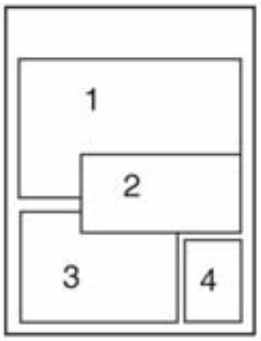
M. S. SWAMINATHAN RESEARCH FOUNDATION

2006-2007
SEVENTEENTH ANNUAL REPORT

CENTRE FOR RESEARCH ON SUSTAINABLE AGRICULTURAL AND RURAL DEVELOPMENT, CHENNAI



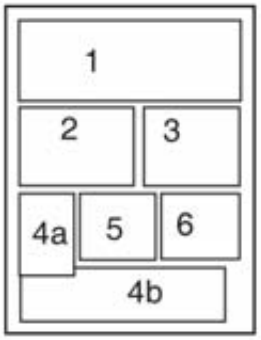
Front Cover

1. View of the Biju Patnaik Medicinal Plants Garden and Research Centre, MSSRF at Jeypore, Orissa

2. Virtual Congress of Medicinal Plants organised during the dedication ceremony on 14 April, 2007

3. Children covered under Education support programme with their mothers, Wardha 29 June, 2006

4. *Vibrio rhizosphaerae Sp. nov.* showing antagonistic activity against rice pathogen



Back Cover

1. A view of the Seawater Farming System that integrates cultivation of mangroves, halophytic creeper, fish and crab.

2. Bhoomi Pooja for the Fish for All Centre at Poombhuhar, TN, Feb 2007

3. Exposure visit for women from the fishing community of Poombhuhar at a Processing Centre

4a. Ennai Panchayat, Pudukottai, one of the sites under Tata Trust Bio-industrial Watershed project

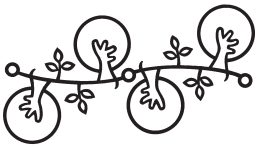
4b. Watershed area of Ennai Panchayat, Pudukottai

5. Field level Agro-met Lab at Amda Village, Rajasthan

6. Fruit of wild Nutmeg tree (*Knema attenuata* Hook. f. & Thoms.) - a rare, endemic and threatened species selected for conservation studies and large-scale multiplication in Wayanad

Seventeenth Annual Report

2006-2007



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

Visit us on the World Wide Web at **http://www.mssrf.org**

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Chairman's Introduction

Year in Retrospect

2006-07 has been a significant year in the evolution of MSSRF. New research and training facilities were created at Jeypore in Koraput District, Orissa and at Kalpetta in Wayanad in Kerala. A Medicinal Plants Garden and Research Centre dedicated to the memory of the late Shri Biju Patnaik, builder of modern Kalinga (Orissa), was inaugurated by Shri Naveen Patnaik, Chief Minister of Orissa on 14 April, 2007. This is a unique centre which will foster studies on the interaction between biodiversity and cultural diversity. In addition, the Centre will help to establish the first herbal biovalley in India, designed to empower tribal women and men to link biodiversity, biotechnology and business in a mutually reinforcing manner. The work carried out by the tribal families in the Koraput district in the area of genetic resources conservation and enhancement, with particular reference to rice, earned them the first Genome Saviour Award instituted by the Plant Variety Protection and Farmers' Rights Authority, India. This is a matter of particular pride, since the proposal to link the rights of breeders and farmers in the same Act originated from MSSRF which prepared the first draft of this landmark legislation.

The facilities at the Community Agrobiodiversity Centre (CAbC) at Kalpetta, Wayanad were expanded by the addition of 28.5 acres of land for strengthening research and training activities. The construction of a Pro-nature, Pro-tribal Facilitation Centre, with generous support from the Government and People of Japan has also been initiated. 2007 has been designated as "the Year of Japan in India" and vice cersa, and this Centre will be inaugurated in October, 2007, on the occasion of the Tenth Anniversary of CAbC. With support from the Sir Dorabji Tata Trust, the Kalpetta Centre also initiated a project for saving 80 rare, endangered and threatened species involving collaborative efforts among the Kerala Forest Research Institute, Peechi, Arya Vaidya Sala, Kottakkal, Centre for Research in Indigenous Knowledge, Science and Culture, Kozhikode and SNM College, Maliankara.

Another facility under construction at Poompuhar in Tamil Nadu is a *Fish for All* Training Centre, which will impart training to fisher families in all aspects of scientific and sustainable fisheries, ranging from capture to consumption or in the case of aquaculture, from culture to consumption. This Training Centre, based on the pedagogic principle of learning by doing, is supported by the Tata Tsunami Relief Committee. It is proposed to inaugurate this Centre on 26 December, 2007, which marks the third anniversary of the titanic tsunami. Several Village Resource Centres and Village Knowledge Centres have also been established along the Tamil Nadu

coast to enable coastal communities to face calamities like the tsunami in a more effective manner in future.

Missions to mark the 60th anniversary of India's independence

August 15, 2007 marks the 60th anniversary of India's independence. At the beginning of the new Millennium and Century in 2000, MSSRF scientists decided to launch two Missions with an initial target date of 15 August, 2007 for accomplishing the desired goals.

Hunger Free India

The first Mission 2007 related to achieving the goal of a Hunger-free India on the lines stressed by Mahatma Gandhi at Noakhali in 1946. This Mission, launched in collaboration with the World Food Programme, resulted in the preparation of Food Insecurity Atlases of Rural and Urban India and an Atlas on the Sustainability of Food Security in India. These Atlases provided valuable guidelines for the preparation of a road map for the elimination of chronic, hidden and transient hunger and resulted in the development of the following seven-point Action Plan.

- Restructure the delivery of ongoing nutrition support programmes on a life cycle basis.
- Universalise the Public Distribution System and enlarge the composition of the Food Basket by including a wide range of nutritious cereals, millets, grain legumes and tubers.
- Introduce a food cum fortification approach for eliminating iron, iodine, zinc and Vitamin A deficiencies and accord priority to overcoming chronic and hidden hunger in children and pregnant women.
- Promote the organisation of Community Grain and Water Banks by local communities and promote the concept of "store food grains and drinking water in every village", with the *Gram Sabha* providing overall social oversight.
- Pay particular attention to drinking water, primary healthcare and nutrition education.
- Enhance opportunities for on-farm and non-farm employment through the biovillage model of human centred development, and improve the productivity and profitability of small farms (small farm families constitute over 50% of India's population) through integrated crop-livestock-fish farming systems.
- Introduce a Food Guarantee Act combining the features of Food for Work and Rural Employment Guarantee Programmes.

The former Prime Minister of India, Shri Atal Bihari Vajpaye commended the goal of Mission 2007 – Hunger-free India in the following words, while releasing the Food Insecurity Atlas of Rural India at New Delhi on 21 April, 2001.

> "Democracy and hunger cannot go together. A hungry stomach questions and

censures the system's failure to meet what is a basic biological need of every human being. There can be no place for hunger and poverty in a modern world in which science and technology have created conditions for abundance and equitable development.

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."

The National Commission on Farmers also endorsed the above strategy for achieving sustainable nutrition security involving physical, economic and social access to a balanced diet and safe drinking water at the level of every child, woman and man. Unfortunately, an integrated strategy is yet to be put in place.

Every Village a Knowledge Centre

The second Mission 2007 relates to the knowledge and skill empowerment of rural families with the help of Information and Communication Technology (ICT). Mission 2007: Every Village a Knowledge Centre stimulated the following developments.

- The Indian Space Research Organisation (ISRO) launched a Village Resource Centre programme at the Block level, involving satellite connectivity and teleconferencing facilities.
- The Department of Information Technology, Government of India, launched a Common Service Centre (CSC) programme designed to cover 1,00,000 villages.
- The Ministry of Panchayati Raj, Government of India, decided to provide to each Panchayat the necessary ICT infrastructure to enable them to participate in the e-Governance programme.
- ITC Ltd decided to expand its e-chaupal programme in order to cover 50,000 villages.
- MSSRF has so far organised 80 VKCs and 15 VRCs.
- Many State Governments, public and private sector companies, academic institutions and NGOs have organised VKCs in different parts of the country.

Thus, Mission 2007 has triggered a national movement for bridging the urban-rural digital divide and for ensuring knowledge connectivity in areas relevant to the day to day life and livelihood of rural families. The Government of India has included knowledge connectivity as an important component of *Bharat Nirman* or a New Deal for Rural India.

MSSRF hosts the Secretariat for the National Alliance for Mission 2007 – a broad based coalition of government, non-government, academic and business sectors committed to the cause of taking ICT to all the 600,000 villages of India as soon as possible. In addition, with the generous assistance of Tata Trusts, MSSRF has established the Jamsetji Tata National Virtual Academy for Rural Prosperity (NVA) and Jamsetji Tata Training School. The NVA currently has 985 Fellows from India and 25 Foreign Fellows drawn from Afghanistan, The Philippines, Sri Lanka, Kenya, Nepal and Nigeria.

These grassroot academicians are the torch bearers of the rural knowledge revolution. The Jamsetji Tata Training School aims to provide opportunities for lifelong professional growth to NVA Fellows, as well as help in identifying suitable staff for VKCs and VRCs as well as CSC and other programmes sponsored by government and industry.

