. The performance of these plantations in terms of survival, growth etc., is being monitored by a committee consisting of members from VDMC, MSSRF and partner NGOs. The survival rate of *Avicennia marina* was around 75 % whereas in the case of *Rhizophora* it was around 90 %. In the Kattumavadi region a number of problems relating to the management of the bioshield were noticed, including deposition of seaweed in the bioshield site, grazing by goats, and crab fishing in the bioshield area; all of them affected the establishment of seedlings. The VDMC of Kattumavadi played a key role in solving these issues. The members of VDMC voluntarily

removed the seaweeds and appointed a watcher to prevent grazing by goats. They also interacted with the leaders of nearby villages to restrict grazing as well as crab fishing in the plantation area. In Keezhavaipar also, the VDMC appointed a watchman to take care of the plantation.

In AP, the establishment of the mangrove bioshield was initiated in about 60 ha with the participation of the people of Sorlagondi village. An extensive mangrove forest is located between the village and the sea. A part of this forest has been declared Reserve Forest and is protected by the Forest Department (FD). Another part of the mangrove forest that is located very close to the village is still under the control of the Revenue Department. Mangrove forests in areas owned by the Revenue Department were cleared and developed into prawn farms during the late 1980s, without permission from the concerned agencies. Many of these aquaculture ponds were totally washed away during the cyclone in 1994. Even though many of these farms were rehabilitated later, prawn farmers suffered losses consecutively for four years due to viral diseases. The Aquaculture Authority of India also made registration of farms mandatory, but these farmers could not comply because their farms had been developed illegally by occupying revenue land. Later, on the basis of the Supreme Court Order, these farmers were evicted. The mangrove bioshield is now being established in the areas that were degraded due to the establishment of such illegal prawn farms. The partner NGO at the Krishna site, PPSS, obtained necessary permission from the District Collector, Krishna district, to raise mangroves in about 100 ha in these areas. The mangrove bioshield is being developed in 60 ha and the other 40 ha will be covered in the coming year. As in the case of TN, the canal method was followed in raising the mangrove bioshield and the survival rate of the plantation was good. The VDMC of Sorlagondi was actively involved in the management of the bioshield.

Non-mangrove bioshield: In TN, no non-mangrove bioshield was established in the project sites during the year. In AP, the establishment of a multispecies non-mangrove bioshield was initiated in the project villages of Mulapeta, Danavaipeta and Narsipeta at the Kakinada site in about 10 ha of community-owned land. In accordance with the wishes of the community, casuarina was the main species planted; other species such as palmyrah (*Borassus flabellifer*), coconut (*Cocas nucifera*), soap nut (*Sapindus emarginatus*) and cashew (*Anacardium occidentale*) were also planted. The EC of the VDMC of these villages played an active role in land preparation and planting, and appointing a community watcher in each of the three villages to protect, water and replace affected plants.

Livelihood

Target groups: The poor families, including families headed by women, in the project villages are the target group of livelihood programmes. In all the project villages, these

groups were identified through livelihood analysis and wealth ranking exercises of PRA. The villagers themselves developed criteria to classify families into poor, medium rich and rich families. Table 1.2 shows the criteria used by the community to classify families in Ponnagaram village in Manamelkudi site. Following this method, a total number of 600 families have been identified as target groups and funds will be leveraged from various schemes of the Government to address the issues of these poor families; for some of the livelihood programmes, which have already been started, project funds are being utilised.

Livelihood interventions: In TN, partner NGOs identified three different groups of activities namely, direct interventions, demonstrations, and training to impart vocational skills to strengthen the livelihood of the community. These activities were identified on the basis of social mapping, livelihood analysis, wealth ranking, occupational diagram and discussions with the identified groups. Under direct interventions, activities to enhance or strengthen the current livelihood are being taken up. For example, providing ice boxes has been identified as a direct intervention in many of the fishing villages, as this would help the fishers to store the catch and transport it to markets in good condition. This will fetch better prices, which in turn will increase the income from fishing. In the second category, potential livelihood opportunities are being demonstrated in a participatory mode so that viable demonstrations can be replicated by the fishing families. In the third category, training is being provided to youth to increase their skills in different vocations. This would create an interest to start their own business or increase their employment opportunities. The livelihood activities that have been identified and implemented in Rojmanagar village in Vembar site are listed in Table 1.3.

At the Krishna site in AP, reclamation of prawn farms into agriculture lands, eco-friendly aquaculture, cattle rearing and IMFFS have been identified as major livelihood interventions and many of them are being implemented. In the project villages in Kakinada, generating a revolving fund to strengthen the existing livelihood activities and to start new enterprises has been identified as the major livelihood intervention.

Table 1.2 ***Criteria used by the community to classify families in Ponnagaram village, TN***

Rich	Medium	Poor
Own concrete house	Own concrete house/ Tiled house	Living in colony house/ own thatched house
Have a government job	Own FRP boat	
Own coconut groves	Own *Vallam / Vathai* with or without engine	Wage labourers
Merchants		Net menders
Jewellery shop owners	Working abroad	Destitute women
Own car or van		

Table 1.3 ***Interventions identified to strengthen the livelihood of the target groups in Rojmanagar village in Vembar site, TN***

Direct Interventions	Demonstrations	Training
Financial Initiative for Substantial Human Resource Regeneration (FISHERR) Programme – releasing from the clutches of money lenders *Status: Initiated*	Preparation of health mix powder *Status: Completed*	Boat engine mechanic *Status: Completed*
Strengthening of community - based gear workshop *Status: Initiated*	Hygienic fish handling (post harvest) *Status: Completed*	Scuba diving *Status: Planned*
Community - based rice business *Status: Initiated*	GPS handling *Status: to be conducted*	
Revolving fund for fish vendors *Status: Initiated*	Crab and lobster fattening *Status: dropped because not feasible*	
Providing ice boxes to improve storage of fish catch *Status: postponed because of the demand for large boxes for which more funds are needed*		

Community based Disaster Risk Reduction

Community-based Disaster Risk Reduction (CDRR) is one of the components of the project. However, due to lack of experience and expertise both within MSSRF and in partner NGOs only very limited progress was made. On the basis of discussions with the partner NGOs, government agencies and funding organisation, it was decided to utilise the services of Asian Disaster Preparedness Centre (APDC), Bangkok, to build the capacity of MSSRF and its partner NGOs in preparing and implementing community-based disaster risk management plans. Assistance from APDC is planned in the form of theoretical orientation and hands on training to middle level managers and field coordinators of MSSRF and partner NGOs.

Joint Activities between MSSRF and project partners in Sri Lanka

The project on strengthening the resilience of tsunami-affected communities is a regional project covering India and Sri Lanka. In Sri Lanka, it is being implemented jointly by two international NGOs, Sarvodaya and Practical Action. While designing the project, it was envisaged that exchange visits would

be organised between the Indian and Sri Lankan partners to learn from each other's experience. During the year, the following activities were completed.

Visit to early warning site by MSSRF and its boundary partners: In July 2007, project staff from MSSRF, grassroots NGO partners, SPRIT, PAD and PPSS went on an exposure visit to the Village Iinforamtion Centre established by Sarvodaya and Disaster Early Warning System established by LIREN ASIA at Barhamanawatta village in Galle district.

Workshop on Disaster Management: All the project partners in India and Sri Lanka, including grassroots NGOs, jointly attended a workshop on Disaster Management, held in Colombo in July 2007, organised by Sarvodaya and IDRC. At the workshop, presentations were made by experts on the role of ICT in Disaster Risk Management, ICT and Early Warning Systems, Livelihood Based Disaster Management and the District-level Disaster Management Plan in Sri Lanka. MSSRF made a presentation on the Role of Remote Sensing and GIS in Disaster Preparedness. On the basis of the above presentations and field experiences, discussions were held in detail on the role of the project in Disaster Management.

Visit relating to bioshield programmes: MSSRF was requested by IDRC and Sarvodaya and Practical Action to provide inputs to the bioshield programmes of Sri Lanka. The experts from MSSRF visited all nine project villages located in Hambantota, Matara and Galle districts in Sri Lanka. The work pertaining to bioshield management being carried out in each village was studied in detail. On the basis of local experience and existing biophysical conditions and social situations, including participation of the stakeholders, suggestions were made to improve the structure and management of different kinds of bioshields. It was also suggested that in some of the sites, mangrove-fishery farming system, which integrates livelihood with mangrove plantation, could be taken up to create an interest among the people in mangrove bioshield development and management. A presentation on the results of the visit was made to Sarvodaya, Practical Action, IDRC and CIDA-Sri Lanka immediately after the field visit.

Sub Programme Area 102

Integrated Mangrove-Fishery Farming System (Seawater Farming System)

A seawater farming system that integrates cultivation of mangrove plants and halophytes and culture of fish, prawn and crabs is being demonstrated in partnership with a progressive prawn farmer and the local community near Pichavaram. The main aim of this programme is to demonstrate the possibility of integrating income generating opportunity with mangrove bioshield development. This system, formerly known as Seawater Farming System, is currently designated as IMFFS and is eco-friendly. The main components of IMFFS are

mangrove plantation, halophyte cultivation and fish culture.

Mangrove plantation: In the outer and inner bunds of the farm, 1,723 *Rhizophora* and 327 *Avicennia marina* saplings were planted last year. The condition of the plantation was monitored and steps were taken to make it a healthy plantation. The increase in height and other growth parameters are comparable to *Rhizophora* and *Avicennia* plantations in any healthy mangrove ecosystem, indicating that mangrove plants can be grown in such semi-enclosed environmental conditions, fed by tidal water.

Last year, the leaves of *Rhizophora* sp., were affected by a species of sap-sucking scale insect of the Coccidae family, which was controlled with neem spray. This year, there was no incidence of pest attack and this could be due to the fact that this pest attacks only young seedlings and not well-established seedlings.

Halophyte plantation: A succulent halophyte namely, *Sesuvium portulucastrum,* which has commercial potential as a component of salads, was planted on the top and sides of the outer and inner bunds of the farm. Stem cuttings of about 15 cm in length were planted at an interval of 1 m. The fresh weight of the plantation, measured at monthly intervals, showed that values increased from 542 g/m^2 in September 2007, reached a peak value of 1,132 g/m^2 in January 2008 and started declining after that. This indicates that the growth of this plant reaches its peak only during the northeast monsoon season when the salinity of the soil is less.

Fish culture: Culture of the commercially important fish *Lates calcarifer* (sea bass) was attempted in the farm and in September 2007, 2,500 fingerlings, each about 2.5 cm long, were purchased from the Rajiv Gandhi Research Foundation, Thoduvai, as availability of fingerlings in the wild is limited. They were kept in large bags made of fine nylon net (*happa*) in the farm water itself for acclimatisation, but survival of the fingerlings at the end of three months was only about 9 %. This was due to the small size of the fingerlings, which could not adapt themselves to the environmental conditions existing in the farm. In the next attempt, 500 fingerlings of 8 cm length were purchased in December 2007 and again acclimatised in the farm itself. At the end of January 2008 nearly 85 % of the fingerlings survived and reached a length of 13 cm. They were released into the farm in February 2008 and the survival and growth performance of the released fingerlings are being monitored.

Sub Programme Area 103

Nuclear and Biotechnological Tools for Coastal Systems Research

The project, supported by the Department of Atomic Energy (DAE), has been in operation in the coastal regions of TN. Two sites are located in the vicinity of the nuclear power plants in Kalpakkam and Kudankulam. Low external input and integrated intensive farming practice models were the focus at Kalpakkam,

in addition to several microenterprises related to agricultural production and productivity improvement. Multiplication of improved varieties of various pulses has been replicated and popularised in the farmers' fields in the region. The major activity of the project is concentrated in Kudankulam region, while the laboratory-based activities with relation to developing salinity tolerant varieties have been undertaken at Chennai.

Community participation with regard to eco-development and horti-agriculture has been the focus of the programme for the last six years. The activities that started at Kudankulam village have now spread to Errukundurai, Vijyapathy, Kuthankuzhy and Uvary Panchayat under Radhapuram taluk. The project began extending its technology to every village through replication of the models developed in partnership with the local institution and villagers. On-site field-based training programmes designed especially for farmers covered under the ATMA programme of the Govt. of TN and SHG members of different taluks in Tirunelveli are being carried out.

103.1 Activities at Kudankulam

BARC seed multiplication

This year, groundnut seeds (TAG 24) developed by BARC, were distributed to 10 farmers. Six farmers harvested groundnut with an average yield of about 700 kg/ha, with oil content ranging from 49 to 54.4 %. Crop duration was observed to be between 100 and 105 days. Yield data was found quite satisfactory and comparable with the best yield obtained under rainfed conditions. Yield loss and crop damage were observed in some fields due to heavy rain prior to harvest.

The performance of the mutant variety green gram (TARM 1) has been well appreciated by the farmers. With intercropping in horticulture plots, this year the cultivation was undertaken by 22 farmers in the region showing an average yield ranging from 200 to 500 kg/ha.

Crop diversification

Performance evaluation and yield testing of hybrid maize under scheduled irrigated condition was carried out in farmers' fields (80-95 days) and found suitable under <500 mm rainfall. The following parameters were maintained: seed material - 15 kg/ha, seed treatments given to avoid shoot borer disease and leaf spot disease, and adequate spacing; germination was 100 %. The whole process was demonstrated and explained to other farmers from neighbouring villages. Five farmers have volunteered to adopt it in their fields in the coming season.

Fodder Bank

Veli masal (Hedge lucerne) fodder crop was introduced in the fodder bank for seed multiplication. Sufficient seeds have been collected for distribution to farmers this year.

Bio-diesel crop (Jatropha)

Multilocation clonal trials of a few selected high yielding, high seed oil content *Jatropha curcas* are being carried out in Kudankulam to produce quality genetic material as part of testing in various selected regions in the country. Experimental blocks were prepared to test

vegetatively propagated saplings from selected superior accessions of *Jatropha*.

Four random block designs were carried out (R1 to R4) for multilocation trials with 987 plants being planted at 3 m x 3 m distance. The plants are growing well and have attained an average height of 1.5 feet.

Each replication has 10 small blocks and each small block has 25 saplings from single superior accessions. 248 plants were planted in R block and 987 plants were planted (R1,R4) in all the four blocks; data from each block is collected and maintained for national multilocation trials. Data entry work sheets have been prepared to record all the information, including the performance of the trial, using statistical packages like SAS, SPSS and STATISTICA.

With all these interventions and consultations on various crops, agriculture practices and soil and water management practises, MSSRF has been able to persuade more than 100 additional farmers to adopt various crops and cultivation models in their fields. The outreach of various crop-based interventions during the year is given in Table 1. 4

Table 1.4 ***Area under cultivation of various crops during 2007-2008***

Pulses	8 ha
Oilseeds	10 ha
Gooseberry	15 ha
Mango	10 ha
Fodder crops/*Azolla*	40 farmers
Jatropha	Trial plots

MSSRF conducted on-site demonstrations of pest and disease control procedures in various crops such as brinjal, tomato, mango, moringa, guava and coconut on a priority basis in farmers' fields, based on the inputs received from the farmers and the need analysis exercise undertaken for the purpose.

Community Development

The ongoing project has been organising SHGs in the project villages of Kudankulam, Idinthakarai, Kuthankuli, Uvari, Radhapuram and Chettikulam Panchayat. Activities are focused on forming SHGs among the local farmers, fisherwomen, landless labourers, and SC/ST women. Ten new SHGs have been formed this year, taking the total strength to 80 SHGs. These SHGs have their own savings to the extent of Rs 1 crore and with the loan received from the local banks for various activities the savings is around Rs 2 crores.

Capacity building

Members of newly formed SHGs were provided training on the maintenance of accounts, bank linkage, leadership and entrepreneurship development. Skill development training was given to 140 SHG members, including 120 women and 20 men, on social development and record maintenance.

MSSRF has also been involved in capitalising from the provisions of capacity building of the community from various DRDA schemes in Tirunelveli district.

Nearly Rs one lakh has been provided by the DRDA, Tirunelveli, for conducting training programmes for 842 SHG members during the year. MSSRF actively participated in ATMA *Kisan Mela* and displayed information on fodder crops in the stall on the topic "Nutritional Fodder Crop". *Azolla* samples were also distributed to farmers. MSSRF conducted on-field training for ATMA SHG members of Radhapuram on rainfed agriculture.

Alternative livelihood

The ongoing project has supported sericulture as a part-time livelihood option for people of south TN. After training more than 30 farmers, *Uralvaimozhi* SHG has harvested the second batch of cocoons.

Interdistrict exposure visits were organised for 15 Kudankulam farmers. They visited KVK Gandhigram Rural University, Gandhigram and attended lectures on IPM, organic farming and animal husbandry. The group also learnt about the role of IT in agriculture development from the MSSRF-VRC Centre, Sempatty. They also visited the watershed areas of Kadavakurichi, Mallanapatti and Kombaipatti in Bathalagundu Block, Dindigul and studied the various techniques of watershed development.

Kitchen gardens for nutritional security were raised in demo-plots. A few selected seasonal hybrid vegetables (tomato, brinjal, lady's finger) were maintained in nurseries. Saplings were distributed to poor SHG members in neighbouring villages under Kudankulam and Vijaypathy Panchayat.

Village Knowledge Centre

The VKC is an ongoing activity of MSSRF, providing computer education to needy children under the Computer Literacy Campaign. Trained students motivate their friends and classmates to join the centre. The VKC had 50 girls and boys enrolled for computer classes this year. The VKC recently started TALLY classes for Kudankulam students and two batches have been completed. It is interesting to note that girls are coming from Anjugrammam (neighbouring Kanyakumari district) to take this course. VKC activities have expanded at Avudayalpuram, and MSSRF has supported a tailoring centre at Avudayalpuram VKC under Vijyapathy Panchayat.

Ten students selected from Bishop Roach Hr. Sec. School, Idinthakarai coastal village participated in a three-day training programme on *Ornamental Fish Culture* (OFC) in February 2008**.** CARE at St. Xavier's College, Tirunelveli, organised the training and covered the overall aspects of income generation through OFC. MSSRF has planned to conduct the same programme at the village level in the coming year.

103.2. Activities at IGCAR, Kalpakkam

Rice cultivation under organic farming in the demo plot yielded 3.78 ton/ha. BARC seed multiplication was carried out in demo plots and seeds were supplied to other trial locations. Seed multiplication of laboratory tested transgenic rice varieties has been done. Introgression studies are being carried out between transgenic lines with white ponni, IR64, IR20 and ADT43. These details are

reported in PA 300. A training programme on INM and IPM, and off-farm demonstration at farmers' fields for rice and oil seeds, were organised.

Mangrove restoration at Buckingham canal - Bay of Bengal mouth at Kalpakkam

The two-year old mangrove plantation at Kalpakkam has established itself and the *Avicennia marina* plants are growing well, with good canopy cover, well-formed pneumatophores (breathing roots) and initiation of flowering in a few tress. *Rhizophora mucronata* growth was normal and many anchor roots have been formed for support, with extended canopy. *Excoecaria agallocha* was observed to be flowering and fruiting and seed dispersal has set been observed.

103.3 Sustainable Ecological and Economic Rehabilitation

Ecological rehabilitation - bioshield

Mangrove nurseries were established at Keelavanjore for supply of saplings to the mangrove bioshield plantation areas. SHGs raised 76,000 mangrove saplings (*Avicennia, Rhizophora, Bruguiera, Excoecaria*) and 67,100 non-mangrove saplings (*Casuarina,* Coconut, Subabul, Railroad vine, *Calophyllum, Thespesia, Spinifex, Pongamia,* Mahua) and supplied them to the Forest Department, NGOs, Panchayat and CBOs. Mangrove and non-mangrove nurseries have been made available at Chandrapadi, Keelavanjore, Nethyalvasal and Pudukuppam.

Bioshield plantation in the coastal areas and maintenance

Three-year old bioshield plantations are being managed by traditional leaders and SHGs at Sadraskuppam, Karaikal, Chandrapadi, Pudukuppam and Pazhayar.

Economic rehabilitation - micro enterprises

Women SHGs' bioshield nurseries: Six women SHGs have developed 14 backyard nurseries, eight individual nurseries and one general nursery for mangrove and non-mangrove plants at Chandrapadi, Keelavanjore, Nethyalvasal and Pudukuppam. The women earned Rs 5.5 lakhs from the nursery activities.

Microenterprise training: Training programmes for ten microenterprises including mud crab fattening, community pond aquaculture, integrated farm ponds, production of oyster mushroom, vermicompost, fish/prawn pickle, clam fishery and harvest, dry fish marketing, poultry farm and bioshield nursery were conducted at Sadraskuppam, Pazhayar, Chandrapadi/ Keelavanjore and Pattinamcherry. 1,572 members participated in these training programmes. Some SHGs have started activities and the impact is under study.

Coastal Village Knowledge Centres

Four VKCs have been established and provide need-based information in Sadraskuppam, Pazhayar, Chandrapadi and Pattinamcherry villages.

Sub Programme Area 104

Remote Sensing and Geographical Information System

Major projects carried out in the GIS lab under this programme area are Coastal Zone Studies and suitability mapping of mangrove and non-mangrove bioshields, which is one of the major components of the project on Strengthening the resilience of tsunami-affected communities.

104.1 Coastal Systems Research

The three components in this project are mapping and monitoring Marine Protected Areas (MPA), mapping mangrove vegetation zonation of TN coast and assessment of mangrove health using remote sensing and GIS data. Under the first component, mapping of MPAs in TN namely, Pulicat Wild Life Sanctuary, Pichavaram Reserve Forest, Vedaranyam Wild Life Sanctuary and Ramanathapuram mangroves were completed and IRS L4 (Indian Remote sensing Satellite Linear Imaging Self scanning System) data were used for mapping. Changes in the coastal resources of MPA between 1,970 (base maps prepared using Survey of India toposheets) and the recent remote sensing data will be mapped during the coming year to suggest the modification required in MPA boundary.

The second component involves mapping of mangrove vegetation zones along the entire coast of TN, except Muthupet and Gulf of Mannar mangroves. This work was completed during the year and IRS L3 data was used for mapping. The study revealed that the major mangrove species found in the entire coast of TN is *Avicennia marina*. Other species found are *Rhizophora, Excoecaria agallocha* and *Acanthus ilicifolius.* This study also showed that apart from the two major mangrove ecosystems located at Pichavaram and Muthupet, most estuaries and backwater systems along the TN coast have patches of mangroves, which also need to be conserved.

Chennai: Small patches of mangroves comprising *Avicennia marina* and *Suaeda* are found along the intertidal margins of the Adyar estuary as well as Ennore backwaters of Chennai coast. *Avicennia marina* is the dominant species.

Cuddalore: Pichavaram is the second mangrove wetland of TN covering an area of about 858 ha with mangrove species such as *Avicennia marina, Rhizophora apiculata* and *R. mucronata* dominating the wetland spread in the Vellar - Coleroon estuarine complex. *Rhizophora* mangroves stretch along the backwaters and canals and the interior wetland is covered extensively by *A. marina.* Associated mangrove species such as *Suaeda maritima* and *S. monoica* are also found.

Puducherry and Karaikkal: In Puducherry, mangroves are distributed along the Ariyankuppam and Chunnambu rivers. Apart from *Avicennia marina* other species found in these mangroves are *Rhizophora* and *Bruguiera cylindrica*. Associated species of *Suaeda* are also found. In Karaikkal, small patches of *Avicennia marina* and *Rhizophora* are found in the Arasalar river mouth. *Avicennia marina* and a few species of *Ceriops decandra*

are found along the mouth of the Vettar river near Vanjiyur. The extent of mangroves in these two districts is about 50 ha.

Nagapattinam: In north Nagapattinam, mangroves are found along the Uppanar and Coleroon rivers. In south Nagapattinam, patches of mangroves are found along the coast of Vedaranyam canal and Vellar river (near Velankanni) and the mud flat areas of Talainayar. *Avicennia marina* is the dominant species in these areas but other species such as *Bruguiera cylindrica* and *Acanthus ilicifolius* and associated mangroves such as *Suaeda* and *Salicornia* are also found. The total area of mangroves in this district is 136 ha.

Tuticorin (Punnakayal): The mangroves in Punnakayal are predominantly *Avicennia* species. *Suaeda* and *Salicorina* are other associated mangroves commonly found here. The district has about 398 ha of mangroves, which are in a highly degraded state.

Pudukottai: Dense *Avicennia marina* and associated mangrove of *Suaeda* are distributed in the mud flat areas of Kattumavadi and along the Vellar river mouth. The total area of mangroves in this district is 90 ha.

Thanjavur: In Thanjavur, dense *Avicennia marina* is distributed along the Ambullar river, and small patches of mangroves are found along the Tedakkiar, Kattar and Agniar river mouths. Nearly 163 ha of mangroves are found in the district apart from the Muthupet mangroves (2,130 ha), which are spread between Thanjavur and Thiruvarur districts.

Ramanathapuram (Devipattinam): *Avicennia marina* is dominantly distributed along the rivers of Kottakarai and Uppar and in the mud flats of Devipattinam. Mangroves are also found along the small creeks near the coast. The total area of mangroves in Ramnathapuram district is 250 ha.

Kanniyakumari (Manakkudi): The River Pazhayar confluences with the Arabian Sea near Manakkudi village, forming the Manakkudi estuary with small islands. One of the islands has artificially regenerated mangroves. *Rhizophora* is the dominant species in this area. It covers less than 1 ha.

The third component of the project, a Remote Sensing and GIS-based model that can be used to assess the health of mangrove wetlands with remote sensing data and GIS, was prepared for Pichavaram mangrove wetlands. The following indicators were used to develop this model: mangrove forest density, canopy cover, floral diversity, natural regeneration, fresh water flow, hindrance to fresh water flow, anthropogenic pressure such as formation of bunds across the river, creeks, grazing, drainage density, aquaculture farms, pollution from settlements/ industries and sedimentation. The draft model has been accepted by the sponsoring agency (Space Application Centre, Ahmedabad) and circulated to experts for comments. During the coming year this will be finalised for replication to assess the health of other mangrove forests.

Suitability mapping for mangrove and non-mangrove coastal bioshield: Suitability mapping for bioshield has been carried out for

the Pudukottai district of TN and Krishna district of AP.

Basemap of the coastal Manamelkudi and Aranthangi blocks of Pudukottai district in TN state and Nagaylanka mandal of Krishna district, AP were prepared. Remote sensing data of IRS P6 LISS 4 was purchased for the study area and geographically corrected to match with the base maps prepared from Survey of India toposheet and administrative boundary maps. Preliminary maps of landuse/ land cover and geomorphology were prepared for the coastal area of Manamelkudi block. Ground truth data was collected to finalise the landuse and land cover map and geomorphology map of Manamelkudi block. Landuse/ land cover map of Nagaylanka mandal was prepared and finalised with ground truth information collected from the field.

Landuse/land cover map, geomorphology map, and topography of the coast were used to derive land suitability for the mangrove and non-mangrove bioshield. The coastal zone up to 1 m elevation from mean sea level was marked from the coastline for the selection of suitable sites. The area suitable for mangroves was identified using the criteria developed from the geomorphology map and from landuse map and as per these criteria newly formed mudflats, waterlogged areas and wastelands have been identified suitable for bioshield development. Land suitability map for mangrove and non-mangrove bioshield of Manamelkudi block will be further improved by incorporating the perception of the local community.

104.2 Ecotechnology

Remote sensing and GIS tools were used in the Bio-industrial watershed project. Ennai and Thalinji Panchayats of Pudukottai district, Karasanur village of Villupuram district of TN and Tolla village of Koraput district of Orissa are the study areas. Maps were prepared with cadastral boundary, contours and drainge. Landuse and landcover maps were also prepared using remote sensing data of Ennai and Tolla for the year 2007. Updation of cadastral boundary using Farm Measurement Book was carried out for one of the study villages, Karasanur village of Villupuram district, by integrating information collected from participating farmers. The database developed is being used in planning and prioritising the watershsed development activities in the study area.

In *Fish for All* programme, land use/land cover map of Keelaiyur revenue village has been prepared. Houshold data of Poompuhar, Keelaiyur and Neithavasal hamlets of Keelaiyur revenue village has been entered in GIS with location of houses in all three hamlets. This will help in identifying the different sectors in the village and to plan the project activities accordingly.

104.3 Information, Education and Communication

Participatory GIS is being applied to develop Household Information System and Farm Information System in Thatchampathu, one of the VKC villages in Wayanad district in Kerala.

The following steps were followed in this Participatory GIS.

Regular PRA exercises were carried out with tools such as transect walk, time and trend analysis, social mapping, wealth ranking, resource mapping and Venn diagram. Locations of important places were collected using GPS along with details during transect walk. Unique identity numbers were assigned for each house in the village. The same identification is used in social mapping, wealth ranking exercises in collecting household details and in locating the respective houses using GPS. The difference in social and resource mapping through regular PRA exercise and the maps produced using spatial methods by GIS and GPS and the importance of scale and direction in developmental plans were explained to the people.

Overlaying of social mapping outcomes such as community, income and social status helped in identifying target groups for project intervention. The database developed is being used in further planning and monitoring of the VKC activities.

Programme Area 200

BIODIVERSITY

Community Agrobiodiversity Centre, Wayanad, completed ten years of operation, contributing significantly towards conservation, livelihood and education. Kalajeera *Growers Association brought 163 ha under* Kalajeera *cultivation during the year. An association of tribal health practitioners of the Bhumia tribe was formed to document the traditional knowledge associated with the medicinal plants used by them.*

Programme Area 200

Biodiversity

Commendable progress was made during the year in community biodiversity conservation and development activities, which helped in achieving the overall programme goal of "bio-happiness".

The activities towards this goal were continued under five thematic areas: Community Agro-biodiversity Centres; Biodiversity Conservation, Utilisation and Enhancement; Enlarging the food basket (focusing on underutilised crops); Integration of Biodiversity Conservation, Biovillage, Community Food and Water Security System (Gene-Seed-Grain-Water Banks) and VKCs; and Capacity building of Panchayat Leaders on Farmers' Rights and Biodiversity Acts.

The activities in the Jeypore tract of Orissa were under a PAN MSSRF mode in which the four theme areas of Biodiversity Conservation, Enhancement and Utilisation, Food and Nutritional Security, Biovillage and VKC were strongly linked together.

The Kolli Hills interventions continue to focus on Conservation, Cultivation, Consumption and Commercialisation of millets. The focus at CAbC at Wayanad has been on Conservation, Livelihood Promotion and Education and Training.

Sub Programme Area 201

Community Agrobiodiversity Centre, Wayanad

Community Agrobiodiversity Centre (CAbC) marked its tenth year. The Strategy Review Report was prepared, which took stock of the work done so far, assessing its impact in the areas of conservation, livelihood and education and what needs to be done further to maximise efforts for overall impact. Based on this Strategy Review and the recommendations of the National Discussion on "Revitalising Agrobiodiversity for Alleviating Poverty and Hunger', held to observe one decade in the service of conservation of agrobiodiversity in Wayanad district, a set of 18 goals was identified after an intensive exercise.

The activities during the year are reported under three thematic areas.

201.1 Conservation of vanishing diversity

Conservation of Native Rice Varieties: Supported by the National Medicinal Plants Board (NMPB), this project concentrates on the medicinal property, validation and market expansion of *Navara* and other speciality rice varieties including *Chennellu, Gandhakasala* and *Mullanchanna,* which are endemic to Kerala. As *Navara* exists in 4 different types, and no key is available to distinguish them, the Centre is engaged in research and collaboration to overcome the situation.

Currently 30 farmers are cultivating speciality rice in 7.50 ha for which 150 kg of seeds of

four rice varieties were supplied. But despite the high demand, the price of *Navara* rice remains low, notwithstanding the cost of production coupled with the low yield. Agencies like Kandamkulathy Pharmacy, Thrissur and Kalady Rice Millers' Cluster Development Society, Kalady have been approached to ensure a steady market. A ten-member farmers' group at Nadavayal has been empowered to apply for assistance from NMPB under the contractual farming system.

At the Puthoorvayal trial plot, morphological characterisation of *Navara* continued during both seasons of the year, following IRRI's rice descriptor. During the *Nanja* season (August/ September – December/January), a trial on the amount of basal fertiliser FYM applied per hactare showed a substantial increase in yield of both black awnless and yellow awnless *Navara* type when the amount of FYM was increased to 4,000 kg/ha from the usual 2,500 - 3,000 kg/ha. Soil analysis of the trial plot which included parameters like pH, NPK, total bacteria, fungi, *Azospirillum, Pseudomonas, Trichoderma*, Actinomycetes and phosphobacteria was completed with the help of the Indian Institute of Spices Research, Kozhikode.

A phytochemical profiling of the selected landraces of rice including *Navara,* initiated with help from the biotech team, has shown some profile variation in the black variety of *Navara*. A Thermal Retention Test was also conducted to observe whether higher thermal retention property is unique to *Navara*. Realizing the need for agreement between the chemical profile and clinical property, a protocol for validating *Navara* rice through clinical trials has been prepared in collaboration with Central Research Institute (*Ayurveda*) Cheruthuruthi.

Conservation of Rare Endangered and Threatened (RET) plant species: Detailed morphological analyses to confirm the identification of the targeted 80 RET species have been completed, of which voucher specimens of 49 species have been deposited at CAbC herbarium. As a conservation measure, 13,558 seedlings of these species were raised through both seeds and vegetative means. As part of the *ex situ* collections, a zone for climbing plants with 168 species and a zone for trees with 42 species that are endemic to the Western Ghats have been set up at the Conservation Garden of the Centre. Recognising the role of traditional beliefs in promoting conservation measures, the Centre has also facilitated the establishment of a zodiac garden in the premises of CAbC. Further environmental education and awareness campaigns were conducted during the year for ensuring a concerted action towards RET conservation. A one-day seminar on 'Taxonomy *vis-à-vis* Conservation' was held to commemorate the 300th birth anniversary of Carl Linnaeus, the 'Father of Taxonomy' on World Environment Day 2007.

***Ex-situ* collection and conservation of wild and traditional species/varieties of tuber crops and legumes at CAbC:** A germplasm plot of tuber crops and legumes was established at the Centre with 14 species of

wild *Dioscorea*, 14 varieties of cultivated *Dioscorea* from 4 species and five different legumes.

Conservation to complement food security and livelihood: The study on 'Family food habits and nutritional status of mothers and children' below three years in selected *Paniya* and *Kattunaikka* tribal colonies of Wayanad' was wrapped up and the findings were shared at separate meetings with the different stakeholders *viz*. mothers, officials of the Integrated Child Development Services (ICDS), Panchayat leaders and Tribal Department officials (See SPA 501.4).

On the issue of malnutrition at Ponkuzhy Katunaikka colony, a discussion was held on the possibilities of disbursing the ICDS allotment of the food material to the colony. As a result of follow-ups, the ward member has formed a Welfare Committee to address such issues and the ICDS has opened an *anganwadi* centre at the colony.

125 kitchen gardens of Paniya, Kattunaikka and Kurichiya tribal colonies have been supplied with 1,125 kg of *Dioscorea alata, 400 kg Colocasia esculenta*, 250 kg of *Amorphophallus companulatus,* leafy greens, 7 varieties of plantain and 3 varieties of sweet potato. A detailed survey was conducted on home garden diversity, quantity of harvest and consumption pattern to gauge the impact of efforts. A tuber crop cultivation programme involving 29 tribal families consisting of 15 Paniyas (9 men and 6 women) at Judgikkunnu and 14 Kattunaikkas at Muthanga (6 men and 8 women) was initiated for income generation.

In collaboration with the Tribal Department, the Centre has been implementing a comprehensive tribal cluster development programme at Kuttimoola tribal cluster in Begur Forest Range under North Wayanad Forest Division in Manathavady Gram Panchayat. A Tribal Cluster Development Society has been formed and registered for effective and transparent utilisation of the funds sanctioned by the Tribal Department. For efficient monitoring of the programme implementation, project funds have been credited in the Society's account.

A Committee consisting of 9 members from the tribal cluster along with an advisory committee consisting of 2 members from Gram Panchayat, the Panchayat President and Ward member, 2 members from the Tribal Department, 1 from the Forest Department, 1 from CAbC and 1 from a Nationalised Bank, has been formed to monitor the expenditure and programme implementation.

Considering the high demand for quality seedlings of coffee, pepper, coconut, arecanut, and medicinal plants in the district, a group consisting of 13 members with 7 women and 6 men was formed to initiate a model livelihood improvement programme. After undergoing a training on basic nursery techniques, they established a 2,000 sq. ft. nursery structure with a capacity to raise 25,000 seedlings at a time. The group has received orders from the Social Forestry Division and Tribal Department for seedlings of local varieties of pepper, cashews and forest species.

201.2 Livelihood development

The Women's Bioresource Complex supported by DBT and the Livelihood Improvement Programme of the Marginalised Men and Women with a focus on Scheduled Tribes through Natural Resources Management and Intensified Microenterprise Activities supported by DST, are the two projects under this theme.

Women's Bioresource Complex: New SHGs were formed along with reorienting the old SHGs towards the goal of the project. Training focused on the economics of medicinal plant cultivation, selection of appropriate species, plants in demand in the industry, current trends regarding medicinal plants in Ayurvedic pharmacies and preparation of simple herbal remedies.

One lakh seedlings of 15 medicinal plant species have been raised at CAbC and two decentralised nurseries for distribution to SHGs for cultivation.

Livelihood Improvement Programme of the Marginalised Men and Women with focus on Scheduled Tribes through Natural Resources Management and Intensified Microenterprise Activities: Various means such as seminars, exhibitions, books, booklets, and brochures were adopted for creating awareness and disseminating information on a wide range of topics like vermicomposting, trichoderma production, pepper cultivation and organic farming, biopesticides, nitrogen fixing plants and mushroom cultivation. Apart from the training, bio inputs like *Pseudomonas*, V*erticilium, Beuveria, Metarhizium, Hirsutella* etc., were collected and supplied to farmers on demand.

To create employment opportunities**,** 72 members were identified as partners to take up activities like vermicompost, *Trichoderma*, *Trichogramma*, mushroom cultivation and eco-market outlet. 2,906 vermicompost pits were harvested by the group and sold for Rs 9,000 while *Trichoderma* was sold for Rs 4,500 by the group.

To sell the organic produce and bio-inputs procured from farmers and SHGs, an eco-shop named 'Greens' has been started in Kalpetta. The market outlet has been registered under the Partnership Act. To ensure a continuous supply of organic produce, a network of organic farmers has been formed. The eco shop has been able to do business worth Rs 15,000 a month with the organic farmers nearby. To strengthen and reinforce organic farming practices, farmers were sensitised to undertake organic vegetable cultivation and assured of buy back through market outlets.

201.3 Biodiversity Education and Training

Village Knowledge Centre and Village Resource Centre - Training and capacity building activities were drawn up, based on the need assessment survey and PRA reports. Sixteen training and awareness generation programmes were conducted at the VKC and VRC. They include organic farming, *Azolla* cultivation, vermi-composting, cultivation of tuber crops, application of organic inputs, nursery raising, bee keeping, modified methods of rice cultivation, vegetable

gardening, dairy farming, health and hygiene, Chikungunya, water borne diseases and alcoholism. A total of 446 people attended the programme, of whom 233 were women and 213 men, with 70 % of the participants belonging to scheduled tribes.

A Microsoft Unlimited Potential Programme (MUPP) was initiated to give basic computer education to the rural youth and students. 34 men and 41 women enrolled for the programme. 50 % of the trainees belonged to scheduled tribes.

Visits were organised for Panchayati Raj members to understand how VKCs facilitate rural development by providing locale-specific and demand-driven information and capacity-building training programmes and establishing linkages with strategic partners. Similarly training programmes for Knowledge Workers and youth on the general management of VKC activities were also conducted.

A detailed PRA was conducted to identify the needs and problems of two villages under the VKC and a micro plan has been developed.

Thrust was also given to develop the content for the VKC, based on need assessment. Fourteen modules were produced in the form of audios, videos, interactive CDs, posters and leaflets. As part of strengthening the service potential of the VRC/VKC, the team collected generic content on 250 relevant topics. The VRC has brought out 12 issues of the Community Newspaper (CNP) in Wayanad. The CNP publishes information about Government schemes and entitlements, local employment news, agriculture information, food and dietary knowledge, crop specific information, biodiversity conservation, etc.

Networking and linkages: The Centre established linkages with various Government and non-Government institutions for solving people's problems, identified through PRA exercises. An entitlement passbook is under preparation with the support of institutions/ departments.

Every Child A Scientist: ECAS intervention was carried out at 10 MGLP SSA schools among the 60 Multi Grade Learning Programme (MGLP) *Sarva Shiksha Abhiyan* (SSA) Schools in Wayanad, ten schools from three blocks (Sultan Battery, Manathavady, Vythiri) were selected for initial intervention after a baseline survey on the community, availability of garden space and number of boys and girls.

ECAS programmes were initiated at four tribal hamlets (Kuttimoola, Vazhakandy, Thachampath, and Puthoorvayal) covering 207 tribal children.

Training programmes were conducted with the help of both external and internal resource persons for SSA school teachers and tribal volunteers of SSA-ECAS Centres on the methodology of informal education and topics such as medicinal plants, butterflies and their host plants, birds, various aspects of biodiversity and environment, Information and Communication Technology and child psychology.

A Biodiversity Conservation Corps (BCC) has been formed with a strength of 14 tribal and

rural children. Training has been imparted on various aspects of biodiversity, environment, traditions and culture and value based education. BCC serves as a resource pool for the field level knowledge centres.

In-house training was provided to five selected tribal volunteers to empower them to serve as teachers/facilitators on the ECAS curriculum. They conduct classes on biodiversity, plant basics, confidence-building, personality development and crafts using paper, coconut shell, grass etc., at SSA schools.

Focusing on new frontiers in science, the programme Swadeshi Science Movement was initiated for high school and higher secondary students. Well-known scientists from different institutions interacted with 70 students drawn from 26 schools. The objective of the programme was to familiarise the students with new technologies such as nanotechnology, biotechnology, genetic engineering, photochemistry, space technology, etc.

A butterfly garden has been established at CAbC campus, where more than 400 host plants belonging to 151 species, which serve as a source of nectar and larval food, have been planted. The garden is maintained at high humidity to ensure the survival of butterflies. The campus attracts 73 types of butterflies belonging to five families. Nature camps for parents and members of the BCC were conducted and a range of topics, including star watching, trekking and butterfly watching, was touched upon.

An exhibition on the agrobiodiversity of Wayanad was organised, showcasing 35 species of edible tubers, 100 species of edible leafy greens, 10 local varieties of rice, 5 species of crabs, 30 species of mushrooms, 30 forest products and traditional agricultural implements. More than 2,000 students from 20 schools, including 10 tribal schools, visited the exhibition.

This programme is also being implemented in Chennai and has been reported under SPA 604.

Sub Programme Area 202

Biju Patnaik Medicinal Plants Garden and Research Centre, Jeypore (BPMPGRC)

A Research and Development Centre has been set up in Jeypore for undertaking intensive and integrated study of medicinal and aromatic plant species of the region, thereby contributing to an era of bio-happiness for the tribal communities of the region, with the overall objective of helping the communities overcome the prevailing dichotomy of the poverty of the people and the prosperity of nature. A PAN MSSRF initiative on integrated management of natural resources is also being implemented here.

202.1 PAN MSSRF Initiative: Integrated Management of Biodiversity Resources

The major objective of this initiative is to concurrently conserve and utilise the rich agro-biodiversity in three agro-biodiversity hotspots:

the Jeypore tract in Orissa, known to be a secondary centre of origin of rice; Wayanad in the Western Ghats of Kerala, a global biodiversity hotspot and Kolli Hills in TN, a site known for cultivation of a range of millets. The project comprises four thematic areas: Biodiversity Conservation, Utilisation and Enhancement (BCUE), Food Security (FS), Biovillage (BIOV) and Village Knowledge Centre (VKC). The VKC component is dealt with under SPA 601. Jeypore is the major site where all the four areas are being addressed.

202.1.1 Biodiversity Conservation, Utilisation and Enhancement

Large scale production and marketing of Kalajeera: The major activities during the reporting period were the preparation of an action plan with officials of the Department of Agriculture and Kalinga Kalajeera Rice Growers' Cooperative Society (KKJRGCS) for area expansion, distribution of seeds to farmers through the Society, training for Government officials on land races and package of practices for raising landrace Kalajeera, strengthening the Society and marketing through NAFED.

To expand the area under Kalajeera by involving more farmers, a comprehensive plan of action was presented to the Department of Agriculture and KKJRGCS. More than 62 quintals of seeds were distributed to farmers as loan through the Society. In addition, farmers raised Kalajeera using their own seeds collected in kharif 2006. This year a total of 333 farming HHs spread across 74 villages located in 17 Gram Panchayats of Kundura, Boipariguda and Jeypore blocks grew Kalajeera as planned (Table 2.1). This expansion has been facilitated by the Department of Agriculture, Government of Orissa and the Society.

Table 2.1 ***Area under Kalajeera during kharif 2007***

Block	No. of farmers	No. of villages	No. of G.Ps	Area (ha)
Jeypore	31	9	3	23.00
Boipariguda	169	30	6	74.50
Kundura	133	35	8	66.00
Total	333	74	17	163.50

A notable event was the visit of the Minister of Agriculture, Government of Orissa, to MSSRF Centre and his assurance to the members of the KKJRGCS of all possible help in cultivating local landraces of Kalajeera.

Site specific trials of Kalajeera: Site specific trial to assess the performance of Kalajeera was conducted in 5 different districts (Rayagada, Malkangiri, Kalahandi, Nabarangpur and Bolangir) of Orissa is on.

Performance of Kalajeera F_7 populations: Seeds from selected plants of F_6 generation (SMP) and F_6 bulks (BLK) were laid out separately. Two farmers selected from the two villages of Pujariput and Nuaguda laid BLK and SMP trials. The SMP was laid in Randomised Block Design (RBD) and BLK in large plots.

***Kalajeera – Kalanamak* hybridisation:** To combine the good attributes of Kalanamak with Kalajeera, a crossing programme was carried

out. Two of the 37 accessions, 3129SN and 3128SN were selected as female parents and Kalajeera was used as the male. Crosses were made in pots at BPMPGRC and the putative hybrid seeds were collected. F_1 will be raised in kharif 2008.