From August 15, 2007, the Mission 2007 programme will grow into a *Grameen Gyaan Abhiyan*, a national movement for knowledge empowerment of rural families. It is hoped that by 2010, the *Grameen Gyaan Abhiyan* will cover every village and home or hut in the country. The last mile and last person connectivity will be achieved through an integrated internet-community radio or internet-cell phone synergy. Already artisanal fishermen are being trained in the use of cell phones for identifying the location of fish shoals and for learning about wave heights at different distances from the shoreline. Thus, appropriate frontier technologies provide uncommon opportunities for increasing the productivity, profitability and sustainability of both small scale fisheries and small scale farming.

Significance of Grameen Gyaan Abhiyan (GGA)

The Green Revolution helped to increase the productivity of crops like wheat and rice. The Knowledge Revolution, on the other hand, helps to enhance human productivity and creativity in several dimensions. *Grameen Gyaan Abhiyan* will be based on the following organisational structure.

- Every Block will have a Village Resource Centre with the help of ISRO.
- Every Panchayat will have a *Gyan Chaupal* or Village Knowledge Centre with the help of the Department of Information Technology, Ministry of Panchayati Raj, Civil Society Organisations, multilateral donors, the academic and private sectors and bilateral and multilateral donors.
- The last mile and last person connectivity will be achieved through combinations of internet and community radio, and internet and the cell phone.

While connectivity can be achieved, content creation and capacity building will be the greatest challenges. The content has to be dynamic, demand driven, locale specific and in local languages. The Jamsetji Tata NVA and

the Jamsetji Tata Training School of MSSRF will help in capacity building and content creation with support from Tata Trusts, Microsoft, IDRC, SDC and other national and bilateral development agencies.

A major role of the *Grameen Gyaan Abhiyan* movement will be the establishment of links between scientific know-how and field level do-how. For this purpose, VRCs and VKCs will have to be intimately linked with appropriate programmes such as *Sarva Siksha Abhiyan* for literacy, *Yuva and Mahila Sakthi Abhiyans* of the Ministry of Panchayati Raj, National Rural Health Mission, National Horticulture Mission, National Rural Employment Guarantee Programme, etc.

In order to accelerate progress in reaching the unreached in terms of relevant information and services in retail trade in fruits, vegetables and grains as well as on methods of safe handling, packaging and marketing, a Quality Literacy Movement based on *Codex Alimentarius* standards of food safety will be launched in association with the Central Food Technological Research Institute, Mysore. GGA will launch a *Knowledge on the Wheels* Programme for accelerating progress in the dissemination of information and the provision of relevant services. To start with, soil healthcare, eyecare and post harvest technology will be covered with mobile vans designed and operated by HP, Sankara Netralaya and Mico Bosch.

The range of services will be gradually increased under the auspices of the *Grameen Gyaan Abhiyan,* which will be managed by the National Alliance for Mission 2007. The Jamsetji Tata NVA will host the Secretariat for GGA. As a single step, the Rural Knowledge Revolution is likely to have the largest beneficial impact on the physical, economic and social wellbeing of the over 700 million people living in villages.

Progress in different Programme Areas

In the following pages, the progress made during the year in different areas such as integrated coastal zone management, biodiversity, biotechnology, ecotechnology, food security, information technology and gender and development is described in detail. The Integrated Coastal Zone Management programme has concentrated on the conservation, rehabilitation and expansion of mangrove and non-mangrove bioshields and on seawater farming through agro-aqua farms. Coastal biovillages which help to strengthen livelihood security without ecological harm are being promoted. Capacity building in the area of integrated coastal zone management will be a major activity of this programme. A collaborative project in coastal bioshield development and in the establishment of Village Knowledge Centres has been initiated with non-governmental partners in Sri Lanka with support from CIDA and IDRC.

In the area of biotechnology, novel genetic combinations for salinity and drought tolerance are in advanced stages of testing, strictly in conformity with the prescribed

regulatory procedures. Selection of superior *Jatropha* lines for bio-diesel production is also in progress. These studies have been made possible through sustained and generous support from the Department of Biotechnology, Government of India.

In ecotechnology, an important development during the year is the continuation and strengthening of partnerships with the Ohio State University in USA and the Punjab Agricultural University, Ludhiana and Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, in the area of sustainable management of natural resources. This partnership, which entered its second phase this year with generous support from Jamsetji Tata Trust, will aim to demonstrate how watershed management can be combined with micro-enterprises, so that there is more income per drop of water. MSSRF is engaged in developing such bioindustrial watersheds in the Villupuram and Pudukkotai districts of Tamil Nadu and in the Eastern Ghats of Koraput district. Ensuring and enhancing the work and income security of watershed communities in an environmentally sustainable and socially equitable manner are the principal goals of this project.

Among other significant initiatives involving national and international partnerships, mention may be made of the Vulnerability and Adaptation to Climate Change Project. This project involves partnership with AFPRO (Action for Food Production) and MANAGE (National Institute of Agricultural Extension Management Agriculture) in the States of Andhra Pradesh and Rajasthan as well as with INFRAS and Intercooperation in Switzerland. The Vulnerability and Adaptation to Climate Change programme initiated in 2005 with SDC support, is yielding promising results on the management of climate change at the local level. MSSRF initiated an anticipatory research programme to meet the challenges of global warming soon after it started its work in 1990. The first project related to facing the consequences of a potential rise in sea level. This led to the Mangrove Wetlands programme both for strengthening the bio-shield role of Mangrove forests and for extracting genes for seawater tolerance and for introducing them in the genetic make-up of rice, pulses, oilseeds etc, through recombinant DNA technology. As will be clear from this Report, both these lines of research have yielded significant results.

MSSRF has been chosen as one of the key partners in the Research Programme Consortium (RPC) under the Energy for Development initiative of DFID, U.K. The consortium partners include the University of Edinburgh, U.K, African Centre for Technology Studies (ACTS), Kenya, University of Dar-es-Salam, Tanzania and Practical Action, U.K. This programme seeks to undertake research leading to the delivery of affordable, reliable and sustainable energy benefits to poor communities in the Indian subcontinent and East Africa. The research themes under RPC are (i) replicable bioenergy

technologies, (ii) impact of climate change on renewable energy delivery, and (iii) capacity building. The focus of MSSRF research would be on how climate change is likely to affect bioenergy provision and on how to respond to the challenge of sustainable energy security. Based on the last 17 years' experience, MSSRF is in the process of developing a draft Act on the Management of Climate Change in Agriculture for the consideration of the Government of India.

Agrarian Distress Hot Spots

The Ministry of Agriculture, Government of India, has identified 33 districts in the country characterised by extreme agrarian distress, leading occasionally to suicides by farmers. The Vidharbha region of Maharashtra is currently the epicentre of farmers' suicide. In 2006, MSSRF initiated in the Vidharbha Region a programme for the education and nutrition of the children of the farmers who had committed suicide. Further, *Gyan Chaupals* (Village Knowledge Centres) are being established, so that farm families can get the right information at the right time and place. Steps have been taken to establish a Livelihood Security Training and Mentoring Centre for the widows and grown-up children of the farmers affected by the crisis. To the extent possible, the programmes of this Centre will be managed by the bereaved families themselves.

At the instance of the Ministry of Agriculture, Government of Inida, MSSRF undertook studies in the Alapuzha and Idukki districts of Kerala on methods of alleviating agrarian distress. The Alapuzha report has been finalised in consultation with all the stakeholders including the Chief Minister, MLAs and MPs from the region.

The Kuttanad ecosystem and the Vembanad lake are unique gifts of Nature and they have to be nurtured carefully based on the principles of ecology, economics, social and gender equity and employment generation. The MSSRF report based on the principle, "good ecology is vital for good business" has suggested steps to repair the damage done to the ecosystem and to strengthen the ecological and livelihood security in the Kuttanad area in a mutually reinforcing manner.

If farm ecology and economics go wrong, nothing else will go right. This is the principal message of the agrarian crisis. The agrarian crisis is likely to spread if the economics of small scale farming is not improved. MSSRF has proposed that the districts affected by acute agrarian hardship may be developed into Special Agricultural Zones (SAZ), where integrated attention will be paid to natural resources conservation and enhancement, eco-farming, improved local level consumption to overcome malnutrition and pro-small farmer commerce. These areas require integrated attention from agricultural scientists, extension agencies and policy makers. Unless the various Government Departments / Ministries dealing with agriculture, animal husbandry, fisheries, forestry, environment, agro-

processing and agri-business, irrigation, commerce and rural development work on the pattern of convergence and synergy, it will be difficult to resolve the agrarian crisis. The major purpose of a Special Agricultural Zone is ecological restoration and the strengthening of the work and income security of farm families with about 1 hectare or less of land. While the Special Economic Zone (SEZ) is designed to enhance trade and export income involving mega-investment by the private sector industry, SAZ is needed for saving the lives and livelihoods of small farmers and landless labour by providing key centralised services to support decentralised small scale production. The SAZ concept will provide an effective method of ending farmers' suicides in the districts affected by the agrarian crisis, by providing a platform for collective action by all the concerned departments and agencies of the Central and State Governments.