Trial of finger millet landraces: Cultivation of finger millet is an old practice of tribal farmers in Koraput region. A number of landraces of varying duration were cultivated earlier. Four finger millet LRs (*Bada Mandia*, *Sana Mandia*, *Jahna Mandia*, *Banushaganthi Mandia*) and one Government released variety *Bhairavi* were laid out in farmers' fields in RBD and the crop was raised using modified practices of cultivation. In one village the crop was transplanted while in two villages, it was sown by direct seeding. The results showed that two LRs were early maturing and two late maturing.

Trial of mixed farming: Trials were undertaken to assess yield performance of crops under mixed farming using appropriate technology and to understand the cultural importance of mixed farming. The trial was conducted under traditional and modified methods using seed ratios of mixed crops used by the farmers. The crops used were upland paddy, niger, little millet, sorghum, blackgram, pigeon pea and finger millet.

Participatory Plant Breeding – led-Conservation programme: The aim of the programme was to raise awareness and encourage farmers to conserve the existing LRs and also undertake trials of some unexplored LRs for which seeds were provided by MSSRF, as well as strengthen the participatory institution of Field Gene Banks.

The PCS layout was so designed that cultivation was around the border of the major crop. A total of 52 LRs of paddy were cultivated by 31 farm families with seed supplied through the village seed banks. Some of the LRs were popular. Agronomic characters were collected from 10 plants in the field and the seeds harvested are preserved in the village seed bank.

Conservation and exploration of rice LRs and documentation of agronomic characters: A trial was conducted at MSSRF campus in which 70 LRs were transplanted in rows. Agronomic data was collected as per the IPGRI format. Photographs were taken and herbarium of each LRs prepared. Twelve new LRs of paddy were identified.

Village Seed Banks (VSB): A new VSB register incorporating new features was prepared and provided to villages to ensure proper record maintenance. The records will now contain information on seeds of varieties / LRs. The VSB extension at Boliguda was completed and inaugurated at Gunthaguda in November 2007.

202.1.2 Biovillage Programme

Grassroot level institutional development through the formation of SHGs, training, demonstration and exposure visits were organised at three villages (Nuaguda, Boliguda and Gunthaguda). Of the 185 HHs in the three villages, 136 participated in this programme to enhance their income through different on-farm

and off-farm enterprises such as off-season vegetable cultivation, mushroom production (oyster and straw), vermicompost, value addition to tamarind, leaf plate stitching, pisciculture, green gram cultivation, inter cropping of *arbi* (common yam) and elephant yam in cashew orchards and groundnut cultivation. Both individual and group activities have been promoted at the project site. Currently, the 10 SHGs have 112 women and 7 men members.

Off-season vegetable cultivation as rainy season crop was taken up for commercial production by 52 HHs individually at all the three villages, covering an area of 13 ha of backyard uplands. Quality seeds of leafy vegetables, brinjal, tomato, bean, radish and perennial crops like papaya and drumstick were provided to the families for initial start up. Additional income to each individual farmer is estimated at Rs 1,000 to Rs 3,500 over a period of three months. A total of 90 HHs have taken up commercial cultivation in winter in upland and low land locations where water is available, on a 0.1 ha of land individually. Quality seeds were provided. The average income from winter vegetables ranges from Rs 2,000 to Rs 5,000. Maize cultivation, introduced last year, is now very popular among the farm families.

Group vegetable farming was initiated as a group activity in 1 acre of land by 7 SHGs in three demonstration villages (Nuaguda - 2 SHGs, Boliguda-2 SHGs and Gunthaguda-3 SHGs). Several vegetables were cultivated. The income from this garden, amounting to Rs 8,000 to Rs 12,000, has been paid into the group fund managed by the SHGs for group member development.

Mushroom production as a group activity continued during the period. Oyster (*Pleurotus sp.*) and straw (*Volvariella sp.*) mushroom cultivation provide an opportunity for value addition to paddy straw and mushroom waste is used for vermicompost production. Training was organised in the project villages. Four SHGs involving 49 women established 65 straw mushroom beds and produced a total of 112 kg. The additional income per household from mushroom sale ranges from Rs 200 to Rs 500. Eight SHGs involving 114 women established 371 oyster mushroom beds and produced a total of 345 kg. The additional income per household from mushroom sale ranges from Rs 500 to Rs 1,200.

Vermicompost units were earlier set up as an individual activity by 10 HHs at Nuaguda, with the support of Spices Board. The individuals producing vermicompost use 75 % of the produce from the pits in their backyard garden and agricultural field, and sell the remaining at Rs 4 per kg to farmers from neighbouring villages. During the reporting period, the activity has been strengthened and upscaled with the construction of 45 additional vermicompost units on a cost-sharing basis, making them partners in the process. Fund from Spices Board is being mobilised for the construction of 25 units at Boliguda and Gunthaguda. Twenty other units are being constructed with contributions from the community in the form of material and labour.

These units are being managed by a group of 24 women and the production is on a commercial scale. A two-time harvest of vermicompost by the SHGs yielded 8-10 tons. This activity has generated an additional income of Rs 8,000.

Value addition of tamarind has been taken up with Mahila Swasahayaka Sangha, a 10 year old SHG at Nuaguda. This trial involves 18 women of the group. The group had procured 1,200 kg of tamarind during the season by paying Rs 7,200 @ Rs 600 per quintal, de-seeded and stored it in cold storage at Jeypore for 11 months. The de-seeded tamarind which totalled 570 kg was stored at the cost of Rs 740. The processed materials were sold at Rs 9,120 @ Rs 1,600 per quintal thus yielding a net benefit of Rs 1,180. This time the market price of de-seeded tamarind was lower than expected and resulted in lower net income.

Leaf plate stitching at Boliguda is carried out by a group of 8 women who were specially selected on the criteria that included physical handicap, elderly, with no other occupational avenue and involvement in this activity for a long period. Each of them is able to produce about 80 to100 leaf plates everyday during the 4 hours they spend on this activity. The leaf plates are sold at the local market for Rs 25 per 100 plates. Based on the proposal put forth by the group, two stitching machines were provided, as well as training, for increasing production, improving quality, minimising time and reducing drudgery. The efficiency of production has gone up by 150-200 % and drudgery has been reduced.

Pisciculture as a group activity has been undertaken by two SHGs involving 24 women at Nuaguda village. Two ponds with a total area of 0.2 ha were taken-up on lease by the group from 2 HHs in the village. MSSRF provided 2,100 fingerlings and feeding materials to the group. The expenditure for the entire enterprise is around Rs 5,000 and income till date from the above enterprise has amounted to Rs 4,000.

***Inter cropping of arbi (Elephant foot yam -* Amorphophallus sp*) and yam* (Dioscorea alata)** was initiated as a group activity in 0.1 ha of land each by 2 SHGs (24 members) in two demonstration villages (Nuaguda and Gunthaguda) to demonstrate improved techniques and inter cropping of new crops in cashew orchards. Around 6 quintals of seed materials have been harvested for use during the next season as there is a high demand for seed materials in all the villages.

Groundnut cultivation was earlier initiated through SHGs and now it is popular as an individual activity. 53 HHs in Boliguda village cultivated groundnut in an area of 20 ha in rabi 2007. The farm families earned additional income ranging between Rs 20,000 and Rs 30,000 per ha. Around 22 ha of land is under cultivation by 58 farm families at Boliguda village in rabi 2008.

Folk Award 2008: Smt. Chandrama Mashia, a SHG member who is actively involved in the project activity since its inception received the Folk Award 2008 instituted by Sri. Srikhetra Suchana, Puri.

202.1.3 Food Security

Grain banks: A Community Gene-Seed-Grain bank (CGB) consisting of two rooms for storing seeds and grain was established at Gunthaguda. Members of the local community contributed to the construction in the form of materials and unskilled labour. The existing grain banks in Boliguda and Nuaguda were strengthened. The storehouses of the two villages were also renovated with contributions from the member HHs.

Training on various dimensions of management was conducted for strengthening the capacities of the management committee members of all the grain banks.

Training on CGB record maintenance: Lack of proper record keeping is a common concern associated with all CGBs. To address this, a one-day training programme on record keeping for the management committee members and record keepers of grain and seed banks from different villages was organised. Thirty-seven participants (29 male, 8 female) along with three residential volunteers of MSSRF, from 15 villages of the two districts of Koraput and Kalahandi, participated in the programme. Orientation on keeping records of CGB transactions was provided to the participants and a new CGB transaction register introduced.

Kitchen Garden: Kitchen gardens have been promoted in all the three villages to generate awareness of the importance of vegetables in the daily diet and to help HHs grow good quality nutritious vegetables throughout the year, especially those rich in iron and vitamin A.

174 HHs of three villages (Gunthaguda, Nuaguda and Boliguda) were given seeds of papaya, drumstick, chilly, brinjal, tomato, radish, beans, onion, bittergourd, pumpkin and amaranthus and seedlings of guava, lime and banana, with orientation for proper cultivation. Performance data of the kitchen garden in Nuaguda village has been collected and the data analysed. A survey on the availability of space, water and human resources, for each participating household was completed. A kitchen garden card which helps in understanding the utilisation of kitchen garden produce has been prepared and field tested.

Diet survey analysis and activities based on diet survey: A diet survey of HHs with infants in the 0-2 age group and adolescent girls was conducted in the three villages. The findings have been shared with ICDS functionaries and with the villagers. (See SPA 501.4)

Promotion of Greengram and Horsegram cultivation: The diet survey supported the need of cultivating pulses like greengram and horsegram to cater to the nutritional needs of the community. Seeds were made available through the Community Seed Bank and biofertilisers (Phosphobacter and *Rhizobium* culture) have been provided to the HHs. In all, 32 HHs in three villages cultivated horsegram in 13 ha and 46 HHs cultivated greengram i n 15 ha of land.

Awareness programme on health and nutrition education: Communication materials regarding nutrition and childcare have been collected from ICDS and CARE-India and is being used. Awareness programmes on sanitation and environmental hygiene were organized. Ninety-two persons belonging to different age groups attended the meeting that provided orientation on nutrition education, child feeding, sanitation and hygiene.

202.2 Medicinal Plants Garden

Last year's report highlighted the establishment of nine Tribal Medicinal Plant Gardens for 9 major tribes of southern Orissa (*Bhatra, Bhumia, Bonda, Gadaba, Gond, Kandha, Koya, Paroja and Saora).* Each garden was planted with medicinal plants used by the respective tribe. In all, the gardens now have more than 3,000 medicinal plants representing 183 species.

During the year, 189 species of plants were planted in the nine gardens to serve as *ex-situ* conservation of medicinal plants used by the nine dominant tribes of the region.

An association was formed taking into account all the traditional healthcare practitioners and the traditional birth attendants of the Bhumia tribe. Altogether 419 (167 female and 252 male) healers from four districts participated in this programme. A database was prepared for all the members with their photographs and detailed contact address. A Panchayat level traditional healers' association was established in the *Asna Gram panchayat* involving 164 members (56 female and 108 male healers). These healers were given the responsibility to monitor the status of the medicinal plants of their respective villages.

Fourteen different species of commonly used medicinal plants were supplied to 378 HHs across 14 villages of eight *Gram Panchayats* in three community development blocks of Koraput district. Out of the 14 plant species, a kit with a minimum of five plants was given to each farm family to be maintained in their backyard garden for daily use. A booklet in Oriya on Home Herbal Garden *(GHAR DESARI)* containing information on the use of these 14 medicinal plants was distributed to the farm families.

Students' herbal gardens were established in nine schools in three Community Development blocks of Koraput district. 500 seedlings of medicinal plants representing 50 species were supplied to these schools. One Community Medicinal Plants Garden (CMPG) was established in Jhalaguda village with 64 medicinal plants commonly used by them. Continuous awareness programmes were conducted in 14 villages of the three GPs in three blocks of Koraput district on herbal prevention of malaria. A demonstration was given in each village on the preparation of herbal preventive for malaria. People's Biodiversity Registers (PBR) are being prepared for two *gram panchayats* in 2 blocks of Koraput district.

Propagation of Medicinal Plant species: About 17,000 seedlings were raised and

distributed to schools, home herbal gardens, community medicinal plants garden and traditional healthcare practitioners with the help of 2 shade net houses and three U. V. stabilised poly houses. Twenty medicinal plants prioritised by NMPB were cultivated in a plot of 3 m X 8 m to demonstrate the agro-technological package. A demonstration cum training programme was conducted to orient farm families on the cultivation of the medicinal plant aswagandha. Around 4 ha were brought under cultivation by involving 24 farm families of 6 villages.

202.3. Livelihood enhancement of the tribal poor

Vegetable cultivation was carried out in six villages of three *gram panchayats* of Kundura block of Koraput district by involving 351 farm families, and 7 vegetable crops were cultivated in the winter and summer seasons. A total of 74 ha was brought under cultivation out of a total of 489 ha of cultivated area and on an average a profit of Rs 1,351 per household was obtained through this activity. Each farm family was provided with seeds of at least three crops of their choice in the off-farm seasons. In Uduluguda village, an SHG consisting of 17 women members from landless families was established. The SHG leased out 3.5 ha of land and cultivated 5 different vegetables during the year. A profit of Rs 18,757 was obtained from this activity. In addition, 0.5 ha of backyard land was brought under vegetable cultivation for home consumption.

Renovation of 13 individual farm ponds was taken up in 4 villages involving 13 HHs. The bund repair work was carried out with the help of farm families who were dependant on these ponds for their livelihood. The bunds were levelled and the ponds were cleaned of all foreign materials. The bunds were ploughed and papaya, banana and finger millets were cultivated. 28,000 fingerlings of *Rohu, Katla and Mircalli* were reared in these ponds, and 1,680 kg. of fish was harvested from these 13 ponds. A total income of Rs 67,200 was realized from these activities, Rs 5,170 being the benefit per farm families this year. Fourteen low-cost poly houses were constructed in six villages to promote nursery raising in controlled conditions during winter. Eight crops were raised, which in turned covered an area of 79 ha with a success rate of 87 %. Technical guidance was provided to farm families on vegetable and spice cultivation.

A backyard garden was designed and a proper plan of action was outlined with the help of the villagers. Eight vegetable crops were cultivated in 5.4 ha of backyard garden, involving 475 HHs. The vegetables were consumed by the families for 10-90 days. This year 8.6 ha of land was under spices (ginger, green chills and onion) cultivation, involving 84 farm families in 6 villages.

Through this programme five crops *viz*: papaya, drumstick, lemon, green chilly and yam were selected as these plants require minimum care and can easily be maintained with minimal family labour input. Altogether 248 farm families were brought under this campaign. So far 700 seedlings of papaya

have been distributed to the farm families to be planted in their backyard. This perennial plant will meet the daily food requirement of one household for at least 45 days in a calendar year. Apart from this, 2 gm seeds of chilly were provided to 376 farm families in the 6 villages.

Two VKCs were established in the revenue villages of Asna and Kundura of Kundura block in Koraput district. A baseline survey was carried out in three villages, and followed by micro-planning. A survey was conducted to analyse the impact of activities conducted under this programme. and a document was prepared.

Spices Board and Horticulture Department have supported the establishment of 200 units of vermicompost pits by 200 FFs. There is a network with the National Horticultural Mission for fruit bearing trees. Government schemes and agricultural loans were also harnessed for implementation. Ten SHGs were established and farm pond schemes have been initiated for establishing farm ponds of 12 m X 12 m in two villages, with an aid of Rs 35,000 per pond. One motor pump (3 HP) was bought under SGSY scheme for the landless women SHG with 50 % subsidy. Seventeen seed kits were brought from the Block office for cultivation during winter.

202.4. Quantitative Assessment and mapping of Plant Resources of the Eastern Ghats

The activities aim at quantitative assessment of the geographic distribution and population status of plant resources and setting up an Eastern Ghats Eco-region specific database on plant resources. Preparation of RET plant list and a database on economically important plants is also among the objectives of the programme. This in turn would provide significant inputs for the identification and collection of important plant resources of the region for conservation at the Research Centre at Jeypore. MSSRF is a partner in this multiinstitutional project being coordinated by Sri Krishnadevaraya University, Anantapur, AP.

MSSRF has been allocated 444 grids of the Eastern Ghats covering 7 districts of Orissa. Of these 444 grids, 203 grids have been covered till date, of which 194 are workable and 9 are non-workable grids. A total of 228 transects were made to cover the 203 grids. Four hundred and fifty-two plant species from these grids were recorded, including 179 trees, 74 shrubs, 113 herbs, 58 climbers and 28 others. A total of 108 herbaria consisting of 39 trees, 22 shrubs, 23 herbs, 18 climbers and 6 orchids were prepared. Three hundred photographs were taken to prepare fliers for individual plant species. Thirty-one endemic species of the region were re-explored and only 4 species so far relocated from the grids of the region. A database was prepared for 674 plants from secondary information of the flora of Orissa.

Sub Programme Area 203

Community Conservation Efforts in Kolli hills

203.1 Biodiversity Conservation, Utilisation and Enhancement

Achieving higher productivity and bridging the gap between supply and demand for little millet by facilitating market linkages were two of the pathways identified for further action. During kharif 2006, 13 farmers adopted the modified method of cultivation. Morphometric characters were taken from all the plots and the results were analysed.

Seed distribution during kharif 2007: During kharif 2006, quality seeds were collected by farmers who adopted the modified method of cultivation. Reaching a consensus in the presence of Panchayat leaders, it was decided to safeguard seeds in the seed bank at Aripalapatti and distribute them during kharif 2007.

The modified method of cultivation was extended across 5 Panchayats through training and demonstration. About 46 farmers have shown interest in testing the modified method of cultivation in millets. Landraces of millets such as *Vellaperunsamai* for Devanur region, *Malliasamai* for Selur region and *Vellaperunsamai* and *Kattavettisamai* for Alathur region have been planned, based on the needs of the farmers. Farmers who adopted the modified method of cultivation in kharif 2006, were given seeds on a priority basis. Excess seeds were distributed to other farmers in the same village.

During kharif 2007, the modified method of cultivation was advocated to farmers. After the analysis of the data gathered from kharif 2006, changes were advised in the method of morphometric data collection *viz.,* field preparation, record maintenance and harvest data collection.

Integrated soil health management training: Training on soil health management was conducted at the project area for 22 participant farmers. Information on soil texture, soil colour, pH, micro and macro nutrients, and the role of soil organisms in nutrient fixing were included.

Distribution of seeds for relay cropping: The traditional relay crop practised in Kolli Hills, mixed cultivation of coriander, pulses and greens, has almost disappeared due to increase in tapioca cultivation, affecting local food security. To address this issue, seeds of green gram and coriander were distributed to farmers practicing modified method of cultivation for crop diversification. This has resulted in increased food security at the individual level and in some cases the farmer has made some additional income. Farmers have expressed interest in relay cropping of diversified crops such as vegetables and pulses.

Mini Pond Construction: Due to erratic seasonal rainfall, farmers could not depend on rain water for raising a second crop. But seepage water from the forests and rock crevices was utilised by the farmers for a

second crop (paddy) in the valleys. In recent years, due to severe drought, farmers were unable to do so. The concept of a mini percolation pond system that could effectively use the seepage was introduced. 11 farmers constructed such mini ponds in their fields in Aripalapatti, Aripalapatti colony, Vilaram, Periyamangalam and Chinnamangalam. Realising the advantage of such structures for farming, especially of millets, vegetable and fruit crops, the farmers are keen to continue the practice.

Seed Bank *(Thombai)* Construction: The commercial cultivation of tapioca has had an adverse impact on the availability of quality millet seeds even in millet growing areas like Devanur. Seed storage systems such as *Thombai* and *Kuthir* have become defunct as traditional exchange of millet seeds between farmers has gradually ceased with decrease in millet cultivation. To address the shortage, community millet seed banks will be constructed at Aripalapatty and Sulavandhi with the revival of the small seed bank at Aripalapatty. The decision, taken after consultation with all the stakeholders, will be implemented shortly with nominal support from the project. A seed bank management committee comprising SHG members, Farmers Club members, elders of the village and Panchayat leader has been formed. Seeds selected in kharif 2006 from 13 farmers have been stored in the seed bank. Apart from little millet, seeds of paddy, ragi and red and black beans have also been stored. All varieties are properly tagged and stored in mud pots. During kharif 2007, millet seeds were distributed to 31 farmers; they have laid demonstration plots in the four panchayats of Devanur, Selur, Alathur and Valappur.

203.2 Biovillage

Awareness Creation and Promotion: Adi 18 festival, 2007: In continuation of the campaign for millets, an awareness camp was organised at Kolli Hills during the traditional *Adi* 18 festival. Representatives of the SHGs participated in the programme by selling value added products of millet. Millet landrace seeds were displayed in the stall for creating an awareness among the farmers and general public. Using traditional folk drama, a play titled *Sarachandran Parasakti* was performed by the Periyakovilur cultural group to deliver conservation messages. Orientation towards marketing was also given to SHG representatives.

As a part of awareness creation on nutritious millets in Kolli Hills and Namakkal, five exhibitions and two training programmes were conducted.

India Organic Trade Fair 2007: To enlarge the scope for millet-based products, MSSRF facilitated farmers' representatives to participate in Organic Fair- 2007 at New Delhi. This has led to networking of the millet farming community, with the farmers in Kolli Hills learning new developments and advances in the organic sector, spurring their interest in organic certification and marketing.

Improving infrastructure of existing mill at Kuchikiraipatti: The millet dehusking mill at Kuchikiraipatti runs on a power generator. To

improve efficiency, *Nanbargal* SHG proposed to electrify the processing unit. A loan of Rs 60, 000 has been taken by the group from 'Friends of MSSRF'. Additional financial support has been sought from the government. Plans have been discussed for improving the standard of machinery. A new set of packing materials has been designed and printed. Efforts are being taken for getting the TIN number for the group from the Sales Tax Office. New packing covers were designed for millet products.

Mobile agro-packing unit: Post harvesting loss due to pest, insects, and fungus, have been major constraints not only for farmers but also retailers and consumers. Good packing technology could solve most of these problems at the initial stage itself. In this context, to create public awareness on good packing technology, a 3-day traveling demonstration in the district was organized with the support of BOSCH mobile agro packing unit.

Minor millet marketing: Millet producers and processors are encouraged to supply their product to various organic shops at Namakkal, Coimbatore and Erode. Efforts were made to tie up with organic shops at Udumalapet, Thirupur, Trichy and Salem. Apart from regular *samai* and *thinai* rice and flour, value added items were also promoted and supplied to shops (Table 2.2).

Recently, 10 more supply links have been created for millet products, in addition to the eight market institutions already established.

Millet processing mill construction: Millet processing involves drudgery and human labour. Two millet de-husking mills have already been installed in two locations in Kolli Hills and are operated by SHGs. Millet farmers and SHGs at Aripalapatti felt the need for a dehusking mill in Devanur Nadu, known for intense cultivation of millets. Resolutions were made by SHGs to get infrastructure support from DRDA, Namakkal. The District Collector assured infrastructure for the mill at Devanur region as per the guidelines of DRDA. The SHGs purchased and registered the land and donated a portion to the Block Development Officer (BDO). After the completion of this prerequisite, the proposal has been approved by DRDA for construction. The SHG has also resolved to purchase land to provide access by road. As a follow-up of this initiative, 5 cents of land has been purchased by *Kaliamman Sutrusuhal Padukappor Sangam* collectively by 12 women SHG members and registered. Of this, 3 cents of land has been donated as *dhan* settlement to the BDO, Kolli Hills block as part of administrative procedure. With the support of DRDA, under the rural infrastructure scheme, a building has been constructed at a cost of Rs 3.75 lakhs. Further efforts are on for the purchase and establishment of mills.

Table 2.2 ***Value added millet product Overall sales details 2007 - 2008***

Product details	Quantity in kg	Amount in Rs
Millet product regular	1,755.00	51,583.00
Readymade mix	365.15	17,556.85
Ready to eat	57.50	5,870.00
Total	**2,177.65**	**75,009.85**

Revival of Organic Pineapple Export Link: From 1999-2005, MSSRF had supported the farmers of Kolli Hills to export organically grown pineapples through the eco-certification process with Ion Exchange Enviro-farm Private Limited, a promotional company. The tripartite agreement ended in 2005. Based on the felt need, efforts are being made to revive such a link with a new partner, ITC Ltd, a leading organic product promoter in India. As a result, an ITC representative visited Kolli Hills in November 2007 and after a series of discussions, an agreement has been reached with ITC and certification with IMO control. Field data and mapping, field inspection, internal control system and maintenance with the support of ICS personnel is likely to commence in the coming months.

203.3 Grassroot Institution building in Kolli Hills

Appraisal of Grassroot Institutions in Kolli Hills

There are 21 SHGs in Kolli Hills, facilitated by MSSRF. They are, for convenience, grouped into 3 clusters named Chenbagam, Mullai and Roja. The 21 SHGs consist of 15 exclusively female, 6 exclusively male and 1 mixed group. Participatory appraisal was conducted in December 2007 to ascertain their income saving status (Table 2.3). Some of the SHGs were given financial assistance in the form of revolving funds.

Farmer club formation at Kolli Hills

Many of the SHGs facilitated by MSSRF consist of women and the efforts in conservation and enhancement are facilitated by them. In this context, involving men in the various training and capacity building programmes was found necessary. Therefore, four men farmers' clubs were formed with 67 members from 4 panchayats.

Capacity Building: A series of training programmes was organised for members of the Farmers' Clubs, SHG members, Panchayat Raj representatives, College Students and NGO members.

Training for others: Training programmes arranged for others are given in Table 2.4. Four women and 9 men from Kolli Hills were selected for the National Virtual Academy (NVA) fellowship for the year 2007 for their contribution to the research and dissemination efforts of MSSRF.

Table 2.3 ***Details of SHGs and Current Financial Status of SHGs***

Cluster Name	Male group	Female group	Mixed group	Total members	Educated members < 8th Std	Current total deposit (savings + internal interest) in Rs
Senbagam	2	5	1	102	30	3,06,569.00
Mullai	2	5	-	105	16	1,71,575.00 *
Roja	1	5	-	83	3	1,83,724.00 *

* Gross Savings of 4 groups only

Table 2.4 ***Training conducted in Kolli Hills from January - June 2007***

Training	Men	Women	Trainee days
Formal method of cultivation for SHG, Panchayat leaders	74	58	154
Poultry Farming	4	2	14
Percolation Pond Digging	35	22	389
Relay Cropping	3	7	20
Millet Processing and Packing	10	10	20
Millet Marketing	15	14	73
Farmer Club Orientation	109	-	176
SHG Management	64	171	697
NVA Fellow	11	4	45
Total	**325**	**288**	**1,588**

Sub Programme Area 204

Community Gene Bank

The Gene Bank provides a mechanism to ensure the sharing of economic benefits with the community which identified and supplied the material. Sometimes, the lack of this facility could mean a loss of benefit sharing mechanisms for the community and country of their legitimate economic benefits and recognition.

The gene bank has identified 5 and 15 traditional paddy varieties respectively from Wayanad, Kerala and Jeypore, Orissa and the process of facilitating farming communities to apply for registration under the provisions of the Protection of Plant Varieties and Farmers' Rights (PPVFR) Act is under way. This gene bank is undertaking a study of the DUS characters of these varieties with financial support from Plant Variety Protection Authority, Govt of India.

A laboratory study on the germination of the salt tolerant varieties of paddy collected earlier from the tsunami affected areas in the southern districts was conducted. Different salt concentrations such as 120 ppm, 140 ppm, 160 ppm, 180 ppm and 200 ppm were used to test germination. One non salt tolerant variety from TN was taken as control; other than salt concentration, normal water was also tested for seedling germination.

The varieties such as *kunthali, kallurundai, kuzhivedichan, soorakuruvai* and *katchakom-balai* were taken for the study. One control, 5 test varieties with 6 treatments in the form of split plot designs with three replications were. Germination count was done on the 15th day of seedling growth after root and shoot emerged. In addition observations on the length of root and shoot were counted on 20 seedlings; fresh and dry weight was recorded on 30 seedlings count. The detailed analysis is under way and the experiment will be continued using higher salt concentrations.

Some of the voucher specimens collected at the time of characterisation were mounted, classified and stored at the Community Herbarium.

Sub Programme Area 205

Capacity Building of Panchayat and Community Leaders and Farmers on the Legislations pertaining to Biological Diversity and Farmers' Rights

The project supported by DSIR was initiated in April 2007 with a formal project launch and workshop on 2 June 2007 with the Hon'ble Union Minister of Panchayat Raj, Shri. Mani Sankar Aiyer as the chief guest. The Panchayati Raj Secretary, Ms. Meenakshi Datta Ghosh was also present (See SPA 606).

Representing various agro-climatic and agro-ecological situations, four districts from TN, namely Cuddalore, Namakkal, Pudukottai and Thanjavur, were identified for implementation of the project. The Project Launch Meeting was attended by 30 District, Block and Panchayat level leaders including 9 women, and 60 participants who included progressive farmers, representatives of NGOs and other CBOs from the districts, government officials, civil society and media.

The first formal district launch of the meeting was chaired by the District Collector of Cuddalore district at Virudhachalam block. Ninety-one people of whom 25 % were women attended the meeting where lectures on the two legislations, group activities and interactive sessions, led to the selection of the first level of trainees. A pre-test questionnaire and a post-test questionnaire filled-in by the participants led to the identification of 45 potential candidates for Training of Trainers to be conducted shortly in chennai.

Programme Area 300

BIOTECHNOLOGY

Significant progress was made in identification and characterisation of novel genes, molecules and microorganism for abiotic stress tolerance and disease and pest control. Flower specific and seed specific cDNA libraries for Pandanus *and* Jatropha *were constructed. Culture protocol for 22 lichen species were established.*

Programme Area 300

Biotechnology

The Biotechnology Programme takes advantage of the recent advances in Biotechnology and Molecular Genetics. The progress made in this emerging field both nationally and internationally, has shown enormous promise and implications for improving agricultural productivity, and ensuring food security and human nutrition. The major activities focused on basic research, application of biotechnology at the grassroots level and dissemination of biotechnology.

The work carried out during the last few years, as detailed in previous Annual Reports, has contributed immensely in developing reproducible *in vitro* protocols for rare and endangered plant species in the Western Ghats and mangroves; documenting diversity among the mangroves and other cultivated species using molecular marker systems; assessing ecosystem health using microbes and lichen species; bioprospecting for novel compounds of medicinal and therapeutic value; identifying and characterizing novel genetic combinations from mangrove species and developing transformation systems for select crop species for generation of location-specific crop varieties offering tolerance/ resistance to abiotic stresses and addressing micronutrient deficiency. These studies have practical application for farming and rural communities.

Sub Programme Area 301

Ecological Restoration and Ecosystem Monitoring

301.1 Production and demonstration of high quality planting material of *Jatropha curcas* and multilocation trials

From a total of 404 accessions, 234 accessions were screened for high oil content and high yield, planted and provided regular watering, weeding and pruning; data has been collected. Selected accessions are being undertaken and variety registrations are under progress under the PPVFR Act provisions for both parents and F_1 generations.

Jatropha curcas *accession selection for national network trials*

MSSRF has been identified by the DBT as one of the major contributors of *Jatropha curcas* accessions. Of the 10 accessions (high oil containing) selected for multi location trials, 5 accessions are from MSSRF. The following accessions have been identified for national trials from DBT network partners: MSSRF (MSSRF-62, MSSRF-51, MSSRF-77, MSSRF-10, MSSRF-16), NBRI, Lucknow (NBRI- J-18), Biotech Park, Lucknow (BTP-K), PDKV, Akola (PDKV, Akola-1, PDKV, Akola-2) and HAP, Dehradun (HAP-GUA, HAP-GUB, HAP-GUC).

MSSRF has supplied 3,440 vegetatively propagated quality saplings from the selected five accessions to the following DBT-identified

network partners for multilocation trials: NBPGR (New Delhi) – 80; TERI-NE (Assam) – 560; FRI (Dehradun) – 560; Biotech Park (Lucknow) – 560; IGAU (Raipur) – 560; AFRI (Jodhpur) – 560; PDKV (Akola) – 560. MSSRF has received 580 vegetative propagated saplings from NBRI, Lucknow, Biotech Park, Lucknow, PDKV, Akola, and HAP, Dehradun.

Two more accessions have been selected from MSSRF for the current year for DBT network trials. New accession collection and selection are being undertaken at MSSRF for extended varieties identification.

Establishment of* Jatropha *seed production orchards and farmers' training

A one-day training programme was conducted for farmers in Tirunelveli district for establishment of *Jatropha* seed production orchards in different soil and climatic conditions. Fourteen farmers (2 women and 12 men) participated and discussions included availability of land, types of soil, water requirements and agricultural practices. Land was selected from each farmer's field (0.2 ha) for seed production.

Jatropha *nursery establishment and training*

Ten members from women's SHGs were federated to a women SHG named *Vairavi Kinuru Mahalir Katamanuku Nadrangal Valarpu Kuzhu (VKMKNVK)* and are involved in nursery development for supply of saplings to the farmers for establishment of *Jatropha* seed gardens in Tirunelveli district. VKMKNVK will propagate quality planting material from MSSRF *Jatropha* genetic garden and supply saplings to identified farmers for establishment of *Jatropha* seed production gardens. Land preparation and sapling development are under progress.

***Micropropagation of* Jatropha curcas**

Direct and indirect organogenesis protocols have been completely standardised and development of protocols for transformation using leaf disc are under way. Induced chemical mutation *In vitro* and field level data collection are under way for identifying accessions for drought resistance, yield higher improvement and disease resistance.

301.2 Demonstration of efficient energy plantation in coastal regions of Puducherry with community participation

Women SHGs *(Kizhavanjur Magalir Sathuppu Nila Kaadu Valarppu Kuzhu)* are planting mangrove saplings at Chunnambar and Thengaithittu, with support from the Government of Puducherry in the implementation of the integrated afforestation and eco-development project (coastal shelter belt development). This year, 10 ha of degraded land were planted with mangroves. SHGs are maintaining the mangrove plantations and taking new initiatives for their extension.

Ecological restoration

4,200 vegetative and micropropagated saplings of *Excoecaria agallocha* were used in Chandrapadi, Paghayar and Keelavanjore villages for mangrove bioshield plantation and restoration.

301.3 Saving endangered plant species

Two RET species were selected for *in vitro* micropropagation and good response was observed in *Syzygium chavaran* with callus induction from leaf disc; it was sub cultured for rapid callus multiplication. Callus and embryogenesis was observed in *Kunstleria keralensis.* Protocols for both RET species are being developed.

301.4 Lichen diversity and distribution pattern in the Madukkarai region of the Western Ghats and correlation with the disturbance regime

The ecological studies on the impact of cement dust on lichen diversity and distribution in Madukkarai-Walayar region, Western Ghats, was completed with a total of 81 lichen species reported from 59 macroplots (59,000 m^2 area) established within the Walayar valley Reserve Forest region in Kerala and TN. The relationship between the environmental variables including pollution and lichen diversity were inter-linked using Non-metric Multidimensional Scaling (NMDS) as it is an effective ordination method and assesses the relationship in community ecological data sets, which have non-normal distribution. The NMDS ordination represented 85 % of variation in the data set, with 74 % loaded on axis 1 and 7 % on axis 2 and the remaining in axis 3, indicating that factors such as pollution load, proximity to the factory and number of trees in a particular site are the major gradients in delimiting the lichen diversity of the Madukkarai-Walayar region.

PIXE analysis on lichen samples from the study sites (polluted and unpolluted) were irradiated using 1.7 MV Tandem accelerator with Proton beam of 2000 KeV and the ion induced X-rays were detected by Si(Li) semiconductor detector. The morphological analysis and localization of elements of these lichen samples were also carried out using SEM-EDX microanalysis as supporting evidence. PIXE spectral elemental output revealed the presence of elements such as As, Ba, Br, Ca, Cu, Fe, K, Mn, Zn, Cl, Ti, Cr and Pd with the incidence of increased calcium levels of up to 99.75 % (percentage by weight) 25.8 ppm in the lichen *Bacidia beckhausii* Körber collected from the polluted areas and a 9.8 ppm calcium concentration in unpolluted areas. Samples of Physcia tribacoides Nyl. exhibited 16.8 ppm of calcium concentration in polluted sites and 13.1 ppm in unpolluted areas. IAEA 336 lichen reference material was used for error calibration. This study confirms the prevalence of calcium rich dust (even though invisible as captured by lichens) in the polluted sites. The study also proved that *Bacidia beckhausii* Körber is able to accumulate and tolerate higher levels of calcium in its thalli whereas *Dirinaria consimilis, Heterodermia dissecta, Heterodermia speciosa, Parmotrema planatilobata, Parmotrema tinctorum*, *Physcia tribacoides, Pyxine cocoes* accumulated lesser levels of pollution (as observed through PIXE) and still showed thallus degradation (as observed through SEM, colony number and cover value). Hence these lichens can be used to indicate cement dust pollution at levels which are not perceivable through ocular surveys and

other conventional pollution detection methodologies such as air sampling.

Sub Proghramme Area 302

Molecular Mapping

302.1 Construction of a flower-specific cDNA library in dioecious *Pandanus fascicularis* L. (Pandanaceae)

Pandanus fascicularis (Kewra) (syn. *P. odorattisimus*) also referred to as screw pine because of the leaf scars on its trunk, is distributed mainly in sub-tropical and tropical regions with significant presence in mangrove swamps. It is a dioecious plant having unisexual male and female flowers arising from separate individuals. While the female flowers are pineapple-like without any fragrance, the male flowers are highly fragrant and are exclusively used to isolate an economically important perfumed oil (*Kewra* oil). Lack of morphological descriptors makes distinguishing of the male and female plants virtually impossible until they reach sexual maturity, which takes 6-7 years.

As reported last year, using DNA markers like RAPD and unanchored ISSRs, we had reported a sex specific SCAR marker. Further analysis with 30 different accessions of *P. fascicularis*, showed consistent amplification in all male plants but not in the female genotypes. Southern hybridization was performed on genomic DNA isolated from male and female plants, digested separately with EcoR I and Hind III and probed with ^{32}P-labeled sex specific fragment. The female DNA did not show any hybridization signal/band in either EcoRI or Hind III digested genomic DNA. The DNA from male plant however revealed an approximately 6 kb fragment for Hind III and a 23 kb fragment for EcoR I. This confirmed that the 1,263 bp segment of DNA was conspicuous only in the males and absent in the genome of the female plants.

In an effort to identify flowering as well as putative sex-specific genes, a cDNA library was constructed by isolating good quality, high concentration total RNA from a fresh flower using a modified LiCl method followed by 1st and 2nd strand cDNA synthesis, proteinase K treatment, Sfi digestion, size fractionation, ligation and transformation using the cDNA library construction kit. When the transformation mixture was plated on LB agar medium containing chloremphenicol as antibiotic, approximately 75,000 – 80,000 clones were obtained, which proved that the library was well represented. Colony PCR was performed to check the size of the inserts and plasmids isolated from individual clones (with insert size greater than 750 bp) were sequenced by an automated sequencer. A total of 979 flower-specific ESTs were thus obtained. CAP3 analysis performed on the above data set grouped them into 82 contigs (549 ESTs) and 430 singlets. Approximately 512 unigenes were identified. Important genes like Dehydrin, metallothionein, LEA, GST, Serine protease inhibitor, ATPases, chaperons, transcription factors, Zinc finger proteins, cellular transport proteins, ribosomal proteins, proteins involved in carbohydrate metabolism, lipid metabolism,

proteolysis etc. have been isolated from the library. In addition to these, several putative sex-specific genes like pollen specific protein, Arabinogalactan, MADS-box transcription factor, LIM transcription factor, profilin, etc., were also isolated. Thus snapshots of the genes involved in the flowering of this economically viable plant were identified from this study. Expression studies (Northern) and Southern hybridizations are currently being performed to identify putative sex-specific genes in this plant.

302.2 Molecular profiling of *Cajanus* species

Pigeonpea (*Cajanus cajan* (L.) Millspaugh) belongs to the sub-tribe Cajaninae of the agriculturally most important tribe Phaseoleae under sub-family Papilionoideae of the family Leguminosae. Among the many edible members of tribe Phaseoleae (*Phaseolus, Vigna, Cajanus*, Lablab etc.), *Cajanus cajan* is the only domesticated species under Cajaninae. There are 32 species of the genus *Cajanus,* of which 18 species are distributed in India, which has been established as the centre of origin of *Cajanus*. Very little documentation has been done on the landraces being cultivated in the Eastern Ghats region of India, especially in the tribal regions, where this legume is being grown by tribal communities. A study has therefore been initiated to collect and examine the nature and extent of diversity among the traditional landraces of *Cajanus* species in this region.

177 seed samples of the local land races of *Cajanus* species were collected from tribal areas in five districts of South Orissa *viz.* Koraput, Rayagada, Malkangiri, Nabarangpur and Kalahandi, which are part of the Eastern Ghats. Nuclear DNA was isolated from 50 plants using a modified CTAB isolation protocol. Assessment of the isolated DNA samples was carried out using molecular markers. Random primer marker systems like RAPD, SSR and ISSRs were used for marker analysis and from the data analysed, 30 % polymorphism was observed among the samples, which can be attributed to the difference in seed coat color observed in the samples. Phylogenetic analysis of the marker analysis data was done and the dendrogram provided a preliminary picture of the genetic relatedness or variation among the samples. Bulk segregant analysis of the seed samples is also being carried out based on the seed coat color of the samples. As a result, 18 different types of seeds were observed, based on their coat color. This will provide a picture of the intra and inter level genetic relatedness or variation among the collected samples. Phenotypic characters of the samples planted are being documented which will later be useful in tagging characters to the polymorphism observed. AFLP analysis of the DNA isolated from all the samples are being carried out, which will add to the assessment of genetic diversity among the landraces of *Cajanus* species.

Another batch of DNA isolation from the samples with more markers is underway to obtain a comprehensive picture of the genetic diversity among the landraces grown in these

tribal regions. Analysis of *Cajanus* samples from other parts of the Eastern Ghats, viz. TN (Kolli Hills) and AP (Vishakapatnam and adjoining areas) will give an idea of the genetic diversity of *Cajanus* species in the entire Eastern Ghats, and the possible origin and distribution of the landraces.

Sub Programme Area 303

Genetic Enhancement

303.1 Introgression of transgenes *Am SOD* and *Ferritin* into local varieties of *Indica* rice

From the population of 200 fourth generation back cross (BC4F1) plants in each variety (ADT43, White Ponni, IR 20 and IR 64), the positive plants (50 %), which possess the transgene, were identified initially by PCR analysis and tagged. These positive plants were screened for recovery of the respective parental character phenotypically, especially floral characters such as days to 50 % flowering and floret size, and a single plant with the highest recovery of parental characters was identified for each variety. The presence of the transgene in the selected plants was confirmed through southern blot experiment in the case of *Ferritin* and through isozyme in the case of *AmSOD.* This plant in each variety was selected as the female parent, backcross five was done and BC5F1 seeds were obtained. The BC5F1 seeds were raised during October 2007 and planted and screened for the presence of transgene through PCR (Foreground selection). The transgene positive plants (50 %) were tagged and a single plant with a high recovery of respective recurrent parent was identified and selfed. The BC5F2 seeds were obtained and 30 such plants were raised in February 2008 and are being analysed for the foreground selection of the transgenes.

303.2 Biofortification

Transformation of Ferritin gene into local indica rice cultiver

Transformation events of ferritin gene in rice were in Basmati and was reported earlier. Transformation of binary vector pFer1 (which contains the ferritin gene cloned at the *Bam*H1 and *Kpn*1 site under the control of endosperm specific promoter GluB-1) into indica rice cultivar (IR20, ADT 45) using the *Agrobacterium* mediated transformation method has been initiated.

AmFer ORF was amplified from Amfer plasmid with GFP-ferritin forward primer which contains a KpnI site and GFP-Fer Reverse primer which contains a *Hind* III site thus avoiding the stop codon and introducing Kpn I site at 5' end and *Hind* III site at 3' end. GFP ORF was amplified using GFP forward and GFP Reverse and cloned in pBSSK in *Bam*HI and *Hind*III sites and the resulting plasmid was named pBSSK-GFP. AmFer cloned in T/A vector was then digested with *KpnI* and *Hind*III and cloned into pBSSK-GFP. The resulting plasmid contains GFP ORF fused at the C terminal end of Amfer ORF. The cloning of Amfer-GFP fused product with *KpnI* and *SacI* site into pCAMBIA1301

(digested with KpnI and SacI) under double strength 35S promoter for tobacco transformation is in progress.

Iron regulated metal transporters are membrane proteins involved in iron uptake from the soil through root cells. To increase the iron content in rice grain, another approach is aimed at overexpression of IRT along with Amferritin in a gene pyramiding approach in transgenic rice. Based on high sequence similarity between Porteresia coarcata and Oryza sativa, a partial genomic clone of PcIRT was isolated using primers designed with rice IRT sequence information. To isolate the full length gene and its promoter, various genome walking approach was followed which resulted in completion of 3' end of the gene and additional 248 bp sequence information at 5' end.

303.3 Characterisation of Dehydrin gene from *Avicennia marina*

As reported last year, *AmDHN1a*, a cDNA coding for a dehydrin, was isolated from the *A. marina* library through sequencing. The open reading frame of *AmDHN1a* was PCR amplified using PC57 REV1 and PC57 FWD2 primers and cloned in a T/A vector. After confirming the integrity of the reading frame, this clone was digested with *Kpn*I/ *Xho*I and cloned into the same sites in *pET32a* (*pET32a-AmDHN1a*). This construct was transformed into the expression host *E. coli* BL21(DE3). Cultures of *E. coli* cells carrying pET32a-*AmDHN1a* and vector controls were grown at 37°C in LB medium containing 100Mg/ml ampicillin to an O.D. of A_{600} = 0.5 and induced with 1mM IPTG for three hours. The cell pellets were resuspended in a binding buffer, sonicated and the supernatant used for Ni-NTA chromatography. The purified protein was dialyzed and used for phosphorylation assays with Casein kinase II (CKII). The purified dehydrin protein was phosphorylated by CKII, as evidenced by an upward shift during SDS-PAGE. This phosphorylation was detectable using anti-phosphoserine antibodies and was reversed by Shrimp Alkaline Phosphatase (SAP) treatment. However, precise identification of the amino acid residues undergoing phosphorylation needs further analysis.

The *AmDHN1a* cDNA (cloned in pSPORT) was digested with *Pst* I / *Hind* III and cloned in pBSSK II (*pBS-AmDHN1a*). This construct was digested with *Bam* HI and cloned in the binary vector pCAMBIA1300 (*pCAM-AmDHN1a*). This construct was mobilized in *Agrobacterium* LBA4404 and used for transforming rice (*Oryza sativa* cv Pusa Basmati). After three rounds of selection on hygromycin (50 Mg/ml) five independent regenerated lines (shoots) were obtained. These were transferred to rooting medium with hygromycin and regenerated plantlets were obtained. The plantlets were hardened in Yoshida medium for two weeks and then transferred to the field for seed multiplication. PCR analysis of the five lines confirmed the presence of the AmDHN1a gene. Copy number, and further analyses are under way.

Isolation of the AmDHN1a promoter has been reported previously. The promoter fragment

was re-amplified from *A. marina* genomic DNA using primers with introduced restriction enzyme (*Pst* I and *Sal* I) sites. This fragment was cloned in T/A vector, digested with *Pst* I and *Sal* I and cloned in the binary vector pCAMBIA 1391z with GUS as the reporter gene. The construct was mobilized into *Agrobacterium* LBA4404 and will be used for transformation into tobacco for further analyses.

To monitor the expression levels of the promoter, dehydrin promoter was isolated by TAIL-PCR method followed by cloning in T/A vector. The promoter sequence was sub cloned in pCAMBIA 1391Z. In this construct the dehydrin promoter drives the expression of the GUS reporter gene. This construct was then mobilized into *Agrobacterium tumefaciens* strain LBA 4404 by freeze thaw method. Future work will concentrate on transformation into tobacco and performance of the promoter under abiotic stress.

303.4 Co-expression of Active Oxygen Species (AOS) scavenging genes in rice and evaluation for increased salinity tolerance

Using *Agrobacterium* mediated transformation of pCAM *Am*-APX + *Am*-MDAR in rice, two lines regenerated under hygromycin selection. PCR analysis for *Am*-APX and *Am*-MDAR revealed that line DC1 was positive for both genes, the 1.1 kb and 1.9 kb fragment specific to *Am*-APX and *Am*-MDAR respectively but in DC2 only MDAR was amplified, not APX. This might be due to partial removal of T-DNA during infection. Genomic DNA was isolated from DC1, DC2 and untransformed control and digested with *Sac* I (linearises the T-DNA) to determine the copy number of integration of *Am*-APX and *Am*-MDAR in the rice genome. Total RNA was isolated from DC1, DC2 and untransformed control plants. Two separate blots were made to hybridize with the two separate UTR probes viz *Am*-APX and *Am*-MDAR. The results revealed that in DC1, both *Am*-APX and *Am*-MDAR were expressed whereas in DC2 only *Am*- MDAR was expressed and no signal was detected for *Am*-APX. Total protein was isolated from DC1 and untransformed control plants and separated on 12 % SDS-PAGE and transferred to Nitro cellulose membrane (Hybond C Extra). *Am*-APX polyclonal antibody was used at 1:500 dilution and secondary antibody was used at a dilution of 1:2000. The results revealed that in DC1 27 kDa protein specific for *Am*-APX was expressed highly and that protein was absent in untransformed control plants.

Twenty-four seeds (T_0 generation) were sown from the DC_1 lines. DNA was isolated from all the lines and PCR analysis revealed that among the 24 lines, 18 lines were positive for both APX and MDAR. The results revealed that the segregation of DC_1 in T_1 generation was in 3:1 Mendelian ratio.

The *Am*-APX promoter (1.6 kb) was cloned in binary vector pCAM1391Z at *Eco*RI and *Hind* III site and the construct was mobilized into *Agrobacterium tumefaciens* strain LBA4404 and was used to transform *Nicotiana tabacum* cv. Petit Havana by the leaf disc

method. Preliminary selection of transformed plants was done using GUS staining. Out of twelve plants regenerated with Am-APX promoter construct, five transformed plants were GUS positive. Genomic DNA was isolated from the five GUS positive lines and was digested with *Eco* RI to determine the copy number of integration of Am-APX promoter in the tobacco genome. Full-length promoter was used as probe. The results revealed that three lines are single copy events whereas two lines have 2 copies.

Genomic clone of *Am-pAPX1* is 3,942 bp in length (Accession No. EU025130), 2,799 bp longer than the *Am-pAPX1* cDNA. Alignment of *Am-pAPX1* (cDNA) with its genomic clone revealed the presence of eight introns. The size of the introns varied from 83-740 bp while the size of the exon varied from 41-16 bp. The genomic clone of *Am-MDAR* is 6,058 bp in length, which is 4663 bp longer than the *Am-MDAR* cDNA. Alignment of Am-MDAR (cDNA) with its genomic clone revealed the presence of fourteen introns. The size of the introns varied between 82 and 711 bp while the size of the exon varied between 41 and 514 bp. Genomic DNA (15 mg) was digested with restriction enzymes namely *EcoRI*, *XbaI* and *EcoRV* for APX and hybridized with APX probe and for MDAR it was digested with *BamHI*, *EcoRI*, and *HindIII* and hybridized with MDAR probe. The results revealed that there are two copies of APX gene and five copies of MDAR gene or its isoform in the *A. marina* genome.

Fusion of GFP with Am-APX in N terminus region was selected as it has a peroxisomal targeting signal in the C terminus. For MDAR, GFP was fused at the C terminus as the MDAR has the chloroplast targeting peptide in the N terminus and confocal imaging revealed that AmAPX is targeted at peroxisomes whereas Am-MDAR targets chloroplast.

303.5 Tissue Specific Expression of the PR244 Promoter and transformation of PR244 into Rice

PR244, a salt inducible gene from the mangrove *A. marina,* is homologous to *rci2a* and *rci2b* from *Arabidopsis.* The isolation of the 5^1 upstream region of PR244 and its cloning in pCAMBIA 1391Z have been reported previously. This construct was transformed into *Arabidopsis thaliana* (Columbia Ecotype) via the *Agrobacterium* mediated vaccum Infiltration/Floral Dip method. Seeds were harvested and plated on 2 % MS with varying concentrations of hygromycin 5-20 mg/ml (selectable marker). A hygromycin concentration of 15 mg/ml was found to be optimal for selection of the transformants. The selected seeds were subsequently transferred to pots containing a 1:3 ratio of vermiculite and biopeat. Seedlings are currently growing and further analysis will be initiated when the plants are fully-grown.

The PR244 promoter was transcriptionally fused with the PR244-GFP fusion and cloned in the binary vector pCAMBIA 1300. This construct was transformed into tobacco via *Agrobacterium* mediated transformation by the leaf disc method. After three rounds of selection on hygromycin (25 mg/ml), the

regenerated shoots were allowed to root in 2 % MS (with hygromycin). Tissue specific expression of the PR244-GFP construct is being studied.

For transformation of c-*myc* tagged PR244 into rice, *Indica* variety Pusa Basmati was used. 12-day old scutellum-derived embryogenic calli [raised on MS medium containing 2,4 D (2 mg/ml)] were co-cultivated with *Agrobacterium* carrying the plasmid pMYC-PR244. Regeneration of putative transgenic rice is under way.

303.6 Characterisation of MYB and NAC transcription factors from salt tolerant mangrove plant *A. marina*

Expression of AmMYB1 cDNA in *E coli* was done to study the expression level of AmMYB1 protein. The open reading frame of AmMYB was amplified from the cDNA library of stressed *A. marina* library. The amplified product was cloned in the *E coli* expression vector (pET32a, Novagen) under the control of IPTG inducible T7 *lac* promoter and transformed into *E coli* BL21 (DE3) cells. Adding 1mM IPTG to *E. coli* culture induced protein expression of *Am*MYB1. The cells were harvested at different time points after IPTG induction. There was a clear induction of MYB protein visible at 1, 2.5 hours after IPTG induction. Purification of AmMYB1 protein was done using nickel-nitrilotriacetic acid (Ni-NTA) affinity column. Electrophoretic Mobility Shift Assay (EMSA) is under way to study the DNA binding property of that protein.

To understand the contribution of NaCl in abiotic stress tolerance in plants, the representation of *Am*NAC1 was studied in the cDNA library, prepared using salt-stressed *A. marina,* as the sequence characteristics were more similar to biotic stress related NAC proteins reported in other plants. *Am*NAC1 transcript expression patterns were analyzed from plants that were grown in tolerable (250 mM) and stressful (500 mM) concentrations of NaCl using RNA-blot experiments. Total RNA was prepared from two different treatments at various time points. Results of Northern analysis using RNA prepared from 500 mM NaCl treated plants showed that *Am*NAC1 transcript expression was up regulated in treated plants from 6 hours to 48 hours after stress and was not detected after 12 and 24 hours of recovery from salt treatment. However, *Am*NAC1 transcript was significantly up regulated only after 48 hours of 250 mM NaCl treatment. Interestingly, *Am*NAC1 transcript level was highest after 10 days in spite of the plants recovering from initial stress symptoms morphologically, suggesting a positive role for the same in maintaining normal growth of the plant for longer durations in the presence of NaCl.

Whether *Am*NAC1 is inducible by ABA, was also investigated as many water stress inducible genes are up regulated by the exogenous addition of ABA and the level of endogenous ABA also increases under salt stress condition. As reported in *Arabidopsis thaliana* for RD26, a NAC protein, *Am*NAC1 transcript expression was up regulated by ABA treatment. Transcript level for *Am*NAC1 was high after 12 hrs of treatment and the transcript expression pattern was similar to 500 mM NaCl

treatment. Investigations on endogenous ABA levels at 250 and 500 mM NaCl are currently being carried out to understand the dependence of *Am*NAC1 expression on ABA signalling. Thus, the results from the present study indicate the involvement of *Am*NAC1 in salt stress tolerance in *A. marina* and the mediation of early stress response by ABA. Future studies will concentrate on the DNA binding property of transcription factors using different DNA core sequence elements that respond to abiotic stress and assessment of *Am*MYB1 transcription factor, using model plant systems.

303.7 Characterisation of Pj 507, from *Prosopis juliflora* for drought tolerance

Pj 507 was selected for further characterisation because six copies of this clone were found in the *P. juliflora* library indicating a possible role in stress tolerance. This cDNA was completey sequenced and analysed in *silico.* An 820 base pair putative promoter fragment was isolated for this gene using TAIL PCR. *Pj* 507 ORF is being cloned in fusion with GFP for the purpose of cellular localisation of the protein. *Pj* 507 cDNA is cloned in pCAMBIA 1301 under the control of 35S promoter and would be transformed into tobacco for functional characterisation. *Pj* 507 ORF is being cloned into pET 28a vector to study the over expression of the protein in a bacterial system.

For intracellular localization of *Pj* GST1 protein, *Pj* GST1 ORF was fused with GFP ORF at the N-terminal with 10 alanine codons as a linker. The fused product was cloned into pCAMBIA 1,301 under the control of 35S promoter. *Nicotiana tabaccum* was transformed with the recombinant vector using *Agrobacterium* transformation method. Transgenic tobacco plants with a strong GUS expression were screened for GFP florescence using a confocal microscope. The experiment revealed the localisation of the green fluorescence in the chloroplasts. The chloroplastic localisation of *Pj* GST1 was confirmed by co-visualising chlorophyll autofluorescence.

Pj GST1 was transformed into Indica rice variety ADT 43 using the biolistic method. PCR positive plants were analysed in the T1 and T2 generation. The putative transgenic lines showed better growth under salt and cadmium stress *in vitro* compared to control un-transformed plants. The performance of whole plants under drought stress was analysed by following three cycles of a watering regime of – 'one day watering – four days no watering'. The putative transgenic lines showed better survival under this stress compared to control un-transformed plants.

303.8 Characterisation of different types of metallothionein and transformation of type II metallothionein from *P. juliflora* into tobacco for heavy metal accumulation

Heavy metal pollution of agricultural soils is one of the most severe ecological problems in the world. Toxic levels of metals can occur in some natural soils as a result of mining, smelting, manufacturing, and agricultural or waste disposal technologies. Metallothioneins (MTs) are small cysteine rich proteins that range in

size from 4 to 8 kDa and bind various phytotoxic heavy metals such as copper, cadmium, zinc and nickel. Three types of metallothioneins from *Prosopis juliflora* have been identified and characterised.

To examine the metal binding ability, ORFs of the three PjMTs were cloned in translational fusion with GST in pGEX4T1 expression vector and transformed into *E. coli* cells. *E.coli* cells expressing the fusion protein or GST were grown in the presence of non-toxic concentrations of cadmium and zinc (0.3 mM each). Metals bound by fusion proteins or GST were examined by Flame-AAS after purification, using Glutathione Sepharose 4B column. All three GSTMT fusion proteins showed a higher ability to bind cadmium as compared to zinc.

To determine the effect of heavy metals on the expression of *PjMT*s, leaves from one month old *P. juliflora* seedlings exposed to heavy metals like cadmium, copper and zinc for 0, 24, 48 and 72 hrs were harvested. About 10 mg of total RNA (per sample) from the leaves was isolated and electrophoresed in a 1.3 % formaldehyde-agarose gel, transferred to nylon membrane (Hybond N+, GE Biosciences) and the blot probed with ^{32}P-dCTP labeled *PjMT1*, *PjMT2* or *PjMT3* (32^{1}UTR). *PjMT1* was induced significantly with copper, H_2O_2 and ABA treatments, with no significant up-regulation under cadmium and zinc stress. *PjMT2* expression was unchanged with both cadmium and copper stress treatments. However, *PjMT2* expression was up regulated with $ZnSO_4$, H_2O_2 and ABA treatments. *PjMT3* transcript increased apparently under all heavy metal stress treatments up to 72 hrs.

5^{1} upstream regions or promoters of *PjMT* genes were isolated using TAIL-PCR and the presence of *cis*-acting elements analysed using PLACE. All three-promoter sequences showed the presence of TATA, CAAT, GATA boxes, ABRE-like elements, MYC- and MYB factor binding proteins. In the 5^{1} upstream region of *PjMT1*, a copper responsive element (CuRE) was present. In addition, elements involved in ethylene response (ERE), stress (STRE) and organ-specific expression (OSE) were also present in one or more of the isolated 5^{1} upstream regions of the *PjMT*s.

PjMT2 was cloned in pCAMBIA in translational fusion with GFP at the C-terminus and transformed into tobacco using *Agrobacterium* mediated transformation. Confocal microscopy of tobacco plants expressing PjMT2: mGFP 6 fusion protein showed that PjMT2 co-localized in the cytoplasm and nucleus. Future work will focus on the transformation of PjMT2 into *Brassica juncea*, a hyperaccumulator plant for efficient phytoremediation.

303.9 Isolation of PcHKT cDNA

Salinity tolerance in many plants is inversely related to the extent of Na+ accumulation in the shoot, notably in major cereals such as wheat and rice. In *Arabidopsis* rice and wheat there is evidence indicating a central role for members of the HKT gene family, (more specifically the HKT 1, 5 subtype) of Na+ and Na+/K+ transporters in controlling Na+

accumulation and, thus, in determining salinity tolerance. *Porteresia coarctata* is a salinity tolerant wild relative of rice and would therefore be a good source material to analyse for HKT genes. mRNA sequences of rice, *Triticum monococcum* and *Triticum aestivum* (HKT 1, 5) were aligned using CLUSTALW. This alignment was compared with their respective genomic sequences and the putative exon-intron junctions were identified. Primers were designed based on conserved sequences in Exon 1 and a 575 bp fragment from *P. coarctata* genomic DNA. To obtain the 3' sequence information of PcHKT, TAIL PCR methodology was adopted and a 650 bp fragment was amplified from *P. coarctata* genomic DNA that was found to contain part of Exon 3 and the 3' UTR. *Sau3A1* adapter ligated *P. coarctata* DNA was used to obtain the 5' sequence information of *PcHKT* and a 404 bp fragment was obtained that had a 99 bp overlap with the previously amplified DNA. Thus the full genomic clone for PcHKT was obtained and was found to be 3194 bp in length. Based on the sequence information primers were designed to clone the PcHKT cDNA. *P. coarctata* tillers with intact roots were subjected to 0.25 M NaCl for 12 and 24 h. Leaves and roots were used for total RNA isolation and subsequent mRNA purification. Full sequence information for *PcHKT* cDNA was assembled in two overlapping fragments of sizes 0.75 Kb and 1.05 Kb.

As reported in the previous year's report, the PcNHX gene has been characterised and cloned, and is being transformed into Indica rice variety Pusa Basmati using *Agrobacterium* transformation method. Many transformation events were performed which are in various stages of selection.

303.10 Understanding salinity tolerance mechanisms in *Sesuvium portulacastrum* L. - a Mangrove associated halophyte

Salinity tolerance in plants is a very complex trait, and is the handiwork of evolution in halophytes that have 'learned' to grow well in the presence of salt or sodium chloride in the soil. *Sesuvium portulacastrum* (Vangaravasi in Tamil), a mangrove-associated halophyte has recently gained the attention of plant biologists for its adaptability to water-deficit stresses like salinity and drought. *S. portulacastrum* is able to complete its life cycle, that is, from the emergence of a plant from the seed to setting seeds, in the presence of high concentrations of sodium chloride in the soil. A systems approach towards understanding salinity tolerance in *S. portulacastrum* was undertaken, which included information from experimental results obtained using physiological, biochemical and molecular studies.

The systems model was suggestive of a probable link between changes in photosynthesis and pigmentation as a response to sodium chloride in the medium of plant growth. As genes that were uniquely expressed during sodium chloride treatment of the plants were also highly represented by those related to photosynthesis, inference could be made that light also might have a role to play in influencing the response

mechanisms. Moreover, it was also observed from our experiments that the possibility of a 'photosynthetic shift' cannot be ruled out. That is, *S. portulacastrum* might take a decision of switching over from a less water-use-efficient photosynthetic pathway called 'C3' to that of a better water-use-efficient pathway called 'CAM' or its variants, based on the presence or absence of salt in the soil. It would be interesting to carry out additional studies that result in solving the missing links in our approach.

303.11 Gene mining from lichen species

The growth of lichens in extreme environments, their vibrant defense mechanism in the form of secondary compounds for biotic and abiotic stresses and their ability to live in symbiotic state with algae and cyanobacteria, exhibit the distinctiveness of their genetic make up. Hence, screening of lichen genome is considered a potential source to provide novel genetic material to combat abiotic and biotic stress in agriculture, human health and environment. Hence the lichen gene-mining program aims at germplasm characterisation of lichen species *Dirinaria applanata, Pyxine cocoes, Physcia tribacoides* and *Roccella montagnei*. Prior to germplasm characterisation, axenic fungal and whole thallus cultures of selected species were established.

cDNA library has been constructed from the lichen species *R. montagnei* and large scale sequencing of ESTs are under way. For the cDNA library, total RNA has been isolated using *Zostera marina* L. protocol. Single stranded cDNA was constructed using the protocol of Creator smart cDNA construction kit, which was subsequently used for synthesizing the double stranded cDNA through LD-PCR. Double stranded cDNA was treated with proteinase K digestion and the cDNA size fractionated and the fractionated cDNA was subsequently cloned into a T/A vector and transformed into plasmid pDNR. 1,000 clones were randomly screened for large-scale EST sequencing. 600 clones have been screened and the clones showing the presence of gene size above 500 bp were selected for sequencing. The plasmids were sequenced using pDNR_2FWD primer and 400 ESTs sequences have been obtained.

The expressed genes having good e-value from the NCBI BLAST showed homology to Catechol dioxyge (1,2-HQD; Hydroxyquinol 1,2-dioxygenase) which catalyses the ring cleavage of hydroxyquinol (1,2,4-trihydroxybenzene), an intermediate in the degradation of a large variety of aromatic compounds including some polychloro- and nitroaromatic pollutants, to form 3-h. From the ESTs sequenced we have genes such as LEA domain protein, CRAL/TRIO domain protein, NRRL 1 TOM complex.

Internally Transcribed Spacer (ITS) region of the nuclear ribosomal DNA has been characterised and sequenced to establish the species identity of cultured lichen thalli with the natural thalli. ITS rDNA based fungal specific PCR in *P. cocoes* natural thallus and cultured thallus has been completed and the sequence information will be validated and submitted to the NCBI nucleotide Genebank database.

Lichens are well known for their synthesis of unique secondary metabolites including polyketides such as Depsides, Depsidones, Depsones, Dibenzofurans, and Chromones. Polyketides are organic molecules that are formed from small carbon precursor acid molecules whose condensation is catalysed by a cluster of enzymes called Polyketide Synthases (PKS). The available information on characterised PKS genes from lichens is very scarce on cloning, and functional and expression analysis of genes. The understanding of the expression patterns of these genes will help in providing the correct physiological, environmental and nutritional conditions for scaling up of polyketides in lichen cultures.

750 bp Ketosynthase domain of PKS gene was characterised from natural and culture thallus of *Dirinaria applanata, Roccella montagnei, R. belangeriana, Ramalina pollinaria,* and *Usnea complanata* through PCR based methods (primers-LC1 and LC2C). Genome walking by domain–hopping approach from the ketosynthase domain towards both the C-terminal as well as the N- terminal end of the pks gene of *D. applanata* and a 4,863bp of pks gene (DNpks) has been characterised and codes for other domains such as Acyltransferase and upstream of acyltransferase and downstream of ketosynthase domain. The Phylogenetic tree constructed from this gene separated nonreducing and reducing pks. DNpks were claded with other nonreducing pks at a bootstrap value of 99. The analyses also intercladed DNpks gene with *X.* semiviridis pks1 (Xsepks1), which belongs to nonreducing clade III, indicating that DNpks belongs to nonreducing clade III. The active sites of KS and AT domains of DNpks were found to be well conserved in *D. applanata*.

The conditions at which PKS genes have been regulated are not yet clearly understood, but many biotic and abiotic stresses are known to upregulate the production of secondary metabolites. Hence expression studies of PKS genes from the RNA isolated from culture samples grown under different stress conditions were studied by analysing mRNA transcript accumulation. In this study, the osmotic conditions with sucrose were found to either down-regulate DNpks or cause no alteration in mRNA levels. Rather than osmotic stress, DNpks was more responsive to UV radiation, showing a constitutive upregulation; an equal response of DNpks was also observed for neutral pH.

303.12 Identification of genes that are uniquely regulated during oil biosynthesis in *Jatropha curcas* seeds

Fossil fuel resources are reaching their finite limits and a sharp increase in oil prices all over the world has resulted in an unprecedented impetus for research on alternative sources of fuel, especially from plants. Many plants have the property of accumulating oil in their seeds. *Jatropha curcas* is one such oil yielding plant that has gained widespread attention in recent times as a source of biodiesel. In addition to many factors that influence seed oil yield, the regulation of the genes that control the

expression of proteins that bring about oil accumulation in seeds is a very basic factor that differentiates a high oil yielding plant from others.

To identify the genes that control active oil accumulation, *J. curcas* seeds were grouped into four maturation stages as follows: early maturation stage, mid maturation stage, late maturation stage and full maturation stage. Since protein expression is more active when the oil accumulation is still progressing, mid and late maturation stage seeds were used for identification of the genes. The experimental design essentially involved 'subtraction' of the genes that are common to the stages mentioned, so that genetic information pertaining only to the late stage of oil biosynthetic pathway would be left as 'unique', for further analyses. In this regard, a cDNA subtraction library consisting of 'unique' information that relates to genes involved in seed oil biosynthesis in *J. curcas* was constructed last year. To identify and characterise the unique information, annotation of the same was performed through sequencing of a small portion of the 'expressed' genetic information called Expressed Sequence Tag (EST). Information annotation of about 300 ESTs has been performed till date, of which a few show identities to genes that have already been reported to be involved in the regulation of oil biosynthesis in other plants.

Standardisation of tissue culture methodologies for transforming *J. curcas* plants through gene transfer has been initiated using emerging cotyledons as starting plant material. Tissue culture methodology development will aid in transferring genes controlling active oil accumulation into *J. curcas* to obtain high and uniform oil yield.

Sub Programme Area 304

Bioprospecting

304.1 Bioprospecting and Culture of Lichen Species

This programme aims at screening and characterising potential anti-microbial secondary compounds of lichen species (symbiotic fungi with algae or cyanobacteria for nutritional requirements) *viz*. *R. montagnei, P. praesorediosum, D. applanata, R. pollinaria, U. complanat*a and *T. eluteriae*. The secondary compounds of these lichen species were extracted in organic solvent gradients and screened for their antimicrobial properties against human bacterial and fungal pathogens. The chemical characterisation of the compounds, which exhibited antimicrobial properties, was carried out in collaboration with the Organic Chemistry Laboratory and Sophisticated Analytical Instrumentation Facility (SAIF), Indian Institute of Technology, Chennai. Qualitative and quantitative extraction of lichen secondary metabolites and subsequent antimicrobial screening provided the basis for the identification of two novel compounds from natural thallus *R. montagnei* and *P. praesorediosu*m and one compound from cultured thallus *T. eluteriae*.

The characterisation of lichen compounds in *D. applanata* using Thin Layer Chromatography (TLC) resulted in the identification of known compounds such as Atranorin, and divaricatic acid and unknown compoun (Compound 1: Ash-Gray Rf class 4; Compound 2: Orange Rf class 5) and High Performance Liquid Chromatography (HPLC) analysis of methanol extract of cultured *D. applanata* showed two unknown compounds. The thin layer chromatogram showed the presence of Evernic acid in *R. pollinari*a; Salazinic acid and Usnic acid in *U. complanata* and seven unknown compounds in cultured thallus of *T. eluteriae*.

Antibacterial assay

Antibacterial assays were carried out using TLC direct bioautographic overlay assay and disc diffusion assays against human bacterial pathogens and fungi (*K. pneumonia, P. vulgaris, S. typhi-A, S. paratyphi–B* and *S. aureus* and *C. albicans*). Atranorin, divaricatic acid, Evernic acid, Salazinic acid, Usnic acid and the 1st, 7th and 5th fraction of *T. eluteriae* showed broad spectrum antibacterial activity.

Compound characterisation

The crude acetone extract of cultured thallus of *T. eluteriae* showed antimicrobial activity. The crude extract showed the presence of seven unknown compounds. The fifth major fraction showed broad-spectrum antibacterial activity against human bacterial pathogens such as *E. coli*, *Vibrio cholera*, *Salmonella paratyphi A*, *S. paratyphi* B and *Proteus vulgaris,* and was crystallised and subjected to XRD crystallographic analyses. The crystals were identified as 6-hydroxy-7-methoxy-2, 3, 3, 9-tetramethyl-2,3-dihydronaptho [1,2-*b*]furan-4,5-dione. The compound was found to be novel through a blast search against Scifinder Scholar facility and Cambridge Structural Database and the crystal structure has been submitted to the Cambridge Crystallographic Data Centre (CCDC- 677670).

Crude hexane extract of *D. applanata* exhibited antimicrobial activity and was subjected to further fractionation and subsequent bioassays. Of the five fractions, two fractions showed anti-microbial activity against five human bacterial pathogens. Hence these fractions were subjected to further purification and structure elucidation of these fractions is being carried out. Similarly, crude acetone extracts of *R. pollinaria* and *U. complanata* were found to be bioactive, and further purification of the active fractions is under way in these lichens.

Genotoxicity and cytotoxicity testing

As a prerequisite for drug development, the identified potential antimicrobial compounds, 4-carbomethoxy-5-acetyl resorcinol from *R. montagnei* and 3- Formyl-2, 4 – dihydroxy-5, 6-dimethyl –benzoic acid 3-hydroxy-4-methoxycarbonyl-2,5-dimethly-phenyl ester from *P. praesorediosum* were subjected to cytotoxic and genotoxic studies on Swiss Albino mice and Wistar rats in collaboration with the Department of Pharmacology and Environmental Toxicology and Genetics,

PGIBMS, University of Madras. All procedures were conducted in accordance with the guidelines of the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), India.

Genotoxic studies on Swiss albino mice against the bioactive compound 4-carbomethoxy-5-acetyl resorcinol from *R. montagnei* showed negative results, hence pharmacologists strongly recommend further screening of this compound as a potential drug. Genotoxic screening of 4-carbomethoxy-5-acetyl resorcinol at higher doses against Swiss albino mice exhibited a lower mitotic index, indicating that it can be a potential molecule for anticancer therapy. Toxicity testing of 3-Formyl-2, 4 – dihydroxy-5,6-dimethyl–benzoic acid 3-hydroxy-4-methoxycarbonyl-2,5-dimethly-phenyl ester from *P. praesorediosum* showed no significant genetic or cytogenetic damage.

Lichen culture

Lichen culture for secondary compound production is a vital component of the conservation of lichen species in their habitat and sustainable utilisation of these novel resources industrially. The protocols for *in vitro* culture for the production of secondary compounds through lichen whole thallus, fungal and photosynthetic partners for *R. montagnei, P. praesorediosu*m, *D. applanata, R. pollinaria* and *U. complanata* and 21 other lichen species such as *Heterodermia diadimata, H. luecomela, Caloplaca serina, Physcia sp., Pyxine nilgiriensis, Graphina obtecta, T. eluteriae, Pseudopyrenula subvelata, Graphis scripta, Graphis inamoena, Glyphis scyphulifera and Lecanora sp.* were standardised. The whole thallus lichen cultures of selected species produce secondary compounds similar to the natural thallus; additionally, the mycobiont cultures also produced a few unknown compounds.

All the culture species were selected from different geographical locations that are rich in secondary compounds. The culture protocols were standardised for inoculum selection, sterilisation process, media and environmental conditions conducive for the successful establishment, growth, thallus formation and secondary compound production of all the selected species. Culturing in a bioreactor for further upscaling of the secondary metabolites is currently under way.

Sekikaic acid, divaricatic acid, caparitic acid, atranorin, evernic acid, norstictic acid and nine unknown compounds have been isolated from *Glyphis scyphulifera*, *Trypethelium eluteriae, Graphis scripta, Pseudopyrenula subvelata* and *D. applanata* so far. One novel compound from the mycobiont cultures of *Trypethelium eluteriae* has been structurally characterised.

304.2 Bioprospecting from E. agallocha

The pesticidal property of 1 % and 3 % crude hexane formulation of *E. agallocha* was demonstrated in field trials (RBD) in lady's finger, cotton, chick pea and pigeon pea in TN and Uttaranchal areas. Further toxicity studies in animal models are under progress.

304.3 Biochemical and Phytochemical investigations of *Navara* and other Rice landraces

Navara (*Oryza sativa* var. Navara), the medicinal brown rice of Kerala, is traditionally used by Ayurvedic healers for curing rheumatism, skin diseases and as a bio-rejuvenator. Chemical investigations indicated the presence of high amounts of tryptophan and proline. The present investigation was aimed at analysing the phytochemical and biochemical parameters of 13 brown rice landraces, including *Navara*. Due to the demand for *Navara* (black awned type) in the market, contamination of the authentic rice grains with a spurious variety was observed. To identify the spurious variety, a two-step qualitative method was developed for the Navara cultivators, based on a simple TLC analysis performed with 13 landraces.

50 g of powdered rice grains from the 13 varieties of rice was soaked in 100 ml of hexane for 24 hrs at 35°C. This was repeated thrice for optimum extraction. The pooled filtrate was evaporated under vacuum to yield the crude extract. The extraction was continued with ethyl acetate, chloroform and methanol. The crude extracts were air-dried and the yields were calculated. 20 mg of the crude hexane extract was dissolved in 400 *µl* of hexane to obtain a homogenous solution. 10 *µl of* this solution was spotted equidistantly on a TLC plate (SiO_2 230-400 with F- 254, 11 X 10 cm) using capillaries of 0.5 mm bore size and air-dried. The plate was eluted in various solvent systems to identify the best ratio. The plates were observed under UV (254 and 366 nm) for compound spots. Hexane extracts of *Navara* and *Veliyan* showed the presence of an ice-blue chromophore (R_f 0.3) that was absent in the other varieties. Hence, the focus was laid on that particular compound as a probable marker.

Large-scale (5 kg) extraction of *Navara* (black awned type or the 'True' *Navara*), using the same order of solvents yielded crude extracts. Column chromatography of the hexane extract using hexane: ethyl acetate (9.8:0.2 to 6:4 ratios) yielded 5 fractions. Fraction-1, pure oil that was subjected to NMR, FT-IR and Mass spectral analysis suggested the presence of an aromatic ring. Fraction-2, the ice-blue marker closely eluted with the fraction-3 and hence was repeatedly purified in silica (60-120) columns for spectral analysis. Further purification is under progress to decipher the molecular structure.

880 g of *Navara* was cooked with 3 litres of water and cooled to room temperature. 1.5 litres of water was further added and it was macerated in a mixer to a semisolid consistency and partitioned using the same order of solvents. The yields were calculated. Further purification of the hexane extract is under progress for a comparative study. *Navara* brown and yellow (awned and awnless types) varieties, *Mullenchanna, Gandhakashala, Arupathamcheera, Chennellu* and *Veliyan* landraces were analysed for total protein, carbohydrate, reducing sugars, free amino acids and free fatty acids. *Navara* black awnless (black seeds) and *Navara* yellow

awned (polished and unpolished) yielded highest total protein of 0.007 mg/g. *Navara* black awned (pol and unpol). *Navara* yellow awnless (unpol) and *Navara* yellow awned (pol) together with *Chennellu* and *Mullenchanna* yielded 1.2- 1.24 mg/g of carbohydrate. *Navara* black awned (pol) variety yielded 185 mg/g of free fatty acids followed by *Arupathamcheera* (173.9 mg/g). Free amino acids ranged from 30.2 to 9.8 mg/g.

Sub Programme Area 305

Microbial Diversity

Bioprospecting and assessment of functional diversity of microbes have helped in identifying novel beneficial organisms, to be harnessed for INM and IPM. Further details on IPM research is reported in Section SPA 404.

305.1 Bioprospecting for Novel Microorganisms

Plant growth promoting novel Vibrio *spp. from mangrove ecosystem*

The research focused on the microbial diversity analysis of the rhizosphere-associated wild rice (*Porteresea caroctata*) of the Pichavaram mangroves for the isolation of PGPRs, nitrogen fixation and antagonistic activity against phytopathogens (bacterial and fungal pathogens). Primary screening resulted in the isolation of many PGPR bacteria strains, which exhibited antagonistic activity or were able to fix atmospheric nitrogen. These strains were grouped into different genera based on 16S rRNA gene sequencing, which belonged to *Bacillus* (99-100 % sequence similarity), *Serratia* (99-100 % sequence similarity), *Vibrio* (95-98.4 % sequence similarity), *Azospirillum* (99-100 % sequence similarity), *Klebsiella* (99-100 % sequence similarity), *Enterobacter* (95-95.6 % sequence similarity) and *Swaminathania* (99-100 % sequence similarity). The strains which had 2-5 % dissimilarity in 16S rRNA gene were taken up for further detailed taxonomic characterisation using polyphasic approach.

Two facultatively anaerobic, nitrogen-fixing bacteria (MSSRF30^T and MSSRF31) were chosen and determined as nitrogen-fixers using the acetylene-reduction assay and PCR detection of a *nifH* gene amplicon. Phylogenetic analysis based on 16S rRNA gene sequences indicated that these bacteria were most closely related to *Vibrio fluvialis* LMG 7894^T (96·8 % sequence similarity), *Vibrio furnissii* LMG7910^T (96·8 % sequence similarity) and *Vibrio tubiashii* CIP 102760^T (96·7 % sequence similarity), but their similarity was below 97 %. Further multilocus sequence analysis using *recA*, *pyrH*, *rpoA* and *nifH* genes also showed low levels of sequence similarities (83-93 %) with all taxonomically validly published *Vibrio* species. Multigene phylogenetic tree using concatenated sequences of four genes (16S rRNA, *rpoA*, *recA*, and *pyrH*) showed that the strains MSSRF30^T and MSSRF31 occupy a distinct phylogenetic position forming a long branching not clustered to any other known *Vibrio* species. The most abundant fatty acids also depicted that these strains belonged to the genus *Vibrio*. The results of physiological, biochemical characteristics, genomic fingerprinting and DNA-DNA hybridisation analysis clearly differentiated both MSSRF30^T

and MSSRF31 strains from their phylogenetically closest relatives *V. cholerae* IID6019, *V. mimicus* LMG7896^T, *V. fluvialis* LMG 7894^T and *V. furnissii* LMG 7910^T. Several phenotypic traits also differentiated the strain MSSRF30^T from other *Vibrio* species. Based on genotypic, phenotypic, chemotaxonomic, phylogenetic and DNA–DNA hybridisation analysis, the name *Vibrio porteresiae* sp. nov. (type strain MSSRF30^T=LMG 24061^T=DSM 19223^T; DNA G+C contents 44.4±3.1 mol %) is proposed for this novel taxon.

Similarly, red pigmented diazotrophic bacterial strain MSSRF38^T was also characterised. Phylogenetic analyses based on 16S rRNA gene sequences indicated that these bacteria were most closely related to *Vibrio rhizosphaerae* MSSRF3^T (98 % sequence similarity), *Vibrio ruber* JCM 11486^T (98.3 % sequence similarity) and their similarity was below 95 % with all taxonomically validly published *Vibrio* species. Further multilocus sequence analysis using *GyrB*, *GapA*, *recA*, *pyrH*, *rpoA* and *nifH* genes also showed low levels of sequence similarities (83-93 %) with all taxonomically validly published *Vibrio* species. Multigene phylogenetic tree using concatenated sequences of six genes (16S rRNA, *rpoA*, *GyrB*, *GapA*, *recA*, and *pyrH*) showed that the strain MSSRF38^T occupies a distinct phylogenetic position not clustered to *Vibrio rhizosphaerae* MSSRF3^T and *Vibrio ruber* JCM 11486^T group . The most abundant fatty acids also depicted that this strain belonged to genus *Vibrio*. The results of physiological and biochemical characteristics, genomic fingerprinting and DNA-DNA hybridisation analysis clearly differentiated strain MSSRF38^T from its phylogenetic closest relative. Based on genotypic, phenotypic, chemotaxonomic, phylogenetic and DNA–DNA hybridisation analysis, the name *Vibrio mangrovi* sp. nov. (type strain MSSRF38^T is deposited in LMG Beligum and DSM, Germany) is proposed for this novel taxon. Another diazotrophic strain MSSRF40T, based on (16S rRNA, *rpoA*, *GyrB*, and *Hsp*60) can be a new genus in the family *Enterobacteriaceae* for which the name *Mangrovibacter plantisponsor* gen. nov, sp. nov. is proposed (type strain MSSRF40^T and has ben deposited in LMG Beligum and DSM, Germany).

Genetic Diversity of Soybean Bradyrhizobia Isolated from India

Soybean (*Glycine max* Merrill.) was introduced to India as soon as it was domesticated in China. However, the diversity of rhizobial strains in India that can nodulate soybean was poorly understood. Diversity and phylogeny of 50 slow growing strains, isolated from nodules of soybean collected from Madhya Pradesh, Orissa and Maharashtra, India, where soybean is intensively cultivated, were studied, using Restriction Fragment Length Polymorphism (RFLP) and phylogenetic analysis. Cluster analysis of 16S rDNA restriction patterns with seven tetrameric endonucleases grouped these isolates with *Bradyrhizobium* spp. resolving two genotypes within these Bradyrhizobia. In the analysis of Intergenic Spacers (IGS) and RFLPs with three restriction enzymes, six genotypes were found. Variability in the length of rDNA IGS regions was detected among different IGS genotypes. The IGS sequences of the strains of Indian origin have very low similarity to those of the strains of

validly described species of *Bradyrhizobium* from other legumes and also from soybean. The RFLPs of symbiotic genes (*nifH* and *nodC*) and phylogeny based on the *nifH* DNA sequence delineated all isolates into two biovarieties. It clearly showed the existence of the potential new biovariety among soybean nodulating bradyrhizobia. Although the strains were isolated from soybean root nodules, the nodulation assays revealed that all the isolates induced nodulation with *Vigna mungo*, *Vigna radiata*, *Vigna unguiculata*, *Cajanus cajan* and *Macroptilium atropurpureum*. All strains are resistant to cloxacillin, polymyxin B, penicillin, gentamicin, oxytetracycline and amoxicillin. They did not grow in the presence of ciprofloxacin, cefuroxime or neomycin and exhibited weak growth in the presence of erythromycin. The novel strain designated M6 exhibited the following characteristics: Gram-negative rods as per the other species of the genus, colonies small, pearl white in YMA at 28 ^{0}C, optimal growth temperature at optimum pH 7–7.5. Nitrate reduction is positive. The strain produced β-galactosidase and urease and hydrolysed aesculin. It utilised glucose, L-arabinose, galactose, mannose, mannitol, N-acetylglucosamine, maltose and L-sorbose as carbon sources. The strain did not grow on lactose, L-rhamnose, trehalose, raffinose, sucrose or adonitol. The strain M6 is being proposed as a novel sp. in the genus *Bradyrhizobium*.

Diversity analysis of actinomycetes from Kolli Hills

Actinomycetes are a group of potent microorganisms known to exhibit antagonistic activity against phytopathogens, promote plant fungal symbiosis in the rhizosphere nodulate roots and also synthesize growth promoters such as IAA and Gibberellins. They are rich sources of secondary metabolites and can serve as a resourceful pool for gene donors. They utilise root exudates for growth and secretion of antimicrobial compounds. Plant growth promoting compounds such as Auxofurans have already been reported from S*treptomyces* strains. The present study was initiated to estimate the diversity of the actinomycetes associated with the Eastern Ghats and on the isolation of rare actinomycetes other than members of the family Streptomycetaceae. *Streptomyces* sp. are easily culturable and about 60 % of the reported biomolecules have been isolated from *Streptomyces*. A total of 96 strains of actinomycetes were isolated from soil samples collected from the Guntur cassava field, Devanur forest, Alathur sparse forest, Ariur rain forest of Kolli Hills and designated as MSACT1-MSACT96. Among them 15 strains exhibited antagonistic activity against *Rhizoctonia solani,* (sheath blight pathogen of rice), 6 strains exhibited activity against *Fusarium udum* (wilt disease in pulses) and 8 strains were active against *Fusarium oxysporum* (wilt pathogen in a number of crops). The strain KAM 11 exhibited broad spectrum activity against all the test pathogens. The strain KAM 11 was identified as *Streptomyces cinnamomeus* by amplification and sequencing of 16S rRNA gene. The strain *S. cinnamomeus* has been reported to be a potent producer of extracellular enzymes. Further studies can provide valuable clues on the mechanisms involved in the antagonism and plant-microbe interactions of *S. cinnamomeus.* The isolation of DNA has

been standardised and the amplification of the 16 S rDNA was carried using fD1 (5'-AGTTTGATCCTGGCTCAG-3') position7- 26 and r P_2 (5'ACGGCTACCTTGTTACGACTT-3')-position1,513 to 1,494 bases. The initial genetic diversity analysis of antagonistic actinomycetes was performed using GTG_5 primer which showed 4 different genotypes of actinomycetes. The sequencing data has also confirmed that members of *Streptomyces* spp. are predominant among the strain that were screened for antagonism. A further study on the characterisation of these genotypes is in progress.

Diversity analysis of actinomycetes from the mangrove ecosystem

Forty isolates of filamentous actinomycetes were isolated from the mangrove ecosystem. The isolates were designated as MSACTM 1-MSACTM 40. These isolates were screened for their antagonistic activity against plant pathogens but none of these strains exhibited antimicrobial activity against the test pathogens. The strains utilised cellulose and peptone and exhibited cellulase and amylase activity. Some of the strains were able to fix nitrogen in nitrogen free medium. The diversity of the strains was determined by amplifying the 16s rDNA using fD1 (5'-AGTTTGATCC-TGGCTCAG-3') position7- 26 and r P_2 (5'ACGGCTACCTTGTTACGACTT-3')-position 1,513 to 1,494 bases. PCR amplification was performed in a DNA thermal cycler. The amplified product of 1,450 bp which was obtained has been reported in actinomycetes. The microscopic structure of the strains was studied by cover slip culture. The restriction pattern was determined using restriction enzymes *Sau*31. The restriction pattern exhibited difference in the banding pattern and hence further studies for the identification of these organisms by a polyphasic approach are in progress.

305.2 Screening for biomolecules from microorganisms collected from different ecological niches

Microbial diversity describes the complexity and variability of microorganisms at different levels in the ecosystem. The measure of microbial diversity manifests the measure of the total community level and the functional components. Discovering novel biomolecules using untapped resources has gained momentum and the modern biodiversity prospecting integrates the systematic search for the new sources of biomolecules, genes and other economically valuable natural products. Attempts were made to isolate microorganisms from soil samples collected from the different ecological regions of the Eastern Ghats. The first set of soil samples covered the areas of the Guntur cassava field, Devanur forest, Alathur sparse forest, Ariur rain forest and Kolli Hills. The soil samples collected from these locations were isolated using 30 different media to isolate both slow growing and fast growing microorganisms. A total of 1,000 cultures/month were isolated to purity and the colony characteristics *viz.*, colony size, colony configuration, colony margin, colony elevation, colony colour, colony mucilage, biofilm formation and pigment production were recorded. The cultures were stab inoculated in the respective medium and dispatched to

Nicholas Piramal Limited (NPL) Mumbai and a duplicate set was stored in cryopreservation vials. NPL will screen these isolates by HITS (High infectivity throughput screening tests) for the identification of novel biomolecules with anti-cancer, anti-diabetes, anti-inflammatory and anti-infectivity activity. Bioprospecting of microbes would lead to the discovery of novel biomolecules which would form the basis for the synthesis of the chemical compounds. The bacterial isolates were further screened for cellulose and amylase activity and the actinomycetes are being screened for antimicrobial activity.