Technology Fatigue

There are frequent references to technology fatigue in agriculture in the documents of the Union Planning Commission. In this context, the MSSRF publication *Measures of Impact of Science and Technology in India: Agriculture and Rural Development* is an analytical documentation of significant technologies and meaningful achievements brought about by public good research in such vital areas like agriculture, animal husbandry, fisheries, forestry, irrigation, energy, healthcare and drinking water. Significant increases in the production of food grains, milk, eggs and fish as well as remarkable progress in access to safe drinking water, electricity and healthcare in the post-Independence period in India are related to scientific advances in the public domain. Given the impressive progress made in technology development, it was felt that we cannot be silent on-lookers to the continued co-existence of mountains of affordable technology and acute agrarian distress in areas where farmers' suicides are unfortunately prevalent. The Office of the Principal Scientific Advisor to the Government of India that provided financial support for this project has extended its support to MSSRF for a follow-up study that focuses on designing an effective technology delivery system in the agrarian hotspot districts.

Human Resource Development (HRD)

Maximising the creativity and output of young scientists is the goal of MSSRF's HRD policies. During the year, Dr Ajay Parida was elected a Fellow of the National Academy of Sciences, Allahabad, as well as of the National Academy of Agricultural Sciences, New Delhi. He received the National Biosciences Award of the Department of Biotechnology. Further, he was selected by the CGIAR for participating in their Leadership Development Programme. Post-graduate educational programmes were strengthened and during the year 8 Ph.D scholars submitted their theses. It is a matter of pride and happiness that N Parasuraman who was the first to join MSSRF as a staff member in 1989, received the Ph.D degree of the University of Madras this year.

Dr M Velayutham retired as Executive Director on 31, March 2007. The Trustees have elected Shri Achyut Madhav Gokhale, IAS (Retd) as the new Executive Director. He brings with him vast experience in the areas of grassroot development in Nagaland, regulatory policies for genetic engineering and the promotion of new and renewable energy sources. His last assignment in the Government of India was Secretary, Ministry of Non-Conventional Energy Sources. The Trustees of MSSRF would like to place on record their appreciation to Dr M Velayutham for his dedicated services and wish him well in the next phase of his distinguished career.

The work summarised in this Report would not have been possible but for the generous support of numerous government and non-governmental agencies, philanthropic organisations and bilateral and multilateral donors. Two unique organisations – Friends of MSSRF, Japan and Friends of Swaminathan, Australia have been extending invaluable support to worthwhile projects. Our sincere gratitude goes to all of them.

This report was compiled by Dr Sudha Nair, Dr Ajay Parida and Ms R V Bhavani. The editing was done by Dr Nandhini Iyengar. The design and printing was done by AMM Screens. We owe a deep debt of gratitude to all of them.

Above all, our indebtedness goes to the distinguished Trustees of MSSRF who have so generously made available their precious time and vast knowledge and experience to guide the work of the institution.

In August 2007, Shri R M Lala, Dr Usha Barwale Zehr and Smt Anuradha Desai will be retiring from the MSSRF Board, after serving for ten years as Trustees. They have all been pillars of strength to both the institution and its staff. Dr Vijay Mahajan, Dr Tushaar Shah and Ms Rita Sarin have been elected in the vacancies caused by their retirement . We place on record our deep sense of gratitude to the outgoing Trustees and extend a warm welcome to the incoming Trustees.

M S Swaminathan
Chairman, MSSRF

Programme Area 100

Coastal Systems Research

Bioshield developments has been undertaken in several locations in Tamil Nadu and Andhra Pradesh with the involvement of the local communities. Technical support was provided to rural people in coastal areas of Srilanka for reducing vulnerability. An additional 241 ha of wasteland was brought under agriculture with multiple crop interventions at Kudankulam. A framework for preparing suitability maps for bioshields, using remote sensing and GIS, was developed.

Sub Programme Area 101

Coastal Wetlands: Mangrove Conservation and Management

101.1 Restoration of mangroves in Andhra Pradesh

Implementation of a Joint Mangrove Management programme (JMM) in an area of about 10 ha in the Coringa Reserve Forest was initiated last year with the participation of the farming community from Chollangipetta village and the Andhra Pradesh Forest Department. The Forest Department (FD) has organised an Eco Development Committee (EDC) in this hamlet, with 844 members and a 16-member Executive Committee, which is the village level institution involved in nursery development and in planning, implementing and monitoring the restoration activities.

Community mobilisation and micro planning: During the year Participatory Rural Appraisal (PRA) was organised in the village, which indicated stagnation of tidal water and the resulting increase in salinity as the main causes for degradation, apart from grazing by feral cattle. On the basis of the information obtained through PRA and biophysical survey, a micro plan was prepared to restore the 10 ha degraded plot. Funds required to meet the expenditure were deposited in the account of the EDC, which is operated by a representative each from the community, FD and the Foundation, and utilised by the community for canal digging, planting and aftercare.

Biophysical survey and species selection: The biophysical survey carried out in the degraded plot showed the presence of mangrove species such as *Excoecaria agallocha, Avicennia marina, A. alba, A. officinalis, Sonneratia apetala* and *S. alba* near the degraded area as well as the halophytes *Suaeda maritima* and *S. nudiflora* in the degraded area. A survey of the area showed a trough-shaped topography, which prevented free tidal flushing. The soil and pore-water salinity were 62 and 85 ppt respectively.

Establishment of a community-owned mangrove nursery: A mangrove nursery was established as a part of the restoration activities and a total number of 54,000 mangrove saplings were raised in the nursery. Saplings of 60 to 80 cm were transplanted in October, 2006. About 1,104 man-days were involved in raising mangrove saplings in the nursery and this provided considerable employment to the local women and men.

Restoration activities: The canals for free tidal flushing were designed jointly with the local community. Main canals of 2.5 m top width, 1 m bottom width and 0.8 m depth were dug in the degraded area along with a number of feeder canals. The canal digging was completed in July and the dug out canals were opened for tidal flushing to reduce soil salinity. Planting of about 55,000 mangrove saplings was completed in October, 2006. The survival rate was about 90 % in November, 2006 and about 75 % in March, 2007. A large number of natural seedlings were found established in the restored area. EDC members were involved

in both canal digging and planting of saplings and 3,352 man days were spent in these two activities. The monsoon and freshwater from the river have substantially reduced the excess salt present in the surface of the soil. It has also resulted in some of the canals being silted up; they will be desilted in summer.

Sub Programme Area 102

Coastal Bioshields

The coastal bioshield programme was initiated last year on the basis of scientific evidence that coastal vegetation, including mangroves and non-mangrove plantations, plays a role in reducing the impact of tsunami and demands by the coastal community to have vegetation around their villages as a protective cover against natural disasters. The mangrove and non-mangrove bioshield programme was therefore initiated in limited areas of one or two hectares in 11 villages. In addition, major bioshield projects were started in Pichavaram and in Pudukottai, Ramanathapuram and Tuticorin districts.

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

This activity is being carried out in the southernmost part of Cuddalore district, which is one of the worst tsunami - affected districts of TN. A large estuarine system called Vellar-Pichavaram-Coleroon estuarine complex is situated in this region. The Pichavaram Mangrove Reserve Forest, which occupies an area of about 1,400 ha, is located in the middle portion of this estuarine system. In this estuarine region, a total number of 9 fishing hamlets are located within a distance of about 2 km from the sea. As a first step towards establishing a community-based mangrove bioshield, a rapid survey was conducted in the entire Vellar-Pichavaram-Coleroon region taking into consideration the following factors: availability of land suitable for raising mangrove and non-mangrove bioshields, willingness of the community to participate in developing and managing bioshields, and ownership of land (if the land is part of a Reserve Forest it was not considered because such lands would not be handed over to the community for management). The study indicated the feasibility of raising mangrove and non-mangrove bioshields in the lands owned by the community and government departments other than the FD. Though a bioshield can be raised both north and south of the Pichavaram Reserve Forest, only the northern part is being covered because of the presence of a large number of settlements with a high population and interest shown by the community.

Project site and hamlets: Between the Vellar estuary in the north and Pichavaram Reserve Forest in the south, there are three fishing hamlets namely, Muzhukkuthurai, MGR Thittu and Mudasalodai. All the three hamlets suffered damage during the tsunami. These three villages are located about 1 to 1.5 km from the sea. Between the villages and the sea a backwater canal and a long sandy beach are

found. There are three islands, ranging in size from 3 ha to 32 ha, present in the backwater canals. All these islands have highly degraded mangroves and open mudflats. Next to the backwater canal is a sandy beach varying in breadth from 200 to 700 m. This sandy beach is characterised by the presence of tsunami-caused degraded sand dunes, man-made coconut and casuarina plantations and open sandy areas. All these indicate the presence of suitable lands for raising mangrove and non-mangrove bioshields between the villages and the sea.

Ownership of the land: Using remote sensing data, GIS and ground truth information, the areas available for mangrove and non-mangrove bioshields were measured. This indicated the availability of about 80 ha (including three large mudflats and foreshore area of the backwater channels and canals) of land suitable for a mangrove bioshield and about 30 ha of land (along the beach as well as within the village) for a non-mangrove bioshield. After assessing the availability of land, identification of the owners of the land was taken up. Discussions with the Village Administrative Officer indicated that all the land identified was designated as coastal *poromboke* (wasteland) owned by the Revenue Department, Government of TN, and could be used for bioshield development with the permission of the District Administration. Accordingly, permission was sought. However, a part of the sandy beach of about 6 ha is occupied by the people of the fishing village, MGR Thittu. During the tsunami it had suffered heavy loss both in terms of people and property and all the families had been shifted to a new settlement, which is located about 1 km from the sea. Since this part of the land is used for various fishery-related activities such as drying fishing nets and hauling fishing boats, this area was not considered for bioshield development. Similarly, in the mud flats suitable for the mangrove bioshield, some areas have been converted into prawn farms by these people and so development of a mangrove bioshield was avoided in this area also.

Community mobilisation and organisation: The project villages of Muzhukkuthurai, MGR Thittu and Mudasalodai are located very close to the villages where a JMM project had been implemented in collaboration with the Tamil Nadu FD from 1996 to 2003. The villagers were well aware of all the benefits of the JMM programme and readily agreed to participate in this project. A series of meetings was held with the different groups of the community to provide orientation to the project objectives and implementation processes and their willingness to provide lands for raising mangrove and non-mangrove bioshields was obtained.

Following this, initiatives were taken to establish a village level institution in each project village, but a number of problems were encountered. An analysis was made of the existing village level institutions in each project village. This study showed that in all the three project villages, the traditional panchayat is very strong and plays a major role in solving family disputes, disputes with other fishing hamlets and approaching government institutions to bring civic facilities to the village.

The organisational structure of the traditional controlling system includes a General Body (GB) in which all adult males of the village are members. This GB elects an Executive Committee (EC) once a year, which deals directly with all issues in the village. During the tsunami, the traditional panchayat played a significant role in relief activities and is playing a very active role till today in the rehabilitation processes relating mainly to housing, replacing fishing crafts and equipment.

Three major weaknesses were noticed in the organisational structure and role of the traditional panchayat: there was no room for women to play any role in either the GB or EC; there was limited opportunity for outsiders to interact with the GB and interest of the traditional panchayat was limited with respect to bioshield programmes. Since the traditional panchayat is strong, it was decided to use it as the village level institution for project implementation with the condition that women should also be included in the GB and EC. This idea was not accepted, even for the sake of the bioshield programme.

Negotiations with the traditional leaders did not help in including women in the planning and implementation processes. Meanwhile, some of the elders made the following suggestions:

- A separate EC, including women, could be formed for the bioshield project.
- This EC would be allowed to participate in the traditional panchayat meetings where plans for the bioshield programme could be explained to get the consent of the entire community.
- This EC would have discussions with the women's groups on a monthly basis and include their views, ideas and decisions in project planning and implementation.

These suggestions were discussed further with the traditional leaders as well as with the women's groups and their leaders. With their concurrence a village level institution namely *Grama Nala Sangam* (Village Welfare Society-VWS) was established in each of the project villages. Each VWS has a savings bank account in the State Bank of India, C. Mutlur. This account is operated jointly by the President and Treasurer of the VWS and a representative of the Foundation.

Micro plan: All the project activities were implemented by the VWS as per the micro plans prepared jointly by the EC of the VWS and the Foundation. They contain the details of the activities to be undertaken for each of the components of the project such as community mobilisation and organisation, bioshield, livelihood support and training. So far, two micro plans have been prepared for each village, covering a period of approximately six months, and implemented.

Entry point activities: As a first step towards winning the confidence of the people, the following immediate needs of the community were fulfilled as entry point activities. Cleaning of the tsunami-affected MGR Thittu settlement was taken up as the first entry point activity.

The second activity was the desilting of the mouth of the estuary. MGR Thittu and Muzhukkuthurai fishers reach the sea through the mouth of the Pichavaram mangrove estuary located at a place called Chinnavaikkal. It was totally silted up due to various reasons and desilting involved huge costs. The project contributed a part of the cost as an entry point activity and to the construction of school compounds both in Muzhukkuthurai and Mudasalodai villages.

Mangrove bioshield: On the basis of the discussions held with the leaders of the project hamlets and the VWS, it was decided to allot 30 ha of land to Muzhukkuthurai, 20 ha to MGR Thittu and 10 ha to Mudasalodai villages for raising the mangrove bioshield. However, the TN FD had taken over the 30 ha allotted to Muzhukkuthurai and the mangrove bioshield was raised only in MGR Thittu (25 ha) and Mudasalodai (5 ha).

Before taking up restoration activities, the soil profile of the mangrove bioshield area was studied during both the summer and monsoon seasons, and it was found that the soil and pore water of the area were hypersaline, requiring free flushing by tidal water to improve the biophysical conditions. The canal method, already tested during the earlier JMM project, was followed in raising the mangrove bioshield. Main canals with an upper width of 2 m, bottom width of 1.75 m and depth of 1 m were dug and each main canal was connected to a number of feeder canals of 1 m upper width x 0.75 m bottom width x 0.7 m depth. In the mangrove bioshield area, a total of 83,000 propagules of *Avicennia marina* and 5000 propagules of *Rhizophora mucronata* and *Rhizophora apiculata* were planted along the banks of the main and feeder canals. Plantation in the space between the canals is to be taken up next year. Of the 5,000 *Rhizophora* saplings, 1,000 were container raised seedlings procured from the nursery run by a women's SHG in MGR Thittu. The remaining 4,000 propagules were received from AP. Planting of mangrove propagules was taken up in December, at the end of the northeast monsoon, when soil salinity was low. Plantation was taken up by the fishing families of MGR Thittu and Mudasalodai villages. The survival rate of *Avicennia marina* was only 68% while that of *Rhizophora* was 90%. Protection of the mangrove plantation against grazing is the most important aspect; so the villagers decided to appoint a community guard. As they could not find a suitable person, the VWS is taking care of this.

Non-mangrove bioshield: The sandy beach between the village and the sea is suitable for raising a non-mangrove bioshield. The District Collector had also given permission to raise a bioshield in this area with the participation of the community and elected panchayat. However, fishing families from MGR Thittu and Mudasalodai have been growing various kinds of trees in these lands for a long time, some families with temporary permission (B –Memo) from the government and some others without any authorisation. Although these plantations were severely affected by the tsunami, these families were not interested in giving this land to the village for raising bioshields. This delayed

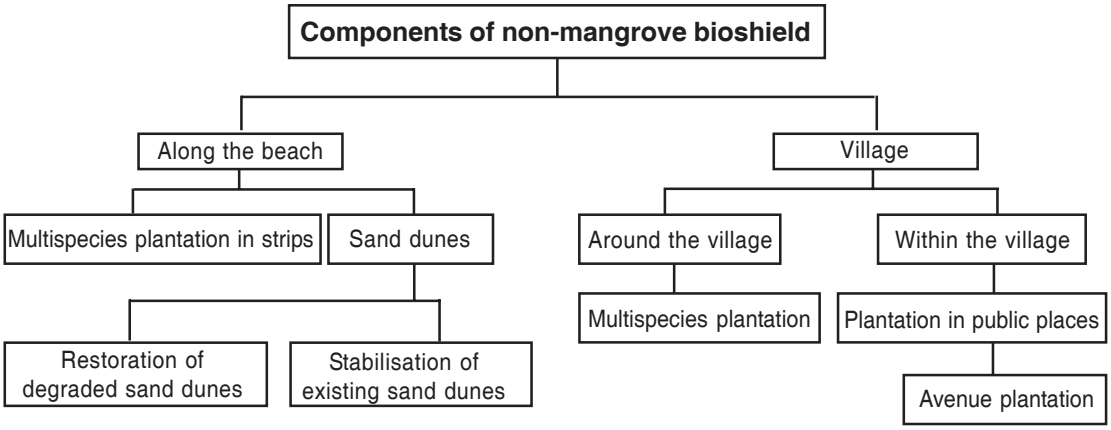


Fig.1.1 ***Flowchart showing various components of the non-mangrove bioshield in the Pichavaram region***

the starting of the non-mangrove programme. After the establishment of village level institutions, negotiations were held with the families who traditionally grow trees along the beach. Now an understanding has been reached that the rows of trees that are going to be planted along the beach would be preserved as a bioshield whereas plantations would be raised behind these rows by the local community for economic benefits. As shown in Fig 1.1, the non-mangrove bioshield consists of various components.

Sand dune restoration and stabilisation: Along the beach where the non-mangrove bioshield is being established, sand dunes are found to a distance of about 2,300 m. Of this, about 1,000 m was destroyed totally by the tsunami, while in the remaining 1,300 m, the impact of the tsunami was less. As requested by the villagers, activities were initiated to restore the destroyed dunes, following the traditional method. According to this method, coconut and palm fronds were placed closely as a barrier along the destroyed sand dune, allowing the sand particles carried by the wind to settle along the destroyed sand dune. When the wind blows from the sea, sand particles accumulate on the seaward side of the barrier, whereas when the wind blows from the land, the sand accumulates on the landward side. This method of sand dune restoration was started in the month of November 2006 and at present the dune has grown to 1 m in height and 7 m in breadth. Apart from this, the sand dune that was partially damaged was stabilised for a length of about 800 m by planting *Ipomea pes-caprae* and *Spinifex* sp.