305.3 Biological control of diseases

Biological control of Blast disease of finger millet using plant growth promoting bacteria

Finger millet (*Eleusine coracana*) is a valuable crop of high nutritive value, which has been estimated as per 100 g: Protein 7.3 g; Fat 1.3 g; Carbohydrate 72 g; Minerals 2.7 g; Calcium 3.44 g; Fibre 3.6 g; Energy 328 Kcal. It contains the amino acid methionine, which is lacking in the diets of hundreds of millions of the poor who live on starchy staples such as cassava, plantain, polished rice, or maize meal. Pediatricians recommend ragi food for infants of 6 months and above because of its high nutrition, especially calcium which is very essential for children and elderly people. Over 20 varieties of ragi are cultivated in India, of which the grains of the white variety yielded superior nutritive value. The grain yield ranged from 600-800 kg/ha in India under rainfed conditions. It has been reported that seeds inoculated with *Bacillus azotobacter* recorded an increase in yield of 20 %. Blast disease caused by *Magnaporthe grisea* has been identified as the greatest constraint to finger millet production. The anamorphic form of the fungus is *Pyricularia grisea* and the teleomorphic stage *M. grisea* causes yield losses from 20 % to 80 % in finger millet. The association of the nitrogen fixers with the rhizosphere of finger millet was found to be sparse. The cultivation of the resistant and the susceptible varieties has been recorded. A survey was undertaken to study the cultivation of finger millet in the coastal regions of TN. Finger millet is cultivated in Tiruvanamalai, Villupuram and Krishnagiri districts. The soil samples collected from these regions were screened for the isolation of Plant Growth Promoting Rhizobacteria (PGPR) and 450 isolates were obtained. The fluorescent pseudomonas strains isolated from these soils were screened for their antagonistic activity against the blast disease pathogen *P. grisea*. The PGPR associated with the rhizosphere of finger millet was isolated and identified based on the amplification of the 16S r DNA.

Biological control of groundnut dry root rot caused by Macrophomina phaseolina *using* Bacillus *sp. and* Pseudomonas *sp.*

Groundnut is the fourth most important source of edible oil and third most important source of vegetable protein. Groundnut is cultivated in over 100 tropical and subtropical countries including India, China, Nigeria and the USA. Every year, 36 million metric tons are harvested from 24 million ha. The average productivity lies at 1.4 metric tons/ha. India is the largest producer with 5.7 million ha; however,

productivity is low with only 745 kg/ha. Pest and disease attack are the most important factors causing low productivity and groundnut is affected by over 55 bacterial and fungal pathogens. Major diseases of economic importance in India are; early and late leaf spots (*Cercospora arachidicola* and *Phaeoisariopsis personata)* rust (*Puccinia arachidis*) collar rot (*Aspergillus* spp.), root rot (*Macrophomina phaseolina*) and stem rot (*Sclerotium rolfsii*). There are no detailed records of yield losses caused by these diseases, but losses are estimated to be 13 to 59 %. *Macrophomina phaseolina* (Tassi) Goid, a fungal pathogen, causes high yield losses in groundnut by invoking stem rot, root rot and dry root rot. Chemical control is often uneconomical and not feasible, because the pathogen is primarily soil-borne. Little research has been carried out on Macrophomina root rot disease and its (biological) management in groundnut so far. The disease has not gained much attention despite causing high yield losses and hence research was carried out on the biological control of the *M. phaseolina* using plant growth promoting bacteria like *Bacillus* sp. and *Pseudomonas* sp. and also *Trichoderma* sp. and the antagonistic activity of the PGPR against *M. phaseolina* was studied. *Bacillus* sp. suppressed the growth of *M. phaseolina* strains considerably in dual culture, up to 56 % inhibition, with a stable inhibition zone of up to 13 mm whereas *Pseudomonas* sp. exhibited inhibitory effect which decreased after 72 h of incubation and the fungus came in contact with the antagonist after 120 h of incubation. *Pseudomonas* sp. was not overgrown by the pathogen; the antagonist stopped the growth of *M. phaseolina* compared to the control, *Pseudomonas* sp. suppressed the growth to an extent of 36 % in dual culture. *Trichoderma* sp. showed fast growth combined with a rapid overgrowth of *M. phaseolina* which was initiated after 4 d incubation and it suppressed the growth of *M. phaseolina* to an extent of 73 % and further incubation resulted in the mycoparasitism of *Trichoderma* sp. on *M. phaseolina*. The crude culture filtrate of *Bacillus* sp. revealed an inhibitory effect with a radial inhibition zone of 13 mm. Although the antagonist *Pseudomonas* sp. exhibited no suppressive activity in controlling the mycelial growth of *M. phaseolina*, it interfered with the formation of microsclerotia whereas *Trichoderma* sp. and *Bacillus* sp. did not effectively suppress the formation of microsclerotia. The effect of the volatiles emitted by the three Biological Control Agents (BCA) on the mycelial growth of *M. phaseolina* was studied. *Pseudomonas* sp. was found to inhibit the mycelial growth of *M. phaseolina* strains by over 70 % in inverted plate assay and the mycelium of *M. phaseolina* strains appeared flimsy and whitish. Further, neither microsclerotia nor pigment production was observed. The colour change from yellow to orange-brown indicated HCN production by *Pseudomonas* sp. but *Bacillus* sp. and *Trichoderma* sp. did not produce HCN. It is essential to identify efficient biocontrol strains for the control of the charcoal root rot disease. The leads obtained from this study will help in identifying suitable control measures for the control of this pathogen.

Programme Area 400

ECOTECHNOLOGY

A five-year evaluation of the Centre and its work was carried out by a team of experts identified by the Tata Trust. A draft Model Act for local level Climate Risk Management has been proposed. Approximately 27,500 trainee days were accomplished this year by the Centre.

Programme Area 400

Ecotechnology

The JRD Tata Ecotechnology Centre was established at MSSRF to research, develop and diffuse environmentally sound technologies through innovative delivery models following an inclusive approach that is human centred, through the biovillage model. Using the concepts of biovillage and eco-enterprise development, in the 10 years of its existence, the Centre has focused on blending sustainable natural resource management and livelihood security through the following pathways: participatory research and development, capacity building and grassroot institution building. Through its operations in the various agro-ecological systems prevailing in TN, Puducherry and Orissa, the Centre is evolving models of sustainable development for policy advocacy with the government, NGOs, private sector, banks and international development agencies. The programme lays emphasis on skill and knowledge empowerment of the rural poor.

One of the significant events this year was the five-year evaluation of the Centre and its work by a team of experts consisting of Ms. Manjul Bajaj (Economist) and Mr. S. Rajashekaran (NRM Specialist) identified by the Tata Trust in Dec 2007-Jan 2008. The process was based on a series of interactions with all the team members, community members and stakeholders, and extensive field visits. During the field evaluation, the reviewers focused on understanding and assessing the status of the technology with reference to the goals of the JRD Tata Ecotechnology Centre, the development of the grassroots institutions, their plans for the future and their interest areas and future plans of the Centre.

An attempt was also made to look at the main aspects of the Centre's *functioning as an institution* in terms of leadership, staff, processes, procedures and finances and to highlight concerns, if any. In general the team of reviewers were of the view that the JRD Eco-technology Centre was largely successful in

- Demystifying technologies and taking a large number of them to the commercialisation stage and helping to achieve development in a pro-poor, pro-women and pro-nature manner.
- Setting up vibrant, articulate and pro-active grassroots groups and institutions.
- Utilising the corpus grant made to it to leverage additional funds in a pro-active manner.

The team had some *suggestions for strengthening* the programme in marketing, developing the newly formed village based organisations into independent and viable institutions in their own right and developing a more holistic, systems-based approach to impact assessment.

The review team also felt that the following two *emerging trends* will have an important bearing on the Centre's structure and working over the next few years. The first is a shift to large multi-

site umbrella projects like the *bio-industrial watersheds* project and the climate control initiatives. The second is the setting up of thematically focused institutional facilities like the *Mentoring Centre* for SHGs and Farmers, and the *Fish For All Centre*. Both these trends are positive in that there is a distinct direction and focus to the Centre's work plan over the next five years or so and the new facilities that are being put in place in the project areas will provide an impetus for delivering the programmes in an energetic and focused manner.

Keeping this in mind the team has consciously tried to address the suggestions for strengthening these areas and the work plans have been revised for all the sites and modified accordingly. The progress and the way forward in the light of the evaluation are addressed here.

The work carried out under the bio-industrial watershed (BIWS) has made significant progress and is reported under the different ecological zones. The broad objective of the project is to extend the techniques of sustainable management of natural resources in five major soil regions of India, on a watershed scale, managed by the local community of farm women and men as well as landless labour for food and nutrition security, environmental quality and enhanced livelihood opportunities. The results of this study will therefore have a large extrapolation domain within the country. This five-year (2007 – 2012) project is spread over five agro-ecological areas, viz. Pudukottai (TN), Karasanur (TN), Koraput (Orissa), Hoshiarpur (Punjab) and Narasinghpur (MP). MSSRF, Chennai, is working with the active collaboration of Punjab Agricultural University (PAU), Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), local NGOs (ASA, Bhopal) and Ohio State University, USA. The first three sites are being directly managed by MSSRF. Hoshiarpur and Narasinghpur, MP are being handled by PAU and JNKVV. Each one of the sites managed by MSSRF has been planned with respect to a thrust area, *viz.* Pudukottai as pulse village, Karasanur as horticulture village and Koraput as bio valley.

Sub Programme Area 401

Coastal Region

The Centre has been working in the Chidambaram region for the last 10 years to evolve a model of livelihood security by developing pathways for optimal and sustainable use of coastal resource bases (such as coastal lowlands, water bodies, etc.) with knowledge-intensive technology that could be self sustaining and thereby nurture grassroot institutions. Post tsunami, agronomic rehabilitation and livelihood promotion activities were initiated in some of the affected villages, in the Nagapattinam region. Based on the interactions with the community and the felt need expressed by them, the *'Fish for All'* training Centre was initiated last year at Poompuhar. All activities initiated post tsunami and coordinating the support for the CBOs nurtured at Chidambaram are being continued under the activities of the Centre at Poompuhar.

401.1 Chidambaram

Due to the role change being undertaken at this site and by way of addressing the strengthening of the grassroot institutions, 300 farmers practising Integrated Farming System (IFS) are being brought under one umbrella and the performance of the SHGs and their income generating activities is being monitored. As part of the on-farm technical interventions this year focus was placed on large-scale participatory farm trials of a paddy seed farm. Sowing paddy directly using Magarasi drum seeder was demonstrated and awareness on biological managements of rats as a part of good agricultural practices was also carried out. Totally, Rs 19.25 lakhs was accessed by the different group members, with Rs 10.90 lakhs as a subsidy from DRDA and Rs 8.35 lakhs as bank credit. In all, 257 women and 41 men are involved in various economic activities. The focus in the coming year will be on strengthening the Federations to help them carry on their activities. In all, 292 men and 229 women were trained in 521 man days this year.

Thenkoodu Federation

The *Thenkoodu* Federation currently has 44 SHGs in 17 villages, including 37 women SHGs and 7 men SHGs, grouped into 5 clusters. Among the groups in the B. Manavelli cluster, the individual average external borrowing was Rs 12,921 head (5 fold of their savings), the average internal borrowing was 4 times their savings. Nine women members of Vekkalliamman SHG raised fodder crops in B. Manaveli village and the green fodder yield this year was 16,217 kg. In Senthirakillai cluster 96 members of 6 WSHGs borrowed a total amount of Rs 2,70,000 from DRDA with a subsidy of Rs 1,80,000. Utilising this amount, 36 women are involved in milch animal rearing, 25 women in goat rearing and 35 in small business. In Manikollai cluster 161 women and 41 men from 14 SHGs borrowed an amount of Rs 16,25,000 with Rs 8,80,000 as subsidy. This amount was utilised to rear milch animals, lease land for agriculture, to make coir, and have small business.

Manikollai Lift Irrigation

The farmers from Manikollai Lift Irrigation Federation developed a community paddy seed production farm for optimum utilisation of available water and to address the cost of cultivation. Here they produce founder seed from certified paddy seeds. In about 4 ha of seed farm area, 6 farmers raised 4,500 kg of BPT founder seed this year. This seed farm can service about 120 ha. The value of paddy seeds produced was Rs 2,20,860 from paddy worth Rs 1,17,000. The Federation Members of the Manikollai village will use the paddy seeds themselves. The cost of lifting water from Paravanaru was found to be about 20 to 25 % of the total cost of cultivation due to the lift irrigation work they had done earlier. The federation has also got power supply from the electricity department. Through the intervention of MSSRF the Govt. of TN has sanctioned Rs 1.25 crores for the construction of a check dam to prevent saline water entry into the paddy irrigation area during off-season. Here 20 men farmers and 10 women farmers were

trained for 14 weeks with the support of the State Agriculture Department under the Farmers' Field School programme. The training included the direct sowing method, paddy seed farm, transplantation and System of Rice Intensification.

Direct Sowing Method

This year the Magarasi drum seeder was adopted in 39 ha by 19 farmers from 14 villages. The yield was to the tune of 5,750 kg/ha/crop. The advantages of the Magarasi drum seeder include less water utilisation, reduced input of paddy seed and high yield with minimum labour cost.

Replication of the IFS

Participatory demonstration of IFS has resulted in its replication in three blocks *viz.* Porto Novo, Mel Bhuvanagiri and Keerapalayam by 300 farmers. These replications have been mapped at the Chidambaram taluk level. The grouping of farmers in clusters is in progress to enable their access to quality fish seed, optimisation of input cost by ecosystem integration, linkage with potential markets and addressing their needs in the form of a strengthened grassroot institution. This will help to promote a strong cluster of IFS farmers who will then be able to start working on a collective approach for mobilising input services and post harvest needs.

401.2 Poompuhar

The establishment of a *Fish for All* Centre was initiated early last year with the identification of the land. The concept of *Fish for All* is to develop a co-management model over the years, through social mobilisation, participatory planning and adequate capacity building of the communities dependent on fisheries as a livelihood source in the region, which will serve as a pilot initiative of its kind. The programme aims at improving the performance of fishers specifically focusing on women for poverty alleviation and distributional equity under the coastal agro-eco system. The construction work is progressing well – the training centre will also house the VKC which is ready for occupation, the dormitory will be ready soon and the pre-processing centre will be ready by year end. It is proposed to inaugurate this facility by the end of this year.

The major work accomplished this year was collection of preliminary information about the area and the lives of the coastal community, the baseline survey detailing aspects of the socio economic conditions of the fishing communities, and the focus group discussions on the various livelihood issues.

Baseline Data

The epicentre of the project, Kaveripoompatinam Panchayat is located at Sirkali taluk of Nagapattinam district. There are 5 hamlets in this panchayat, *viz.* Poompuhar fishermen colony, Mandakarai, 92-Keezhaiyur, Neithavasal, and Puthukuppam. Puthukuppam is a small traditional fishing hamlet. Poompuhar fishermen colony is a major fishing hamlet in this panchayat and others are agriculture-based hamlets. It is important to understand the pivotal role played by the traditional fishermen Panchayat (this Panchayat is

different from the one elected under local body elections) that functions only within the fishing community and is managed by the elders of the community. Poompuhar has its own unit of council that functions as a decision making body on the issues concerning the fishing community. Under this traditional governance system, any dispute relating to internal family matters or the community is taken up by the panchayat. and their decision is final.

The fish catch in Poompuhar comprises 80 % fin fishes and 15 % crustaceans such as shrimps, crabs and lobsters; rays, skates, cuttlefish and squids contribute the other 5 %. The fish catch has been stagnant since 1997 and in 2005 it decreased due to the tsunami. The main catch is of sardines and mackerels, which form nearly 50 %.

Poompuhar has only two categories of craft: FRP boats (motorized boats) and high power mechanized vessels (above 15 HP). The catamarans, which were prevailing in the pre-tsunami period, have become extinct in the post-tsunami period due to the rehabilitation efforts of NGOs. There are nearly 75 FRP boat and 54 mechanised vessel operators. The fishers sell their catch directly to the retailers (fisherwomen) through auction and to the wholesalers through their local agents.

Focused group discussion with the coastal aquaculture and fresh water aquaculture farmers revealed that they are in need of a water testing laboratory; awareness programmes on alternative aquatic species cultivation; training programmes on good management practice and field demonstration farms for crab and sea bass farming. Fifteen farmers have been identified and the activities will begin shortly.

Good Aquaculture Practice

To demonstrate good aquaculture practice in shrimp farming in Vanagiri area through participatory mode, 10 marginal farmers with water-spread area of 16 ha, were formed into a cluster. Seed selection, stocking, feeding and feed management and water quality management were covered. The local technicians and farm labourers are playing a key role in following this practice. The essentials of record keeping have also been included.

Integrated biological management of water hyacinth by grass carp and weevil

The ongoing experiments were conducted in a confined environment and the farmers taking part in participatory demonstration in biological control of water hyacinth by grass carp and weevil concluded that

- big sized grass carp (> 1 kg) perform efficiently in the pond
- a combination of big size grass carp (> 1 kg) and weevil gives higher efficiency when compared to a single agent (weevil or fish)
- integration of the fish and weevil is efficient
- improved water qualities were noticed in the low water hyacinth populated ponds
- impact on environment is less when

compared to other types of control measures.

In the coming year this practice will be promoted in majority ponds in the area.

Livelihood Promotion

Crab Fattening: This was one of the livelihood options introduced post tsunami at Madavamedu, one of the coastal villages affected by tsunami. The group has been sustaining its activities and modifications have been brought about in the design of the cage to bring down the cost; the number of crabs which can be held in one cage has also been brought down from 10 to 6, to increase the survival and free growth of the crabs. There has been a request from other group members to help them start this activity. Therefore a survey was conducted to identify the areas to extend this activity. There is a shortage of water crabs, so this needs to be addressed. This pilot initiative has helped to bring out many key lessons on the challenges that one will face if this activity is scaled up.

Crab Farming: With the support of the Rajiv Gandhi Centre for Aquaculture, 10 WSHG members from Poompuhar fishermen colony were trained in crab farming. Land has been purchased for the construction of a crab farm. The design and construction are in progress and will be part of the first on-farm demonstration model being developed near the Poompuhar office. The activity will be initiated in the near future.

Pickle making and candle making: While fish pickle making could be a good value addition proposition, marketing is still a grey area. Pickles are being sold in the local markets in sachets. This is being revisited. The other activity introduced was candle making – which is picking up slowly.

Agronomic Rehabilitation

Post tsunami, consistent efforts were made and the detailed soil quality analysis and close monitoring of the affected soils show that soil quality has improved. In addition to agronomic rehabilitation of soils affected by the ingressed saline water, steps were taken to promote disaster resilient farming communities through social mobilisation and encouraging farmers from these areas to promote IFS through participatory mode in one wetland and three dry land areas. MSSRF has been working directly with four farmers' associations, four women farmers' groups and two women farm labourers' groups in the four agricultural hamlets located in Nagapattinam district for the last 12 months.

Crop Performance

MSSRF continued to collaborate with the three farmers' associations of the three project villages where the agricultural land was affected by tsunami waves. An extent of 13 ha of land was taken up for farmers' participatory demonstration at Neithavasal, Anaikovil and Vellapallam villages from April 2007 and input support was given to these farmers. The practice of summer ploughing, land smoothening wherever needed, green/ greenleaf manuring, provision of adequate drainage, application of FYM or vermicompost,

use of growth promoters and paddy varieties such as, Co43, ADT38 and traditional landraces like *Kuzhivedichan* were continued as reclamation activities as in the previous years. The total area covered was nearly 13 ha with 43 farmers from three villages and the yield ranged from 5,250-6,250 kg/ha for the former and 2,560 kg/ha for the latter.

The other contingency crops such as pulses, groundnut and vegetables have become regular crops. The ADT2 pulse variety yield was around 700-875 kg/ha and groundnut pod yield 2,125-2,750 kg/ha in Vellapallam village. The vegetables (brinjal, cluster bean and tomato) average yield was 11,250-15,000 kg /ha. Farmers feel that the crops are well suited to the soil and climatic conditions and that large scale cultivation can be taken up if markets are available.

Local Seed System and Promotion of Community Seed Bank

Most of the paddy crops in Vellapallam village were affected by the tsunami, except some landraces like *kuzhivedichan* and *kallurundai*. The landraces are seen to be tolerant to salt as they withstood seawater at the time of the tsunami. These land races were collected from nearby villages and distributed to farmers in the coastal areas in Vellapallam and multiplied on a large scale. The farmers believe that *kuzhivedichan* is suitable for saline and flooded conditions compared to other varieties grown in that area. This village has very poor post harvest technology and there are no proper seed storage facilities. The farmers follow direct seed sowing methods. In the coastal regions, around 25 traditional varieties suited to the local agro-climatic conditions had been recorded, but most of them have disappeared from the region. Keeping this in mind, a community-based seed bank was established in Vellapallam village. The traditional method of the *thombai* and *kottai* method of seed storage practices are followed in Vellapallam. The traditional knowledge of cultivation and post harvest practices of the local paddy varieties were documented and efforts were taken to involve the *Mullai* farmer association in the management of the community seed bank. Since the region is prone to different types of natural disasters, steps were intensified to promote utilisation of the community-based seed bank. Nearly 750 kg of paddy seeds were transacted during the year, including two local varieties. During the last harvesting season, 5 additional local varieties were purchased and stored in the traditional containers. This year the seed bank catered to the needs of the local farmers and it is planned to expand the facility to farmers in other villages of the area in the coming year.

Integrated Farming System

The farmers of Neithavasal, Anaikovil, Vettaikaranirruppu and Vellapallam decided to develop one participatory IFS model in each village. The 4 farmers' groups decided to include components like aquaculture, dairy, poultry, goat rearing, cropping (paddy followed by pulse), horticulture crop, banana, forage crop, vermin composting, *Azolla* pit and agro forestry.

Dairy-based Integrated Farming System (IFS): Four cross bred Jersey milch animals were added in the four villages. The stud bull in stall fed condition was fed with concentrated feed by mixing rice bran, groundnut oilcake and black gram husk in right proportions to meet the energy requirements. The cost of the concentrated feed was Rs 18/kg and 2 kg of the mixture in addition to liberal quantities of rice straw and green fodder were provided.

Goat-based integrated farming system: Under this system, boyar crossbred goats were introduced with improved cropping under dry land and wetland conditions. The goats were medium sized with an average weight of 30-35 kg and capable of yielding 0.5 litre milk per day. The goats yielded more meat and exhibited grazing habits similar to sheep. The goats were fed with leaves from perennial fodder trees and dry fodder: green fodder 3 kg, dry fodder 3 kg and 100 gm oilcakes were given to each goat. The manure collected was applied to the fields at the rate of 3 tons of organic manure valued at Rs 750 which is an additional income through recycling of organic waste.

The 4 farmers' groups held monthly meetings and feedback was collected from them, regarding need-based technology transfer.

Training and capacity building

Need-based capacity building and cross learning programmes were organised to enhance the capacity of the farmers and to develop a network among the four farmers' groups across the villages. Separate group discussions were held with women and men farmers' groups in each of the villages to assess training needs. The programmes organised were on selection of good animals, animal nutrition, livestock disease management, low cost decentralised production of animal feed using local crop products, forage cultivation, *Azolla* production, bio pesticide and integrated rat control. The duration of the different training programmes was around 12 training days. The members of the farmers' associations are slowly emerging as a cadre of local resource persons. It was observed that farmers here were also adopting the IFS model practised by about 300 farmers at Chidambaram.

401.3 Kendrapara

During the period under report the Centre has concentrated on conducting training and stakeholders' workshops at the district and state levels to disseminate key learnings. Reviews of the various activities carried out this year have indicated that delivery mechanisms of the potential eco-entrepreneurial activities would need strong and independent grassroot institutions, which would be able to provide the supporting linkages for up-scaling and replication. With this aim, a survey was conducted for replication of some potential interventions in the district. The following activities have been observed in the farmers' fields after initiation of the Centre at Kendrapara.

SHG Organisation and micro-credit system

The SHG members have formed three clusters named *Nari Shakti Mahila Sangha* (12 SHGs),

Jeevan Jyoti Sangha (24 SHGs) and *Jhansi Rani Cluster* (5 SHGs) in different demo fields. All the members under the umbrella of MSSRF are actively participating in the group activities such as participatory research, community banking management, kitchen gardening, poultry rearing, mushroom cultivation, apiary management, flower cultivation and small business. The total financial transaction for the year was Rs 13,05,235. Loan recovery was Rs 7,62,000 and bank loan Rs 1,90,000. The clusters would be further strengthened the coming year to undertake activities on their own.

The SHGs were able to generate income from micro-enterprises in both on-farm and non-farm sectors, supported by micro-credit, and create employment opportunities. The money thus covered by the SHGs was used for agriculture, dairy and poultry enterprise, mushroom cultivation, health care activities, petty grocery business and education of children.

Capacity building

To build capacity and enhance the ability of the rural community for eco-entrepreneurship and sustainable development 763 trainee days were organised on interactive learning programmes with in-house training strengthened with field demonstration and exposure visit. MSSRF organised five workshops on IFS at the district level and one workshop in partnership with OUAT in October 2007, in which more than 120 participants from various departments and organisations participated. The district level stakeholder meeting, held in April 2008, was chaired by the District Collector; more than 130 participants participated and the experiences of MSSRF were shared with other institutions to replicate the model.

Livelihoods

At Kuhudi Panchayat *Nari Shakti Mahila Sangha* members of the cluster have organised a milk society. MSSRF has given an interest-free loan of Rs 5,28,000 to develop 44 individual dairy units and supply milk to the Orissa Milk Federation (OMFED). The society has 80 members and the collection of milk is more than 200 lt twice a day. The total income from the dairy unit was Rs 6,76,150.

Aqua Based Integrated Intensive Farming System

The concept of integrated intensive farming system can be summed up as a high production system that makes judicious use of water to get maximum production from the land. The pond is used for aquaculture activities during the monsoon season and in the post monsoon season, the harvested water would be used for providing life saving irrigation to the vegetables cultivated on the bunds and in areas adjacent to the pond. The SHG members were able to harvest and sell the fresh vegetables from the IFS model farm. From 2005 kharif, every year the SHG members have harvested water from the pond for raising a 2 ha paddy nursery in early July and planted the crop at the appropriate time in more than 25 ha and had a bumper yield of rice every season, which was never seen before they started their activity. They have had a net profit of Rs 64,000 from the aquaculture

activities and an additional income of Rs 90,000 yr from grain due to the availability of water to raise seedlings. About 300 agro-forestry saplings on the periphery of the model will fetch more than one lakh after 5 – 7 years. MSSRF has successfully demonstrated this aquabased IIFS model at Manitiri, Kendrapara, which will be replicated in the whole district with the help of the Government, financial institutions, universities and non governmental stakeholders.

A model IFS will be established as a farm school at Manitiri village to disseminate the successful results to farmers, women SHG members and other visitors. The women SHG members will maintain the farm school as they are well trained and they are now resource persons for the farm school.

Paddy seed production

Paddy seed production was initiated in the 2006 kharif season; 75 kg of breeder seeds of different varieties such as *pratikhya* and *uphar* and scented varieties such as *basuabhoga*, *ketaki joha*, *dhusara*, *geethanjali* and *kalajeera* brought from OUAT and CRRI, were distributed in adopted villages for demonstration and multiplied by 28 farmers. In the 2007 kharif season the foundation seeds produced by the farmers could be distributed to 72 farmers, covering an area of 8.0 ha. This will be multiplied in geometrical progression in the coming season.

Sunflower cultivation

During 2006-07, 17 farmers participated in sunflower cultivation and 15 kg of the hybrid MSFH-1 sunflower seeds were distributed to them in 6 adopted villages, in an area of 2.80 ha, which recorded a yield of 16.12 qtl. per ha and the oil content was 31.55 %. Survey results showed that besides rhe sunflower demonstration plots, 136 farmers from these villages cultivated the crop, covering 33.50 ha, and received an average yield of 15.30 qtl per ha. After seeing the encouraging results, and considering this is the only possible oil seed crop for this saline tract, many farmers have cultivated it this year, where water is available. Most of the sunflower fields are yet to be harvested. A survey of the area under this crop showed that 173 farmers have cultivated sunflower as sole or inter crop, early or late after potato, in the MSSRF-adopted and nearby villages. In other blocks like Garadpur, Derabis and Kendrapara, a vast area was covered under sunflower cultivation in 2007 – 2008.

Backyard kitchen garden

Kitchen gardening is basically practised as an individual activity in Kendrapara district, where vegetables are cultivated in the backyard. The activity was streamlined with technical guidance and use of improved high yield varieties. Currently 412 HHs are maintaining the activity and each household has about 4.3 cents and their annual production is estimated at about 300 kg. The activity could be popularised at the household level with institutional support ensuring the availability of quality seeds for scaling up production.

Backyard poultry

In the Kendrapara site, poultry rearing is one of the income-generating activities and is one

of the economically viable options. Birds like Black Rock, *Banaraja* and *Giriraja* are reared because of their quick growth and easy marketability. The chicks are available only at the Central Poultry Research Institute at Bhubaneshwar. From April 2007 to March 2008, 6,000 chicks were distributed among the 112 women SHG members in 8 adopted villages. MSSRF imparted training and demonstration, which created an awareness on poultry management and marketing. The net income from this activity was Rs 4,10,400.

Mushroom production

Ecological conditions in Kendrapara are suitable for mushroom production as plenty of paddy straw is available in the coastal region. Therefore, several training, demonstration and exposure visits were held for the women SHG members. Paddy straw mushroom and oyster mushroom were produced in the project site. During the year, 133 women participated in the project and got a net income of Rs 11,140.

Village Knowledge Centre

A VKC is functioning at Nembara village of Kuhudi GP since 2005. It is handled by *Nari Shakti Mahila Sangha,* a WSHG. College and school going students are availing of the facility on payment basis and trained SHG members have taken up coaching. Forty nine students were selected in 4 batches for computer training and Rs 1,225 was collected from them. For meeting the stationary expenses and purchase of educational materials, normal charges are collected from the users. The centre also organises debates, drawing and essay competitions among the students. The centre also provides information on pests, and weather forecasts and information from line departments, which are displayed on the notice board. Cluster members have installed a small library for computer learners and a telephone.

401.4 Puducherry

The MSSRF biovillage programme was initiated in 1991 in three villages, with the support of The United Nations Development Programme (UNDP) and in collaboration with the administration of the Union Territory of Puducherry and has now reached 56 villages. This movement has been accelerated by two institutional structures *viz.*, *Innuyir Grama Sangam* called the Biovillage Council (BVC) and Biocentre.

A new project on Community Managed Bio industrial Watershed for Sustainable Natural Resource and Enhanced Livelihood Programme was initiated in July 2007 in Karasanur village, covering 470 ha.

Strengthening Biovillage Council and Community Banking

In active collaboration with all the stakeholders, the Biocentre has been promoting, monitoring and strengthening SHGs and has so far facilitated 346 SHGs with a total membership of about 4,200 women. At present no new SHGs are being formed but efforts are on to strengthen the existing SHGs. Almost 95 % of the SHGs availed credit facility. The financial transaction of the SHGs has reached nearly Rs 5.2 crores in the current financial year, which includes their savings and interest, loans

from banks, subsidy/grants and enterprise turnover.

A loan of Rs 2.33 crore has been credit linked for 1,550 members, which helped them in uplifting their IGAs and livelihoods. In addition, 140 SHG members availed of Rs 8,40,000/- as subsidy from PONLAIT under the dairy development programme. For easy operations, continual support and regular monitoring of these 346 SHGs, the working regions have been divided into 6 clusters. Through cluster level meetings village level animators were identified, to look after the 346 SHGs in 56 villages. The SHG grassroots institution, called the Biovillage Council, has been re-registered in the name of *Innuyir Grama Sangam* under the Trust act to facilitate all the federation's activities. *Innuyir Grama Sangam* Community Bank was established on 12 January, 2007, with the contribution of an annual membership of Rs 500 from each SHG. About 220 SHGs were brought under the Community Bank fold. Until now Rs 4,60,000 has been given as loan to 46 beneficiaries and regular repayment is being done.

SHG Capacity Building and Mentoring Centre

The training needs of the SHG members were identified through cluster level meetings and training for a total of 4,255 trainee days was conducted on various topics. Sixty eight percent of the SHGs were interested in taking up IGAs, 27 % were interested in accounts and bookkeeping, and the rest were interested in social aspects. As part of the streamlining of existing SHGs, village level group leaders' training was conducted for the 346 SHG leaders/ representatives. Three one-day training programmes on cattle feed management and fodder production were conducted, along with PONLAIT, Govt. of Puducherry in Mangalam, Senthanatham, Ulavaikkal, Uruvair, and Keezsathamangalam villages. Training was organised for BVC members to document their community development work for the NVA Fellow award.

A five-day IGP training was conducted for the DRDA SHGs at the request of DRDA. Also, with financial support from NABARD, five one-day awareness training programmes (ODAP) or IGP were organised for 206 SHG members. Five, three-day Micro Enterprise Development (MEDP) training programmes for 152 selected SHG members were conducted. Training was imparted on mushroom cultivation, vemicompost, kitchen garden, book keeping and accounts, fodder cultivation and dairy management. Orientation on the Biovillage model was given to grassroots NGO officials, bank managers and national and international university students. Five IEC material brochures / handouts were prepared for the training programmes.

Establishment of Sanitary Napkin Unit

BVC members have been regularly participating in the mother and child health programmes in the villages, where they found that many village women in the age of 25 to 40 face gynecological problems, particularly related with personal health and hygiene. The BVC conducted a survey among the rural women in the biovillages, and realised that

there is a demand for low cost sanitary napkins. The BVC decided to start a low cost sanitary napkin unit to make available hygienic as well as low cost napkins in the villages. An exposure visit was arranged to a unit managed by a person in Coimbature who has developed low cost machinery to produce these napkins and was adjuged for the innovation award. They were also trained to establish and manage the unit, and developed a business plan. It was supported with a 30 % grant. The *Innuyir Grama Sangam* under its *Thozhir Pirivu* established for the first time in Puducherry as federation activity a low cost sanitary napkin unit. The product is being marketed under the brand name of 'Softex'.

Dairy Activity

In Puducherry, there is a huge demand for milk (daily demand of 1,00,000 litres *vs* supply of 55,000 litres). There is an assured market for milk through village cooperative societies; training is available for clean milk production in this region. As dairying has potential as a good option for an enterprise, the SHGs were interested in it. Training and financial linkages were given to this activity; 140 SHG members have purchased milch animals, by availing of Rs 6,000 as subsidy. A total subsidy of Rs 8,40,000 was got from PONLAIT.

Networking

Partnerships were built with small and marginal farmers, Agriculture and Horticulture Departments, FD, TNAU, KVK, PONLAIT, PASIC, nationalised banks, NABARD, DRDA, research institutions, educational institutions, medical colleges, Shankara Nethralaya, veterinary college, Fish Farmers' Development Agency and NGOs.

Funds Leveraged

For the past one year a sum of Rs 2.05 lakhs has been mobilised from different sources (NABARD, Agriculture, Horticulture department and DRDA). In addition the SHGs have been credit linked and availed of loan and subsidies of Rs 2.41 crores from banks and Ponlait (2.33 crore+ PONLAIT subsidy Rs 8,40,000).

Bioindustrial Watershed

The Biocentre coordinates the implementation of the BIWS programme at Karasanur village. Karasanur is located 20 km away from the Biocentre office. It falls in the Nallavur watershed No.4CID4 and extends upto Kaluveli in Villipuram district. It includes wetlands cover (35 ha) and dry land around (360 ha). Major crops in the wetland are paddy, finger millets and vegetables such as lady's finger, onion, chilly and brinjal. In dry lands casuarina is the major crop.

Initial Interventions

As an entry point, eye camps and cattle health camps were organised. To strengthen the BIWS programme, PRA, benchmark survey, soil /water testing in both wet and dry lands, cattle survey and soil health survey were conducted. As a trial, 4 ha of wetlands were brought under SRI and vegetables. Adaptive Research Trial was initiated with the support of the agriculture department, for pulses and kitchen garden.

Grassroots Institution building

Intensive Farmers' Field School (FFS) was started to support IPM and INM activities. Crop-based Farmers Interested Groups (FIG) were established for SC and BC farmers. All the existing SHGs and other institutions were brought under one umbrella, and the BIWS committee. 1,109 mandays of training was conducted as part of the capacity building in on-farm techniques and social capital building. To strengthen the BIWS programme in the project area networking was established with various government and other agencies for credit and technological support.

Sub Programme Area 402

Semi Arid Region

402.1 Kannivadi

Efforts continued on facilitating the role change process for the two grassroot institutions *viz Kulumai:* SHG federation and Reddiyarchatram Seed Grower's Association: farmers' association. The main activities have been focused on strengthening institutional / organisational capacity to handle the operations and on income generating strategies. Networking and linkages with line departments, banks, NGOs working in the region and universities have been promoted. Attempts were made to implement the joint action plan evolved to strengthen the self sustainability of grassroot institutions.

Kulumai-SHG Federation: The current strength of the federation is 156 SHGs. The focus is on strengthening the capacity of the SHGs and facilitating credit linkages and rural entrepreneurship. The annual turnover of the federation is Rs 2.8 crores with repayment of around 85 %. The utilisation pattern of the micro-credit component of *Kulumai* community bank shows that promotion of livelihood activities is gaining importance (has increased slightly from 74 to 78 %) followed by education and health needs. The auditors have completed the external audit for the groups and statements were shared with them. The audited statements are being used as one of the indicators to assess the status of the group for credit linkage and enterprise development. Through its partner-agent model risk cover scheme, it supported 3 members during the year.

To strengthen the organisational structures and systems, the present management processes and working methods of the animators were assessed with the support of external experts and the following points were discussed for further action: promotion of mixed community members while forming groups, inter-seed agreement model for the community banking transactions, organising periodical recovery camps with the support of banks and groups, necessary formats for the plan and progress, and performance linked pay for the animators. The revamping process is helping the federation to strengthen its administrative and management systems. As part of its social agenda, it coordinated two eye camps with the support of a private hospital based at Trichy and one animal health camp with the participation of the Department of Animal Husbandry.

With reference to strengthening infrastructural facilities, the building plan was evolved jointly with the Federation and the engineer was identified. Based on an agreement, a construction management committee was formed and the construction process was started. The construction cost of the building is being borne by the Friends of MSSRF and the project is to be completed by October 2008. The land was purchased by the *Kulumai* Fedaration.

Kulumai has identified and is practising the strategy of running an enterprise as an income earning opportunity to sustain the federation. An integrated dairy was the first initiative with 65 members and the daily transaction is around 700 litres. Low cost cattle feed production is being tried as a second initiative. NABARD has supported the federation with technical and hands-on training and an exposure visit to feed production unit. Preliminary assessment of the cattle feed requirement, consent of the SHG members in supporting *Kulumai* in this new initiative, as well as other preferences, were obtained from each of the members through a questionnaire handled by the animators. On this basis, *Kulumai* has developed a business plan for the unit and submitted it to the MEM initiative of community banking, Chennai. In the current year it is planned to strengthen and expand the management system to reach nearly 300 groups with a focus on socially and economically disadvantaged sections of the community.

Reddiyarchatram Seed Growers Association: According to the role change plan, linkages were established with the State Department of Agriculture and some companies. As an outcome, the association achieved 40 ha of cocoa cultivation as an intercrop in coconut fields with the support of the Horticulture Department and Cadbury Ltd (Rs 4 lakh), 10 ha under Bt cotton with the support of KVK, Gandhigram (Rs 1 lakh), 5 vermicomposting large size pits (Rs 2 lakh), seven percolation ponds, etc. The National Horticulture Mission is working in collaboration with the association in identifying the right partners for the programme. Five farmers who have been continuously practising the SRI method of paddy cultivation received the *Best Farmer* award from the Department of Agriculture. The institution, in collaboration with International Development Enterprise, is promoting drip irrigation and 10 farmers are in the process of installing the system. The membership of the association has increased from 105 to 160 and there are many active participants. Two more groups have been linked to NABARD and 4 groups are in the process of joining. The institution is recognised as a centre for training by KVK and the district administration. The association manages the hub of the Community Learning Centre (CLC), which provides need-based information on market prices, input prices and availability from different markets and medium range weather forecast through a decentralised weather station. The local newspaper *Seithisolai* has been providing seasonal information, farmers' experiences and schemes available for regional farmers.

Revamping the institution's governing system was carried out; as part of this process, election

was carried out and new EC members were elected. Activities were focused through village level thematic groups and they have started savings and credit activities. Measures have been taken to strengthen the service of the association to the members with the technical support of BASIX, Hyderabad. It was recommended by the Trust external reviewer that the association must change the strategy from 'service' to 'business' in order to move forward and become financially self reliant. The identified sectors are credit services, input and market support and risk management services. A database of the members was produced.

Community Informatics: CLC's have been functioning with a focus on facilitating functional literacy, and providing need-based locale-specific information on market trends, government entitlement schemes, educational opportunities, agriculture, pest management and weather forecast. Five centres have been promoting functional literacy, and three centres are in the process of reaching 100 % of the HHs, in which more than 60 % are women.

Nearly 12,360 members visited the centre during the year, of whom nearly 60 % were men and 40 % were women, which is a slight improvement over the last year. On an average 62 % of the total visitors approached the centres to seek information; women requested information related to education, health and government PDS, while men requested details on prices related to agricultural products, schemes, etc. During the year the centre facilitated 16,000 trainee days covering 85 % women and 15 % men participants.

Based on the progress, the support of Friends of MSSRF were sought to upscale the process to reach 1,000 learners from socially and economically weaker sections. In continuation of this effort, a detailed database of the villages with community details was prepared and criteria evolved to select the ten potential villages for expansion.

Ecoenterprises for Livelihood Security

The production methodologies of biological products *viz Trichoderma viride*, *Pseudomonas fluorescens*, *Trichogramma chilonis, Paecilomyces*, *Azosprillum*, phosphobacteria and *Arbuscular Mycorrhiza* (AM) were demystified, both at the production and unit establishment levels. In the role change process, the members are able to manage on their own except for market deals. Efforts are under way to involve them in the process. Also, to strengthen the local and regional marketing, the groups have engaged a marketing person and have also shared the responsibility to reach other farmers and relatives in their own village. The production process has been stabilised in all the units except for *Trichogramma* production. Though the technical component is being addressed with the support of other private units and experts, getting a suitable place for production is difficult. As market requirements and technology change, the groups need to change their production process and products. Right now there is a good scope and demand for liquid-based formulations rather than talc-based products, hence it is essential to develop simple production processes for the new technology.

Attempts have been made to identify the right partners to provide the technology and the process of simplification is being initiated.

The production details of the units are: 3,100 kg of *T.viride* and 500 kgs of *Paeciliomyces* (Bionematicide) by the *Elayathendral* group, 3,500 kg of *Pseudomonas fluorescens* by Durga group, 6,000 kg of biofertilisers (3,000 kg each of azosprillum and phosphobacteria) and 2,500 kg of VAM. To strengthen the market links, agreement has been established with Thiagarajar School of Management, Madurai, to establish viable and sustainable market links with a pilot survey for branding the products and package, collection of database of the planters' association in the hill as well as valley regions, an intensive market survey and sales campaign, training the group members on multiple marketing and developing a market report. As part of the agreement *Gramotsav,* a two-day rural awareness event with a focus on cardamom growers was conducted on the western hilly tract of the neighbouring district. It helped the women group members to establish and initiate contact with big land holders growing commercial crops.

The units have trained a farmers' group from Aga Khan Foundation, Gujarat and a team from BASIX, Hyderabad on the production processes.

With reference to the handmade paper production unit, an agreement has been signed with *Kalangium Thozilagam* Limited, Madurai, for technical and marketing support. The machinery in the unit is completely serviced and the unit is running to its full potential. The members have enhanced their capacity and efficiency in paper production and reached the amount of 500 papers per day from 150 papers in a day earlier. A full time resource person is supporting the group members in terms of production and marketing. The unit is generating around 250 labour days in a month and has established consistent market links with five reliable firms. Efforts are being made to enhance the production capacity further by adding additional infrastructure and manpower.

Sesame Seed Village

The management of the Sesame Seed Village project that was initiated in 2004 as an explorative Public-Private Partnership with Idhayam Group, Virudhunagar, was handed over on completion of the three year period to Idhayam for further development and implementation. The learning from the project has been documented and brought out as a report.

MSSRF continued with the implementation of the Front Line Demonstration (FLD) on sesame as part of the All India Coordinated Project on Sesame and Niger (ICAR) in Erode and Salem district. Thirty farmers participated in this programme (18 from Erode covering four villages and 12 from Salem covering 4 villages). 12 ha were covered under FLD from August 2007 to December 2007 and the yield performance in all cases was better under FLD when compared with the Farmers' Practice (FP). Under FP the yield ranged from 400 kg/ha to 1,100 kg/ha while under FLD it ranged from 1,100 kg/ha to 1,600 kg/ha. Net returns ranged from Rs 3,055 /ha to Rs 25,910 /ha

under FP and Rs 16,987 /ha to Rs 44,600 /ha under FLD.

402.2 Pudukottai

In Pudukottai, one of the sites under the bio-industrial watershed, the activities were concentrated on mobilisation, awareness creation, forming SHGs and federation, PRA, vegetation on catchment areas of horticultural crops and forest trees, introduction of new varieties, seed multiplication, and demonstration on optimum utilisation of available resources. In addition, details of various research studies including benchmark survey, bio-physical survey and census survey have been documented. Work on the drought tolerant red gram introduced by ICRISAT was also initiated.

Mobilization, Awareness Creation , Forming SHGs and Federation

To create awareness among the farmers regarding the importance of the BIWS and to gain their confidence, several meetings were held in the village. For the development of bio-industrial watershed with the participation of the entire community, the farmers in the village were encouraged to form SHGs among themselves; 15 of them were formed with a total savings of Rs 52,318. A Federation was formed with the office bearers of all the Small Farmers' Watershed Development SHGs.

Participatory Rural Appraisal – Meiya-goundanpatti

For the implementation of the BIWS, it is necessary to know the socio economic pattern, availability of natural resources, skills, details of HHs, agrarian structure, cropping pattern and livestock. A PRA exercise was conducted at Meyagoundanpatti and documented.

Integrated Dairy and* Azolla *Multiplication for Animal Feed

Under this scheme, an Agricultural Term Loan (ATL) of Rs 32,000 from Indian Overseas Bank has been sanctioned to each of the 15 applicants for the purchase of two milch animals and insurance expenses. To provide quality, proteinaceous fodder to the animals and to bring down the cost of the enterprise by reducing the amount of concentrate feed purchased, *Azolla* is being multiplied in small pits in the backyard by 10 HHs.