Multispecies non-mangrove bioshield: During the year, the non-mangrove bioshield was raised along the beach, covering a distance of 160 m and a breadth of 80 m, just behind the sand dune that was restored. This bioshield consists of 3 species namely, *Calophyllum inophyllum* (Pinnai), *Pongamia glabra* (Punnai)

and *Cocus nucifera* (coconut), which were selected by the community for both economic and ecological reasons. They were planted in 15 rows: *P. glabra* was planted in the first three rows, followed *by C. inophyllum* in two rows, with coconut in the last five rows. The coconut plantation was again followed by three rows of *P. glabra* and two rows of *C. inophyllum*. Thus, a total number of 397 saplings were planted, of which 190 were *P. glabra*, 106 *C. inophyllum* and 190 coconut. Only organic manure and biofertilisers were used in raising this bioshield. The VWS appointed two families to take care of watering and protecting the bioshield. In addition, a similar multispecies bioshield with the same species was also developed in the vacant area on the eastern side of the MGR Thittu new settlement, and 540 saplings of coconut were planted along the street and in public places.

Livelihood support: During discussions with the women members of the VWS, it was often mentioned that women vending fish in nearby towns were facing problems in transporting fish and the project should address this issue. Following this, a door to door survey was conducted in all the 3 project villages, which showed that a total number of 203 women belonging to MGR Thittu (46 women), Muzhukkuthurai (61) and Mudasalodai (96) are involved in fish vending as a means of livelihood. All of them are poor and they purchase fish in the landing centre in the village and transport it by public transport to nearby towns. Each woman carries about 20 to 25 kg of fish for marketing.

In order to avoid these problems and reduce the drudgery of fish vending, it was decided collectively to buy and maintain a van in each of the project villages. It was also decided that funds for buying vans would be given only as a revolving fund and income from the transport should be paid back to the VWS; fare would be collected on the basis of the distance at which the marketing town is located and the quantity of fish carried; when the van is free it would be used for other activities to earn sufficient profit to maintain the van and a driver and also repay the loan.

The women's groups of all the three project villages now own one vehicle each. These vehicles are managed by the women's groups, which decide the daily use of the van and also maintain accounts.

Training: As indicated in Table1.1, four training programmes were organised for the people of the project villages on micro credit, micro finance and accounts management. The training programmes were conducted by the officials of the Indian Bank, Puduchery. Members of the women's groups of MGR Thittu, involved in nursery development, participated in two one-day training and exposure programmes on nursery management and marketing, conducted by the Horticulture Department of Annamalai University. The NGO *Pasumaithozhan* (Friend of Greenery) provided hands-on training on vermi-composting.

In addition, an orientation workshop on participatory approaches in the development

Table 1.1 ***Training programmes organised in the project villages***

Training Programme	No. of programmes	Duration (days)	No. of trainees
Leadership development	2	2	78
Micro credit & Accounts management	2	2	70
Nursery management & marketing	2	2	39
Vermi-compost	1	1	17
Total	**7**	**7**	**204**

and management of bioshields was organised for final year students of the Department of Sociology, Annamalai University. A training and exposure visit to the bioshield area was conducted for students of the Department of Agriculture, Annamalai University. A total number of 96 students participated in these orientation programmes.

102.2 Indo-Sri Lanka Project on Strengthening the Resilience of the Tsunami Affected Communities

The goal of this project is to reduce the vulnerability of the rural poor in coastal areas of Sri Lanka and India to natural disasters, rehabilitate and improve mangrove and non-mangrove bioshields and introduce new village level management to share the benefits, expand livelihood opportunities for women and other groups through access to information and strengthen the capacity of local organisations and local governments to prepare for and mitigate the effect of natural disasters through knowledge empowerment and training. This project is being implemented in India and Sri Lanka. It is being implemented in Sri Lanka by Jatika Sarvodaya Shramadhana Sangam (*Sarvodaya)* and Practical Actions, an international NGO.

Project sites: The project is being implemented in Pudukottai, Ramanathapuram and Tuticorin districts of TN. All these three districts are shielded by Sri Lanka in the east and hence the impact of the tsunami was not as severe here as in the case of Nagapattinam and Cuddalore. Though the loss of human lives was limited in the project districts, damage to property, particularly fishing crafts and gear, was high. As shown in the records of the government, about 49,000 families residing in 72 villages were affected in the three project districts. Two sites in TN, Manamelkudi and Vembar, Sorlagundi site in Krishna district and Danavaipeta in East Godavari in AP have been selected for project implementation because they are backward in terms of the socio-economic conditions of the people and available natural resources; they are prone to cyclones and storm surges; limited attention was given to these areas after the tsunami; they are located in remote areas with limited interventions from NGOs, voluntary organisations and donors; flow of information and attempt to empower people with

knowledge is limited and there has been no attempt to introduce ICT based tools and systems in developing these areas.

Project partners: Unlike other projects of the Foundation, this project is being implemented through grassroots NGOs. This decision was taken to enhance the capacity of the grassroots organisations in designing and implementing developmental projects in the coastal areas, particularly in mangrove and non-mangrove bioshields, to enhance the outreach of the JMM programme, which was implemented from 1996 to 2003. Table 1.2 shows the grassroots NGOs selected for project implementation for TN and Sorlagundi site in AP.

The Society for Participatory Research and Integrated Training (SPRIT) has its headquarters in Madurai and was registered in 1993 as a secular, non-profit voluntary organisation engaged in rural development. It has experience in implementing tsunami relief activities in 10 villages in Pudukottai district and working with the youth of tsunami affected villages in Kanyakumari district. The People's Action for Development (PAD) with its headquarters in Vembar was registered as a voluntary organisation in 1983 with a commitment to undertake pro-nature interventions to strengthen the food and livelihood security of the rural communities through conservation and sustainable use of natural resources. The Praja Pragathi Seva Sangam (PPSS) is a NGO registered in 1993 with its headquarters in Machillipatnam. It is a partner NGO of CARE-India and has implemented tsunami relief and rehabilitation activities in 27 villages in Krishna district. These NGOs were selected because they have been working in remote coastal areas for a long time, follow a participatory process, have a good rapport with the local community and government institutions and are willing to have a partnership with the Foundation.

They were given an orientation to the programme and the implementation process of the project. An agreement has been signed with them as boundary partners and a half-yearly workplan has been prepared with SPRIT and PAD.

Table 1.2 ***Grassroots NGOs selected for project implementation in the project sites***

Name of the grassroots NGO	District	Site
Tamil Nadu		
Society for Participatory Research and Integrated Training (SPRIT)	Pudukottai	Manamelkudi
People's Action for Development (PAD)	Ramanathapuram and Tuticorin	Vembar
Andhra Pradesh		
Praja Pragathi Seva Sangam (PPSS)	Krishna	Sorlagundi

Table 1.3 ***Activities identified in the project villages***

Site	Name of the village	Activities
Manamelkudi	Manamelkudi	VRC
	Seetharamanpattinam	Mangrove bioshield, livelihood
	Melasthanam	Mangrove bioshield
	Kattumavadi	VKC, Mangrove bioshield, livelihood
	Ponnagaram	VKC, livelihood
	Keezhakudi iruppu	Mangrove bioshield – research
Vembar	Vembar	VRC
	Rosemanagar	VKC, non-mangrove bioshield, livelihood
	Keezha vaipar	Mangrove bioshield, VKC, livelihood
Danavaipeta	Kakinada	VRC
	Danavaipeta	VKC
	Yerrayapeta colony	Non-mangrove bioshield, livelihood
	KMusalayyapeta	VKC
	Mullapeta SC colony	Non-mangrove bioshield, livelihood
Sorlagundi	Machillipattinam	VRC
	Nali	VKC, mangrove bioshield, livelihood
	Sorlagundi	VKC, mangrove bioshield, livelihood

Project villages and identified interventions: The project villages have been identified on the basis of the need and willingness of the people. Activities for each village have also been identified (Table1.3).

Community mobilisation and organisation: In TN, informal meetings were held with traditional leaders, youth and women's group leaders of the project hamlets to discuss the goal and purpose of the project and its various components, including social and gender equity. In all the selected project villages, leaders and all the different groups have agreed to participate actively in the project. The newly elected panchayat leaders have passed a resolution in their General Body (*Grama Sabha*) meeting to extend full cooperation for the implementation of the project and the establishment and management of the VRCs and VKCs, bioshields and livelihood activities. In AP, informal meetings were held with the village leaders, women SHG leaders and youth in all the villages as well as with the panchayat leaders. Formal meetings with the elected panchayat leaders and passing of the resolution in the *Grama Sabha* will be taken up shortly.

Village level institutions: In Vembar, a Village Level Institution (VLI) called Village Development Committee, formed by PAD, is participating in project planning and implementation. In Manamelkudi, the process

of forming a VLI has been initiated. In AP, the Village Forest Council formed by the AP FD would be involved in project implementation in Danavaipeta, whereas in Sorlagundi, the EDC, which was also formed by the FD, is participating in project implementation.

Activities relating to PRA, baseline survey, bioshield development and management, establishment of VRC and livelihood analysis have been initiated in all the project villages. Meanwhile, the identification of land for mangrove and non-mangrove bioshields has been completed and VKCs established in 6 project villages in TN.

Exchange visit: An exchange visit to bioshield VRC and VKC programmes was organised in India for the Sri Lankan partners in close collaboration with IDRC, New Delhi. The participants were also exposed to the conceptual framework as well as practical models of the community-centred, science-based and process-oriented approach to both mangrove and non-mangrove bioshield development and management. They were shown models of mangrove and non-mangrove bioshields in Pichavaram region in TN, where attempts are being made to integrate opportunities for income generation. The new seawater farming system, in which mangrove plantation, cultivation of halophytes and culture of crab and fish are being integrated, was shown to the participants. They appreciated this system and affirmed that there is much scope for the replication of this model in Sri Lanka.

Sub Programme Area 103

Seawater farming

A seawater farming system is being developed in partnership with a private entrepreneur and the local community in the Puliyanthurai region of Nagapattinam district. In this system, attempts are being made to integrate mangrove plantation, halophyte cultivation and fish culture. It is being developed in a farm of about 0.3 ha. In aquaculture farms, most of the area is used to rear prawn and fish. In this seawater farming system, space is given for growing mangroves and halophytes by constructing bunds inside the pond in a zigzag manner. Secondly, in intensive and semi-intensive types of aquaculture farms, water is pumped in and out of the ponds regularly to maintain the quality of the water. In the present experimental system, the bottom of the pond is 3 ft below the tidal level. This is done by digging the soil, which is used to construct the inner bunds. Since the bottom of the pond is below the tidal level, brackish water enters into the pond during the high tide and drains out during the low tide. The inlet and outlet have swing doors which open and close as per the tide to allow water to enter and drain. Thirdly, no artificial feed is used in this system since the water of the pond is exchanged twice daily with the adjacent natural waterways.

Mangrove plantation: A total number of 1,723 *Rhizophora* saplings, and 327 *Avicennia marina* saplings were planted during the year. *Rhizophora* saplings were planted in two rows along the lower edges of the bund whereas

Avicennia saplings were planted about 2 m above the *Rhizophora* plantation. Both *Rhizophora* and *Avicennia* were planted at 5 m intervals in a row. It is expected that well-grown trees would act as a barrier against natural disasters such as cyclones, storm surges and tsunami, stabilise the sand and thereby prevent bund erosion during floods. The most important purpose is that these trees would provide shelter and food to the commercially valuable mud crab or mangrove crab. Raising mud crabs is difficult in open aquaculture ponds because they easily climb the bund and move out. Secondly, mud crabs are cannibalistic and weak moulted crabs are killed and eaten by strong unmoulted crabs. It is expected that when mangrove trees grow, their root system would provide a natural environment for the crabs and thereby prevent migration and the intricate root system would provide protection to moulted crabs. Data on growth parameters of both *Rhizophora* and *Avicennia* were collected at 3-month intervals and the survival rate was observed once a month. At the end of 11 months, the survival rate of *Rhizophora* was about 70 % and that of *Avicennia* was 90 %. The average height of *Rhizophora* after 11 months was about 74.8 cm and the average number of leaves per plant was 36. The average height of *Avicennia* was only about 21 cm.

The reason for the low survival rate of *Rhizophora* was pest attack, which is not normally observed in wildlings. A species of sap-sucking scale insect of the Coccidae family was found affecting the leaves of the *Rhizophora* plants. It was noticed in 28 plants (1.6 % of the total population) and all of them died before control measures could be taken. It was observed that attack by scale insects was severe when the salinity of the water of the farming system goes below 24 ppt. In order to prevent infestation, the plants were sprayed with different concentrations of neem oil, which showed that 5 % solution was very effective, when sprayed 3 times at an interval of 15 days. Attempts were also made to control the disease by spraying salt water of different concentrations (30, 35, 40 ppt) but no control of the disease was observed.

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 bunds in January 2007. Survival rate and biometrical data are being collected at monthly intervals.

Fish culture: A total number of 1,250 fingerlings of the commercial fish sea bass (*Lates calcarifer*) were introduced into the seawater farm in October 2006 but all of them died after a period of three months. All these fingerlings were nursery grown and introducing them all of a sudden to wild conditions might have caused mass mortality. Another postulated reason was preying by sea otter, which frequently visited this seawater farming system. In order to prevent this, a fence has now been erected around the entire pond.

Monitoring of water quality: Water quality parameters, including temperature, salinity, pH nitrite, nitrate, ammonia and phosphate, were monitored at intervals of 15 days. The observed values were within the normal range.

Sub Programme Area 104

Nuclear and Biotechnological Tools for Coastal Systems Research

There are challenges facing the agricultural systems in the coastal regions. This is due to increasing population pressure, depleting natural resources and increased biotic and abiotic stress factors that adversely affect the stability and sustainability of major farming systems, thereby affecting the food and livelihood security of the coastal communities. Advances in the field of biotechnology, nuclear sciences, space and information technology, agroecology, soil sciences and landscape ecology have profound implications in the field of agriculture and natural resources management.

The research project on Nuclear and Biotechnological tools for Coastal Systems Research, a partnership programme between the Department of Atomic Energy and the Foundation initiated in 1998, was primarily designed to integrate conservation of natural resources and sustainable development in the rural communities in coastal areas adjoining nuclear power plants, with an overall objective to evolve models for sustainable development by strengthening the livelihood security of rural communities by blending frontier sciences and technology with the traditional wisdom of rural coastal communities. Since its inception, the project has given concurrent attention to both marine and land-based alternative livelihoods to reduce over exploitation of already degraded coastal bioresources, thereby ensuring development with conservation, in a win-win approach.

The primary objectives of the programme undertaken in Kalpakkam, Chidambaram (SPA 401) and Kudankulam regions of coastal TN are to introduce nuclear and biotechnology tools for sustainable development of agriculture, fisheries and animal husbandary in the region through grassroot level institutions, promote sustainable eco-enterprises and strengthen local communities through capacity building and knowledge empowerment. The approach included both strategic and anticipatory research, and participatory and adaptive research for addressing the prevalent problems of the coastal region.

104.1 Activities at Kudankulam

Evaluation of mutant varieties of pulses and oil seeds by farmers

The superior and drought tolerant mutant variety developed by BARC has spread in coastal villages. The farmer-evaluated mutant varieties of groundnut are cultivated by more than 160 farmers, covering almost 168 acres of land under different soil conditions, in three villages adjoining Kudankulam. The farmers recorded a total of 384 kg/acre, under rainfed conditions.

BARC pulses (black gram and green gram) were tested and evaluated by farmers during

the last few years and have been adopted as they are suitable for the rainfed conditions that prevail in the region. The transition has been from the supply of seeds by the Foundation to farmers using their own saved seeds through traditional methods. There has also been farmer to farmer exchange of seeds in the region. The details of the cultivation of the different crops are given in Table 1.4

The number of farmers cultivating groundnut increased by 6.6 % and the total area under groundnut cultivation has increased by 6.3 %. There is a significant increase in the yield in groundnut production by 6.9 %. In the case of green gram, the number of farmers cultivating the crop has increased by 60 % and the total area of cultivation of this crop has increased by 60 %. However, due to poor rainfall the yield was not as expected. It decreased by 28.5 % as compared to 2005-2006.

Genetic Garden for Fruit Crops

A genetic garden has been established for participatory evaluation and adoption by local communities. The performance of these varieties was assessed in relation to the growth parameters and water use efficiency. Based on these studies, introduction of more species and varieties was undertaken.

Among the fruit crops, amla, mango, sapota and cherry were found to be most suitable for this agro-climatic zone, particularly in Radhapuram taluk area. The programme has now linked these farmers with the National Horticulture Mission. So far 32 ha (Amla - 12 farmers and Mango - 20 farmers) have been covered under the programme and they have direct access to credit and technical inputs. Inputs for Irrigation schedules and micro nutrient management strategy have been provided to each farmer after analysing the soil characteristics. Some of them have adopted drip irrigation, which is available at a subsidised rate.

Performance evaluation of different crops under rainfed conditions

Various promising crops (red gram, finger millet and gingelly) suitable for this area have been tested by 10 farmers, covering an area of 15 acres as a demonstration and as an evaluation of their suitability for the region.

Table 1.4 ***Cultivation of pulses from 2006-2007***

Crop	Number of farmers		Total area (acres)		Yield (kg)	
	2005-06	2006-07	2005-06	2006- 07	2005-06	2006-07
Groundnut	151	161 (6.6) #	158	168(6.3) #	60200	64400(6.9) #
Green gram	20	32 (60) #	20	32 (60) #	2240	1600+(-28.5) #
Black gram	13	*	13	*	2820	*

 # Percentage increased and decreased during 2006-07
+ Yield due to scarcity of rainfall during flowering period
** Yield was not as expected (farmers prefer cultivation of groundnut and green gram)*

Jatropha plantation in farmers' fields

135 superior varieties were selected out of 404 collections and planted in the demo-plot. The third year data were collected and analysed. The best yielding plants/lines were marked and seed collected from them to raise the nursery and for laboratory analysis. The nursery-raised plants were used for planting in farmers' fields. Looking into the extent of wastelands available in the area, plantation of *Jatropha* as a biofuel crop is being considered as one of the viable options. Based on the analysis during the last three years, it has been established that more than 10 accessions from the collections can grow in water deficit areas. Local communities have been trained in nursery development as well as plantation and during the last year, six farmers have voluntarily taken up cultivation of jatropha in their own land. More than 40,000 planting material are available for planting during the coming year.

The aim is to reach many more farmers in the region. The newly developed model focuses on interventions that combine low input costs (less water/ labour) and the best utilisation of land. In turn, farmers are able to get good returns. The Foundation has also linked the activities with the ATMA (Agriculture Technology and Management Agency) programme so as to bring the power of partnership as well as synergy to the agricultural development of the region. Table 1.5 shows the area covered by different crops at Kudankulam over the years.