Participatory Planning for Establishment of Community Managed Small Scale Irrigation

The major problem faced by these farmers is the failure of the groundnut/paddy crop sown during *Karthigai Pattam,* due to the failure of rains during the pod/grain filling stage. If life saving irrigation could be provided to the crop at this stage, the crop could be saved. For this, rainwater harvesting was the only option as they have no access to groundwater. So, the farmers resorted to sprinkling the rainwater collected in natural storage structures in and around their fields to save the crop. The farmers identified four places where rainwater could be harvested for irrigation. They have given a schematic representation of the crops grown, expected increase in income, management of the structure, settlement of disputes, etc., The plan for the farm ponds has been worked out with the help of an engineer, covering 33 ha, including 34 farms.

Watershed Plan

The watershed plan has been drawn up, including the construction work, and is to be taken up survey number-wise.

Road map I - Watershed plan for Meyagoundanpatti watershed showing proposed sites for rainwater harvesting, supply channels, check dams, etc.

Road map II – Watershed Plan for Ennai and Thalinji watershed area, with estimates of the physical work to be undertaken. The report shows detailed descriptions of the work to be implemented in each survey number of the selected project area.

Participatory Community Nursery

A community multi-purpose nursery with the following number of seedlings *Pongamia*: 3,446; annual Moringa: 1,864; *Sesbania:* 1,189 and Papaya: 1,752 was established and the seedlings were distributed to 96 families.

Revival of Backyard Gardens

To enhance the nutritional security of the rural HHs, farmers were encouraged to revive the traditional practice of maintaining a nutrition garden in the backyard. Seeds of various vegetable crops like lady's finger, *Hibiscus cannabinus*, snake gourd, bitter gourd, ridged gourd, field lablab, etc., were distributed to 114 HHs at Meyagoundanpatti village through the Federation. In all, 74 gardens have been established and are being maintained by the women. The families are realising an average yield of 5.5 kg vegetables per month for their domestic needs.

Soil and Water Sample Collection

In all 256 soil samples and 19 water samples were collected from the villages by the team from Chennai, with volunteers from the villages assisting them. The points at which the samples were taken were marked using GPS.

Census Survey

The census survey including demography, literacy, dwelling status and land and livestock holding covered 135 HHs in Meiyagoundanpatti.

Benchmark Survey, Preparation of Master Tables and Tabulation

Benchmark survey was completed with the help of well-qualified investigators. The survey covered 35 HHs by selecting every fourth household and a master table was prepared. The data has been computerised for further analysis.

Development of Integrated Farm Pond

With MSSRF intervention, three farm ponds have been converted into an integrated farm pond. A meter to measure the water level in the pond has been installed. The bunds of the pond are being utilised for the cultivation of fodder crops and fruit bearing tress. In addition, buffalo grass and hybrid maize have been planted on the inner sides. After creation of awareness and motivation, 39 farmers came forward to implement the scheme. 26 ha of land was brought under tree cultivation and the following tree species were planted: Teak (*Tectona grandis*): 1,980; *Eucalyptus* spp.: 36,260; Red Sanders (*Pterocarpus santalinus*): 320; Neem (*Azadirachta indica*): 980;

Pongamia pinnata: 180; *Gmelina arborea*: 1,260; *Ailanthes excelsa*: 2,040; *Dalbergia* 140; taking it to a total: 43,160. More than 5 ha of rainfed fallow land belonging to SC families was brought under tree cultivation and more than 26 ha of fallow land was brought under cultivation.

National Horticulture Mission

With the help of the Horticulture Department, MSSRF has facilitated the implementation of NHM in Meyagoundanpatti village. Thirty farmers were provided with (2,190) mango and (2,291) amla grafts under the scheme. Many of the farmers are cultivating pulses like greengram, blackgram and horsegram as intercrops along with these trees.

Animal Health Camp

Animal rearing is the main occupation in this hamlet. Following an outbreak of Foot and Mouth Disease in this area, an animal health camp was conducted with the help of the Veterinary Assistant Surgeon and the animals were vaccinated. The veterinarian advised the farmers and gave them training.

Introduction of New Crops and Varieties

One of the objectives of the community managed bio-industrial watershed project is the introduction of new crops and varieties suited to the watershed area to maximise the income and meet the demands of food, fodder and fuel. In this connection the following crops and new varieties have been introduced: Sweet Sorghum SSV 84 – 0.16 ha; Red gram ICRISAT Hybrids – 2 ha; Greengram Trombay 1- 11.5 ha and adopted by 70 farmers; Bajra-Napier Hybrid (CO 3) by 20 farmers; Sunflower (CO 4) – 0.15 ha; Horticulture (Amla – NA 7, Krishna, Kanchan, Chakya and Mango – Alphonso and Banganapalli) – 25.2 ha by 30 farmers; Teak (*Tectona grandis*), *Eucalyptus* spp., Red Sanders (*Pterocarpus santalinus*), Neem (*Azadirachta indica*), *Pongamia pinnata, Gmelina arborea, Ailanthes excelsa, Dalbergia – 26.3 ha by 39 farmers;* MDU –5 Paddy (Drum seeder) – 4 ha by 7 farmers; direct sowing Paddy in 15.9 ha by 29 farmers and *Azolla* was introduced in 12 pits.

Direct Sowing of Rice

The conventional method of paddy cultivation by transplanting the seedlings is highly labour and input intensive. To overcome the problem of labour shortage during the season and also to reduce the input cost, direct seeding of rice by a drum seeder is an efficient method.

The paddy farmers of Ennai and Thalinji faced severe water and labour shortage during the regular season and hence, direct sowing was suggested. MDU 5 variety was purchased by the farmers from Agricultural College and Research Institute, Madurai. Twenty-nine farmers from Thalinji and Thattankudi hamlets of Ennai have taken up rice cultivation by this method in 16 ha.

Redgram (arhar) seed village

In order to introduce high yielding cultivars of redgram in the project area, the centre has initiated the redgram seed village project with technical input from ICRISAT. Under this project, new hybrids developed by ICRISAT has been introduced in the area and the seed

production of the parental lines is been carried out in the village with the participation of the farmers. Preliminary work towards this, in terms of mobilising farmers for a field demo has been initiated.

Sub Programme Area 403

Hill Region

403.1 Thonimalai

The geographically isolated villages of Thonimalai and Pulayar Colony in Lower Palani Hills of the Western Ghats are inhabited by *Pulayars* and *Mannadiyars.* Farming major economically important species like coffee, lemon, pepper and banana in the hilly slopes under rainfed conditions is their primary livelihood. It is supplemented by the income earned through agricultural labour during the peak season. The VKC located both at Thonimalai and Pulayar Colony impart need-based information, maintain a database on organic farming and facilitate functional literacy. The centre provides a critical link between the farmers and the Coffee Board and the Horticulture Department to access the scheme. It also informs them of the market prices of coffee, lemon and pepper from the standard markets. The centre is in the process of finalising the GIS based farmers' database to facilitate organic farming practices and market intervention. The GIS based maps are being used to plan the improved soil and water conservation structures in consultation with the Department of Agricultural Engineering at the district level.

Organic farming

The major constraint faced in commercialising the traditional farming production systems through certification is the poor quality of the produce. During the year, IMO Control Pvt Ltd, Bangalore certified 110 HHs, covering 210 ha, for coffee, black pepper, lemon, banana, orange and sour orange as 'fully organic'. Linkages have been established with potential buyers both at the national and international levels, which is a crucial part of the process. Agreements have been made with corporate companies for continuous market links. Ten potential buyers have been identified for further tie ups and the team has been getting queries for pepper and coffee.

The consistent efforts helped to market 2,000 kg of black pepper with a premium of around 40 %. This year, activities have been focused on systems for collective action, improving the harvest and post harvest processes and grading. One more observation is the prevalence of pre-harvest contracts among farmers to meet immediate financial needs. It restricts the farmer's interest in getting the benefits and an attempt has been made to promote fair practices. Appropriate remedial measures need to be ensured through the farmers' association during the pre-harvest phase itself.

Three model demonstration plots have been established in the 3 hamlets in the region and the focus areas are pest and disease management, agronomic practices such as pruning, shade management and nutrient management. During the year, around 1,050

trainee days were completed in the three hamlets on these themes.

Community based initiatives on shade management through planting adequate trees and coffee berry borer management with traps are the successful initiatives carried out during the year. Planting of around 2,000 different tree species and placing 760 traps have been adopted as a community practice. In order to enhance soil fertility, vermicomposting was introduced but results have shown that it has limited scope for replication. Effective microorganisms enabled composting practices which have has good scope for replication have now been demonstrated. In addition, the use of biodynamic soil activator BD-500 is being promoted. One SHG is continuing to produce seedlings to supply to the farmers. During the year, around 25,000 seedlings were produced. *Thonimlai Thottakalai Farmers' Association* is the key operator in the certified organic farming initiative and maintains the documents. The proposal for post harvest processing facilities has been accepted by the Coffee Board and is awaiting the release of financial support under the Eleventh Five Year Plan. As farmers are informal and do not have the necessary licenses for marketing, they face constraints while transacting with external buyers. Considering the number of farmers in this region and the cost and effort needed to maintain accounts and follow up on legal forms and licenses, it is planned to link these groups with RSGA.

Apiculture – an ecoenterprise

Apiculture has been introduced as a value addition strategy to the traditional skills of Pulayars, a forest dwelling community. Floristic survey was done before initiating the activity and 45 boxes were provided with the support of Keystone Foundation, Kothagiri. Hands-on and exposure training programmes were organised. But the group could not fill all the 45 boxes as the domestication process takes a long time. On an average, 30 boxes are being cultured and efforts have been made to change their place. A local animator is managing the unit with close technical support from Keystone Foundation and local bee growers in the hills. Goat farming was taken up as on additional income generating option and each household has planted about 20 different forage tree species.

403.2 Koraput

The BIWS programme at Koraput district was initiated during May-June 2007 with a focus on developing activities aimed at skill building in sustainable agriculture, demystification of suitable remunerative technologies and promotion of multiple livelihoods and also the use of ICT for the development of the community. Emphasis has been given to value addition, marketing and introduction of suitable medicinal crops to convert the project area into a herbal valley.

Tolla revenue village which is 24 km from Jeypore under Mahuli GP of Boipariguda block has been identified for the implementation of the project. The village is situated at latitude 18^0 - 26'- 43" N to 18^0 -28'-4" N and longitude 82^0 -11'-E to 82^0 -12' E, and has a dry sub-humid climate. The project area has 186 HHs

and a population of 674. Of these, 107 HHs with a population of 361 are tribals and 47 HHs with a population of 115 are general and the rest are SC.

For the sustainability of the grassroot institutions, human resources and financial aspects were taken into consideration. A transparent management system and governance were focused on through training, capacity building, exposure visits for cross learning and discussions for organisational sustainability, linkages and leadership building. In addition to this, need-based technical capacity building programme, were conducted and the process is continuing. Emphasis has also been given to make women participate in the programme. The institutionalisation process at the site is in the nature of revitalising and regrouping of the existing SHGs into 9 functional SHGs.

Baseline data has been collected to study the existing socio-economic condition of the community. Several awareness/mobilisation programmes were conducted to streamline and drive forward the watershed activities. A draft plan on a series of activities has been carried out by participatory rural appraisal. A watershed committee (now being named Village Development Council) has been formed, consisting of 21 members and 9 SHGs as a platform for decision making, proper implementation and smooth running of activities. Several activities were taken up at the project site during the reporting period.

Twelve water samples were collected and sent for testing. Around 200 soil samples were collected to determine the health status and sent to the IPM Lab at Chennai (See SPA 404). Twenty-five twin vermicompost units were completed with financial support from the Spices Board, Koraput for sustainable development of organic agriculture.

A study on integrated nutrient management of lowland kharif paddy was carried out with a focus on yield advantages. The experiment was carried out through different doses of three different organic fertilisers with their combination, which were given to seven farmers (5 local land races and 2 high yielding varieties) in two hamlets selected for the trial. Organic fertilisers were supplied from the project fund and FYM and labour for the trial were provided by the farmers. Yield was calculated on the basis of plants taken from one square metre area of three different places in a single field. In order to extend seed support to the poor and replicate the programme in other WS hamlets, 5 kg of runner bean seeds as early winter crop were given to 18 HHs of the WS area

Onion was cultivated in 1.2 ha to introduce a new variety; 10 kg of onion seed was supplied to 25 farmers. The seeds were procured from a private source; the beneficiaries have contributed 5 % of the cost of the seeds. This year, farmers have planted it as mixed crop in the vegetable field. It is planned to increase the acreage in the coming year.

In rain-fed areas, alternative land use system (rice-potato system) in upland paddy is a key for sustainable agriculture. In this system, the succeeding crop will get the advantage of the

residual remains of the succeeding crop as organic manure. Considering all components such as soil depth, slope and available resources, potato cultivation was promoted as a cash crop to accelerate farmers', income.

The Water Shed team made the villagers (both land holder and landless) aware of the importance and relevance of vermicompost in sustainable agriculture by conducting several meetings at the village level. Landless people were also included as this activity of selling vermicompost and worms can partially support their livelihood. The decision was taken by the community to cover all the HHs with vermicompost production units.

As per the decision taken by the Committee, 2 diesel pumps (2 HP) were supplied to the groundnut grower groups for raising 18 ha of crop. The crop was grown organically and aspects of seed treatment, application of gypsum and other crop care technical support was provided. A total of 55.78 ha was covered by rabi vegetables in the watershed area, of which 6 ha was covered through the central community nursery. The farmers of Malliguda village are traditionally vegetable growers. So, technical support was extended along with a supply of quality vegetable seedlings to these farmers for growing vegetables organically.

Mushroom requires simple technology and paddy straw as strata or bed. As it requires less land and indoor work, it gives good employment opportunity to landless labourers, destitute women, unemployed youth and even school-going children. Mushroom production helps in utilising agricultural waste and recycling of biomass. Mushroom is rich in protein. Therefore MSSRF has promoted mushroom cultivation through a WSHG of Bebartaguda in the bio-industrial watershed. After conducting meetings with the SHG, the WS staff facilitated the group to take up mushroom cultivation in the bio-industrial watershed area. In view of its prospects training on mushroom cultivation was given by the experienced technical staff and also through the Nuaguda SHG who have been doing it for 3 years. One concrete tank was constructed for straw wash and treatment from the project funds at a cost of Rs 1,000. A temporary (*kachha*-mud) thatched house was constructed by the SHG to keep mushroom beds in the shade and maintain temperature. All the operations during cultivation will be managed by the SHG.

Efforts were made to activate the Community Seed and Grain Bank (CSGB). As the watershed project is going on in this village, it was discussed with the community. They have shown interest in reviving and regularising the CSGB in their village. This is also one of the major components of the WS project, which needs to be activated, so that the people will be benefited, particularly during the lean season and is being addressed.

In the watershed village pipla is cultivated by 5 farmers belonging to one family, in an area of 4 ha. It is understood that pipla is a paying crop and there is a potential market for the root in AP. They get a net profit of Rs 50,000 per acre if proper care is taken. The crop is grown organically. However, the only disadvantage is

that the harvesting of the crop starts after 3 years of planting; the crop will continue to yield for more than 12 years, with harvesting every year during December-January. Efforts were made to persuade other farmers to take up pipla cultivation, but they declined. There is scope for making the WS valley a herbal pipla valley because of its suitability to the area and market potential. Efforts will be made to cultivate this crop with WS project support.

Twenty-six User Groups (UG) have been identified for implementation of the soil and water conservation project. Various soil and water conservation measures against depletion have been identified, with detailed estimation of costs. A check dam at Bebartaguda hamlet is at the final stage of earthwork. Plantation has commenced as a measure to check soil erosion and *in situ* moisture conservation.

Training and Capacity Building: 221 training days were organised on various aspects of on agriculture, horticulture, INM / IPM to the watershed dwellers, SHGs and watershed management team. Three exposure visits were conducted, one to Western Orissa Rural Livelihood Project (WORLP), Kalahandi, to build awareness, resources and skills.

Networking institutions: During the process, the Government line departments were approached for accommodation of the watershed activities. Village level workshops and meetings were conducted to leverage micro-credit facilities for the development of entrepreneurship and livelihood programmes.

Sub Programme 404

Land - Lab-Land Linkages

The two labs which come under the Centre at Chennai, the INM (microbiology lab, See SPA 305) and the IPM provide support for ecotechnology development and the adoption of biological software (biofertilisers, biocontrols etc) in the farmers' fields. They also conduct soil testing to provide the data to develop the soil health card for the farmers at the sites where on-farm interventions are being carried out under the Centre's programmes. The work done by both the labs has been highly commended by the review team which recommended that laboratory facilities should be upgraded and modernised as the Centre should retain, over time, its competitive edge in this area.

The details for the INM lab is reported under PA 301 under section SPA 305 and the one on IPM is reported in the following paragraphs.

The IPM laboratory at Chennai focused on the biological control of red flour beetle *Tribolium castaneum* using entomopathogens *Beauveria bassiana* and *Paecilomyces lilacinus*. Mass multiplication of entomopathogens and spawn production were standardised. A training programme for farmers on pest and disease management was conducted. The chemical, physical and biological properties of the soil samples collected from different parts of Pudukottai, Puducherry and Jeypore under the bioindustrial water shed programme were analysed and soil health cards were prepared based on the soil analysis.

***Biological control of entomopathogens against red flour beetle: Efficacy of* Beauveria bassiana *and* Paecilomyces lilacinus *against different stages of* T. castaneum**

Grub

The antagonistic activity of *B. bassiana* and *P. lilacinus* at different spore concentrations was assessed on the developmental stages of grubs *viz*., pupation (%), grub duration (days), pupal duration (days) and adult emergence (%). Least pupation of 16.66 % was observed in grubs treated with *B. bassiana*, at a spore concentration of 2.4×10^7 and 2.4×10^6 spores/ml followed by 20 % in 2.4×10^5 spores/ml. The reduction in pupation ranged from 70 to 83.33 % at different spore concentrations of *B. bassiana* whereas maximum pupation (100 %) was observed in the controls (distilled water and Tween 80). In addition to mortality, reduced feeding, sluggishness, prolonged grub duration, grub-pupal intermediates and grub shrinkage were observed and the pupal duration was increased by 1.9 days in grub treated with 2.4×10^7 spores/ml as against controls (4.3 days). Further disruption in metamorphosis was observed, which resulted in higher degree of malformed/dead adults. The adult emergence was nil at all spore concentrations tested except for 4.76 % in 2.4×10^6 spores/ml of *B. bassiana* and 66.66 % for 0.006 % (v/v) cypermethrin treatment. The adult emergence was normal (100 %) in controls *viz*., distilled water and 0.02 % (v/v) Tween 80.

The grubs treated with *P. lilacinus* at 2.9×10^7 resulted in a pupation of 20 % which was the least as against the control (100%). The infection was confirmed by re isolation of the pathogen from the surface of dead infected grub. Different spore concentrations of *P. lilacinus* tested did not have any impact on the larval development but the pupal duration was prolonged by one day (approx.) in those grub treated with 2.9×10^7 and 2.9×10^6 spores/ml as against control. Forced pupation and adult emergence were noticed in 0.006 % (v/v) cypermethrin treatment.

The malformed /dead adults were 50 and 16.66 % in 2.9×10^7 and 2.9×10^6 spores/ml treatments respectively. Except for this, the adult emergence was normal (100 %) in all other spore concentrations of *P. lilacinus* as well as in controls.

Pupa

The pupae treated with *B. bassiana* and *P. lilacinus* were assessed for various parameters such as pupal mortality (%), pupal duration (days) and adult emergence (%). The pupa treated with *B. bassiana* showed an increase in pupal mortality with increasing spore concentration. The maximum pupal mortality of 36.6 % was observed with 2.4×10^7 spores/ml followed by 26.6 % in 2.4×10^6 and 2.4×10^4 spores/ml. In general the pupal duration was prolonged (6.5 days) in the highest spore concentration (2.4×10^7 spores/ml) as against control (distilled water) (4.05 days). Malformation was observed among the adults which varied from 15.8 to 31.7 % with different concentrations of 2.4×10^3 to 2.4×10^7 spores/ml.

The percentage of pupal mortality was 53.3 and 43.3 % in those pupae treated with 2.9×10^7

and 2.9 x 10^6 spores/ml of *P. lilacinus* whereas 40 % was observed with 2.9 x 10^5 to 2.9 x 10^3 spores/ml.. The malformed or dead adult (30.0 %) was observed only in the highest spore concentration. (2.9 x 10^7 spores/ml) which was on par with 0.006 % (v/v) cypermethrin (28.3 %) whereas in all other spore concentrations no malformation or death of adults was observed.

Adult

The mortality of adults treated with different spore concentrations of *B. bassiana* and *P. lilacinus* at different exposure time was recorded. The results obtained indicated that, in general, the adult mortality (%) increased with the increase in the period of exposure and spore concentration. Maximum and minimum mortality of 21.6 % and 6.66 % respectively was obtained with those treated with 2.8 x 10^7 and 2.4 x 10^3 spores/ml of *B. bassiana* for 20 seconds. The mortality of adults increased in all the concentrations except for 2.4 x 10^5 spores/ml with increasing exposure period from 5 sec to 20 sec. Mycelial growth (white fluffy) was observed over dead infected adults. Similarly in adults treated with *P. lilacinus*, the mortality (%) increased with increasing exposure time in all the spore concentrations, which was recorded as 10.0 to 41.6 % with 2.9 x 10^7 spores/ml. The reduced mortality of 10.0 % was observed in those treated with lesser spore concentration of 2.9 x10^3 spores/ml.

Mass multiplication of entomopathogens: Growth kinetics in liquid medium

The growth kinetics *viz*., radial growth, sporulation and biomass of the two fungi, *B. bassiana* and *P. lilacinus* in eight different culture media *such as* Emerson YPSS agar (EMYPSSA), Sabouraud dextrose agar (SDA), Sabouraud dextrose agar + 1 %(w/v) yeast extract (SDAY), Potato dextrose agar (PDA), Potato dextrose agar +1% (w/v) yeast extract (PDAY), Yeast peptone glucose agar (YPGA), Czapek's agar (CDA) and Sabouraud malt yeast peptone agar (SMYP) was estimated.

B. bassiana: Among the different media used, PDAY supported the maximum radial growth (62 mm) which was on par with YPGA (60 mm). This was followed by 58 mm on PDA alone. The least vegetative growth (35 mm) was observed on EMYPSSA. The sporulation was highest on PDA (22.3 ×10^6 spores/ml) followed by PDAY (18.4 × 10^6 spores/ml). On CDA and EMYPSSA, mycelial growth was extremely sparse and least spore production of 6.2 ×10^6 and 3.3 ×10^6 spores/ml respectively were observed.

P. lilacinus: *SDAY supported the maximum* radial growth of *72 mm,* followed by SMYPA (66 mm). CDA resulted in the least radial growth (45 mm). The spore production of 24.6 × 10^6 spores/ml was favoured by SDA and it was followed by 19.8 × 10^6 on PDAY. The least sporulation of 4.3 × 10^6 spores/ml was observed on EMYPSSA.

Mass multiplication in solid substrate

The substrates (rice, sorghum, barley, groundnut, potato, beetroot, carrot, sawdust and paddy straw) for mass production were used in four different conditions with three replications each as follows. The first set of

treatment was supplemented with 2 % (w/w) sucrose (A), the second set with 1 % (w/w) yeast extract (B), the third set with 2 % (w/w) sucrose and 1 % (w/w) yeast extract (C) and the fourth set served as the control without either sucrose or yeast extract supplementation (D).

The observations on spore count per gram of the various substrates used for mass production of *B. bassiana* and *P. lilacinus* were made on 10 and 20 DAI. The results in general indicated that the production of conidia increased with the increase in incubation time.

The addition of 1 % (w/w) yeast extract (YE) in all the substrates enhanced the sporulation of *B. bassiana* against the control. However, the addition of 1 % YE to paddy did not have any influence on the sporulation. Among the grains tested, the maximum sporulation of *B. bassiana* was observed on rice supplemented with 1 %YE (117.0 x 10^8spores/g). The least sporulation was observed on sorghum in all the four conditions.

In contrast, maximum sporulation of *P. lilacinus* was observed on barley (55.2 x 10^8 spores/g) supplemented with 1 % (w/w) YE. Among the tubers, beetroot favored highest sporulation generally in all treatment, followed by carrot and potato for both the fungi. No significant increase in spore production of *B. bassiana* was observed in the substrates supplemented with 2 % (w/w) sucrose except for rice, groundnut, carrot and sawdust; the addition of 1 % (w/w) YE + 2 %(w/w) sucrose enhanced spore production only on rice, sorghum, beetroot and sawdust against the control for *B. bassiana* whereas sorghum, groundnut and straw for *P. lilacinus*.

Mushroom spawn production: Standardisation of the protocol for the production of healthy spawn to support mushroom cultivation in the Biocentre was carried out. The process was standardised as follows: 250 g of sorghum grain was washed thoroughly in fresh water to remove the chaff and other impurities, soaked overnight, boiled for 10 minutes to soften the grain and washed with cold water. The excess water was removed by drying the grain in the shade, adding calcium carbonate @ 10 g/kg and sterilised in a cooker for 120 minutes. Ten discs of 9 mm pure culture *Pleurotus florida* was inoculated per 250 g packet under sterile conditions and incubated at 23 ^{0} ± 2 ^{0}C for 15-20 days to attain the full growth. Fifty packets of oyster mushroom spawn of 250 g each were supplied to the Biocentre. In addition to mother spawn, pure cultures and bed spawn of *Pleurotus florida* are maintained in the laboratory.

Field Trials

Support to organic farming at Thonimalai by way of field survey, and identification of pests and diseases, was provided. The major pests and diseases observed and the IPM practices followed at Thonimalai are given below.

Coffee berry borer: 150 berry borer traps have been installed anticipating the emergence of CBB covering 25 acres of Robusta. 16,000 adults have been trapped.

Banana pseudostem weevil: During the first inspection, 85 out of 245 trees in 2 fields were infested with banana pseudostem weevil. Prophylactic pseudostem injection of neem oil coupled with soil application of neem cake was carried out to prevent the incidence of banana pseudo stem weevil. 146 pseudostem traps + 2.6 kg of *B. bassiana* pasted traps were installed.

Pepper quick wilt: During the first phase of scouting (May-June), out of 1,332 vines in 2 fields 238 vines were found to be infected with wilt. 71 kg of *T. viride* was distributed /applied covering nearly 38 ha of 34 farms.

Training

Training on the management of secondary pest infestation in *Corcyra* production (50 trainee days) at Kannivadi and on IPM of pests and disease of paddy for Karasanur farmers – Watershed Project (31 trainee days) was organised. The major pests and diseases of paddy, its life cycle, damage symptoms and integrated management practices for these problems were explained to the farmers. This was followed by a field visit where the farmers were taught to differentiate between pests and diseases as well as beneficial insects as measures of plant protection.

Soil analysis for sustainable agricultural practices

One hundred and forty eight soil samples from Chidambaram were analysed for organic carbon. 122 soil samples from Thonimalai and Nagapattinam were analysed for pH, electrical conductivity, organic carbon and macro nutrients (N, P and K). Sixty-seven water samples from Jeypore and Puducherry were analysed for pH, electrical conductivity, anions, cations, SAR and RSC.

Soil analysis and preparation of soil health card

Crop production depends on a well-balanced nutrient status and need-based application of fertilisers to attain the expected maximum yield. Hence it is the need of the hour to develop a soil health card, which would out the complete profile of nutrient status of the soil based on which the fertiliser recommendations would be made. The various physical, chemical and biological properties were analysed. However the amounts and kinds of fertilisers required for the same crop vary from soil to soil, and high crop yields can be obtained by applying the required fertilisers in the required dose to overcome existing deficiencies. The recommendation for the application of fertilisers is based on the results of the soil-testing and up-to-date agronomic research on the crop. With these concepts, the soil testing for the proper recommendation of the use of fertilisers was carried out for the different sites under the water shed programme.

Antifungal activity of actinomycetes and bacteria against plant pathogens

The antifungal activity of the microbes isolated from soil (bacteria and actinomycetes) was studied against the selected plant pathogens (*Rhizoctonia solani, Helminthosporium oryzae, Curvularia lunata, Fusarium oxysporum* and *F. udum*). The study showed that two isolates (Act-8 and Act-10) have strong activity against most of these pathogens with maximum

inhibition of zone diameters ranging from 1.1 cm to 1.5 cm. A few isolates showed minimum inhibition of <0.8 cm.

The *in vitro* biocontrol activity of the bacteria isolated from the soil samples exhibited good activity against rice pathogens *viz*., *R. solani* and *H. oryzae*. Most of the strains isolated were identified as *Bacillus* spp. Out of the 36 strains, 20 showed positive antagonistic activities.

Sub Programme Area 405

Climate Change Initiatives

405.1 Vulnerability Assessment and Enhancing the Adaptive Capacity to Climate Change in Semi-Arid India

Implementation of various adaptation-related interventions such as lining of irrigation channels, revival of traditional system of irrigation, weather based-farming, treatment of alkaline soil, promotion of energy-efficient stoves, establishment of fodder banks, and common pasture development were carried out in the project sites Udaipur in Rajasthan and Mehabubnagar in AP with community participation.

One of the major highlights is the development of a monitoring framework and identification of suitable indicators for monitoring various activities. The monitoring framework provides an overview of the activities and how they will be operationally supported.

The project consortium entered into an understanding with local agricultural universities in Rajasthan and AP to help monitor the functional aspects of the agro-met observatories established in different project sites and advice on utilising the data generated locally. The trial run of the prescribed cropping mix suggested for both rabi and kharif seasons are being carried out.

Various capacity building activities, including training of women masons in the construction of efficient stoves, SRI method of cultivation, and ground water monitoring, were carried out. There was a sustained focus on awareness-building on climate-related issues in the project sites.

To implement the mandate on improving the delivery system, a scoping exercise was undertaken by the project partner, MANAGE along with the consulting agency Winrock India, to take stock of the various extension-related courses and curricula offered at the national level, to develop and introduce specific modules providing information on the cause and effects of climate variability and change, as well as possible adaptation remedies.

Joint Implementation Group, which is an internal mechanism set up to monitor and discuss all project-related problems, functions as an active forum to develop a cohesive vision and shared sense of direction. It undertook an internal assessment of lessons learnt so far and discussed the road map for the upcoming State and National Policy workshops.

The media workshop was organised for young journalists from South East Asian countries,

at which about 15 selected journalists were introduced to various concepts and themes by experts associated with the project and taken to the field sites to have first hand information about adaptation through interaction with the communities. This program received wide coverage in international newspapers especially in the articles that appeared as a prelude to the 13th Conference of Party meeting held in Bali in December 2007.

The dialogue on "Community Management of Climate Change: The Role of Panchayats and Nagarpalikas" (See SPA 606), brought together about 50 participants, including panchayat leaders, sectoral experts, lawyers, policy makers, NGOs and media persons, to deliberate on the needs, possibilities and future avenues in climate risk management. The dialogue focused on the perceived risks of climate change, available options at the local level for pro-active action and modalities to develop a simple regulatory framework to handle climate related issues at the local level. The deliberations resulted in a Draft Model Act for Local Level Climate Risk Management. The draft act covers food security, energy security, non-farm employment, human diseases, carbon trade opportunities and climate literacy issues. A small review group has been constituted to take this further.

The project's focus has shifted now, from seeing the project off the ground to following the useful lessons learnt through capacity development and knowledge sharing supports.

405.2 DFID - Policy Innovation Systems for Clean Energy Security

MSSRF is one of the key partners of the five member international Research Program Consortium (RPC) floated by DFID, UK, to conduct research on replicable bioenergy technologies, assess the relationship between impacts of climate change and bioenergy use, and provide capacities at different levels in related aspects. The focus of MSSRF is on how climate change is likely to affect bioenergy provisioning and how to respond to the challenges of sustainable energy security.

As a part of the inception phase, MSSRF has started gathering secondary data, particularly on the various types of bioenergy and their utility, general policy scenario with respect to bioenergy in India, available technologies, the predominant bioenergy crops and the profile of the locations where bioenergy crops are cultivated. Several linkages have been established with institutions responsible for implementing state level energy policies, farming communities actively involved in the cultivation of bioenergy crops, and market sources. Several site visits have been undertaken to understand the various aspects of the bioenergy production cycle.

Project staff participated in two major workshops convened to develop a monitoring framework for the project activities and designing a good communication strategy for disseminating periodic information about the project at various levels. The first annual review meeting of the project took place at Dar es-Salaam, Tanzania.

Sub Programme Area 406

Designing Rural Technology Delivery Systems for Mitigating Agrarian Distress

This is a research study, the main focus of which is to design an effective technology delivery system in areas that are currently experiencing a severe agricultural crisis. Since the mid 1990s it has been particularly severe on the small and marginal farmers cultivating cash crops in the rain-fed regions of the country. The factors underlying this crisis are complex and manifold. The major factors relate to the nature of the economic strategy pursued by the state, although there are several institutional, technological, ecological, and weather- related factors. In this study, the concern is to analyse one dimension of the problem facing Indian agriculture, namely, the technological dimension. Technological dimension is defined in a very broad sense, as covering an entire bundle of techniques and steps that are required to improve and stabilise crop yields. It encompasses a wide spectrum of factors relating to crop production, including the nature and quality of the agricultural inputs used, the type of crop protection practices followed, the kind of agents used for protection, the overall management practices adopted in cultivation, including irrigation practices, and technology delivery.

The major objectives of the study are:

- to analyse the constraints faced by farmers in the adoption of technology related to crop production;
- to critically examine the technology delivery system that is in place;
- to provide an action plan for a suitable technology delivery mechanism.

An acute manifestation of the current crisis in agriculture is the persistence of suicides by farmers in some regions. From among the 'distress' districts identified by the Government of India in this context in the states of Maharashtra and AP, the study proposes to examine the technological issues related to the agrarian crisis in two districts, one each from the two states. The district of Wardha in Maharashtra and the district of Anantapur in AP have been chosen for our study.

To analyse the set of available technologies for crop production and processing, and understand the constraints in the prevalent system of extension, detailed interviews with farmers as well as experts in various research institutions will be held. The survey will focus on the various aspects of crop cultivation and management and the role of agricultural extension, to ascertain the constraints faced by the farmers. An attempt will also be made to study in detail the practices adopted by farmers who are successful, that is, farmers who are often referred to as 'model' farmers. This is expected to sharpen our understanding of factors that have contributed to their survival and success, even while a vast majority is affected by the widely prevalent distress.

Given the above framework and methodology, the 2-year study will be completed by June 2009. Since July 2007, we have been engaged in surveying the literature and have undertaken field visits to Wardha. We have carried out intensive qualitative surveys among farmers across different size classes in two villages in two different taluks.

The preliminary investigation into the technological dimension of agricultural distress has revealed a number of contributing factors such as:

- Degradation of natural resources including land degradation, soil erosion, and decline in soil fertility and ground water table;
- Drought and erratic rainfall pattern;
- Pests and diseases;
- Spurious inputs and unavailability of inputs at the appropriate time;
- An almost complete absence of agricultural extension services in the public domain.

The intensive qualitative surveys have revealed that there is a striking difference in cultivation practices among different classes of farmers, particularly with regard to the input use, the quantity, timing, and application methodology, awareness about good farm practices, the yield rate of crops, the holding capacity of harvested produce, and access to market intelligence. Our survey also substantiates the observation made by many other researchers that the small and marginal farmers had the twin handicap of poor quality of soil and lack of irrigation facility. The location of their cultivable land was another factor which added to their vulnerability; the lands were located closer to the hills and forest areas, rendering their crops a frequent target for wild animal attack. A total lack of access to extension service was noticed across all classes of farmers.

Programme Area 500

Food Security

Concerted efforts were initiated to ensure the sustainability of the Community Foodgrain Banks. The findings of the field studies on the nutrition status were shared with the community at Wayanad and Orissa to sensitise them and promote positive action. The National Nutrition Conclave outlined the measures needed for a 'Nutrition Secure India'. Both research study and field interventions in Orissa and TN sought to establish and promote the cultivation and consumption of millets as a nutritious cereal. An initiative for empowerment of women farmers– 'Mahila Kisan Sashaktikaran' *- was launched in Vidarbha.*

Programme Area 500

Food Security

Research on sustainable food and nutrition security is being undertaken by the B V Rao Centre for Sustainable Food Security and the Ford Foundation Chair for Women and Food Security. The initiatives in Vidarbha are also coordinated under this programme area.

Sub Programme Area 501

B V Rao Centre for Sustainable Food Security

Research, field interventions on food and nutrition security, training and capacity building, evaluation studies, advocacy, and dissemination, formed the focus of activities during the year. The Centre also collaborated with other Programme Areas on some special projects and conduct of national consultations.

501.1 Report on the State of Food Insecurity in Rural India

The study, based on the latest data of the National Sample Survey Organisation (NSSO) and National Family Health Survey (NFHS) and the last Census, examines the state of food insecurity in the country and undertakes a critical evaluation of the food policy measures in the country over the years. States are ranked on the basis of a chosen set of indicators and a composite food insecurity index is developed to show their relative positions. Maps have been developed for each of the indicators as well as the composite index, to show the position of the states in the ranges between highly food insecure to food secure. The thrust has been on outcome indicators with four of the seven indicators chosen being outcome indicators –

- Percentage of population consuming less than 1890 Kcal (NSSO, 1999-2000, 2004-05)
- Percentage of HHs without access to safe drinking water (Census 1991, 2001)
- Percentage of HHs without access to toilet facilities (Census 1991, 2001)
- Percentage of ever-married women with any anaemia (NFHS-2, 1998-99, NFHS-3, 2005-06)
- Percentage of ever-married women with Chronic Energy Deficiency (NFHS-2, 1998-99, NFHS-3, 2005-06)
- Percentage of children (6-35 months) with any anaemia, (NFHS-2, 1998-99, NFHS-3 2005-06)
- Percentage of children (6-35 months) who are stunted (NFHS-2, 1998-99, NFHS-3, 2005-06)

Data has been compiled for two time periods, 1998-2000 and 2004-2006, and a comparative picture drawn to highlight changes in trend and in the relative positions of the States on the Food Security scale if any.

The report also analyses, the state of the public food delivery systems, *viz.* Public Distribution System (PDS), Mid-day Meal Scheme (MDMS)

and Integrated Child Development Services (ICDS) were taken up for in depth study and analysis.

The main policy recommendations of the report are in the following areas:

- Initiatives needed to address the food availability issue - enhance production by enabling small farmers' production
- Measures for ensuring livelihood security; NREGS – a step in the right direction
- Expansion of MDMS and universalisation of the PDS and ICDS to ensure access
- Appropriate investments in public healthcare and nutrition education to address the issue of absorption.

The Report of this study will be released by the end of the years.

501.2 Community Foodgrain Banks

An evaluation of the impact of community foodgrain banks was undertaken in six villages in Koraput and Kalahandi districts of Orissa and two villages in Kalrayan Hills, TN. This was based on a sample household survey with a structured questionnaire and focus group discussion done by field staff in 2005-06. The main finding is that while grain banks serve the purpose of helping to tide over the immediate food scarcity and positive qualitative changes are observed, capacity building and community ownership are very crucial to ensure sustainability. The reports are being finalised.

A similar observation was also made by the in-house review undertaken in July 2007 of the 23 community gene-seed-grain banks set up by MSSRF under different projects across Koraput, Kalahandi and Kandhamal districts between 1999 and 2006. MSSRF does not have a direct presence anymore in Kalahandi and Kandhamal districts. Lapses were observed to have crept in over a period of time, with defaults in repayment, conflicts, poor management of storehouse and lack of follow-up for repayment. Illiteracy and consequent poor record keeping were a common problem. Following the visit and discussions with the village community, cluster level volunteers have been appointed in Koraput district to help oversee the operation of the grain banks in areas where we have a presence, covering nine grain banks in the process. Follow-up and monitoring are being done with assistance from field staff across different projects, to ensure that the community's capacity to utilise the initiative to its benefit is developed. One-time assistance is also being provided where needed, for repair of grain bank storehouses with community participation, to revive the momentum.

Local NGOs like *Antyodaya* in Kalahandi, have been requested to assist in areas where we no longer have a presence. A one-day workshop on record keeping was organised in September for all the grain bank committee members and volunteers. Simplified registers have been introduced for easier maintenance of records (see SPA 202.3).

In TN likewise, a visit to Kalrayan Hills in January 2008, after a year, revealed few

lacunae in operation. Unlike in Orissa, where the entire hamlet is involved, the banks in Talvellar and Melvazhapadi are being managed by SHGs. Steps are now being taken to involve the entire community and the Panchayats and discuss the need for CFBs and their management.

The review also brought out the need to have a long-term focus beyond the life of a project in areas where project-based initiatives are started, and build a withdrawal strategy into the approach.

501.3 Community Fodder Banks in Ladakh

Support was given to a Leh based NGO, CENSFOOD, for starting fodder banks in two villages in 2004-05, in the Changthang valley of Ladakh, where the nomadic pastoral community resides. Livestock mortality is high during the winter months due to lack of proper shelter and food. Following an emergency request late last year, funding was provided for the purchase of tarpaulins to provide shelter for the livestock in Kharnak village.

The feedback received from CENSFOOD is quoted below –

"Fortunately this winter, under our intervention, the people of Kharnak had themselves stocked feed as per their individual capacity topping up our stocking. The supply of tarpaulins in November 2007 to be used as animal shelter was indeed very timely. This helped to sustain the livestock through the long severe winter without any unusual high mortality till date. As per feedback received from the nomads of Kharnak, had it not been for our support, at least fifty to sixty percent of the livestock would have perished. The people recall how sixty to seventy per cent of flock / herd of livestock perished under such natural calamity some ten years back".

501.4 Nutrition Security Initiatives

The nutrition security initiatives fall under three broad categories namely, research-based interventions, academic work and advocacy initiatives.

501.4.1 Research-based interventions

Nutrition Intervention in Orissa: The intervention to improve infant feeding practices in Orissa as part of the PAN MSSRF initiative followed the results of the diet survey conducted earlier in 76 HHs from three project villages to assess the food practices and nutritional status of children under three. With regard to household food practices it was found that food was cooked twice a day but consumed thrice a day. Rice and ragi were the staples. Ragi porridge was made in the morning and eaten before lunch. Very often it was consumed in the evenings also. Twenty four percent of the families had the habit of drinking morning tea. While 8 % had tea with milk, 15 % took black tea. Since there was no practice of drinking curd or milk-based products, it was concluded that milk was not a major food item. Ninety seven percent of families had cooked and eaten vegetables on the day of the survey. Thus besides rice and ragi, vegetables form an important part of the diet. Seventy four percent of HHs had cooked

potatoes, 34 % had used tomatoes, 29 % had cooked brinjal, 21 % had cooked country beans and 18 % had cooked jackfruit. Only 3 HHs had cooked leafy vegetable. Eighty four percent of HHs had a domestic animal. However they were meant for economic purposes and not for domestic consumption.

In the overall sample 37 % of children were infants, while 42 % were between one and two years. Twenty one percent were in the age group of two to three years. Sixty three percent of the children were males while 37 % were females. Forty six percent of the children were normal while 54 % were malnourished. Since feeding and healthcare practices hold the key to improving the nutritional status of young children, an intervention campaign for infant and young child feeding was mooted. As a first step, a nutrition literacy workshop was held for the community members of Gunthaguda and Nuaguda hamlets and Bolliguda village at Jeypore on May 9 and 10, 2008. The objectives of the workshop were to help participants understand the concept of nutritional status, help them reflect on the critical periods in the life cycle with special focus on infancy, sensitise them about infant feeding practices and the nutritional status of children and assess the prevailing scenario in their own villages, shortlist critical messages in infant feeding, strategies for taking them forward and action for establishing monthly weighing of children through ICDS.

It was a multi stakeholder workshop, including both men and women. The thirty participants consisted of parents of young children from the surveyed HHs, traditional birth attendants, members of SHGs, community grain banks and village development committee, MSSRF volunteers, ASHA volunteer, *anganwadi* worker, village health nurse and street theatre artists. Participatory methodologies such as group discussion, role-play and activities were used. The workshop was structured to enable participants to undertake a critical self-exploration and exhibit their knowledge, skill and talent. Care was taken to provide space for different perceptions and view points and to encourage team spirit. The participants identified six messages considered critical to infant feeding, which were:

- Breastfeeding should begin within the first hour of birth
- First milk should be given
- Only breast milk to be given for six months and no other food
- Complementary feeding should begin by introducing home foods such as ragi and rice *kanji* after six months alongwith breast milk
- The child should be fed atleast four to five times a day
- The density of the food should increase as the child grows older.

They composed two songs containing these messages and agreed to take it forward into their communities. They also decided to join hands with mothers in the villages and ICDS to initiate monthly growth monitoring of all children below six years.

Following the workshop a dialogue was organised on 12 May 2008 with the workshop participants and Government functionaries on the food and nutrition security situation in the project sites in Orissa. The objective of this exercise was to provide an interface between the community and the public delivery system. The workshop focused on the current initiatives of MSSRF with regard to food and nutrition security and the rights and entitlements of the community under the various schemes of the Government.

Nutrition Intervention in Wayanad: The research report on 'Family food habits and nutritional status of mothers and children below three years in selected *Paniya* and *Kattunaikka* tribal colonies of Wayanad' was finalised and the findings were shared with members of the community and local government bodies at seven stakeholder meetings. The stakeholders were mothers, officials of the ICDS, tribal leaders and Panchayat representatives. As a result of this intervention, an ICDS centre has been opened at *Poonkuzhi Kattunaikka* colony and the ward member has formed a committee to oversee the distribution of ICDS supplement to the target families. In addition, 125 HHs of *Paniya, Kattunaikkas* and *Kurichiya* tribal HHs have been supplied with traditional and wild varieties of 1,125 kg of *Dioscorea alata, 400 kg Colocasia esculenta*, 250 kg of *Amorphophallus companulatus,* leafy greens, 7 varieties of plantain and 3 varieties of *Ipomoea batatas*. The yield and consumption patterns of the harvested products have been surveyed and are being analysed.

501.4.2 Enhancement of Nutrition Curriculum

Following up on the brainstorming workshop held in March 2007 reported in last year's Annual Report, the second workshop for enhancing the curriculum for the undergraduate course in Nutrition was held for two days at Kizhakarai in Ramnad district in September 2007 under the auspices of Thassim Beevi Abdul Kadar College for Women. The workshop participants discussed the definitions of the term nutrition, the scope of the syllabus in today's context, the core subjects and their subsidiary papers, existing lacunae in transacting the curriculum and the role of professional bodies. A conceptual separation was made between the study of foods and the study of nutrition at the undergraduate level. The group felt that while the usual nomenclature of 'Food and Nutrition' included both the physical aspects of food as well as its interaction with the human body, the former had nevertheless emerged as a fully grown discipline needing to be offered as a separate undergraduate course. Hence Food Science and Quality Control should be the subject of a three year B.Sc programme. Since the term nutrition encompasses the biological, social and environmental aspects it was thought appropriate to rechristen the term nutrition as 'Nutrition Science'. Nutrition Science would include the disciplines of dietetics and community nutrition.

The issues having implications for curriculum enhancement were identified as follows:

- There was a preponderance of biological aspects in the current curriculum in general

with little scope for social and environmental dimensions or policy issues

- While a good theoretical base was essential, practical exposure even at the UG level was equally important. Besides good laboratory facilities, the institutions needed to have linkages with the industry (for food science and quality control), the hospitals (for dietetics) and with NGOs and Government (for services).
- Institutions could offer any one of the branches of specialisation in the final year depending on the facilities available.
- Rural institutions had more difficulties with regard to enrolment of students, getting appropriate teaching faculty, library and laboratory facilities.
- Refresher training would be necessary for the teaching faculty if new courses are introduced.

The scope of the content under the broad heads of nutrition sciences and food science and quality control was worked out and the participants agreed to share the task of enhancing the curriculum. They could co-opt other colleagues, nutritionists and professionals.

The third workshop held in March 2008, saw the participants sharing the homework and discussing at length the reworked syllabus for the undergraduate course in Food Science and Quality Control and of Dietetics under Nutrition Sciences. It was agreed at this juncture that the first two years of study at the undergraduate level should expose the student to all branches of nutrition sciences such that the student would be able to opt for a major paper in the final year. A new paper on Sports Nutrition was suggested for inclusion. While the content was discussed at length, the system of credits, major and allied papers as well as electives were worked out. Practical work for students included project work, writing a term paper and seminar presentations. It was agreed that the curriculum would be finalised by the group at the end of June and distributed to a wider audience for critiquing by the end of August.

501.4.3 Advocacy

The high levels of undernutrition among Indian women and children paradoxical with a burgeoning middle class and increasing growth rate is a matter of serious concern that has generated a lot of debate in the country as a whole. It was to discuss how to achieve nutrition security that a National Nutrition Conclave was organized from 12 to 14 August 2007 (see SPA 606 for details). About 100 participants drawn from interdisciplinary fields of agriculture, nutrition and social sciences representing academia, NGOs, Government, corporate sector, civil society organisations and donor agencies participated in the brainstorming. The conclave adopted the participatory technique of Open Space Technology to have indepth discussion on critical issues. There were 36 working groups on the first day which deliberated in depth on the chosen themes. On the second day, participants identified ten key recommendations as essential to nutrition security, some of which were integrating nutrition on the

national agenda, preparing a national strategy for children under two, preparing a white paper on nutrition, focusing on the urban poor, improved monitoring of nutrition programmes and undertaking nutrition education, communication and awareness. As a follow up of the conclave, USAID facilitated the formation of a Coalition for Nutrition Security with Prof M S Swaminathan as the Chair. Two Task Forces have been formed, one on writing the white paper on nutrition and the other on preparing the strategies for children under two; MSSRF is one of the members in the former group.

A meeting was held on 17 February 2008 at the Central Food Technological Research Institute (CFTRI) Resource Centre, Bangalore with Prof Swaminathan as Chair, to deliberate on viable action for reducing undernutrition levels among infants in rural India. Based on the discussion, a Forum for the Alleviation of Rural Infant Malnutrition (FARIM) was formed with CFTRI as the coordinating centre. The Forum decided to function at two levels: Policy advocacy at the national level and demonstration for capacity building for the elimination of rural infant malnutrition at the village level. While the short term goal would be to end chronic infant malnutrition, the long term goal will be increasing income and livelihood security for the rural poor. A small group, of which MSSRF is a member, is to prepare a Vision and Mission Statement and a brief action plan for 2008. The Forum would try to bring about convergence and synergy among the numerous ongoing government programmes such as the ICDS, Mid Day Meal Scheme, National Rural Health Mission, National Horticulture Mission, National Food Security Mission, etc. It would also work in collaboration with UN agencies, NGOs and Science and Technology and Educational Institutions.

501.5 Sustainability of Farming Systems-Integrating the objectives of conservation with the economics of farming in the rice farming systems of Tamil Nadu

The study was undertaken against the backdrop of advancements in improving production in irrigated rice farming systems accompanied by doubts regarding India's ability to continue with its rate of growth in the production of rice and its capability to meet the calorie requirements of the increasing population. The earlier gains achieved in the production are now threatened by stagnant yields or yield declines, especially in continuous double-cropped rice farming systems.

Objectives

The following research objectives were defined.

- Identify the ecological and economic constraints to farm productivity in the irrigated rice farming system based on empirical evidence from the rice belt in the north-eastern coastal parts of Tamil Nadu.
- Compare and contrast the dialectics of ecology and economics of farm production in farms under varying levels of intensification, diversification and crop–livestock integration.

- Document the social and institutional factors that have enabled farmers to promote intensification, diversification, and crop–livestock integration in their farms.
- Derive suitable strategies for the sustainable management of rice farming systems.

Methodology

A study of the ecosystem structure, productivity and profitability of randomly identified sample farms was carried out initially in the village. This was followed by a detailed comparative study of four farm types. One 'standard' (STD) farm from within the village was compared with other farms located within and outside the village, which had varying levels of intensification, diversification and crop-livestock integration. These farms have been under the same management for three years or more.

Indicators

The indicators selected to study the sustainability of the farming systems are given below:

Ecological indicators

- Production constraints in paddy (yield, yield gaps and ecological constraints to higher yields, total factor productivity – land, water, nitrogen, seed)
- The farm ecosystem structure (species number and diversity, guilds, chain length, linkage density)
- Ecosystem functions (quality enhancing processes within the soil water consumption)

Economic Indicators

- Farm Profitability (profitability from paddy, whole farm profitability, valuation of benefits from crop–livestock integration

Social indicators

- Gender disaggregated labour profile·
- Access to productive resources: Land and water·
- Institutions and their roles in resource management

Findings

The following are the major findings of the study.

- Ecological crises in rice farming systems are brought about by management practices that do not appear to enhance natural ecosystem processes such as soil fertility regeneration, and use water non-judiciously. With paddy mono-cropping and very little livestock integration, current farms in rice farming systems also have simplified ecosystem structures and seem to support poor on-farm crop and animal diversity.
- Paddy dominates the rice farming system with very little integration of legumes (84 % and 12 % respectively of the gross cropped area). Other crops such as vegetables, chilli, gingili and black gram appear to be very poorly represented (together they form less than 4 % of the gross cropped area). Livestock integration is minimal with an average of 0.8 animals per farm. As a consequence, the farm

structure is very simplified and made up of paddy as the dominant farm output.

- Cropping intensities in paddy are low and restricted by overall water non-availability. Water in the tanks has been found to be insufficient to support a second crop of paddy within the tank command area. There has also been a shift in the cropping calendar from the *sornavari* season (April to September) which used to be the main season, to *navarai* season (December – April).

- The economic crisis is evident in the almost complete dependence on external markets for paddy cultivation. Almost all the sample farms depend heavily on external markets for chemical fertilisers, organic manure and biological inputs. Soil fertility has been found to be dependent on inputs purchased from the markets. Groundwater was also observed to be highly appropriated among the farmers for irrigation uses, the riparian rule prevailing. 'Buying' groundwater for a full paddy crop by any farmer has been reported to be quite high: one-third of the paddy produced had to be shared for a season's share of water.

- Poor farm ecosystem has reduced the economic viability of the farms. The average cost of cultivation of paddy in the sample studied is about Rs 20,750/ha. Profitability is affected by several other factors such as lack of storage of harvested grains, credit dependency of farmers leading to farmers pledging their future produce in return for inputs for the coming season, instability in the prices of other crops which reduces the ability of the farmer to purchase inputs for the next season paddy crop, and the farmers' dependence on private merchants for sale of paddy due to the absence of active government procurement.

- A study of the gendered labour profile in paddy cultivation shows high casualisation of labour, a predominance of female casual labour and a high 'gender gap' reflected as low wages for women with respect to men.

501.6. Using Markets to Promote Sustainable Utilisation of Minor Millets

A case study on minor millets in Kolli Hills and Dharmapuri plains, TN, India, was undertaken to understand the use of markets to promote the sustainable utilisation of crop genetic resources (CGR). This is a collaborative research study with Agricultural and Development Economics Division (ESA) of the FAO and the International Food Policy Research Institute (IFPRI). The major objective of this activity was to study the agricultural markets and their relationship to farm level decisions on using crop genetic resources.

Minor millets are a group of annual grasses found mainly in arid and semi-arid regions of the world. Compared with other dryland crops like sorghum and pearl millet, the harvesting and processing of minor millets is extremely labour-intensive and the crop is also more prone to bird damage. Though the area under minor millets is limited to certain states of India, these crops still play a significant supplementary role in dryland farming systems.

A detailed farm as well as market level study was undertaken in two sites namely Kolli Hills and Pennagaram in TN, where minor millets are grown in different agro-ecological situations. In Kolli Hills, the research evaluated the impact of some development interventions by MSSRF towards the improvement of minor millets in terms of utilisation and conservation among the local communities through improved seed exchanges and value-addition opportunities. In Dharmapuri district, minor millets are grown in semi-arid plains, as a rainfed crop and no specific minor millets based development interventions exist. The preliminary findings from the economic analyses of markets and HHs are discussed below.

Local market hubs – Dharmapuri district, Tamil Nadu

The objective of this research was to understand how variations in market transactions and vendor characteristics affect access to minor millet crop genetic resources by focusing on local market hubs (towns). The data used in this analysis was collected in March-May, 2007 before the planting season in the district, a major market centre among south Indian states for the sale of two minor millet crops, namely little millet (*Panicum sumatrence*) and finger millet (*Eleucine corocona*). Farmers here accessed minor millet crop seeds through multiple sources – both informal and formal. They either used their own farm-saved stocks or borrowed from neighbours through informal exchanges at the village communities. The supply channels and actors (vendors) differ, based on the types of 'products' (seed or grain) being sold in the markets. For minor millet crops, the research systems are poorly developed and still traditional varieties dominate the farming systems. Therefore explicit, formalised channels of seed are not well-developed.

Within each major market town of the district, during the planting season, there are four different channels through which farmers accessed minor millet genetic resources. The channels consist of *mandis* (wholesale grain traders with permanent structures in the market), retailers (who sell millets in small quantities, in market towns mainly for consumption purposes) or local shops, agro-dealers, and government sponsored agro-depots or centres. There is another channel through which seeds were exchanged, and operated mainly at the village level: the weekly markets namely *shandies.* These are composed of petty vendors or farmer-traders who sell small quantities (5-10 kgs) of minor millets, to buy other consumption goods for the household.

The proportion of minor millet seeds sold during the planting season across these vendors varied significantly. Only 2-3 % of the total minor millet sales were as 'seeds' by wholesale traders and retailers. The *shandy* traders, especially during the planting season, sold almost all the grains as seeds. The agro-dealers were the only formal source of seed supply in the entire chain.

Farm household surveys - Kolli Hills and Pennagaram, Tamil Nadu

The major purpose of this research was to analyse the determinants of household market participation for either product or seeds of minor millets and its impact on farm welfare.

In Kolli Hills most of the seed and grain exchanges are autarkic, except in communities where 'interventions' have taken place. From our preliminary analysis of the project impact, we found that in general, the percentage of HHs that replaced their seed at least once was higher for the farm communities who participated in interventions than the control group (69 % versus 60 %). This replacement took place mainly through formal sources of seed such as an extension agent, researcher or NGO (50 %) than control group (6.9 %). Nearly 21 % of the HHs in intervention communities exchanged minor millet seeds with other HHs compared to only 11 % of the non-intervention HHs. Further among the HHs who exchanged seeds, 28 % supplied to formal sources such as an extension agency or NGO. In general, we found that the HHs from the intervention communities were more actively involved in market-based seed exchange activities for minor millets. The preliminary results of the different econometric estimations also show that the participation of the HHs in any MSSRF-based intervention for minor millets had a significant and positive impact on their household dietary diversity *i.e.*, the consumption of minor millets have increased through various food items, as well as the household level food security among the HHs surveyed. On the whole, in Kolli Hills the significant welfare effects among the intervened minor millet growing communities were seen through enhanced participation in conservation and cultivation aspects and also by creating an economic stake in the same.

In the case of Dharmapuri district, the preliminary analyses on the minor millet growing HHs and their economic welfare were determined through their participation in local markets. It was found that among the surveyed HHs the total per capita income, the area share allocated to minor millets and the ratio of the active household population (14-60 years old) engaged in farming had a significant impact on household welfare. In terms of household dietary diversity patterns, it was found that the number of food items consumed per household ranged from 8-22 while the average number of food groups consumed was 7 from the total of 12 food groups. The diet of the people in this area consists of cereals, vegetables, tubers, legumes, and spices with a preference for finger millet items. On the other hand, meat, fish and egg consumption was considerably low. Compared to Kolli Hills, the most food insecure HHs were found in the plains.

The case study presents an example of an economically minor (but nutritionally rich) crop, that provides supplementary income as well as food security opportunities for subsistence HHs in two different agro-ecological and fragile environments through varied degrees of market participation either for seed or grain or both. The overall findings from this research on the economic impact of minor millets reveal

that in Kolli Hills, participation of HHs on any minor millet-based intervention had a positive impact on their crop yields, dietary diversity and food security levels as well as the number of attributes (consumption and production) used by the farm HHs in the communities. In the case of Dharmapuri plains, the farm HHs which grew minor millets and participated in agricultural markets, benefited from increased food security levels and improved dietary habits, but in lesser magnitude compared to the hills. The major difference among the two case study scenarios, especially in Kolli Hills, is the creation of an economic stake in conservation as well as in cultivation aspects of minor millets among the farmers. This calls for more effective and concerted public policy towards crop improvement and in creating improved marketing opportunities for minor millet crops in the state and elsewhere that would improve the welfare of the farming communities living in dryland environments.

501.7 Empowering the rural poor by strengthening their identity, income opportunities and nutritional security through the improved use and marketing of neglected and underutilised species

This is an international project located in India, Yemen, Peru and Bolivia, funded by the International Fund for Agricultural Development (IFAD) and internationally coordinated by Bioversity International, Rome. In India, the project is being implemented by five agencies including MSSRF, which also serves as the national coordinator. The other four partners are University of Agricultural Sciences (UAS), Bangalore, UAS, Dharwad, G.B. Pant University of Agricultural Sciences and Technology (GBPUAT), Ranichauri campus and the CFTRI, Mysore. The implementation followed an annual work plan meeting of all partners including the international coordinating partner in Chennai in May 2007.

The Neglected and Underutilised Species (NUS) included in the project are finger, little, Italian and barnyard millets and grain amaranth. The project is being implemented in 33 tribal or economically backward villages across four States. Five tribal villages in Kolli Hills (TN) and seven tribal villages in Kundra block, Koraput district (Orissa) have been chosen by MSSRF. In South Karnataka, the project is implemented in five villages in Kolar and Chamarajanagar districts by the UAS, Bangalore, while in North Karnataka the project is being implemented by the UAS, Dharwad in six villages in Haveri and Bellary districts. The GBPUAT implements the project in ten villages of Tehri Garhwal district of Uttarakhand. CFTRI, Mysore provides the backstop on the required grain processing technology.

Small millets belonging to six species are grown in India. Among them, finger millet is the most predominant and grown across the country. Italian and little millets are largely grown in peninsular India, while barnyard, proso and kodo millets are more common in Central and Northern India. All these crops are known for their high adaptability under low and erratic rainfall, and marginal soil and management conditions. Their low input requirement, freedom from pests and

diseases, high drought tolerance and safe grain storability are features preferred by the tribal and poor farmers in hilly and arid regions. They have the added advantage of relatively better nutritional profile for certain minerals, vitamins, amino acids and dietary fibre. The low glycemic index of these grains is receiving increasing importance in the nutraceutical context. These grains contribute significantly to the food and nutritional security of people who, by and large, are poor and eke out a livelihood under marginal conditions. The grain amaranth is a nutritionally rich crop grown in higher elevations, particularly in the Garhwal Hills of Uttarakhand and the BR hills (Chamarajanagar district) of Karnataka.

***Project goals, pathways and processes*:** The project aims at empowering the rural poor, raising incomes and strengthening the identity and food security of small farmers and rural communities by securing and exploiting the full potential of the genetic and cultural diversity contained in the NUS. The income increase from NUS is being achieved through productivity increase of these crops and companion crops in the intercrop system and value addition of NUS produce. Linkages are established with local and distant markets for the value added products to enhance the farm income. Introduction and promotion of grain processing technology is part of the value addition process. Conservation of local land races of NUS, expansion of local genetic base with introduction of new varieties, farmer participatory selection of varieties, empowering in quality seed production of varieties, participatory evaluation of NUS-based intercrop systems offering better and sustainable income, capacity building in value addition to develop traditional and novel food products and their marketing are important activity components to achieve the project goals. Social mobilisation under SHGs and farmers' clubs, capacity building of these groups through institutional and on-farm training and exposure visits are important processes being followed.

Benchmark Survey: A benchmark survey format was finalised and the survey was conducted in two MSSRF field sites. A sample size of 148 HHs in Kolli Hills and 105 HHs in Koraput were selected for the survey. Among these, 4 HHs in Kolli Hills and 1 household in Koraput have no land for farming. About 4 % of cropped area by 51 HHs in Kolli Hills and 54 % of area owned by 101 HHs in Kundra are being used for millet cultivation. Almost all these HHs were using a local variety of seeds. While the majority of farmers in Kolli Hills grow millet as mono crop, intercrop of millet is more common in Kundra. In both locations sowing is always by broadcasting. The range of average yield of finger millet is between 243 kg and 1988 kg/ha in Kolli Hills, while this varied from 247 kg to 1,235 kg/ha in Kundra, which fetched a gross value between Rs 1,944 and Rs 13,916 in Kolli Hills and from Rs 592 to Rs 9,880 in Kundra. Only women members of 19 HHs in Kolli Hills, who were trained during the first phase of this project, knew about value addition of millet and use this approach for income generation. The millets contribute on an average 30 – 60 % of the daily food grain intake in the villages in Kundra block, while

about 42 % of the HHs surveyed in Kolli Hills reported consumption of millets. Some of the very poor HHs reported cent percent dependence on millets. Based on the Planning Commission poverty level income definition, all the HHs in Kundra and 43 % of HHs in Kolli Hills are below the poverty line.

Income generation through sustainable increased farm productivity of NUS: In many of the project villages farmers used millet varieties selected under the participatory method. Thus farmers of Karnataka used GPU 28, MR 1 and MR 6 of finger millet, *Sukshema* of little millet and *Krishnadevaraya* of Italian millet while in Uttarakhand finger millet varieties PRM 1 and PRM 9802 were used. Seeds of these varieties were distributed to many farmers in all the villages for cultivation following improved and traditional methods. Participatory Variety Selection (PVS) deploying 30 varieties of finger, little and Italian millets in Kolli Hills and 22 varieties of finger millet in Kundra was performed. From these varieties farmers shortlisted HR-911, PR-202, GPU-45, INDAF-9, MR1 and MR6 among finger millet varieties, OLM 203 and *Kattavetti samai* among little millet varieties and *Perunthinai* among Italian millet varieties. Seeds of the varieties which received high selection ranking from farmers were multiplied during off season. Similarly, participatory evaluation of improved agronomic and traditional practices was conducted in selected farmers' fields in all the villages. The improved practice advocated varieties with higher yield potential, their planting in rows rather than by broadcast, choosing appropriate row ratio for different intercrops and better management with weeding, interculture and top dressing. Cost benefit analysis of these practices was conducted to demonstrate the income generation potential of the farmer-selected varieties, quality seed and scientific agronomy. While the traditional practice offered Cost-Benefit Quotient (CBQ) between 1.05 and1.47, the selected seed under improved practice offered the CBQ between 1.58 and 2.44.

Introduction of tapioca as an industrial crop has resulted largely in replacing small millets in Kolli Hills over the last 20 years. For different reasons including economic gains, farmers prefer tapioca to small millets while they do value their long tradition in consuming these millets.

With the increasing availability of rice through PDS and drudgery associated with the traditional processing of millet grains, there is a decreasing trend in the local consumption of the grain produced. A plan to promote cultivation of millets without displacing tapioca has been started for the first time with the introduction of early maturing finger millet as an intercrop with tapioca. First year results on such trials showed the possibility for co-production of about 750 kg of finger millet grain/ha under such intercrop without influencing the tapioca yield. It also provided one ton additional quantity of dry fodder for cattle.

Organic farming is followed by default by the farmers in Kolli Hills and the hills of Tehri Garhwal. However, chemical fertilisers are used for tapioca cultivation in Kolli Hills and vegetable cultivation in Tehri Garhwal region.

Organic production of small millets and grain amaranth is being promoted in the project villages of Tehri Garhwal with training and capacity building on production of organic inputs and application.

Enhancement of human and social capital to manage NUS and derive benefits from their use: SHGs and farmers' clubs are important institutional mechanisms being used for advocacy and promotion of activities such as conservation of local landraces in village seed banks, organising farm women and men in participatory variety selection and improved farming methods, quality seed production, and capacity building on value addition, product development and their marketing. The technologies for millet value addition are sourced from the Rural Home Science Colleges of UAS Bangalore and Dharwad. These institutions also help in building the capacity of farm women and men on value addition and packaging in project villages. CFTRI is being requested to provide the badly needed machinery for de-husking and polishing the little, Italian and barnyard millets and automised finger millet malting unit. The Mc Gill University, Canada kindly extended financial support to supply eight de-stoning and milling machines in the project villages in Kolli Hills, BR Hills and Kolar. Important products being developed and marketed are malt, *chakkli* from finger millet, *laddu* from finger and Italian millets, *papad, nippattu* and *tengulu* from little millet, rice and semolina (*rava*) from little and Italian millets. Among these, finger millet malt is the most cost-effective product, fetching at least eight-fold higher income than that from the grain, apart from generating substantial income from the additional employment generated. The products are being marketed in the local and urban markets under different brands and appropriate labeling.

Assessment of nutritional values of NUS and development of strategies for enhanced use of NUS in nutrition programmes: A study was conducted at the Rural Home Science College of UAS Dharwad on the protein availability in millet diets and changes in the polyphenol associated antioxidant activity in millets during processing and cooking. One serving of enriched millet breakfast foods costing between Rs 2 and 6 is found providing around 6.0 to 16.0 g protein and 220-585 calories. The polyphenol content of millets ranged between 148.5 and 653.5 mg/ 100 g and the highest polyphenol was recorded in brown finger millet. Milling and cooking reduced the polyphenol content with highest reduction effected by milling. Traditional Karnataka food preparations like finger millet *mudde* and navane rice enriched with fenugreek seeds, pepper powder, vegetables and green gram helped in significantly enhancing the polyphenol content. Methanol extracts from the whole grain foxtail millet, decorticated grain and enriched rice *i.e.*, *bisibelebath* were evaluated for antioxidant activity. The antioxidant activity of Italian millet grain estimated by DPPH method was 11.3 % and this was reduced by decortications. However, enrichment of Italian millet rice with traditional antioxidant rich ingredients enhanced the antioxidant activity up to 68.7 %.

Intervention feeding for long term using breakfast foods based on Italian, little and finger millets was conducted in UAS Dharwad for assessing the acceptability and measuring the nutritional impact on thirty-four farm women labourers and thirty adolescent school girls. Eighteen standardised breakfast food items of millet providing one-third RDA of energy and protein were fed for a period of three months. Nutritional status was assessed through anthropometric measurements, biochemical estimation of Hb, blood pressure and 24 hr dietary recall method and physical fitness. Results indicated acceptance of all breakfast foods, although 5 % of subjects were reluctant to accept the food for a long period. Post-feeding assessment indicated no significant change in BMI, B.P. and also physical fitness among the labourers, whereas there was an improvement in physical fitness of the adolescent girls. Finger millet malt was highly acceptable to the girls. Regular consumption of millet as breakfast food showed an incremental change at 0.5 %, 3.4 %, 15.4 % and 37.28 % in height, weight, Hb level and PFI, respectively.

***Improvement of availability, knowledge and maintenance of NUS resource base*:** Building on work done during the previous phase, more emphasis was placed on the generation of greater awareness among farm families on the nutritional benefits of small millets, quality seed multiplication of new and traditional varieties for enhancing variety diversity in the project villages, compilation of Indigenous Knowledge (IK) associated with millet cultivation, conservation and consumption, and traditional recipes followed in different regions to document the linkage between the cultural diversity and genetic diversity. Conservation of NUS resource base in project villages has been achieved by leveraging women SHGs and establishing Village Seed Banks. Farmer participatory quality seed production, storage and distribution were linked to these seed banks. The three University-based project partners organised several field level awareness and training programmes on NUS including telecasts on DD channel (Kannada) to highlight the important features of small millets, their improved cultivation practices and their varied value added products. Enthused during an awareness programme on millets organised by the UAS, Dharwad, the Member of Parliament from Dharwad South constituency, offered Rs 2 lakhs assistance from MP's special fund to a SHG for construction of a building to house millet value addition activities. In Uttarakhand, there has been success in incorporating small millets in the *Anganwadi* feeding programme. Another important goal of this project is to win over policy makers for introducing millets in the mid-day meal programme in the schools of selected regions.

***Exploring the role of rural tourism in promoting NUS*:** Activity related to this role is confined to the project villages in Uttarakhand. In the context of a decision by the Uttarakhand Government to introduce grain amaranth and small millets as part of '*prasadam*' in the four famous spiritual sites of the State, namely, Badrinath, Kedarnath, Gangotri and Yamunotri, efforts are being made to introduce recipes

from these crops in the menu of Garhwal Mandal Vikas Nigam (GMVN) and Kumaon Mandal Vikas Nigam (KMVN), two premier tourism agencies of the State. The help of media is also being sought to promote this goal.

Promotion of better policies and legal frameworks for the sustainable and equitable use of NUS: Generation of a sound database on millets, its role and potential as a critical supplementary grain for nutritional and food security of communities inhabiting inconvenient locales and facilitating appropriate policy and legal framework on developing seed systems, possible support price, inclusion in school feeding and public distribution programmes and promoting dietary systems, are important components of the project goal. To meet this end, the project endeavours to influence policy makers with awareness programmes and demonstrations of the strengths of the NUS. The Minister of Agriculture, Uttarakhand, participated in 'Farmers' Fair' in Ranichauri, where he was apprised of the project activities, the nutritional advantages of these grains and given a taste of the novel food items prepared from them.

The British Broadcasting Corporation (BBC) produced a thirty minute documentary on the millet revival programme being undertaken by MSSRF in Kolli Hills under the title "Forgotten Fruit". This documentary was repeatedly telecast in February 2008 under its Earth Report programme. It was also screened at the Eighth Conference of Parties of the Convention on Biological Diversity recently held at Bonn, Germany. Other telecasts on small millets were made in national channels such as DD, ETV and TV 100.

Sub Programme Area 502

Ford Foundation Chair on Women and Sustainable Food Security

The aims of the Chair have been to undertake research work related to the concerns of women in getting equitable access to food, drinking water, resources, livelihoods, and healthcare, using both primary and secondary sources; disseminate research findings and conduct workshops and seminars to promote better understanding on women and food security and stimulate debate

The Program Advisory Committee of the Chair met in April 2007 and gave suggestions.

During 2007-08, the draft of a book – 'Bearing the Brunt – Adverse Impact of Rural Distress on Women' was completed and submitted to SAGE Publications. The book attempts to examine the impact on women's wellbeing in rural India against the backdrop of growing agrarian distress. The first chapter gives evidence of deteriorating rural livelihood opportunities to support the thesis of spreading rural distress at the turn of the century. The last chapter computes the gender gap Index for all India and across the states for rural populations to examine the areas of concern, where the gap is widening. The four chapters in the middle deal with various concerns of women in food production, natural resource

conservation, livelihood access and nutrition and health outcomes.

The report of the workshop on Gender Concerns in Food Security organized in February 2007 was complied and widely circulated.

As part of advocacy and dissemination, the Chair delivered lectures at various forums. These are highlighted in the section on participation in conferences and workshops.

Sub Programme Area 503

Initiatives in Vidarbha

Work in Vidarbha picked up momentum during the year. The VRC-VKC network in the region expanded during the year and is reported under SPA 601. The Education Support Programme was consolidated and an initiative for women farmers was launched during the latter part of the year.

503.1 Education Support Programme for Children of Families Affected by Farmers' Suicides

Seventy nine children from 39 families spread across the 8 blocks of Wardha district are being supported under the Programme from Primary to High School level. The coordination is being done by field staff under the guidance of a local committee of committed individuals. Monitoring is done by staff through periodic house visits and follow-up where needed; for instance in cases where a child suddenly drops out of school, efforts are made to find out the reason and help if the child is willing to study. Following talks with *Sai Ashram*, a residential home for orphan boys in Nagpur, four diligent boys in the 10-12 age group, who are doing well in their studies and are currently covered under the programme, have been recommended for admission there with the consent of their mothers. The home run by Shri Datta Meghe, MP, takes care of the children's education and development upto class XII and equips them for a trade/livelihood. It can accommodate upto 50 children and is currently housing 46, leaving room for four more.

Children who completed X and XII standards in 2007, were felicitated at a programme in October. Older children who stopped studying after they failed in class X or XII and dropouts, are to be addressed in terms of putting them on some vocation-based training programme for acquiring additional income earning skills. They are mostly engaged in farming and are currently being included in training programmes organised for the mothers. Three of them were also sent as part of the group of fourteen farmers on a week's exposure trip to Coimbatore to learn about cotton cultivation practices, sponsored by the South India Cotton Association (SICA).

Following a meeting with the affected families, chaired by Prof Swaminathan and organised by the Vidarbha Jan Andolan Samiti at Pandarkhauda in Yavatmal district in October 2007, it was decided to extend the programme to affected families with school-going children in the district. Yavatmal being a much larger district, this will have to be done in phases.

The programme was formally launched in Ralegaon *tehsil* in May. The mothers with school going children from families where a parent had committed suicide between 2003 and 2007 were called to a meeting on 17 May 2008, and the programme was explained to them. There are about 25 families with 47 children who will be covered. One family of three brothers came with their uncle. Their mother had died earlier and the father had committed suicide in 2006, leaving them orphaned.

No-frill accounts are being opened in the names of the mothers and children at SBI Ralegaon. If the mother is also not alive, the guardian with whom the child is staying will be the joint account holder. The tri-annual instalments will be deposited in the accounts, commencing from the current school year.

503.2 *Mahila Kisan Sasakthikaran Pariyojana* (Women Farmers' Empowerment Initiative)

The Education Support Programme has been an entry point to get to know the mothers. Most of them are young, and engaged in farming; some have land in their name; many work as farm labour.

Following meetings in Sept – Oct 2007 (see SPA 606), an initiative for women farmers, *Mahila Kisan Sasakthikaran Pariyojana* has been launched. A Technical Support Consortium of agencies for technical support (agricultural university, research institutions, finance and marketing support) has been formed.

The women participated in "Technology Demonstration and Linkage Programme for Women Farmers on Profitable Cotton Farming and other Livelihood Opportunities", organised by Community Polytechnic and College of Agriculture, Wardha on 2-3 January 2008. Various technologies like bee-keeping, vermicompost and vermiwash manufacture, solar drying of vegetables, soya products and pulse processing mill, were demonstrated at the venue.

Training in Sustainable Farming under Rainfed Agriculture

As part of the skill training for women farmers, training in sustainable agriculture under rainfed conditions was organised in technical collaboration with Chetana Vikas, a local NGO. On 1 and 2 February 2008, an exposure cum demonstration programme was organised at the Chetana Vikas Farm. 26 women and four of the older children of farmers who had committed suicide, participated. The subjects included NRM, soil and water management techniques, multiple cropping systems (season-wise) under dryland farming conditions; self-reliant (*swawlambi*) agriculture; equipment and tools required for the technology, inter-cropping of companion crops; fruit farming; kitchen garden; formation of SHGs and micro-enterprise activity.

Chetna Vikas listed areas in which they could offer training for farmers to adopt practices for sustainable agriculture and the participants were asked to list their priorities. Those who opted for training in sustainable agriculture

practices were then called for the second phase of training on 8 and 9, April which comprised a one-day visit to see soil and water conservation and management on farmers' fields and interact with the farmers on their experience after adopting the methodology. About fifteen persons participated. Following this, ten came forward for the third phase of intensive training from 15-17 April that covered all aspects of the model from soil health and water management on the farm, to seed treatment, crop selection and cultivation under the multiple cropping model, spacing, and insect and pest management. Seven of them volunteered to have their land treated for contour bunding and follow the steps prescribed in full. Of them, finally six got the work done and have been given seeds for sowing and are being guided.

Exposure Trip to Coimbatore

Fourteen men and women farmers from Vidarbha (6 women and 8 men) visited Coimbatore from 16 to 21 February 2008 to learn about cotton farming practices. The group included three widows and four sons of farmers who had committed suicide. The trip was sponsored by SICA and Super Spinning Mills. During the six days there, the farmers were taken to farms of SICA, Super Spinning Mills, TNAU and CICR, to see standing cotton crop in the field and discuss with experts on cultivation methods, seed production and proper seed selection; they also had discussions with farmers and visited a ginning and pressing mill. Follow-up activities are being explored.

Soybean based Farming System

A Consultation on 'Soybean cum Livestock based Farming System Approach for Work and Income Security in Vidarbha' was organised in Nagpur on 10 May 2008. Six women farmers participated in the meeting and spoke of the problems being faced by them in soybean cultivation. A detailed report of the consultation is given in SPA 606 under conferences and workshops.

***Formation of* Mahila Kisan Samitis**

Starting with the widows of farmers who had committed suicide, the attempt is now to bring more women farmers into the fold and give them an identity as women farmers and enable them to access their entitlements, undergo need-based trainings, hone their skills as well as acquire new ones that will be of use. To this end, clusters of women farmers are being formed in the villages. Women farmers who have title to land either singly or jointly are eligible to become members. The first such Samiti, *Jagrut Mahila Shetkari Samiti* was formed with ten members in Talegam village of Wardha block on 14 May. The members after discussion decided to have a membership fee of Rs 50 and an annual subscription of Rs 50. A second Samiti has been formed in Neri village, Wardha block and a third in Wabgaon, Deoli block; discussions are on in other villages as well. Bank accounts will be opened for each of the Samitis and proper record books maintained. The objective is to form a Federation of *Mahila Kisans* in the region, over a period of time.

503.3 Financial Inclusion

MSSRF continued to coordinate with the banks operating in Wardha district to bring the entire population under the formal banking system and make the district 100 % financially inclusive. State Bank of India is coordinating the effort among all banks and it is targeted to declare Wardha district, a financially inclusive district on 2 October 2008. This will mark the completion of the first phase of every household in the district having a bank account. The next step will be to make them aware of and enable them to access other schemes of the banks.

Programme Area 600

Information, Education and Communication

NVA has so far set up 17 VRCs and 96 VKCs. A 9 - point charter has been proposed for Mahila Kisans*. Mission 2007 has been rechristened* Grameen Gyan Abhiyan. *Knowledge-on-Wheels and Fisher Friend Mobile Application benefited a number of farming and fishing families. Several conferences and meetings were organised.*

Sub Programme Area 601

Jamsetji Tata National Virtual Academy for Rural Prosperity

Since 1992, the Informatics Division of MSSRF has been establishing Village Resource Centres (VRCs) and Village Knowledge Centres (VKCs). In 2003, the VRC and VKC programmes were further strengthened by creating the Jamsetji Tata National Virtual Academy for Rural Prosperity (NVA) and establishing collaboration with several international and national partners for developing content and undertaking capacity building efforts for sustainable rural development.

The main aim of the programme is to empower the vulnerable rural communities to make better choices and achieve better control of their own development and build the skills and capacities of the rural poor with a view to enhancing livelihood opportunities. The VRC/ VKC programme brings together the experts and grassroots level communities in a two-way communication with the objective that knowledge should reach every home and hut.

NVA is an umbrella for different ICT-enabled development activities of MSSRF such as the intranet / internet network, VRCs and Knowledge on Wheels, ICT-based curricula for rural youth (both women and men) and children, Jamsetji Tata Training School for Leadership in Rural Knowledge Connectivity (JTS) and *Grameen Gyan Abhiyan* (Rural Knowledge Movement – Mission 2007: Every Village a Knowledge Centre).

Three tier network - NVA

NVA has a three-tier knowledge network. Informatics Division, Chennai (National Level Hub) has been connecting several data generators and data providers (universities, experts, financial institutions, corporate sector, technocrats,NGOs, grassroots academicians, etc.) focussing primarily on content and capacity building. It has been connecting with VRCs (block level hub) through Indian Space Research Organization (ISRO) uplink / downlink satellites and transfering the knowledge / information to VRCs and vice-versa. From the VRCs, locale-specific, demand driven content is being disseminated through VKCs / Community Technology Learning Centres (CTLCs).

Through systematic collection of secondary data and well-planned need assessment, VRCs/VKCs/CTLCs develop locale-specific demand-driven content, organise training and awareness programmes and make linkages with appropriate organisations for transforming the content into action / application.

As of now, NVA has set up 17 VRCs and 96 VKCs (in TN, Puducherry, Maharashtra, AP, Orissa, Kerala and Rajasthan) with the help of different philanthropic organisations. From May 2007 to May 2008, NVA set up 8 VRCs and 37 VKCs in TN, Maharashtra, Orissa, AP and Kerala. A VRC is normally located at the block level or at the centre of a cluster of villages.

Knowledge Workers

NVA has been selecting knowledge workers with the help of local partners for maintaining the VKCs. It has been continuously imparting training to knowledge workers on various aspects such as the concept of VKC, methodology of collection and dissemination of need-based content, managing users and visitors, maintaining the user register, bill books and other records pertaining to the VKC, building rapport with users and community members, gender concerns and basic hardware and software. VRCs conduct quiz programmes for Knowledge Workers (KWs) based on the content in VKCs. Some of the KWs have developed training material related to VKC management based on their field experience and VRC training. The coordinators of NVA conducted general management training programmes for KWs in several places such as Jeypore, Kalpetta, Annavasal, Thiruvaiyaru, Chidambaram, Nagerkovil and Puducherry.

The VRC technical staff is providing basic hardware and software training to KWs to ensure effective system maintenance at VKC level. VRC technical staff is also preparing several technical manuals based on the problems faced by the VKCs.

Content and Linkages

Creating and updating relevant content to suit local needs is a key factor in the programme. The information provided is time and locale-specific, demand-driven and relevant to the day-to-day life and work of rural women and men.

VRCs continuously debate updating the need-based dynamic and static information that the people may need. Particular attention is given to making the information content simple and easy to understand and to disseminating the same to the community in a practical manner. They also collect local information pertaining to the day-to-day life of the people.

VRCs / VKCs establish links with a number of institutions, organisations, experts and government departments regarding the content, addresses and linkages of other related institutions and capacity building programmes. These links are in the form of VRC level meetings, face-to-face in their institutions or in the fields, besides email or telephone.

Through these links VRCs / VKCs are able to help the rural community in availing of several government schemes / services, such as the centrally sponsored scheme “Strengthening Infrastructure for Quality & Clean Milk Production” during the 10th Plan Period and the NETFISH programme for addressing the extension requirements of the fisher folk of coastal states.

VRCs collect and generate demand driven locale-specific content based on seasonal queries related to agriculture, fisheries, health, etc., community newspaper readers, user register analysis, findings from village profile, thematic segregation, need based user meetings, employment news from local companies, and area specific target groups.

The VRCs have produced a number of dissemination materials in the form of

questions and answers, pamphlets, web page, PowerPoint, word format, flash cards, dialogue mode, audio and video format. The VRCs also use the readily available information from various organisations and government departments, combination of scientific inputs and local terms, season based advisories based on the needs assessment, local experts, advisories / suggestions, historical background of local villages, environmental protection, value addition for extension departments and reliant web based material.

Dissemination

VRCs are using both modern (mobile phone, Very High Frequency-VHF, WiFi and satellite based video conferencing, off line CDs for both audio and video, telephone – both landline and WLL, wired and wireless public address system, KYAN-PC (consisting of PC, Projector, TV tuner card, DVD player, amplified speakers and modem), and traditional methods (community newspaper in vernacular language for each VRC, pamphlets, notice boards, pictorial based exhibitions etc.) to spread relevant knowledge to the community. The community newspaper has been reaching 591 villages and 605 organisations.

Fisher Friend Mobile Application (FFMA)

Overcoming a major obstacle in the dissemination of information to rural areas, QUALCCOMM, MSSRF, Astute Systems and Tata Teleservices have developed an application for fishermen with up-to-date relevant information through the mobile phone. On 26th December 2007, MSSRF organised a seminar "Three years after Tsunami: a new life for fisher communities" at MSSRF, Chennai, and officially launched the FFMA by distributing 40 mobile phones to the fisherfolk of Puducherry, Chidambaram, Nagapattinam, Manamelkudi, Vembar, Thangachimadam and Nagerkovil. The recipients were the socially and economically marginalised members of the community.

On the basis of the feedback from the users, the project partners are in the process of making modifications in the FFMA.

Content Dissemination through All India Radio (AIR)

Under the IDRC-CIDA Tsunami project, NVA disseminates audio content through AIR. This is a 52-week programme from 19 November 2007 to 10 November 2008 relayed every Monday between 18:45 and 19:00 hrs. on Chennai "A" – medium wave 416.7 m 720 khz, and also on short wave 60.08 4920 KHz.

The topics enclude VRC/VKC concept and activities, Integrated Coastal Zone Management, micro-enterprises, climate change in the context of rural development, and government schemes.

Advisories through Video Conferencing

As mentioned, all the VRCs are connected with the NVA of MSSRF through ISRO uplink and downlink satellites.

In addition to daily advisories and clarifications, several thematic video conferencing programmes related to farming, health and

enterprise management were organised with the help of expert institutions and development workers.

Training / Awareness Programmes

NVA regularly conducts awareness and capacity building training programmes for converting knowledge into action. From May 2007 to May 2008, the VRCs / VKCs conducted 206 training / awareness programmes in TN, Kerala, Maharashtra, Orissa and Puducherry. 11,252 (M:5,684; F:4,983) persons participated in these training / awareness programmes.

Several programmes in the agriculture sector, fisheries sector, micro-enterprises sector, health sector, environmental sector and animal husbandry sector were conducted.

In the agriculture sector, programmes such as sunflower plantation, kitchen garden, seed collection, ginger and turmeric cultivation, friendly insects of cotton, management of weed and preparation of compost from weed, organic farming, system of rice intensification, jasmine cultivation, gingelly cultivation, paddy crop management during flood, orange management, oyster mushroom cultivation, vermicompost, coconut farming, *azolla* cultivation, usage of biofertiliser, tuber cultivation, application of Trichoderma and Pseudomonas were conducted.

In the fisheries sector, programmes such as GPS handling and using navigational map for fishing, hygienic handling of marine fishing products, fish quality management and sustainable fishing were conducted.

In the micro-enterprises sector, programmes such as screen printing, honey bee rearing, craft training, ceramic painting, artefacts made from bamboo, preparation of phenol and soap oil, fish and prawn pickle preparation, incense stick preparation, washing powder preparation, entrepreneurship development for SHGs, value added fisheries products (40 types), neem seed collection, tailoring were conducted.

In the animal husbandry sector, programmes such as fodder management, concept of co-operative dairy, livestock camps, livestock management – diseases and prevention methods, feed materials, clean milk production and quality milk procurement, goat rearing were conducted.

In the health sector, programmes such as awareness on HIV/AIDs, chikungunya, tuberculosis, general health camps, health camps for pregnant women, women's reproductive health issues, diseases caused by mosquitoes, tobacco eradication awareness were conducted.

In the environmental sector, programmes such as sea turtle conservation, integrated coastal zone management, were conducted.

Under the dissemination of government schemes / entitlements sector, details of various schemes under child and welfare department, availability of various training programmes in agricultural schemes of banks, self-employment schemes, Right to Information Act and legal literacy, were covered.

Programmes on maintaining SHG accounts, SHG credit links with financial institutions, savings and credit management, discussion with panchayat leaders regarding various schemes and career guidance were also conducted.

ICT-based Curricula:

Microsoft Unlimited Potential Programme (MUPP) Curriculum: VRCs and VKCs conduct the Microsoft Unlimited Potential Programme (MUPP). The curriculum covers fundamental aspects such as Computer operation, Digital Media, Internet and World Wide Web, Web Design, Word Processing, Presentation, Database and Spreadsheet.

The target audiences for this course are SHG members, women and men from the farming and fishing communities, unemployed youth, school teachers, employers from various organizations and school children. Before attending the final MUPP curriculum examination, each trainee spends 60 hrs on hands on training and 60 hrs on theory. Sometimes the rural trainees spend more than 180 hrs to complete this course. They also attend two model examinations. The successful candidates are given certificates.

VRCs and VKCs also hold exposure meetings for students, rural youth and women, along with education institutions and private consultancy groups. Some of the trainers disseminate information on health, agriculture and livestock, to the rural community. Some of the trainees have been consistently helping in the VRC and VKC activities such as distribution of the community newspaper, running eye camps and training and awareness programmes.

This year VRCs developed several MUPP course modules (in PPT) in vernacular languages (Tamil and Marathi). The modules include computer fundamentals, web designing, Word, Excel, Powerpoint and Access.

In the last year, 6,677 trainees have enrolled in the MUPP and 1,158 passed the final examination. This programme covers 624 villages in TN, Puducherry, Maharashtra and Orissa.

Computer Aided Learning Programme (CALP): In cooperation with the Azim Premji Foundation, NVA initiated the Computer Aided Learning Programme in VRCs and VKCs. The target groups for this programme are children in the age group of 6-13 years in classes I to VIII. Under this programme the VRCs and VKCs are using 62 interactive CDs.