Table 1.5 ***Additional area brought under agriculture***

Crops	Area (ha)
Pulses & Oil seeds	125
Jatropha	4
Fodder grass	80
Fruit crops	32
Total	**241**

Self Help Groups

During the year 17 new SHGs were formed in four coastal villages, taking the total to 71. Eligible SHGs have been trained on various aspects with resource persons drawn from the local institutions. Some of these SHGs have applied for initiating microenterprise activities. A DRDA-supported training programme under tsunami emergency assistance programme (TEAP) for the representative and leader of each group, was conducted with technical support from the Foundation. DRDA-supported subsidised loans for economic activities were granted to two groups for seaweed cultivation and support for a fish transport vehicle. Other activities like production of fish pickles and dry masala fish is under consideration by the Project Officer of DRDA and awaiting final approval. Table 1.6 shows the credit support availed by the SHGs during the last five years and the total revolving fund received.

Three SHG members participated in SARAS, 2007 (Sales of Articles by Rural Artisans Society) held at Salem. The ongoing ecoenterprises being undertaken by the SHGs

Table 1.6 ***Credit support to the SHGs***

Total number of SHGs	71 groups
Total credit support in the last five years	1 crore
Revolving fund received	20 lakhs
DRDA sanctioned projects	2 proposals (5.5 lakhs)

include eco-enterprises, production of oyster mushroom, vermicompost, fish pickle/prawn pickle production, dry fish/masala fish, milch animal, milk based value added products, poultry /goat rearing, fodder, pig rearing, turkey rearing, seaweed cultivation.

Capacity building

Under the capacity building programme, various training and exposure visits were conducted at Kudankulam, involving 2,180 trainee days. Specific training programmes on vegetable seed production and value addition to fruit crops were conducted, involving 30 vegetable growers of Kudankulam, supported by Krishi Vigyan Kendra, Tenkasi. Table 1.7 gives the details of the capacity building exercises undertaken in the region.

Village Knowledge Centre (VKC)

The computer literacy campaign (CLC) is running successfully in three coastal villages. Under the CLC, 60 women from different SHGs were selected and trained.

Table 1.7 ***Capacity development programmes at Kudankulam***

Topic	Participants M/W	Training days
Concept of SHG	120/90	210
Leadership development/accounting	22/10	32
Micro-enterprises development	120/80	200
Dry land agriculture/seed production	100/120	220
Livestock management	46/10	56
Fodder production practices	100/100	200
Micro watershed	10/22	32
Sanitation/safe drinking water	120/50	170
Iodised salt	20/60	80
Vermicomposting	300/300	600
Solid waste management	10/40	50
Computer and its uses:Tally batch of 10 students started (80 SHGs)	20/310	330
Total	**988/1,192**	**2,180**

104.2 Activities being undertaken at Kalpakkam

A model demonstration-cum-experimental plot has been developed at the Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, based on the model of sustainable natural resource management with emphasis on critical water use efficiency, forward backward linkages, organic farming and low input agriculture.

The major objective of this demonstration plot is a number of activities in a single location that could form a facility for technology incubation and adoption. During the year, large-scale seed multiplication of mutant black gram, green gram and groundnut was conducted, and evaluated by the farmers of the region in a participatory manner. The farmers involved in the participatory assessment were happy with the performance of these varieties as compared to the locally used varieties. The multiplied seeds were supplied to a large number of farmers in the region for adopting these mutant varieties.

During the year new interventions like horticulture, aquaculture and vermicomposting were undertaken. The priority areas for training and capacity building included natural resource management, innovative agricultural practices and agricultural waste management. The focus has been to move from demonstration to the farmers' fields. Three villages in the adjoining region have been identified for undertaking activities aimed at adding value to available bioresources. A number of exposure visits for farmers and school children were conducted so as to give them exposure to various aspects of agriculture and resource management.

In addition, the demonstration site also served as a testing facility for the pre-breeding genetic material being developed using the transgenic approach; the details are provided in SPA 202.

Mangrove restoration at Buckingham Canal – Bay of Bengal mouth at Kalpakkam

After the tsunami devastation in the region, the mangrove restoration at the Buckingham Canal – Bay of Bengal mouth at Kalpakkam was undertaken by the Samanthi Women Self Help Group (WSHG) from Vitilapuram (Kalpakkam). The group's activities are mainly mangrove nursery management, planting and after-care.

The following zonation pattern from water to land was used to restore the site: first three rows – *Rhizophora* species, followed by ten rows of *Avicennia* species, followed by a row of *Excoecaria agallocha.* The *Ceriops* saplings were planted in between *Rhizophora* and *Avicennia*. Four months after plantation, the following mortality rates were observed: *Rhizophora* 7 %, *Avicennia marina* 8 %, *Avicennia officinalis* 14 %, *Ceriops* 8 % and *Excoecaria* 3 %, and the saplings were replaced. At the end of the first year the mortality rate was around 8-9 %. The SHG is maintaining around 500 mangrove saplings in the nursery for gap filling. In the restored site, almost all individual plants of *Avicennia* species have formed pneumatophores and *Rhizophora* species have already developed stilt roots, an indication of establishment and growth of these species in the site.

Sub Programme Area 105

Remote Sensing and Geographical Information System

105.1 Coastal Systems Research

Two major projects are being carried out in the GIS lab under this programme. One is the Coastal Zone Studies and the other is the suitability mapping of mangrove and non-mangrove bioshields, which is one of the components of the Indo-Sri Lanka project on strengthening the resilience of tsunami-affected communities.

Coastal Zone Studies: Mapping and monitoring Marine Protected Areas (MPA) of TN (Pulicat Wild Life Sanctuary, Pichavaram Reserve Forest, Vedaranyam Wild Life Sanctuary and Ramanathapuram Mangroves) is the first component of the Project. Base maps of all MPAs were prepared using Survey of India toposheets, forest maps and village maps. Mapping of the MPAs for the period 2005-2006 for Pichavaram, parts of Ramnad mangroves and Pulicat Wild Life Sanctuary were completed.

Under component two, preliminary maps were prepared for small and large mangrove wetlands of TN other than Muthupet and the Gulf of Mannar region, using available remote sensing data and the data received from the Space Application Centre. Mangroves of Thiruvallur, Chennai, Kancheepuram, Villupuram, Cuddalore, Thanjavur and Pudukottai districts were mapped in this manner. Ground truth verification for the preliminary maps was completed.

Component three of the project is to model the health index of Pichavaram mangroves using remote sensing and GIS. Data on environmental parameters of the wetlands for postmonsoon, summer and premonsoon seasons were collected in random sample locations. The model is being developed.

Bioshield suitability map: The aim of preparing bioshield suitability map is to identify and demarcate suitable areas for raising mangrove and non-mangrove bioshields. These maps are to be produced on a large scale of 1:12500. Though the project is implemented in different sites in TN and AP, the concept of preparing bioshield suitability maps is being tested in the coastal area of the Manamelkudi block in Pudukottai district of TN and Thondangi block in East Godavari district of Andhra Pradesh. A framework of suitability mapping of mangrove and non-mangrove bioshields has been developed (Fig.1.2) and will be enhanced in consultation with experts and stakeholders.

Mapping the coastal zone of the Cauvery delta: Geomorphology, landuse / land cover, bathymetry and other shoreline features of the coastal zone from Parangipettai to Nagapattinam were mapped and monitored using temporal remote sensing data for 25 years. The area displays two significant geomorphological features from Parangipettai to Karaikkal and Karaikkal to Nagapattinam. The former region has a wider coastal extent

with discontinuous beach ridges whereas the latter represents a narrower coastal spread with one or two low elevated small beach ridges and sand dunes. The process of erosion has caused changes in the shoreline of the coast. Progradation in the Coleroon river mouth shows the eastward migration of the coastline. Offshore of Porto Novo shows an increase of 4 m in near shore bathymetry and a decrease in Karaikkal by 2 m and in Nagapattinam by 4 m. The Nagapattinam near-shore region is shallow, whereas towards Porto Novo it is steeper. Shallow depth in the near–shore continental shelf region is one of the main reasons for the maximum devastation in Nagapattinam area during the December 2004 tsunami. While studying the landuse of the coast, the area was found to be attractive for investment in shrimp aquaculture, especially in Karaikal and Tarangampadi and south of Porto Novo. Out of the 1,11,469 ha of geographical area in the present study, 1,250 ha (1.2 %) of agricultural land was converted to aquaculture between 1977 and 2000. This sector represents a significant change in land use.