VRCs and VKCs are disseminating information about this programme through KWs and school activities, VKC users, and meetings at the village level. Previously VKCs used to have separate sessions to suit “Sarva Shiksha Abhyan” students. Now both “Sarva Shiksha Abhyan” and others attend the same sessions in the evening. VRCs also conduct pre and post evaluation tests for students before and after the use of each CD.

This year NVA covered 268 schools and 5,896 students participated in this programme.

Intel Learn Programme: Intel Learn Programme includes three aspects, namely technology literacy, critical thinking and collaboration. Technology literacy involves the ability to use technology such as computers to communicate, solve problems, and collect, organise, and share information. Critical thinking involves problem solving. Collaboration involves teamwork – working with one or more people to complete a task. Under this programme students produced 34 projects, covering topics such as rain water harvesting, disasters, problems of their community and the future of the community. During the year, 364 students from 37 schools participated in this programme.

Knowledge on Wheels

On 7 August 2007, NVA launched a new programme called "Knowledge on Wheels". On 29 December 2006, NVA and Sankara Nethralaya Medical Research Foundation signed a Memorandum of Understanding to provide eye care facilities and eye care awareness using a van for this purpose.

In March 2008, Sankara Nethralaya opened another surgery unit at Rameswaram for this purpose. So far 12,708 patients have been screened from 381 villages (TN, Puducherry and Maharashtra). 197 camps were conducted.

With the help of HP and ISRO, NVA has now been strengthened with a soil and water testing mobile van that helps to test soil parameters. With this facility, NVA plans to show a few documentaries on Soil Nutrient Management, Crop Cultivation Practices, Integrated Pest Management, Post Harvest Technologies, etc. This van now provides services to the Cauvery Delta farmers.

In Vidarbha, with the help of the College of Agriculture, Amravati and Indian Farmers Fertilizer Co-operative Limited's (IFFCO) soil vans, more than 350 farmers in Jasapur, Bodad and Lonswali villages got soil health cards. This is a continuing activity.

PAN-MSSRF Training programmes

NVA is working with Coastal Systems Research and Biodiversity Programme Areas for setting up VRCs and VKCs as a PAN-MSSRF project in TN, AP and Kerala. This year, several workshops on monitoring, evaluation and capacity building were conducted to improve the capacity building of project staff and partners.

- 6-8 September 2007, Workshop on Monitoring and Evaluation System for the NGO partners of IDRC-CIDA Tsunami project, Thangachimadam VRC
- 20-22 September 2007, Training in developing Logical Framework Approach for VRC and VKC activities, MSSRF, Chennai
- 18-22 January 2008, GIS based community needs assessment training, Thachampathu VKC, Wayanad
- 15-17 May 2008, Orientation on Participatory Monitoring and Evaluation for the NGO Partners & Community members of IDRC-CIDA Tsunami Project, Thangachimadam VRC

- 19-21 May 2008, Training on Gender Sensitisation for the staff of IDRC-CIDA Tsunami Project, Olaikuda, Rameswaram

Digital Library

NVA is developing a digital library which contains the photographs of the activities of VRCs and VKCs such as knowledge workers training, ICT-based educational programmes and Knowledge on Wheels.

Several events, such as Virtual Congresses, MUPP—NGO partners' meet, mud crab farming, and diet for women have also been documented in the form of video tapes.

Monitoring and Evaluation

NVA is systematically monitoring its activities through an evaluation framework. Data collection and compilation plans are prepared on the basis of indicators developed for various programmes of the NVA. The collected data are periodically analysed using SPSS package and communicated to all the stakeholders to take appropriate decisions and make future plans.

In addition, NVA also conducts periodical internal reviews with the VRC staff to make necessary midcourse corrections wherever necessary. Documenting the outcome of various activities of the NVA using case study and other qualitative and quantitative methods is a continuous process and helps to identify the changes among rural communities. The documented outcomes are shared among the partners in the form of publications. A number of researchers, academic institutions and policy makers have studied the VRC and VKC activities and compared them with other entrepreneurship models such as n-Logue, government initiatives (*e-seva*) and corporate models (ITC e-Choupal).

From January 2007 to March 2008, apart from trainess, 27,907 one time users and 14,703 repeated users (more than two times) visited the VRCs and VKCs.

Grameen Gyan Abhiyan (GGA – Rural Knowledge Movement)

In 2004, MSSRF initiated steps to extend the VKC concept to different parts of the country in the form of multi-stake holder partnerships called "Mission 2007: Every Village a Knowledge Centre". By 2005 this network consisted of more than 200 partners and was getting support from both national (including government) and international agencies. Since early August 2007 this network / movement is being referred to as *Grameen Gyan Abhiyan* Rural Knowledge Movement (See SPA 606).

GGA is a multi-stakeholder partnership, facilitating national and regional events related to ICT-enabled rural development activities. Some of the GGA partners are testing different technologies and developing applications for VRCs and VKCs. Academics, the corporate sector and policy makers use this platform for knowledge and technological empowerment.

The major role of the *Grameen Gyan Abhiyan* movement is to establish a link between scientific know-how and field level do-how.

Rural Innovation Fund (RIF)

As envisaged by Mission 2007, one of the major obstacles in the emergence of "Rural Knowledge Societies" across India is the lack of cost-effective and adaptive technologies that can address area-specific needs and demands and can function effectively in varied rural environments. It necessitates "innovation" of new technologies and "adaptation" of existing ones in such a way that they operate efficiently under prevalent rural constraints and conditions. To address this problem Microsoft and Telecenter.org (a collaborative initiative of Microsoft, IDRC, Canada and the SDC have constituted this Fund.

In July 2007, the Secretariat of Mission 2007 invited applications through email from those working towards developing innovative applications / solutions / content / services in any of the following areas.

- Enhancing livelihood and agriculture practice
- Education & literacy
- Rural Health & telemedicine
- E-Commerce
- Local content management applications & village level administration tools
- Disaster preparedness & management

The Fund only supports project costs, and not recruitment, core organisational costs and recurrent needs. The official representatives of the sponsors served as selection committee members. More than 1,400 applications were received. The committee short listed the applications. Telecentre.org and Microsoft allot the resources and provide necessary guidance to select 5 RIF's award winners. GGA secretariat monitors the entire programme and the award winners will bring and develop submiting their software applications to the GGA secretariat.

NVA Fellows

On 1 August 2007, NVA conducted its 5th convocation for newly elected NVA Fellows at IGNOU, New Delhi. 527 Fellows (M:329, F:198) from 19 states (AP, Assam, Chhattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Kashmir, Kerala, Madhya Pradesh, Maharashtra, Orissa, Puducherry, Punjab, Rajasthan, TN, Uttar Pradesh, Uttarakhand and West Bengal) and 25 International Fellows (M:22, F:3) from 6 countries (Afghanistan, Kenya, Nepal, Nigeria, Philippines and Sri Lanka) were present.

On 31 July 2007, NVA organized a one-day orientation programme on cultural topics of practical relevance with the help of several schools Indira Gandhi National Open University (IGNOU).

On 30-31 July 2007, NVA conducted the 5th National Participatory Knowledge Management Workshop at the National Academy of Agricultural Sciences, New Delhi and Indira Gandhi National Open University, New Delhi for newly elected NVA Fellows. On 18-19 December 2007 NVA conducted participatory knowledge management workshop for AP Fellows at Adult Education Department

Training Hall, Guntur, AP in collaboration with the Adult Education Department, Guntur and 21-22 December 2007 at Adult Education Department Training Hall, Medak, AP. NVA has developed a video film on "Journey from VKCs to NVA and the objective of NVA Fellow" in three languages, Tamil, Telugu and Hindi.

Four Soil Health Management (16-18 October 2007, 24-26 November 2007, 27-29 December 2007 and 12-14 March 2008) training workshops were held in partnership with IFFCO in TN, Mahararashtra and AP.

So far 985 Fellows have been selected from 21 States in India (AP, Assam, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Puducherry, Punjab, Rajasthan, TN, Uttar Pradesh, Uttarkand and West Bengal) and 25 Fellows from 6 foreign countries.

In August 2007, NVA brought out the second volume of the directory of NVA Fellows (Profiles and Core Competencies). The brief profiles of the NVA Fellows outlined in this publication reveal the wide range of competencies and expertise they represent. Despite the wide diversity of their interests, the common link among them is the special spirit of service that each Fellow possesses, and the quality of leadership to bring about rural transformation.

MSSRF's Intranet / Internet Network

The Informatics division has been looking after the intranet / internet network and maintaining six servers, namely Mail, Proxy, Domain, DNS, Firewall and ISA Server (Internet provider for VRCs), controlling the SPAM mails, email back-up facility, maintaining the satellite-based connectivity between MSSRF, Chennai and the VRCs and VKC network, and intranet network of more than 120 computers and 60 printers. This year, the internet connection was upgraded from 512 kbps (1:4) to 512 kbps dedicated line (1:1). E-print server was set up for the library to publish all the MSSRF research papers into the web- based public domain (open access). Informatics also upgraded the Firewall from Checkpoint NG R 5.5 to R 6.5, blocked certain web sites based on the request of the staff, allotted direct internet access for some machines for internet-based video conferencing (SKYPE), changed manageable switches (to create segment network) in a few locations of MSSRF, Chennai, from 100 Mbps to 1 GB, and installed AntiSPAM Iron Port in mail gateway to filter SPAM mails.

Sub Programme Area 602

Uttara Devi Resource Centre for Gender and Development

During the year, the Centre coordinated the publication of two major collections of studies:

The first - MSSRF held a Consultation in July 2007, with the support of the Department of Science and Technology and FAO-RAP at Bangkok, on the theme of "Technology Development and Delivery Models for Sustainable Livelihoods", involving participants

from a wide spectrum of activities to consider how S&T could be better harnessed towards sustainable livelihoods and inclusive goals (See SPA 606). The aim was to explore current systems of technology dissemination to the resource-poor, study emerging models and delivery systems and analyse the key elements that make for a successful strategy, including use of ICT, in diverse sectors. The participants in this consultation included representatives of leading organisations in technology development, NGOs who have developed successful models reaching out to the resource-poor, financial institutions, Panchayat Raj institutions (PRIs) or elected local bodies, Krishi Vigyan Kendras (KVKs/District Agricultural Science Centres), private educational institutions, Universities and other stakeholders. The proceedings of this Consultation have been published separately.

To focus on issues of inclusion, it was at first decided to devote one session specifically to this topic. But it soon became clear that this would be inadequate for in-depth analysis and discussion which could lead to an understanding of the constraints, and possible approaches to overcome them. So a preliminary one-day brainstorming was held, with the support of FAO, at the end of June 2007, on the theme of "Strategies for Gender and Social Inclusion with regard to Technology and Sustainable Livelihoods" with a smaller group of NGOs who had worked intensively with different categories of excluded groups in various sectors and with different approaches, and who would be able to share their successful strategies for social inclusion. Eight presentations were made at this meeting and discussed by a larger peer group, and a consolidated paper summarising and commenting on their experiences was presented at the main Consultation in July.

Six of the participants in the brainstorming were able to write their papers in greater depth, and these, along with an overview paper, were developed into the form of a publication titled "Gender and Social Inclusion for Sustainable Livelihoods" which appeared in November, 2007 and has been widely distributed.

Secondly, in 2004, MSSRF organised a series of five seminars as part of the observance of International Rice Year, each on different themes and issues related to rice, and each in a different part of the country. The fourth in this series, which was held in Chennai in September 2004, was on the theme of 'Gender, Rice and Food Security'. The series of papers emphasised the vital role played by women both in rice production and in household food security, as well as the impact of current trends and policies on development paths and gender justice. Six of these papers were published in *Economic and Political Weekly* (18-24, June 2005) as a Special Section.

Later, when STREE came forward to develop these essays into a book, it was decided to expand the original theme from rice production to include all rural natural resource-based livelihoods, and to add papers from other contributors. An experienced and insightful editor was needed to undertake this task of identifying and getting new contributions, guiding the process, and editing the entire set of papers.

Dr. Maithreyi Krishnaraj, one of the most outstanding figures in Women's Studies in the country, was invited to accept the Visiting Fellowship in Gender and Development for 2006 and edit and prepare this volume, as well as conduct a short course on Women's Studies during the year. The book, Gender, Food Security and Rural Livelihoods (STREE, December 2007) is the outcome of her hard work.

Sub Programme Area 603

The Hindu Media Resource Centre

The Hindu Media Resource Centre (*TH*MRC) disseminates information on sustainable agriculture and rural development, using mass media as a technological tool to reach the masses. It acts as an interface between the scientists and media professionals. The activities have resulted in more space in the media for developmental stories.

Communication strategies

To achieve the above mandate, *TH*MRC has consistently organised media workshops, public fora, public lectures, media tours and Press interactions on relevant scientific issues.

Networking and partnership

All the events organised by *TH*MRC are targeted towards research scholars, post graduate students and academics, in addition to the mainstream media professionals and emerging Community Radio Stations. Depending on the theme of the workshop/ lecture/brainstorming, these target groups are invited to participate in the event. The events are structured to give scope for interaction and dialogue. The consistent efforts in organising events have resulted in establishing a network among Arts, Science and Engineering colleges and media houses in Chennai. Twenty colleges were added to the network this year.

Event management and impact

During the year, *TH*MRC organised 22 events (See Table on page 156). A total of 196 media professionals visited us; 305 feature stories were published and 15 news stories were telecast. Each event was attended by eight journalists on an average. Around 40 news and feature stories are being published in the national dailies, regional journals, private commercial television channels, *Gyan Vani* and Community Radio Stations.

Training and capacity building

Communication strategies and skills were taught to grassroot academics of the NVA, participants from various NGOs and representatives from the farming and fishing communities through the workshops organised at Puduchery, Sempatti (TN) and Medak (AP).

Website

The feedback from journalists, students and scientists of several institutions confirms the usefulness of the website. Media tracking confirms the increased number of publications in the newspapers and magazines using the audio from the website. The Video Corner has two films, *Science and Tsunami-Two Years*

Details of activities conducted by THMRC

Media Workshops

Date	Title
25 September, 2007	Nonviolence to Nature – to commemorate the International Day for Nonviolence
26 December, 2007	Three Years after Tsunami: New Life for the Fisher Communities
11 February, 2008	The Role of ICT in management of Climate Change at the Grassroots Level-

Public Lectures

Date	Title
11 August, 2007	Lecture by Mr. Pedro Medrano, Regional Director (Latin America & Caribbean) UN World Food Programme on "Initiatives to Eradicate Chronic Undernutrition in Latin America"
3 September, 2007	To commemorate National Nutrition Week- "Nutrition Interventions in the Past and Present" by Dr. S. Raja Gopalan, Secretary, CRSARD

Press Interactions

Date	Title
26 July, 2007	Three Day National Consultation on Technology Development Delivery Models for Sustainable Livelihoods
14 August, 2007	Recommendations of National Nutritional Conclave
15 November, 2007	Rural Innovations Award
3-7 January, 2008	Mahila Kisan Congress, Indian Science Congress (Visakhapatnam & Chennai)
20 February, 2008	95th Indian Science Congress – "National Challenges Programme" - Chennai
23 February, 2008	Bio-fortified Crops – "Crops for better Nutrition"
21 April, 2008	The summary and the key decisions derived from the International Dialogue on Community Management of Climate Change - Role of Panchayats & Nagarpalikas

Millennium Lectures

Date	Title
9 August, 2007	"Lessons from India for Africa's Economic Development", Prof. Jeffrey Sachs Director, Earth Institute at Columbia University
22 August, 2007	"Globalisation of Food and Agriculture and the Poor: Driving Forces, Consequences and Policy Implications", Prof. Joachim Von Braun, Director General, International Food Policy Research Institute

25 September, 2007	"Agrarian Crisis: Causes and Concerns", Ramon Magsaysay Award Winner, Mr. P. Sainath, Rural Affairs Editor, *The Hindu*
11 February, 2008	"Global Knowledge Partnership for Meeting the Emerging Global, Environmental and Economic Challenges", Dr Walter Fust, Director General, Swiss Agency for Development and Cooperation

Seminars

Date	Title
7 August, 2007	Inauguration of an Interdisciplinary Dialogue on "Bread and Biotechnology"
16 October, 2007	To commemorate World Food Day – Food for All & Forever
28 January, 2008	Role of Media in Women Empowerment

Training Workshops

Date	Title
28 & 29 September, 2007	JTS: A Virtual Workshop for the Trainers: Content Development & Management
2 & 3 November, 2007	Workshop on Needs Assessment of Youth, Sempatti , Dindigul
18 December, 2007	Workshop on Exploring Skills and Needs of NVA Fellows – Medak and Guntur (AP)
16 March, 2008	Workshop on Communication with Special Reference to Multimedia Packages

Public Fora

Date	Title
15 September, 2007	Coastal Zone Management, Rameswaram
26 December, 2007	Coastal Zone Management, Chennai

Discussions/Dialogues

Date	Title
21 May, 2008	Panel Discussion on Green Genes and Global Warming

Later and *We Shall Overcome*. Both the films can be downloaded into any multi media-enabled mobile phone. The regular monitoring of web hits shows that both the films are viewed 50 times on an average per month and the overall page is viewed 500 times on an average every day.

Media Tracking

All the news features that are published in the newspaper/magazines are tracked and available to the staff, web subscribers, media professionals and online discussion groups. Three hundred and five published stories are preserved for research and documentation.

This reference material has motivated other journalists to develop stories for their newspaper/channel.

Concept Bank

It consists of write-ups, classified on the basis of themes, highlighting the initiatives of MSSRF. They are useful to the media/ researchers/public to get an idea before discussions with the scientists to develop news stories or research papers. These write-ups are available online in *TH*MRC.

Video Catalogue

To make effective use of the 35 documentary films so far produced by *TH*MRC, a video catalogue containing details about free access, concept, format, and availability of the films was developed. The catalogue is available online for reference. Software, which has the feature of built-in audio to read the text in English, was also developed to facilitate distribution of the video catalogue in CDs.

Media relations

A database of all media professionals is maintained and updated regularly. The details of online journalists have also been collected and used for online information sharing and discussion.

Public relations and image management

MSSRF receives visitors from all walks of life including Government officials, delegates, scientists, research scholars and students from schools and colleges. There were nearly 1,700 visitors this year.

Sub Programme Area 604

Every Child A Scientist Programme

This programme has been functional in Chennai since August 2002 and the target group are students belonging to the economically challenged sections of society, studying in Corporation schools. Activities under the programme in Wayanad have been reported under SPA 201.3. The centre in Chennai is equipped with fifteen computers and multimedia learning material with new content creation every month. With encouragement from the Zonal Supervisors, the centre has established a good rapport with Corporation Middle School headmasters, headmistresses, schoolteachers, orphanage schools and government-aided schools in the neighbouring zones IX and X.

Students from zone IX and X participate in the programme, in batches of 20 students for fifteen days from 10.00 a.m.- 4.00 p.m. Each batch of students is exposed to a combination of both lectures and some practical experimentation. The interactive lectures for the students are mostly on Biotechnology, Biodiversity, Information Technology, Health and Diseases, Global Warming and Greenhouse Effect, Types of Pollution and Rain-water Harvesting. Apart from these topics, students learn MS Office and fundamentals of Computers. So computers are used as tools to help students understand the concepts, principles, and amazing facts of science. This

year, 400 students benefited from the programme. Students from 11 zone schools, Advent Christian Schools in Velachery and Kanagam and Seva Samajam Home at Pallipattu participated (6 schools from IX zone and 5 schools from X zone).

All the students were encouraged to prepare models, draw charts and herbaria, enact skits, conduct quiz, games, etc. At the end of each training module, the students submitted projects on topics of their choice and showcased their ideas in the form of assignments, charts and models. These charts and models serve as a source of information to subsequent batches of students. This year, additional resource materials on topics like Biodiversity, Facts on Volcanoes, Greenhouse Effect, Solar System, Ozone Layer, Energy-renewable and non-renewable, were included. A Green School programme was organized in July 2007 and 15 schools participated (both government and private schools). This programme was to orient teachers to carry out a green audit as a self-assessment of the environmental practices of the school through their students. The teachers have agreed to conduct this audit in the coming year and compete for the Green School Prize. On 28 February, 2008, Science Day was celebrated with participation from students of both zones and they demonstrated their talents through skits, quiz and experimental models.

Touch and Smell Garden

This garden was developed for visually impaired people to experience the joy of nature and learn by exploration through the senses of touch and smell. Apart from children from the blind schools, visually impaired adults from various NGOs also visit the garden. A group of visually impaired computer trainees from National Institute for Visually Handicapped, Dehradun and teacher trainees from the institute in Poonamalle, Chennai, visited the garden in January 2008 and learnt about setting up similar gardens in their campuses. A herbarium of about twenty touch and smell garden plants was developed for children to learn about the types of plants and their medicinal value. The herbarium gives the botanical classification and medicinal uses of the plant. A detailed explanation of touch and smell garden plants is available in a CD. Some of the students from Corporation schools helped to make the botanical name boards for the plants in the Touch and Smell Garden.

Genome Clubs and Vacation Training Programme

The Department of Biotechnology, Govt of India, has set up DBT Natural Resources Awareness Clubs – "DNA Clubs" – in selected schools in every State. These clubs operate as a nucleus for a suite of activities and hands-on learning opportunities focusing on bioresources that seamlessly blend with formal course curricula. Regional Resource Agencies (RRAs) have been established at different locations in the country to facilitate this activity and MSSRF has been selected to coordinate the activity in the southern States, including Orissa. These clubs concentrate on hands-on training for children, lectures by eminent experts, field visits to national institutes engaged in

biotechnology research and nature walks. The clubs have been established through our partners, namely, Shri AMM Murugappa Chettiar Research Center (MCRC), Chennai (for Puducherry), Loyola Institute of Frontier Energy, Loyola College, Chennai (for TN), Salim Ali Centre for Ornithology & Natural History (SACON), Coimbatore (for Andaman & Nicobar Islands), The American College, Madurai (for AP) and Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore (for Karnataka). MSSRF implements the programmes directly for Orissa and Kerala.

School students need to learn the importance of our environment, biodiversity, biotechnology and the relation of all these with everyday life. To create an enlightened brigade of bright, young students curious about the world around them and its importance, a Vacation Training Programme on Bioresources is being carried out regularly since 2002. This programme is held annually for children who have appeared in the class X board exams. The programme is of 3-4 weeks duration, fully residential and held during the summer vacations, in which 30 children are trained. The course consists of interactive lectures, hands-on laboratory and fieldwork and projects of relevance to the students, such as the study of plants, animals and microbes of their area, web page designing on bioresources, simple biotechnology-based experiments, etc. This is a unique activity that benefits children immensely.

This year, MSSRF conducted two vacation-training programmes in Wayanad, Kerala and Jeypore, Orissa. The programme in Jeypore was conducted from 5-30 May, on Bioresources and Bio-technology. A total of 30 students (16 boys & 14 girls) from 22 schools from 13 districts of Orissa participated in the programme. The programme had a blend of exposure visits and classroom interactive sessions. The students visited industries like National Aluminum Company (NALCO), Ballarpur Paper Industry (BILT) in Koraput district and were exposed to the environmental safety precautions and measures taken by these industries. During the course they were exposed to nature trails in the highest mountain peak of Orissa (Deomali- 3000 ft Msl), forest nurseries, propagation techniques, vegetable cultivation, vermicompost preparation, herbal bio-valley, preparation of herbariums of economic forest plants, sericulture and the process of silk production, sacred groves, reserve forests, millet cultivation and preparation of value added items. They visited MITS, Rayagada and learnt basic computer application.

The students also visited a village, which was electrified under the Rural Electricity programme by the Ministry of Non Renewable Energy. They were able to see electricity generated by using wood from the forests. They interacted with the traditional healthcare practitioners in 3 tribal villages to document their knowledge on the use of plants and animals. Through interactive lectures they were oriented to subjects such as biodiversity,

cytogenetics, centre of origin of different crops and mapping of plant resources. A poster competition was held for all the students on environmental issues and 9 environmental games held to make them understand nature and the environment.

A similar vacation training programme was held in Wayanad from 19 May – 6 June, in which 30 students participated.

Sub Programmme Area 605

Library and Information Services

The library strives to provide efficient information service to the users. Currently, there are 16,723 books of which 1,100 were added during the year. In addition it also holds 239 CDs, 126 journals, 230 newspaper clippings for the year 2007-2008 and 2,250 back volumes of journals. The library also houses reports of MSSRF, development reports and Annual Reports of several organisations. Recent information downloaded from the Internet on relevant topics is also provided to the staff.

The following services are given to the end-users

- Current Awareness Service (CAS)
- Selective Dissemination of Information (SDI)
- Online Information Retrieval (E-Alerts)
- Reprographic Services (Photocopying)
- Publication & Distribution Service (Exchange Basis)
- Newsletter and Alert Services

The library serves not only the in-house staff, but also caters to the needs of users from various organisations, universities, colleges, and schools. There were 880 external users during the year. Scholars from different universities within India and the University of Ottawa, University of Bristol, University of Tokyo, Yale University, University of San Francisco and University of Bonn, visited the library during the year.

The library is also planning to expand the intranet based Open Access Archives (OAA) and Online Public Access – Catalogue (OPAC) and make it web-based to provide access to scholars from across the globe.

Sub Programme Area 606

Conferences and Workshops

Seminar on* Taxonomy vis-à-vis Conservation*, 23 May, 2007, CAbC, MSSRF, Wayanad

A one-day seminar on *Taxonomy vis-à-vis Conservation* was organised to observe the Tercentenary Celebration of Carl Linnaeus, which was attended by 120 researchers, students and teachers. Shri H. Nagesh Prabhu, IFS, CEO, State Medicinal Plants Board, delivered the keynote address on medicinal plants; it was followed by a series of lectures by experts on biodiversity. The event was

sponsored by Investing in Nature (IIN), NBRI and Sir Dorabji Tata Trust, Mumbai.

Capacity building workshop for Panchayat and community leaders, farmers and other workers on the recent legislations pertaining to* Biological Diversity and Farmers' Rights*, 2 June, 2007, MSSRF, Chennai.

The inception workshop for launching the project *Capacity Building of Panchayat Raj Institutions on the Biological Diversity Act and Protection of Plant Varieties & Farmers' Rights Act* was held at MSSRF (See SPA 205). The project, supported by the Department of Scientific and Industrial Research and National Biodiversity Authority, aims at training and capacity building of local level leaders and functionaries of Panchayats, on the BD and PPVFR Acts, in four districts, namely Cuddalore, Thanjavur, Pudukottai and Namakkal of TN, over a period of two years. The Hon'ble Union Minister of Panchayat Raj, Shri Mani Sankar Aiyar, was the chief guest at the meeting. Block Panchayat Presidents and District Panchayat Presidents of all four districts were specially invited for this event. About 48 of them, including 9 women representatives, participated. A few progressive farmers, representatives of NGOs and other community organisations from all these districts also participated at the meeting.

Workshop on* Strengthening the Linkages of Different ICT4D Models*, 22-23 June, 2007, Chennai

Mission 2007 has been focusing on strengthening partnership among various alliance members for promoting self-sustaining, self-replicable and self-generative Village Knowledge Centres. The involvement of a wide range of stakeholders in the alliance provides us with opportunities to study and understand the structures and functions of different types (Community, Entrepreneur, Corporate Sector, and Government Initiatives) of VKC, Telecenters, Information Kiosks, Village Information Centres, Community Service Centers, etc. An understanding of the social and economic context of VKCs is essential to define the roadmap for the future. Based on this background, GGA (Mission 2007) Secretariat organised a two-day workshop on strengthening the linkages of different ICT4D models to address aspects such as identifying various models of VKCs and ICT4D and share their experiences, understand the viability of different technological options for ICT4D, define the linkages with various missions, programmes and projects, delineate the programme management and policy advocacy strategies and arrive at a road map for strengthening Mission 2007 with more than 25 telecentre managers. The outcome of the meeting has been brought out in the form of a publication.

National consultation on* Technology Development and Delivery Models for Sustainable Livelihoods*, 26-28 July, MSSRF, Chennai

The National Consultation was organised with the help of financial support from FAO, Bangkok, DST, New Delhi and SBI, Chennai, to explore the four facets of the inclusive

technology system identified as technology development that is responsive to diverse rural clients, technology transfer modalities, technology service processes that transcend social inequities and policies and programmes for inclusive technology development, delivery and adoption. The inclusive perspective examined the social and economic inequities that perpetuate technology divide in rural communities. The consultation submitted twelve recommendations to the policy makers, technology development and transfer organisations and other stakeholders to help the pathways of the multi-sector stakeholders to refine and reform technology development and delivery modalities to improve rural livelihoods. There were more than 40 participants. The proceedings have been brought out as a publication titled *Technology Development and Delivery Models for Sustainable Livelihoods.*

4th Convention of the National Alliance for Mission 2007: Every Village a Knowledge Centre, 1-3 August 2007, Indira Gandhi National Open University, New Delhi

Mission 2007 Secretariat and alliance partners conducted the fourth convention of the National Alliance at IGNOU, New Delhi. Mission 2007 is a multi-stakeholder partnership, facilitating national and regional events related to ICT-enabled rural development activities. Many experts, including central ministers, policy makers, technocrats, the corporate sector, academic, UN bodies, ICT-enabled development workers and NGOs, participated in this event. Many recent technologies were demonstrated in technology Partners Pavilion. Many aspects such as knowledge connectivity in rural areas, role of Gram Panchayats in rural knowledge revolution, public-private partnerships, meeting the knowledge and livelihood needs of rural communities, global partnerships, announcement of Rural Innovation Fund awardees, etc. were covered. Mission 2007 has now been renamed *Grameen Gyan Abhiyan* (Rural Knowledge Movement). See SPA 601.

Annual Dialogue on* Bread and Biotechnology*, 7-9 August, 2007, MSSRF, Chennai

Many developing countries are advancing efforts to use biotechnology to improve the agriculture and healthcare sectors for the benefit of their populations. Significant efforts have been made to establish research capacity, bio-safety and regulatory frameworks. Both publicly funded and private sectors in Africa, Asia and Latin America are combining new biotechnology techniques with an overall objective of ensuring food, nutrition and health security for their ever-increasing population. The rapid advances made in the area of biotechnology call for accelerated efforts on the delivery of products to the farmer and consumers, based on the established evidence of safety and sustainability of these interventions to the food, nutrition and human health as well as to the environment.

The Pugwash Conferences on Science and World Affairs and MSSRF organised the Annual Dialogue on *Bread and Biotechnology*

in collaboration with national and international agencies to discuss and deliberate on issues related to safe and sustainable use of biotechnology in the priority areas of agriculture and human health. Experts representing various stakeholders took part in the three-day dialogue that helped in providing a road map for biotechnology research and application as well as essential riders for the safe, sustainable and equitable use of technology.

Inaugurating the dialogue, FAO Director General Dr. Jacques Diouf said that "Crop yield potential is likely to increase at higher latitudes for global average temperature increases of up to 1 to 3°C depending on the crop, and then decrease beyond that and at lower latitudes crop yield potential is likely to decline for even small global temperature rises, which would increase the risk of hunger." Dr. Diouf called for exploiting the new biotechnologies for enhancing yield levels, increasing input use efficiency, reducing risk, and enhancing nutritional quality, as well as ensuring that new biotechnologies help achieve this goal, in full awareness of bio-safety, socio economic and ethical concerns associated with the use of some of these technologies.

The major output of the dialogue was a consensus on developing guidelines for the safe and responsible use of biotechnology and for assessment of risks and benefits in a transparent manner that would build professional, political, public and media confidence.

National Nutrition Conclave, 12-14 August, 2007, MSSRF, Chennai

A National Nutritional Conclave was organised in collaboration with USAID and ICMR. The main objectives of the workshop were:

- To facilitate new and creative thinking and produce a shortlist of priority actions for improving nutrition security in India
- To re-energize the expanded nutrition community and increase collaboration and commitment to take the selected actions forward

Around 100 participants representing the Union Government, several state governments, UN and bilateral agencies, academia, the private sector and NGOs got together to deliberate on the road map to a Nutrition Secure India. The conduct of the Conclave was on Open Space Technology mode, a participatory meeting methodology to facilitate creative thinking and in depth discussion, facilitated by experts in the line. Following a film on the theme and initial introduction to the methodology on the first day, 36 working groups emerged and deliberated on different issues cent ring around the main theme on the second day. Their recommendations were collated and circulated for review and discussion the next morning. These were further deliberated on and the final outcome of the workshop was a 10 point *Chennai Declaration*, which was briefed to the media on the concluding day. The main areas identified for further action are - nutrition to be a priority on the national agenda, national strategy for nutrition of children under two, nutrition security focus on the urban poor,

improved monitoring and evaluation of nutrition programming, including ICDS increasing its focus on measuring nutrition outcomes, more focus on nutrition education, communication and awareness. A Coalition for Nutrition Security has been formed as a follow-up to the Conclave (SPA 501.4).

Socially Sustainable Strategy for Agriculture in Vidarbha, Sept 8 2007, Nagpur and* Mahila Kisan Sashaktikaran Pariyojana*, Oct 6, 2007, Sewagram, Wardha

A meeting of academic and research institutes, civil society organisations, farm men and women, bankers, industry and government representatives in Nagpur on Sept 8 resulted in an action plan for 'bringing new life to the women farmers of Vidarbha'. A Technical Support Consortium of participating institutions and agencies was formed to work towards this end. A follow-up meeting in Sewagram, Wardha on Oct 6 had women farmers speaking about the issues faced by them in the forenoon and the technical support consortium members giving their suggestions in the afternoon. The two meetings laid the foundation for the '*Mahila Kisan Sashaktikaran Pariyojana*' – Women Farmers' Empowerment Programme in Vidarbha (See SPA 503.2).

National Discussion on* Revitalising Agrobiodiversity for Alleviating Poverty and Hunger*, 24 – 26 November, 2007, CAbC, MSSRF, Wayanad

A three-day National Discussion on *Revitalising Agrobiodiversity for Alleviating Poverty and Hunger* was held to mark the tenth year of CAbC. The programme was inaugurated by Mr. M.P. Veerendrakumar, Hon'ble MP, and chaired by Mr. Shreyamskumar, MLA. Prof M.S. Swaminathan delivered a special talk on 'Agrobiodiversity and Sustainable Food Security'. Three technical sessions were held *viz*., Revitalisation of Community Biodiversity Conservation Practice, Biodiversity and Food & Nutritional Security, Protecting Community Rights for Conserving Biodiversity. Each technical session was attended by about 50 people; the keynote speakers, panelists and participants gave suggestions for revitalising agrobiodiversity conservation, which was later presented as recommendations. Simultaneously an exhibition on wild foods, leafy greens, traditional crop varieties and organic products was organised, which was visited by over 3,000 people including students, children, farmers, and planters. The National Discussion was partially supported by the State Bank of Travancore, Thiruvananthapuram.

First National Virtual Congress of* Mahila Kisan*, 5 January, 2008, Visakhapattinam

MSSRF, Indian Space Research Organisation and Andhra University organised the first national Virtual Congress of *Mahila Kisans* at the Convention Hall, Andhra University, during the 95th Indian Science Congress at Visakhapattinam. During the congress, MSSRF, Chennai, VRCs of Jeypore (Orissa), Waifad and Yavatmal (Maharashtra), Moosapet (AP), Thiruvaiyaru (TN) and Pokran (Rajasthan) were connected through ISRO uplink and downlink satellites. This brought several women agriculturists together on a single platform to discuss and guide a policy change. The *Mahila Kisan* who participated in

the Virtual Congress raised many generic issues related to agriculture in their respective regions, practical problems faced by farm families headed by women, and involvement of women in agriculture.

Several issues such as lack of adequate credit, problems of security as they had to go to their farms at night for pumping water due to erratic power supply, need for crèches to take care of their children when they go out to work, medical and risk allowance, demands for drought-resistant seeds, seed and grain banks in villages, government run shelters for abandoned cattle, women-friendly agricultural tools and machines, engendering curriculum in agriculture, and joint title deed for agricultural land, were raised and discussed during the Virtual Congress in their local languages (Telugu, Tamil, Marathi, Hindi and Oriya). The issues discussed fall under major categories such as land care and soil health, *jal swaraj* or water security, credit and insurance, technology, extension and inputs, post-harvest technology, marketing and pricing. Based on the outcome of the Congress, a nine-point Charter was developed to address the issues of women in agriculture which is as follows:

Nine point Charter for Mahila Kisans

- Title to Land: Joint *Pattas* are absolutely essential for *Mahila Kisans* to get access to Kisan Credit Cards and institutional credit.
- Right to Credit both individual and to women self-help groups, and to insurance: New insurance schemes should be started for *Mahila Kisans* to cover them from occupational hazards, like leptosporosis infection in paddy fields.
- Support services like creches, *anganwadis,* etc. to take into account the multiple burden on a woman's time, such as child rearing, home keeping and income earning activities.
- Access to quality inputs like seeds, organic and mineral fertilizers, extension advice, etc. at the right time and place.
- Training and Capacity Building and imparting quality, genetic, trade and legal literacy; engendering the curricula of agricultural, veterinary and fisheries universities and Krishi Vigyan Kendras. The agricultural university movement will be 50 years during 2008 and it will be appropriate that the gender dimensions are mainstreamed in the curricula.
- Jal Swaraj or irrigated and domestic water security through training in water harvesting, aquifer recharge and more income per drop of water techniques.
- Meeting the needs of mixed farming, involving crops, livestock, fish and trees; special attention to fodder and feed in the case of livestock, and to seed and feed in the case of aquaculture; appropriate post-harvest technologies for processing, storage, transporting and marketing.
- Assured and remunerative marketing; linking *Mahila Kisans* to markets, ensuring fair price and timely payment; provision of rural godowns and warehousing facilities; training in safe storage and in sanitary and phyto-sanitary measures.

- Reduction in drudgery and enhancing income per hour of work; Farm implements, which can help to enhance work efficiency and reduce drudgery, are urgently needed. Traveling Exhibitions and Knowledge on the Wheels programmes may be organized to familiarise *Mahila Kisans* with the gender sensitive implements available in Agricultural Universities, ICAR institutions, IITs and KVKs.

Study tour of 25 Nenasala operators on knowledge and experience sharing mission, 4 – 11 February, 2008, MSSRF, Chennai

ICT Agency (ICTA) of Sri Lanka sent 25 Nenasala operators (like VKCs) to MSSRF, Chennai and Puducherry VRCs and VKCs to discuss various aspects such as concept and activities of VRCs and VKCs, NVA Fellows, capacity building, training for knowledge workers, monitoring and evaluation of VRCs and VKCs, functions of *Grameen Gyan Abhiyan* secretariat, ICT-based trainees, and NVA Fellows. On 10 February 2008, the participants had a debate on activities that could be replicated in Sri Lanka (both content and dissemination), difference between MSSRF VRCs, VKCs and Nenasala's, and how to improve Nenasala centres by using different monitoring and evaluation methods.

Workshop on Role of ICT in the management of Climate Change at the Grassroots Level, 11 February, 2008, MSSRF, Chennai

Many aspects such as the role of SDC and GKP in climate change, the role of space applications in disaster management, climate change management at the grassroots for governance, role of Panchayat, vulnerability assessment and enhancing the adaptive capacity to climate change in semi arid areas, and climate literacy through VRCs and VKCs were discussed. Dr. Walter Fust, Director General, SDC, Ms. Rinalia Abdul Rahim, Executive Director, Global Knowledge Partnership Secretariat, Dr. V.S. Hegde, ISRO, Mr. Malan, Dr. G. Palanidurai, Gandhigram University and many dignitaries including Panchayat leaders and NVA Fellows participated in the workshop. NVA Fellows shared their experiences related to climate change. The participants also had discussions with farm women and men, fisher folk, NVA Fellows and Panchayat leaders of Puducherry, Nagapattinam, Waifad, Annavasal, Thangachimadam and Jeypore through ISRO-based satellite conference regarding their preparedness for meeting the adverse impact of changes in precipitation, temperature and increase in drought, floods, coastal storms and sea level rise (hydro-meteorological events). Aspects such as sea water ingress (shifting the settlements, reducing the space for drying fishing nets and landing their boats), increased humidity (vegetable crops matured much earlier resulting in poor quality and quantity), reduced dew (low productivity of wheat), disappearing species increased water temperature, coral reefs bleaching (bleeding)), fluctuations in fish finding zones, changes in the fishing season and season advance were discussed.

Annual Interdisciplinary Dialogue on Community Management of Climate Change: Role of Panchayats & Nagarpalikas, 19 - 21 April, 2008, MSSRF, Chennai

The main objectives of the dialogue were to discuss (i) issues that help to understand the perceived risks of climate change and available options at the local level for pro-active action, (ii) ways and means to enhance local capacities through education, social mobilisation, training and awareness for handling climate related stresses and (iii) develop a simple regulatory framework to handle climate related issues at the local level. About 50 participants including Panchayat leaders, policy makers, scientists, civil society representatives, and lawyers were present. The dialogue resulted in a draft model Act for local level Climate Risk Management (Climate Risk Management Act, 2008). The draft Act outlays provisions to enhance the ability of local communities to develop and implement climate change adaptation programmes and policies within a framework of ecologically, ethically, economically and socially sustainable development. The draft Act covers food security, energy security, non-farm employment, human diseases, carbon trade opportunities and climate literacy issues. A small expert group has been constituted to finalise the draft.

Soybean cum Livestock Based Farming System Approach for Work and Income Security in Vidarbha, 10 May, 2008, Nagpur

Around 100 participants from research institutes, animal and agricultural science universities, scientists, bankers, farm men and women, civil society and media met at VANAMATI, Nagpur and deliberated on the issues cent ring on soybean cultivation and related aspects. The meet was organised by MSSRF, Chennai and The Soybean Processors Association of India (SOPA).

The main thrust was to highlight the importance of having a farming system approach to soybean cultivation and linking livestock with the crop cycle as an integral part of the system. This was felt important in the light of the recent trend of more area coming under soybean cultivation in the Vidarbha region. Soybean is both a protein and oilseed crop and soybean *bhusa* is excellent cattle feed.

The programme structured in four sessions focused on the production and potential for soybean in the country; the situation in the Vidarbha region came in for special focus. The need for a whole soybean farming system approach from the production stage to the marketing stage was emphasised. Production support needs strengthening of seed breeding programmes, promotion of seed production, awareness of agronomic practices and attention to soil health. A livestock integrated farming system approach and development of post harvest infrastructure is imperative.

A Support Consortium comprising research institutes, government agencies, bank and insurance companies, industry and civil society was formed for rendering appropriate technical and other support to farmers.

Special Projects

MSSRF was requested by the Ministry of Agriculture, Government of India, to undertake two studies in Kerala, on sustainable development of Alappuzha district together with Kuttanad Wetland region and Idukki district. The reports have been submitted.

Programme Area 700

Studies on identifying and recommending measures to mitigate agrarian distress in Alappuzha district together with the Kuttanad wetland ecosystem, and Idukki district of Kerala State

The Government of India, in view of the farmers' distress, had declared a special rehabilitation package for 31 distressed districts of AP, Karnataka, Kerala and Maharashtra. Approval for a special plan of action for improving the farming conditions in Alappuzha district together with the Kuttanad Wetland Ecosystem (KWE) region, and Idukki district of Kerala was also granted. MSSRF was invited by the Ministry of Agriculture, Government of India, to undertake studies and make specific recommendations on the sustainable development of KWE region together with Alappuzha district and Idukki district with particular focus on the measures for strengthening the ecological security and expanding sustainable livelihood opportunities for the people of these areas. The reports pertaining to these two regions have been submitted to the Ministry of Agriculture, Government of India. Both these reports have been technically approved by the Government of India as well as the State Government and are currently under different stages of administrative and financial approval.

The two regions, the Alappuzha district together with the whole of KWE and the Idukki district, are important agricultural hubs of Kerala. Kuttanad, which in part lies 2.2 m below mean sea level, has a very large area under rice, with relatively high productivity and hence is recognised as the "rice bowl" of the State. Idukki district, on the other hand, is a hilly region well known for the commercially valued plantation and spice crops and is known as the "spice district" of the State. Notwithstanding this contrasting geomorphology, an important common factor between these two regions is their unparalleled endowment of natural charm, which is uniquely distinct for each region. However, the natural charm of these regions is fading and their wealth is being frittered away. Unsustainable development paradigms, misuse of technologies, increasing intensity and frequency of natural calamities, greedy plundering of natural resources, pessimistic public apathy, inadequate policy and administrative interventions and acute shortage of financial and infrastructure resources are increasing the growing threat to the ecology and the livelihoods of economically and socially vulnerable groups such as small farmers, fishermen and agricultural workers.

The studies and the reports on Alappuzha district including Kuttanad region and Idukki district were conducted under the guidance of Prof M S Swaminathan by two teams led by Dr S Bala Ravi, Advisor, MSSRF. The MSSRF members in the first team were Dr Sudha Nair, Director, JRD Ecotechnology Centre, Ms Deepa Varma and Dr Anil Kumar, Director, Biodiversity and Head CAbC, Kalpetta. Dr K U K

Nampoothiri, Director, BPMPGRC, Jeypore was on the second team. Both these teams were supported by a panel of eminent technical experts.

The studies in both the districts followed almost similar processes. They involved initial studies of earlier important reports on these districts, wherever such reports were available, extraction of all relevant databases connected to the mandates of the study, several field visits, collection of data from case studies and organising over 25 wide-ranging consultations in both districts involving all stakeholders impacted or concerned by the agricultural economy and threat to ecological and livelihood security. The stakeholders included Ministers, all elected representatives up to the Panchayat level, senior officials of all concerned line departments in the districts, scientists, farmers, farm/plantation workers, fishermen, farm women and their respective associations, members of SHGs and NGOs, eminent citizens, experts and media. During the consultations in the two districts, oral inputs from over 1,900 persons and written inputs from 913 memoranda were received. These, together with the detailed study conducted by the teams at many locations were used to develop the report and administrative and financial recommendations.

In both the districts, agriculture constitutes the primary and predominant source of livelihood for the majority of the population. For more than 80 % of the population in Kuttanad and Alappuzha, agriculture is the only source of income and this dependence exceeds 95 % in Idukki. While agriculture contributes to more than 90 % of the GDP of Idukki district, it exceeds 60 % in Kuttanad region, including Alappuzha district. In Idukki 82 % of agricultural income is from rubber, cardamom, pepper and horticultural crops and another 11 % is from the animal sector, 90% of which is contributed by milk. In the case of Kuttanad, nearly 80 % of the agricultural income is contributed by rice, coconut, rubber and fish. While Alappuzha is the most densely populated district in the State, Idukki has the lowest population density. Nearly 50 % of the area in Idukki is under forest, notwithstanding the threat imposed by various anthropogenic factors, while Alappuzha is known for the large backwater bodies and labyrinthine river system. In the Alappuzha-Kuttanad region, more than 95 % of the farmers own less than 0.4 ha land area, while 95 % of holdings in Idukki district have less than 2 ha of land area with per capita availability of land marginally above 1 ha. According to the data for 2004-05, out of about 4, 00,000 families in Alappuzha district, 39 % are below the poverty line. In Idukki district, 44 % of the 2,65,000 families are classified as BPL.

The ecological security of both regions is imperiled by anthropogenic factors, although in a quite dissimilar manner. Revival of agriculture in these districts, to make it a sustainable and vibrant economic occupation for securing livelihoods with enhanced income, is intrinsically linked to the restoration of ecology and strengthening the respective natural endowments of these regions. Nothing underscores the strong link between farm

economics and ecology more than the axiomatic statement of Prof. M.S. Swaminathan that "If farm economics and ecology go wrong, nothing else will go right in agriculture".

The farm crisis in Idukki has multiple causes and is manifested in extensive and deep indebtedness, serious agricultural decline and many farmer suicides. The three major reasons for this distress are the very high cost of production of major plantation and spice crops, high volatility of prices, often dipping below the cost of production, and the increasing incapacity of farmers in repaying their debt. Added to this, the alternate drought and heavy rainfall in the last six years has shattered the economic backbone of many farmers with small and medium holdings. The economic decline and continuous neglect made the plantation crops more vulnerable to pests and diseases, with appalling decline in productivity. The increasing prices of farm inputs and labour were impediments to a return to successful agriculture. The productivity decline compounded the distress from price fall and escalated the cost of production.

Kuttanad illustrates another paradox of acute agrarian distress amidst natural bounty. As in Idukki, causes behind the agrarian distress in Kuttanad are multiple. A unidirectional development agenda followed over the last few decades, ignoring the ecological fragility of the KWE and its vulnerability to regular flooding, such as construction of criss-crossing roads blocking many waterways, reduction of flood area by reclamation of wetlands, serious pollution of the water bodies, and interference in the natural backwater flushing during tidal action in the Arabian Sea. The consequent changes in ecology have cumulatively promoted economic decline and livelihood loss from agriculture. The livelihood from agriculture is further threatened by the high cost of production, increasing production risk, declining cultivation of rice and income from coconut, and rising indebtedness of farmers. Major income from the uplands has declined due to low yield of root-wilt-infested coconut palms and crashing prices, resource crunch for alternate income generation from on-farm or off-farm activities and shrinking income from rice cultivation and inland fishery. Consequently, Kuttanad, which was once recognized as the 'rice bowl of Kerala' has become a 'basin of distresses'. Incidentally, Kuttanad is an important part of the Ramsar site, constituting the wetland system of this part of Kerala.

The study has identified the elements of ecological decline with short- and long-term impact on agriculture and other means of livelihood:

- declining water spread area in Vembanad Lake, surrounding wetlands and discharge capacity of all the waterways
- increasing flood vulnerability with rising risks to farm production and economy
- problems due to the ongoing regulation of saline water intrusion
- choked waterways and resulting problems in drainage, pollution, sanitation, human

health and availability of clean drinking water and water for irrigation

- multi-factored pollution of water bodies including the invasive water hyacinth
- declining wetland ecosystem services like water recharge and fish production, and habitat loss and biodiversity,
- lack of locally produced quality paddy seeds and need for massive replanting of low yielding and sick coconut palms with quality disease tolerant seedlings,
- declining productivity and income from coconut and lack of coconut based inter or mixed cropping and value addition for income and employment generation,
- incapability of local markets to procure and locally process the paddy
- declining profitability from rice farming, increasing fallowing or conversion of paddy fields, decreasing rice intensification, under utilisation of one-rice-one-fish production technology, shortage of farm labour and high labour cost

The report on Alappuzha district and Kuttanad offered integrated and well prioritised recommendations to address all the major issues for achieving ecological revival and restoration and strengthening of livelihoods from agriculture and allied activities.

The study in Idukki district identified that many farmers, particularly small farmers, are under heavy debt and the state of their farm economy is not healthy enough to service the loan, even by paying the interest. At least 91 % of cultivated area in the district is under perennial and high value crops, which essentially demand heavy annual investments to sustain productive health and better productivity. The low prices of pepper, cardamom, coffee and tea, which in some cases were below the cost of production, is the prime cause behind the poor state of farm economy. While the prices have crashed, the cost of production has gone up. This has led to failure in loan servicing, which in turn has blocked fresh lending. Failure in fresh investment on these crops for over a couple of years led to yield decline and crop loss from major pests and diseases. This shrank the farm income further. The total outstanding agricultural loan in the district from the cooperative and commercial banking sectors in March 2007 was estimated at above Rs 630 crores. About 85 % of this loan was due to small farmers and about 82 % was as crop loan. Data on the magnitude of private lending in the district were not available. Apart from the farm distress precipitated by the market prices, farm economy also suffered from continuous drought during 2002 and 2003 and heavy rain and wind during 2007. The cumulative economic crisis and the farm distress were so deep that the farmers, particularly the small farmers, are getting further entrenched, without a special economic and development package designed to help them.

Pepper which is grown by virtually every farm family and is a major contributor to farm income, had suffered serious setbacks from slow and fast wilt, leading to loss of plantations and severe yield decline. Replanting the

damaged gardens and nursing back the poorly managed ones are inevitable for securing income. Cardamom, grown by more than 25,000 farm families, a majority of them small farmers, has become less competitive due to the high cost of production under severely depressed prices. Introduction of high yielding farmers' varieties like '*Njallani*' is being misused by adopting ecologically unsustainable farming practices and destruction of forest cover in the Cardamom Hill Reserve forest region (CHR forest) for achieving higher yield. The price crisis has made several plantations unproductive and uneconomical, requiring replanting for reviving income generation. Tea gardens, small and big, are suffering from the low productivity of senile bushes, high cost of production and depressed market prices. Liberal support is essential to revive this important sector, which is providing employment to many poor families. Apart from plantation crops, seasonal crops such as vegetables, plantains, and spices like ginger and turmeric are suffering from low prices, increasing cost of production, absence of fair market and exploitation by middlemen. This exploitation is being exacerbated by the poor communication and marketing system available in this hilly region. Certain parts of the district in Devikulam taluk have great potential to expand production of temperate vegetables and fruits. The developmental systems in place are far too inadequate to attend to these problems and the other crying needs of the district. Hence a special package is imperative for enhancing the income generation of the farmers. It is important that such package focuses on sustainable production at competitive cost, and provision of a need-based fair market system, preferably managed by farmer groups/cooperatives, infrastructure for short-term storage and value addition in certain crops, and arrangement for bank loans against stored produce to discourage distress sale at low prices.

On the ecological side also, the state of affairs is dismal, with the looming threat of its effects on agriculture and other sources of local livelihood, including tourism. Idukki district receives the highest rainfall (3,506 mm) in Kerala and probably also has the highest number of rainy days. Due to the high altitude and large rain forest area, which accounts for about 51 % of the district, the hilly region has a comfortable range of maximum and minimum temperatures. The weather and the charming scenic views of the hills contribute to the popularity of Munnar hills as a tourist spot, as well as the high suitability of the region for high value plantation and spice crops such as cardamom, pepper, clove, tea, and coffee as well as temperate vegetables and fruits. The weather also contributes to the unique quality of the spices produced here. Thus, the rainforests of the district have a profound and multiple implications for the climate, ecology and economy of the district and the surrounding region.

Over the years, the ecologically unfriendly development paradigm, increases in settlements and population, agricultural expansion, heavy total or partial deforestation by the people and the government, have led to

substantial reduction in forest area, coverage and the forest profile. These degrading processes have reached such an extent that it is significantly impacting the local and neighborhood climate and ecology, to seriously threaten the economy and livelihoods of the people in the immediate as well as long term. The study, using weather data from different locations in the district, revealed that the total rainfall and rainy days have declined significantly, particularly during the main rainy season (south-west monsoon); the maximum temperature has increased substantially while the minimum temperature has decreased. It has also revealed the development and alarming expansion of a rain shadow region in the north-eastern part of the district. The farmers of the district with their long experience are aware of these changes, although not technically. Their observations were the prime reason for this climate analysis.

The report stresses the need and urgency for restoring the forest in the district, strengthening efforts to conserve water and soil, discouraging commercial agro-forestry with underground-water depleting alien species such as *Eucalyptus*, appropriate intervention for re-foresting the expanding rain shadow region, scientific harnessing of forest resources for sustainable livelihoods, including alternate options and promotion of farming, promoting culture fishery in man-made reservoirs, managing steadily rising man-animal conflict in the wild animal corridor regions, and sustainable extraction of non-timber forest produce. The full reports can be accessed at www.mssrf.org

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Gnanappazham, L. 2008. Remote Sensing Application on Mangroves Management. *Training Programme on Geospatial Technology – Concepts and Applications.* Sathyabama University, Chennai. March 31.

Gopinath, R. 2007. Farmer's Participation in Management Local Resources: A Case Study of Parambur Tank in Pudukottai District, TN. *International Conference on Water Resource Management: Challenges and Opportunities in the 21st Century.* Assam University, Silchar. April 23-26.

Gopinath, R. 2008. Changing Irrigation Pattern in an Indian Village: Case Studies of Two Farmers. *International Seminar on Intensive Village Studies to the Understanding of the Rural Scenario in India.* G. B. Pant Social Science Institute, Allahabad. February 29-March 01.

Isaac Manuel, R. 2008. Enhancing Adaptive Capacity to Climate Change. *National Seminar on Climate Change: South Asia and Southeast Asia.* Society for Indian Ocean Studies, New Delhi. February 16.

King, E. D. Israel Oliver. 2007. Cultural and Conservation Dimensions of Malyali Tribes of Kolli Hills, TN. *Conference on Tinai – A Social Order*. Madras Christian College, Chennai. November 2.

King, E. D. Israel Oliver and A. Vedhamoorthy. 2007. Public-Private Partnership Model in Organic Pine Apple Export – A Case Study. *India Organic 2007 Seminar on Indian Organic Agri Business: Threshold of Growth.* NASC Complex, New Delhi. November 29-30.

King, E. D. Israel Oliver. 2007. Role of Youth in Sustainable Rural Development. *Regional Youth Camp.* Nehru Yuva Kendra, Namakkal. December 8.

King, E. D. Israel Oliver. 2007. Strategy for Conservation of Sacred Forest of Kolli Hills, TN, India: A Study on Botany, Ecology and Community Interaction. *International Conference on Sustainable Forest Management and Poverty Alleviation: Roles of Traditional Forest related Knowledge.* Kunming, China. December 17-20.

Mahapatra, Sushanta Kumar. 2007. Operation and Maintenance of Surface Irrigation System: An Empirical Analysis from Selected Distributaries of Hirakud Command Area: Orissa. *International Seminar on Water Spatial Dynamics, Competitive Claims and Governance, How to Reduce Stress on the Resource in Urban, Peri-Urban and Rural Areas?* Pondicherry University, Pondicherry. November 30-December 01.

Maity, Bijay Kumar, Sudha Nair, Vijay R Subbiah and R. Jeeva. 2007. Adoption of Integrated Pest Management (IPM) Practices for Controlling Pests in Biovillage Programme in Kendrapara. *National Symposium on Sustainable Pest Management and Safer Environment.* Orissa University of Agriculture & Technology, Bhubaneswar. December 6-7.

Maity, Bijay Kumar. 2007. Effect of Different Storage Receptacles on the Oviposition, Development and Quantitative Loss by the Bruchid, Caryedon Serratus (Oliv) in Stored Groundnut. *National Symposium on Sustainable Pest Management for Safer Environment.* Orissa University of Agriculture & Technology, Bhubaneswar. December 6-7.

Malarvannan, S., R. Rengalakshmi., R. Seenivasan., V. R. Prabavathy and Sudha Nair. 2007. Use of White Muscardine Fungus, *Beauveria Bassiana* in the Integrated Management of Banana Pseudostem weevil, *Odoiporus longicollis* Oliv. in Thoni Hills,

Western Ghats. *48th Annual Conference of the Association of Microbiologists of India*. Indian Institute of Technology (IIT), Chennai. December 18-21.

Mani, K.G. 2007. Bioshield Development and Management. *Seminar on Ecological Development of East Coast of India*, Coastal Poor Development Action Network India (COPDANET), Chennai. December 21.

Mani, K.G. 2008. Poverty and Corruption. *Symposium on Poverty and Society.* Annamalai University, Chidambaram. March 26-27.

Mitra, Sudip and Sudha Nair. 2007. Bioindustrial Watershed Project Concept and Approach. *Workshop on Water Management Strategies for Food Security and Environmental Quality.* Punjab Agricultural University, Ludhiana. September 19-21.

Mitra, Sudip. 2008. Evergreen Revolution: Efficient Management of Natural Resources through Bio-Industrial Watershed Approach. *95th Indian Science Congress*. Visakhapatnam, AP. January 3-7.

Nagaraja, C. 2007. Women Based Aquaculture in TN - A Sustainable Model. *National Workshop on Sustainability of Indian Aquaculture Industry (Sustain-Aqua 07).* Indian Institute of Technology (IIT), Kharagpur. September 28-29.

Nair, Sudha. 2007. Engaging Women in Science – Options for Developing Countries. *Women in Science.* Bibliotheca Alexandria, Egypt. October 23-24.

Nair, Sudha and R. Rengalakshmi. 2007. Value Addition and Byproduct Utilisation in Banana. *Case Studies of Two Commercially Sustainable Small Enterprises*. National Banana Research Centre, Trichy. October 29-30.

Nair, Sudha. 2008. Bio-entrepreneurship for Women. *National Conference on Showcasing Cutting Edge Science and Technology for Women*. Department of Science and Technology, Govt of India., New Delhi. March 8-9.

Nair, Sudha. 2008, Empowerment of Women in Rural Areas. *Sustaining Global Pressures: Women in Science & Engineering, Next Generation challenges and Opportunities*. Indian Women Scientists' Association, Kalpakkam, IGCAR, Chennai. January 3-5.

Narayanan, Rama. 2007. Women's Multiple Work Roles, Maternity Support and Management of Breastfeeding in Urban Slums in Chennai. *39th Annual Conference of the Nutrition Society of India. National Institute of Nutrition,* Hyderabad. November 16.

Narayanan, Rama. 2007. The Obesity Syndrome: Issues and Challenges. *National Conference on the Facts and Myths of Obesity.* PSG College, Coimbatore. December 19.

Narayanan, Rama. 2008. Determinants of Infant Feeding Practices in Chennai Slums. *95th Indian Science Congress*. Visakhapatnam, AP. January 3-7.

Narayanan, Rama. 2008. Measurement of Undernutrition and Immune Status Assessment. *National Conference on Nutrition*

and HIV AIDS: From Knowledge to Action. International Life Sciences Institute India(New Delhi), Nagpur. February 14.

Palled, Vishwanath. 2007. Social Capital: The Missing Link in Development Intervention. *Empowering the Poor in the Era of Knowledge Economy*. Confederation of NGOs of Rural India, New Delhi. April 24-26.

Parasuraman, N. 2008. Every Child A Scientist Programme. *95th Indian Science Congress.* Visakhapatnam, AP. January 3-7.

Parasuraman, N. 2007. Successful Establishment of Alternate Livelihoods for the Rural Poor Youth in Coastal Areas. *YES Alexandria 2007,* Alexandria. August 26-30.

Parida, Ajay. 2007. Biotechnology for Ensuring Food and Nutrition Security. *National Conference on Recent Advances in Biotechnology*. Osmania University, Hyderabad. October 16-17.

Parida, Ajay. 2007. Tissue-Specific Histochemical Localisation of Iron and Ferritin Gene Expression in Transgeneic Indica Rice Pusa Basmati (*Oryza Sativa L.*). *Harvest Plus Rice Crop Meeting.* Bangkok. November 3-5.

Parida, Ajay. 2007. Biotechnology Options for Enhancing Food and Nutrition Security. *Annual Symposium of the National Academy of Sciences.* Central Food Technological Research Institute, Mysore. November 6-8.

Parida, Ajay. 2007. Enhancing Crop Productivity in Saline Soils. *76th Annual Meeting of Society of Biological Chemists (India).* Tirupati. November 25-27.

Parida, Ajay. 2007. Opportunities and Options for Crop Biofortification for Alleviating Micronutrient Malnutrition. *International Symposium on Food Technology for Better Nutrition*. Nutrition Foundation of India, New Delhi. November 30-December 01.

Parida, Ajay. 2008. Biotechnology for Global Public Good. *95th Indian Science Congress.* Visakhapatnam, AP. January 3-7.

Parida, Ajay. 2008. Developing Crop Varieties for Adoption to Climate Change. *95th Indian Science Congress*. Visakhapatnam, AP. January 3-7.

Parida, Ajay. 2008. Abiotic Stress Tolerance in Plants – Emerging Opportunities. *National Workshop on Abiotic Stress Tolerance in Plants*. Institute of Life Sciences, Bhubaneshwar. March 11-15.

Parida, Ajay. 2008. Ensuring and Enhancing Crop Productivity in Response to Emerging Abiotic Stress Conditions. *Indo-Australian Workshop on Transgeneic Crops.* National Institute for Plant Genome Research, New Delhi. April 21-22.

Punitha, S. 2008. Distribution of Mangroves in TN – Analysis through Remote Sensing. *National Seminar on Hyperspectral Remote Sensing Data on Natural Resource Management.* Annamalai University, Chidambaram. February 13-15.

Purohit Deepanweeta, 2008. Rice Iron Fortification for Combating Micronutrient Deficiency. *International Conference on Recent Advances in Bioengineering*. SRM University, Chennai. February 7-9.

Rameshkumar, N. and Sudha Nair. 2007. *Vibrio porteresiae* sp. nov., A Novel Diazotrophich Bacterium Isolated from a Mangrove Associated Wild Rice (Porteresia coarctata Tateoka). *48th Annual Conference of the Association of Microbiologists of India.* Indian Institute of Technology (IIT), Chennai. December 18-21.

Rengalakshmi, R. 2008. Gender and Information and Communication Technology Based Functional Literacy. *IAWS Annual Meeting*. Lucknow. February 8-11.

Rukmani, R. 2007. India's Agricultural Development: Some Concerns. *National Seminar on India: The Emerging Super Power*. Institute of Technology, Mayyil, Kerala. October 3.

Rukmani, R. 2007. Perspectives and Issues in Indian Development. *Refresher Course in Economics for College Teachers.* Bharathidasan University, Tiruchirapalli. November 20.

Satheesh, K., P. S. Udayan and Indira Balachandran. 2007. Notes on Ten Rare, Endemic and Threatened Plants of Western Ghats of Conservation Concern**.** *Indian Association of Angiosperm Taxonomy Conference.* Sivaji University, Kohlapur, Maharashtra. November 19-21.

Selvam, V. 2008. Seawater farming: An Adaptive Strategy to Sea Level Rise. *95th Indian Science Congress*, Vishakapatnam, January 3-7.

Selvam, V. 2008. Seawater Farming for Coastal Area Prosperity*. National Science Day Workshop.* Central Institute of Brackishwater Aquaculture, Chennai. February 12.

Selvam, V. 2008. Resilience, Adaptation and Transformation in Turbulent Times. *International Conference on Resilience*. Stockholm, Sweden. April 14-17.

Selvam, V. 2007. Coastal Bioshields. *National Workshop on Cyclone Risk Management.* National Institute of Disaster Management, New Delhi. August 27-31.

Senthilkumar, V. 2007. GAP in Aquaculture. *Workshop on Application of HACCP Principles in Shrimp Farming*. Marine Products Export Development Authority, Pondicherry. April 22-23.

Senthilkumaran, S. 2007. Telecentre Networks, Network Strategic Plan, Network Structure and Governance. *Consultative Meeting.* The Establishment of Regional Knowledge Network of Telecentres in Asia-Pacific, Bangkok. September 27-28.

Srinath, J. 2007. Knowledge Revolution for Livelihood Security: Village Knowledge Centres of M. S. Swaminathan Research Foundation. *National Seminar on Rural e-Empowerment*. National Bank for Agriculture and Rural Development (NABARD), Mangalore, Karnataka. October 11.

Subbiah, Vijay R. 2007. Evergreen Revolution: Farm to Fork. *International Conference cum Exhibition on Agri Business & Food Processing.* Federation of Indian Chambers of Commerce and Industry (FICCI), Chennai. October 26-27.

Usha, B., Gayatri Venkataraman and Ajay Parida. 2008. A-Nucleo-Cytoplasm Co-localised Type 2 Metallothionein from Prosopis Juliflora Confers Heavy Metal Tolerance to Transgenic Tobacco. *Plant Biology 2008*. Mexico. June 26-July 01.

Vepa, Swarna S. 2007. The Impact of Economic Reforms on Agriculture. *Seminar on the Impact of Reforms.* Vivekananda College, Chennai. September 5.

Vepa, Swarna S. 2007. Agriculture and Food Security. *Symposium on Growing Sectoral Imbalances in the Indian Economy.* Madras Christian College, Chennai. September 17.

Vepa, Swarna S. 2007. Government Policies of Poverty Reduction and Human Resource Development. *Symposium on Pro-Poor Policies for Poverty Reduction.* DHAN Foundation, Madurai. September 28.

Vepa, Swarna S. 2007. Policies to Alleviate Agricultural and Rural Distress and Agricultural Price Policy and its Relevance in the Era of Globalisation. *Refresher Course on Contemporary Issues in Development.* Madras School of Economics, Chennai. December 7.

Participation in Training Programmes/ Workshops

Anil Kumar, N., K. A. Sujana, K. Sathheesh, C. S. Dhanya, K. S. Surabhi and S. Smitha Nair. 2007. *National Seminar on Medicinal Plants: Strategies for Conservation*. Arya Vaidya Sala, Kottakkal. December 4.

Anuradha, G. 2007. *NSS, ASI & IIP Data Processing*. State Planning Commission and University of Madras, Chennai. November 26.

Anuradha, G. 2007. *Whole Person Process Facilitation*. Vistar Project of USAID, New Delhi. December 4-6.

Arivudai Nambi, A. 2007. *Seminar on Climate Change and Indian Agriculture: Impact, Vulnerability and Adaptation Assessment*. Madras School of Economics, Chennai. August 31.

Arivudai Nambi, A. 2007. *GTZ Appraisal Workshop for Indo-German Bilateral Project on Climate Change Adaptation for TN.* Directorate of Environment, Chennai. September 22.

Arivudai Nambi, A. 2007. *Quiz Programme on Environment for School Children*. US Consulate, American Centre, Chennai. October 10.

Arivudai Nambi, A. 2007. *Young Climate Savers: Teachers Training Workshop on Climate Change and Energy*. WWF-India, Chennai. November 21.

Arivudai Nambi, A. 2007. *National Workshop on Climate Change and its Impact on Health.* WHO, Lonavala, Mumbai. November 26-27.

Arivudai Nambi, A. 2007. *Panel Discussion on Al Gore's Film an Inconvenient Truth.* US Consulate, American Centre, Chennai. June 13.

Arivudai Nambi, A. 2007. *United Nations Forum on Climate Change Conference (UNFCCC) – CoP-13 Meeting.* Bali, Indonesia. December 3-14.

Arivudai Nambi, A. 2008. *Delhi Sustainable Development Summit on Sustainable Development and Climate Change.* The Energy and Resources Institute, New Delhi. February 7-9.

Arivudai Nambi, A. 2008. *Climate Change Leadership Program*. Al Gore The Climate Program, New Delhi. March 15-16.

Arivudai Nambi, A. 2008. *World Meteorological Day Theme Meeting on Observing Our Planet for a Better Future.* Indian Meteorological Society, Chennai. March 25.

Balasubramanian, T. N. 2007. *National Conference on Impacts of Climate Change with particular reference to Agriculture.* Tamilnadu Agricultural University, Coimbatore. August 22-24.

Balasubramanian, T. N. 2007. *TERI, DFID, IDS Project Meeting.* New Delhi. September 25-26.

Balasubramanian, T. N. 2007. *UNDP Media Workshop.* United Nations Development Programme, Udaipur. October 26-28.

Baskar, R. 2007. *India Organic Trade Fair 2007*. International Competence Centre for Organic Agriculture and Indian Council of Agricultural Research, New Delhi. November 29-December 02.

Bharath, P. 2008. Thelotremataceae Lichen Workshop. The Field Museum, Chicago, USA and Ramkhamhaeng University, Bangkok, Thailand. March 10-15.

Bhavani, R. V. 2008. *Workshop on Tool to Assess Local Level Food Security.* SEVA Mandir, Udaipur. March 19.

Bhavani, R. V. 2008. *Asian Commonwealth Conference on Strengthening Role of Civil Society and Media in Climate Change Adaptation and Disaster Mitigation.* Commonwealth Foundation and All India Mitigation Institute, Chennai. April 23-25.

Gopinath, R. 2007. *National Conference on Human Development in India*. North-Eastern Hill University, Shillong. May 24-25.

Gupta, Ravi Kumar. 2007. *Training Programme on Understanding the Environment Impact Assessment*. Centre for Science and Environment, New Delhi. August 27-31.

Isaac Manuel, R. 2007. *Seminar on Climate Change and Indian Agriculture: Impact, Vulnerability and Adaptation Assessment.* Madras School of Economics, Chennai. August 31.

Isaac Manuel, R. 2007. *Environment Quiz Programme.* US Consulate, Chennai. October 10.

Isaac Manuel, R. 2007. *National Workshop on Biodiesel.* Madurai Kamaraj University, Madurai. October 17-18.

Isaac Manuel, R. 2007. *NATCOM Workshop on Issues in Vulnerability Assessment and Adaptation in India.* WINROCK International India, New Delhi. November 1-2.

Isaac Manuel, R. 2008. *National Conference on the Environment and Indian History.* CPR Foundation, Chennai. January 11.

Isaac Manuel, R. 2008. *Monitoring and Evaluation Meeting of Inter-cooperation.* AFPRO, Udaipur. January 29-February 1.

Isaac Manuel, R. 2008. *5th International Biofuels Conference.* WINROCK International India, New Delhi. February 7-8.

Isaac Manuel, R. 2008. *Regional Workshop on Building Adaptation Strategies to Climate Change for Selected Flood and Drought Prone Areas of Bangladesh.* Bangladesh Centre for Advanced Studies, Dhaka, Bangladesh. February 14.

Isaac Manuel, R. 2008*. World Meteorological Day Theme Meeting on Observing Our Planet for a Better Future.* Indian Meteorological Society, Chennai. March 25.

King, E. D. Israel Oliver. 2007. *Training Course on Property Rights, Collective Action and Environmental Governance: The Links between State, Community and Resources*. Institute of Social Economic Change and CGIAR, Bangalore. April 16-20.

Mahapatra, Sushanta Kumar. 2007. *Towards Behavioral Foundation for Environmental Policy.* Madras Institute of Development Studies, Chennai. August 29.

Maity, Bijay Kumar. 2007. *Coastal Biovillage Programme of Kendrapara*. Bapatla Agriculture College, AP. November 12.

Maity, Bijay Kumar. 2007. *National Symposium on Sustainable Pest Management for Safer Environment.* Orissa University of Agriculture & Technology, Bhubaneswar. December 6-7.

Maity, Bijay Kumar. 2007. *Strategies for Achieving 4 % Agricultural Growth in Orissa*. Institute of Public Finance and Policy (IPFP), Bhubaneswar. December 22-23.

Maity, Bijay Kumar. 2007. *Citizens Priorities: State Budget on Agriculture in Orissa.* Centre for Youth and Social Development and Centre for Policy Research and Advocacy. Bhubaneswar. December 29.

Mani, K.G. 2008. *Workshop on Role of Media in Women Empowerment*. Draupadi Trust, Chennai. January 28.

Mani, K.G. 2008. *Workshop on Research Methodology in Social Science.* Annamalai University, Chidambaram. January 30.

Menon, Manjula. 2008. *Training Programme on Water Management.* Rajaji Bhavan, Chennai. March 28-29

Mitra, Sudip. 2008. *Food Security and Environmental Change-Linking Science, Development and Policy for Adaptation.* Oxford University, Oxford. April 1-4.

Mitra, Sudip. 2007. *Conservation Council for Small Water Resources.* DHAN Foundation, Chennai. July 21.

Mitra, Sudip. 2007. *Soil Survey Coordination Committee Meeting.* Department of Agriculture, Government of TN, Chennai. September 24.

Nageswaran, M. 2007. *Madurai Symposium 2007 – Policy Seminar on Enhancing Rainfed Farming Livelihoods: Need of Policy Changes.* DHAN Foundation, Madurai. September 26.

Nair, Sudha. 2007. *Consultative Workshop on Bringing Gender Sensitivity in Rural Development: Programmes and Policies*. National Institute of Rural Development, Hyderabad. October 16 - 17.

Nair, Sudha. 2007. *Ecoagriculture Partnership, Launch of the Community Knowledge Services.* Foundation for Revitalisation of Local Health Traditions, Bangalore. October 21.

Nancy J. Anabel. 2008. Training Programme on Decentralised Disaster Risk Management, Colombo, Sri Lanka, Febrauary 21-23.

Parasuraman, N. 2007. *Magsaysay Awardees Conference.* Asia and the Magsaysay Award: Ripples of Reform. The Ramon Magsaysay Award Foundation, Chennai. November 14-17.

Parida, Ajay. 2007. *Harvest Plus Project Management Committee Meeting*. Washington D. C. October 30-31.

Parida, Ajay. 2008. *CGIAR Change Steering Team Meeting.* Addis Ababa. April 3-5.

Parida, Ajay. 2008. *Priority Setting Workshop on Agricultural Biotechnology for Sri Lanka.* Colombo, Srl Lanka. May 5-6.

Parida, Ajay. 2008. Harvest Plus Project Management Committee Meeting. The International Food Policy Research Institute. Washington D. C., U.S.A. June 12-13.

Pradhan, Shishusri. 2007. *Seminar on Climate Change and Indian Agriculture: Impact, Vulnerability and Adaptation Assessment.* Madras School of Economics, Chennai. August 31.

Pradhan, Shishusri. 2007. *Environment Quiz Programme.* US Consulate, Chennai. October 10.

Pradhan, Shishusri. 2007. *National Workshop on Biodiesel.* Madurai Kamaraj University, Madurai. October 17-18.

Pradhan, Shishusri. 2007. *Training Course on Innovation Systems and Energy Policy for Africa Development.* African Centre for Technology Studies, Kenya. November 26-30.

Pradhan, Shishusri. 2007. *Talk on Coastal Ecosystems and Human Wellbeing: The Case of TN Coast.* Madras School of Economics, Chennai. August 31.

Pradhan, Shishusri. 2008. *5th International Biofuels Conference.* WINROCK International India, New Delhi. February 7-8.

Pradhan, Shishusri. 2008. *Interdisciplinary Research Methodology Workshop on Environment, Sustainable Development and Human Wellbeing.* Madras Institute of Development Studies, Chennai. February 19.

Ramana, Sana Venkat. 2007. *Training cum Workshop on Watershed.* Watershed Organisation Trust, Ahmadnagar. August 21.

Remesh, M. 2007. *National Conference on Intangible National Heritage and Museums*. Regional Museum of Natural History and Directorate of Tourism, Calicut. April 18-20.

Remesh, M. 2007. *National Workshop on Prioritisation and Characterisation of Fast Growing Native Tree Resources*. Ministry of Environment & Forests, Government of India and Institute of Forest Genetics and Tree Breeding, Coimbatore. August 8-9.

Remesh, M., K. S. Surabhi., P. Sujanapal. and K. Satheesh. 2007. *Seminar on Flowering Plant Diversity*. Sree Narayana College Maliankara, Ernakulam, Kerala. September 27-29.

Rengalakshmi, R. 2007. *Organic Agriculture, Marketing and Organisation Building.* International Competence Centre for Organic Agriculture, Bangalore. September 24-25.

Rengalakshmi, R. 2007. *Community Knowledge Service – International Steering Committee and CKS Asia Launch Meeting.* Foundation for Revitalisation of Local Health Traditions (FRLHT), Bangalore. October 21-22.

Rengalakshmi, R. 2007. *International Task Force Meeting on Gender and ICT*. Convention Center, Kuala Lumpur. December 9-10.

Rengalakshmi, R. 2007. *Global Knowledge Partnership Meet Workshop.* GKP, Kuala Lumpur. December 11-13.

Rosario, D. 2008. *Tata-ICRISAT-ICAR Project Review and Planning Meeting on Productivity Enhancement Initiatives in India.* ICRISAT, Patancharu. April 24-26.

Rukmani, R. 2007. *National Seminar on Agrarian Crisis: Causes and Remedies.* National Centre for Agricultural Economics and Policy Research, New Delhi. August 1-2.

Santhamurthy, P. 2007. *Leaders Retreat for Community Based Organisation*. DHAN Foundation, Madurai. September 28-29.

Selvam, V. 2007. *National Workshop on Tsunami Risk Management.* National Disaster Management Authority, Government of India, New Delhi. October 31.

Selvamukilan, B. 2008. *Training Programme on Nesolynx thymus (Parasitoid of Silkworm) Production*. Regional Sericulture Research Station, Salem. February 4-7.

Selvamukilan, B. 2008. *Training Programme on Low Cost Cattle Feed Production*. TN Veterinary College and University, Namakkal. February 26-28.

Senthilkumar.V 2007. *AQUAINDIA-2007.* Society of Aquaculture Professionals, Chennai. September 27-28.

Senthilkumaran, S. 2007. *3rd Global Knowledge Conference*. Global Knowledge Partnership, Kuala Lumpur, Malaysia. December 9-13.

Shanti, Duraisamy. 2007. *Sustaining SHG Federations*. DHAN Foundation, Madurai. September 27.

Sivakumar, A, 2008.Training programme on Decentralised Disaster Risk Management, Colombo, Sri Lanka, Febrauary 21-23.

Sivakumar, A. and Vedamoorthy. 2007. *TNAU-CIDA-McGill University – Industry Meet on Food Processing and Post Harvest Technology.* Tamilnadu Agricultural University, Coimbatore. June 25.

Sivakumar, M. N. 2007. *Conservation and Co-Creation.* The Covenant Centre for Development and CESCI Campus, Madurai. August 1-2.

Sivakumar, N. 2007. *Industry Conference on Driving the Next Agri Revolution.* Confederation of Indian Industry and Chennai Trade Centre, Chennai. November 26-27.

Sivakumar, P. 2007. *3rd Global Knowledge Conference.* Global Knowledge Partnership, Kuala Lumpur, Malaysia. December 11-13.

Sivan, V. V. 2008. *Discussion on the PBR Format designed by the National Biodiversity Authority*. Kerala State Biodiversity Board, Thiruvananthapuram. February 18.

Sivan, V. V. 2008. *Training Course on Project Planning and Writing*. ADWANA, Thiruvananthapuram. May 8-10

Sivan, V. V. 2008. *Field Course on Interdisciplinary Approaches and Tools for Ecological Monitoring of Natural Resources and Livelihoods*. Keystone, Kothagiri. May 5-14.

Sophia, J.D, 2008. Training programme on Decentralised Disaster Risk Management. Practical Action, Colombo, Sri Lanka, Febrauary 21-23.

Srinath, J. 2007. *Community Radio for Health Care, Education and Livelihood Generation*. India International Centre, Media Lab Asia and World Development Foundation, New Delhi. April 16-17.

Srinath, J. 2007. *Global Knowledge Partnership (GKP) South Asia Partners' Meeting and Discussion on Preparation for GK3 Global Conferencing*. BRAC Centre, Dhaka, Bangladesh. July 15-16.

Subbiah, Vijay R. 2007. Emerging Agri-Business: Opportunities and Risk Management. Indian Bank Management Academy, Chennai. November 1.

Subbiah, Vijay R. 2007. *Infra 2007 – MAP Tomorrow's Chennai – Conference on Fuelling Inclusive Growth through Holistic Regional Development*. Confederation of Indian Industries, Chennai. December 18.

Sujana, K. A. 2008. *Training in Botanical Illustration*. Department of Botany, University of Calicut, Calicut, Kerala. March 13-15.

Swain, S. 2007. *Training Programme on Participatory Approaches in Agro-Biodiversity Conservation in Assam*. Assam Agricultural University, Jorhat, Assam. November 19-29

Swain, S. 2007. *National Level Multi-Stakeholder Consultative Workshop on Management of the Herbal Wealth of India*. PRAGYA, New Delhi. October 4-5.

Swain, S. 2007. *National Level CAMP Workshop on Medicinal Plants of Orissa.* Rural

Poverty Research Center Foundation for Revitalisation of Local Health Traditions and (FRLHT), Bhubaneswar. October 7-11.

Thangavel, P. 2007. *Soil Health Management Training.* Tamilnadu Agricultural University, Coimbatore. October 16-18.

Awards/Honours

Anil Kumar, N. 2008. *Alcoa Foundation Fellowship* on *Sustainability Practitioner.* Alcoa Foundation, USA.

Anil Kumar, N. 2008. *Watson Institute of International Studies Scholarship.* Watson Institute of International Studies, USA.

Bharath Kumar, S., N. Rameshkumar, C. Appunu, V. R. Prabavathy and Sudha Nair. 2007. *Dr. Rana Memorial Award* for the best poster presentation at 48th Annual Conference of Association of Microbiologists of India, IIT, Chennai.

Parasuraman, N. *Member, IUCN – Commission on Education and Communication.* IUCN, Geneva

Parida, Ajay. 2008. *Member, International Advisory Board, Transforum*. Government of Netherlands, Netherlands.

About the Foundation

M.S. Swaminathan Research Foundation (MSSRF) was registered in 1988 as a non-profit Trust, recognized 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.

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39, A.G.S. Colony
Velacherry, Chennai 600 042

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Project on Designing Rural Technology Delivery Systems for Mitigating Agrarian Distress, MSSRF, Chennai

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Programme Area 700 : Special Projects

Ministry of Agriculture, Government of India

List of Acronyms

AFLP	Amplified Fragment Length Polymorphism
AIR	All India Radio
AP	Andhra Pradesh
ATMA	Agricultural Technology Management Agency
BARC	Bhabha Atomic Research Centre
BCC	Biodiversity Conservation Corps
BCUE	Biodiversity Conservation Utilization and Enhancement
BDO	Block Development Officer
BIWS	Bioindustrial Watershed
BPL	Below Poverty Line
BPMPGRC	Biju Patnaik Medicinal Plants Garden and Research Centre
BVC	Biovillage Council
CAbC	Community Agrobiodiversity Centre
CALP	Computer Aided :Learning Programme
CBB	Coffee Berry Borer
CBO	Community Based Organisation
CBQ	Cost Benefit Quotient
CFTRI	Central Food Technological Research Institute
CGB	Community Gene-Seed-Grain Bank
CGR	Crop Genetic Resources
CICR	Central Institute for Cotton Research
CIDA	Canadian International Development Agency
CLC	Community Learning Centre
CMPG	Community Medicinal Plants Garden
CRRI	Central Rice Research Institute
CTAB	Cetyl Trimethyl Ammonium Bromide
CTLC	Community Technology Learning Centre
DAE	Department of Atomic Energy
DBT	Department of Biotechnology
DDS	Deccan Development Society

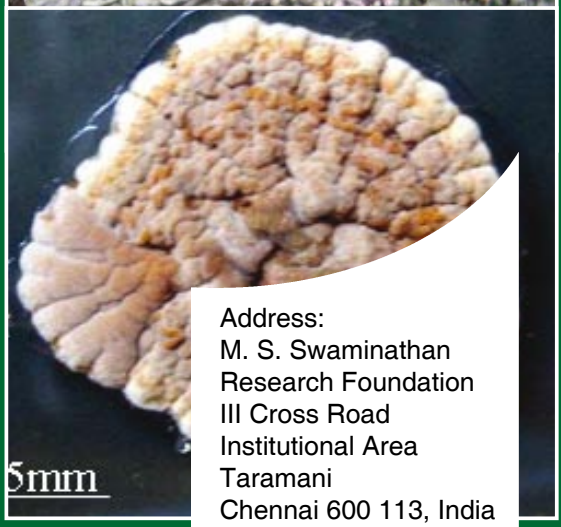
DFID	Department for Funding International Development
DNA	Deoxyribonucleic acid
DRDA	District Rural Development Agency
DSIR	Department of Scientific & Industrial Research
DST	Department of Science & Technology
EC	Executive Committee
ECAS	Every Child A Scientist
EST	Expressed Sequence Tag
FAO-RAP	Food and Agriculture Organization – Regional Office for Asia Pacific
FD	Forest Department
FFMA	Fisher Friend Mobile Application
FLD	Front Line Demonstration
FP	Farmers' Practice
FRP	Fiberglass Reinforced Plastic
FYM	Farm Yard Manure
GB	General Body
GBPUAT	G.B. Pant University of Agricultural Sciences and Technology
GDP	Gross Domestic Product
GFP	Green Fluorescent Protein
GGA	Grameen Gyan Abhiyan
GIS	Geographical Information System
GKP	Global Knowledge Partnerhsip
GP	Gram Panchayat
GPS	Global Positioning System
GUS	Glucuronidase
HAP	High Altitude Plant
HH	Household
HP	Hewlett Packard
IAEA	International Atomic Energy Agency
ICAR	Indian Council of Agricultural Research
ICDS	Integrated Child Development Services
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics

ICS	Internal Control System
IDRC	International Development Research Centre
IEC	Information, Education and Communication
IFAD	International Fund for Agricultural Development
IFFCO	Indian Farmers Fertiliser Cooperative Limited
IFPRI	International Food Policy Research Institute
IFS	Integrated Farming System
IGA	Income Generating Activity
IGCAR	Indira Gandhi Centre for Atomic Research
IGNOU	Indira Gandhi National Open University
IGS	Intergenic Spacers
IIT	Indian Institute of Technology
IK	Indigenous Knowledge
IMFFS	Integrated Mangrove Fishery Farming System
IMO	Institute for Market Ecology
INM	Integrated Nutrient Management
IPGRI	International Plant Genetic Resources Institute
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
IRT	Iron Regulated Transporter
ISRO	Indian Space Research Organization
ISSR	Inter Simple Sequence Repeat
JMM	Joint Mangrove Management
JNKVV	Jawaharlal Nehru Krishi Vishwa Vidyalaya
JTS	Jamsetji Tata Training School
KKJRGCS	Kalinga Kalajeera Rice Growers Cooperative Society
KVK	Krishi Vigyan Kendra
KW	Knowledge Worker
KWE	Kuttanad Wetland Ecosystem
LB	Local Body
LED	Light Emitting Diode
LR	Land Races

MANAGE	National Institute of Agricultural Extension Management
MDMS	Mid Day Meal Scheme
MEM	Micro Enterprise Marketplace
MGLP	Multi Grade Learning Programme
MNRE	Ministry of New and Renewable Energy
MPA	Marine Protected Areas
MSL	Mean Sea Level
MUPP	Microsoft Unlimited Potential Programme
MYB	Myoblastisis
NABARD	National Bank for Agriculture and Rural Development
NAFED	National Agricultural Cooperative Marketing Federation of India Limited
NBPGR	National Bureau of Plant Genetic Resources
NBRI	National Botanical Research Institute
NFHS	National Family Health Survey
NHM	National Horticulture Mission
NMDS	Non-metric Multidimensional Scaling
NMPB	National Medicinal Plants Board
NREGS	National Rural Employment Guarantee Scheme
NSSO	National Sample Survey Organisation
NUS	Neglected and Underutilised Species
NVA	National Virtual Academy
ORF	Open Reading Frame
OUAT	Orissa University of Agriculture & Technology
PAD	People's Action for Development
PASIC	Pondicherry Agro Service and Industries Corporation Limited
PAU	Punjab Agricultural University
PBR	People's Biodiversity Register
PCR	Polymerase Chain Reaction
PCS	Participatory Conservation System
PDKV	Dr. Panjabrao Deshmukh Krishi Vidyapeeth
PDS	Public Distribution System
PGPR	Plant Growth Promoter

PIXE	Proton Induced X-ray Emission
PKS	Polyketide Synthases
PONLAIT	Pondicherry Cooperative Milk Producers' Union
PPSS	Praja Pragathi Seva Sangham
PPVFRA	Protection of Plant Varieties and Farmers Rights Act
PRA	Participatory Rural Appraisal
PRI	Panchayat Raj Institution
PVS	Participatory Varietal Selection
RAPD	Random Amplified Polymorphic DNA
RBD	Randomised Block Design
RET	Rare Endangered and Threatened
RFLP	Restriction Fragment Length Polymorphism
RIF	Rural Innovation Fund
RNA	Ribonucleic Acid
RRA	Regional Resource Agency
SAU	State Agricultural University
SBI	State Bank of India
SCAR	Sequence Characterized Amplified Region
SDC	Swiss Agency for Development and Cooperation
SDS-PAGE	Sodium Dodecyl Sulfate - Polyacrylamide Gel Electrophoresis
SEM	Scanning Electron Microscopy
SGSY	Swarnajayanti Gram Swarojgar Yojana
SICA	South India Cotton Association
SIFFS	South Indian Federation of Fishermen Societies
SPRIT	Society for Participatory Research and Integrated Training
SRI	System of Rice Intensification
SSA	Sarva Shiksha Abhiyan
SSR	Simple Sequence Repeat
TERI-NE	The Energy Research Institute – North East
*TH*MRC	*The Hindu* Media Resource Centre
TN	Tamil Nadu
TNAU	Tamil Nadu Agricultural University

UAS	University of Agricultural Sciences
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
VAM	Vesicular Arbuscular Mycorrhiza
VDMC	Village Development and Management Council
VKC	Village Knowledge Centre
VLI	Village Level Institution
VRC	Village Resource Centre
VSB	Village Seed Bank
VWS	Village Welfare Society
WSHG	Women's Self Help Group



Address:
M. S. Swaminathan
Research Foundation
III Cross Road
Institutional Area
Taramani
Chennai 600 113, India