Development of simplified image processing package with special reference to mangroves: A simplified version of a software package was

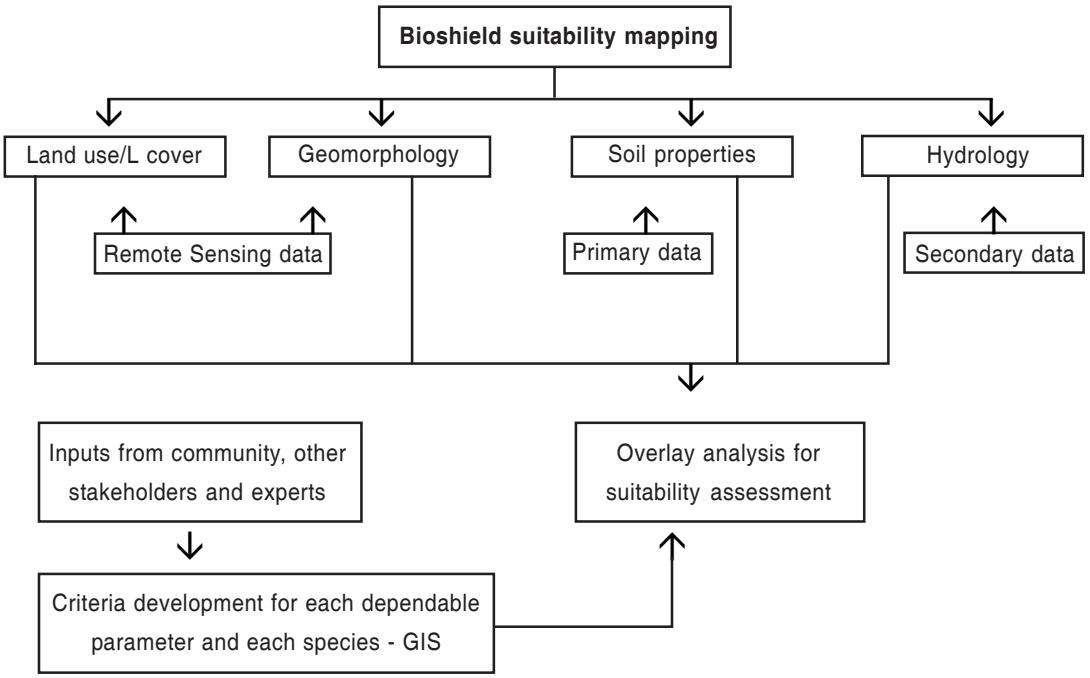


Fig 1.2 ***Flowchart showing the methodology used in the preparation of bioshield suitability maps***

developed for the classification of remote sensing images in the commonly used image formats such as jpg and bmp. This could be used to get a broad idea of the percentage of area of major land use / land cover classes in a region. The package has the provision of further classifying each major land use / land cover up to seven sub categories. It also has edge enhancement, blurring and rotation features for further interpretation of the image. This package distinguishes the mangrove and non-mangrove vegetation clearly. Further, the sub classifications under vegetation class shows 85 % accuracy in density classes.

105.2 Biodiversity

Land tenure mapping of Kolli Hills: Land types, land tenure system and cropping pattern of the three villages of Devanur Nadu, Valavanthi Nadu and Alathur Nadu of Kolli Hills, Namakkal district, were developed using GIS. GPS survey in each farm was conducted to identify the divisions in the available cadastral map. Since there is a large number of divisions in each farm, it is proposed to integrate the farm measurement boundary records in cadastral maps.

105.3 Ecotechnology

Maps of land use / land cover of Poompuhar and Annavasal blocks were prepared, using high-resolution remote sensing images namely, IKONOS and IRS P6 LISS IV respectively, as a supporting tool for the ecotechnology projects in planning and implementing the field activities such as selection of study area and suitable means and methods of developmental work. Locations of the ponds developed by the Foundation in Parangipettai block under the project “Intensive Integrated Farming System” were surveyed using GPS and data on farming and fishing practices were integrated in the spatial database of the block in GIS. This would be used to plan the future activities in selecting the location for new ponds and resource distribution in the region. The spatial database of Annavasal block of Pudukottai district is under development.

105. 4. Information, Education and Communication

The network of VKCs was mapped for each VRC and hands-on training was provided to the animators and staff of TN VKCs in scaling the wave height map downloaded from the internet, using the principle of geographic coordinates and scaling procedures.

Programme Area 200

BIOTECHNOLOGY

New genes, promoters and transgenic events have been generated during the year. A sex specific marker has been identified. Culture protocols have been established for 15 lichen species for compound production in vitro*. A reproducible protocol has been developed for* Jatropha*. 45 marine red-pigmented* vibrio *species were isolated and characterized, of which a potential novel species has been identified.*

Programme Area 200

BIOTECHNOLOGY

This programme takes advantage of the advances in Biotechnology and Molecular Genetics, which have opened up new avenues of research for improving agricultural productivity and ensuring food security and human nutrition. The major focus is on basic research, application of biotechnology at the grassroots level and dissemination of biotechnology information.

The work carried out in the last 10 years has contributed immensely in developing reproducible *in vitro* protocols for rare and endangered plant species in the Western Ghats as well as in coastal mangrove ecosystems, documenting diversity among the mangrove species using molecular marker systems, assessing ecosystem health using microbes and lichen species, bioprospecting for novel compounds of medicinal and therapeutic value, identifying and characterising 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.

Sub Programme Area 201

Ecological Restoration and Ecosystem Monitoring

201.1 Production and demonstration of high quality planting material of *Jatropha curcas*

Jatropha curcas is a non-edible oil plant belonging to the family Eupborbiaceae. It is a perennial, small tree that has drought and disease resistance traits. Efforts have been on to develop high quality planting material for cultivation of *Jatropha* in dry land areas with financial support from the Department of Biotechnology(DBT).

Collection of Jatropha germplasm accessions

Of the 404 accessions screened for high seed oil content and yield, only 10 accessions which gave >2 kg/plant and had >30% seed oil content have been selected for micro propagation and plantation.

Nursery development

Women SHGs were trained both in nursery establishment and plantation in TN and Puduchery; 24,000 saplings were made available across sites in TN, Puduchery and Orissa through seed and vegetative propagation.

Plantation and maintenance

Genetic gardens were established by 18 farmers in 12 ha at field sites (TN - 6 ha, Puduchery - 2.5 ha and Orissa - 3.5 ha). Panchayat leaders and farmers volunteered their land for *Jatropha* cultivation and these gardens were established. Farmers and SHGs were trained in nursery development and management and capacity building exercises were undertaken for *Jatropha* cultivation at all these sites. SHGs were involved in rapid vegetative multiplication of selected accessions at nurseries for uniform sapling production. Seed setting was tried at Kudankulam in TN.

Micropropagation of Jatropha curcas

Direct organogenesis protocols were standardised in the laboratory. Indirect organogenesis protocol is also underway. Scaling up for production of tissue cultured, micropropagated saplings is under progress. *In vitro* induced chemical mutations for drought resistance, yield improvement, oil quality and diseases resistance are also being undertaken. Chemical mutagen EMS treated seedlings have been planted at field sites and are being monitored for various parameters.

Training programme

Two workshops were conducted to address issues relating to *Jatropha* cultivation. One was held in Chidambaram at which farmers, farmers' associations and SHGs from Cuddalore District participated. The second workshop at Kudankulam, on cultivation aspects of *Jatropha*, was attended by 225 dryland farmers.

201.2 Demonstration of efficient energy plantation in coastal regions of TN with community participation

Planting mangrove tree species at Chunnambar and Thengaithittu

Kizhavanjur Magalir Sathuppu Nila Kaadu Valarppu Kuzhu (KMSNKVK) are working with the Government of Puduchery on the implementation of the integrated Afforestation and Eco-Development Project (Coastal Shelter Belt Plantation). This year, a total of 10 ha of mangrove plantation is under maintenance at Keelavezhi, Karaikal.

Ecological restoration

Micropropagation of *Excoecaria agallocha* was standardised and 2,500 hardened saplings were supplied to Kalpakkam and Karaikal regions for mangrove restoration and plantation in the tsunami affected regions.

201.3 Saving Endangered Plant Species

The following Rare, Endangered and Threatened (RET) plant species were selected from the CAbC, Kalpetta, for development of tissue culture protocols for mass multiplication: *Anaphyllum wightii*, *Curcuma vamana*, *Hedyotis wynaadensis*, *Medinilla malabarica*, *Eugenia argentea, Cynometra beddomei*, *Syzygium chavaran*, *Kunstleria keralensis*, *Salacia beddomei* and *Symplocos wynadense*. Initial *in vitro* response was observed in *Kunstleria keralensis* and they have been

subcultured for rapid multiplication of callus. Other species are under various stages of standardisation.

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

It has been established that lichens (symbiotic fungi with Algae or Cyanobacteria for nutritional requirements), due to the absence of protective and conductive tissues, are the first indicators of air pollution. Large-scale quantitative data on lichen diversity and distribution pattern can provide vital information on the levels of ecosystem health. The impact of cement dust on lichen diversity and distribution in Madukkarai-Walayar region (E 76° 45'30" N 10° 49' 50" to E 76° 54' 10", N 10°54'10") was studied using large-scale quantitative ecological sampling protocols followed by laboratory studies on the titre levels of pollution through the analysis of elemental accumulation patterns of lichens followed by statistical analysis in order to identify the environmental variables influencing lichen diversity and distribution. In the Madukkarai-Walayar region of the Western Ghats, anthropogenic sources of pollution (Malabar cement factory and ACC limestone mines) are located close to the biodiversity "hot spots". Lichen diversity is influenced by intense pollution in the forest sites within a radius of 1.5 km and moderate pollution within a distance of 1.7 km to 5.6 km. Beyond 5.6 km the pollution levels were very low.

Compared to the dry deciduous forests in normal sites within the Bolampatti II reserve forest region, there is a loss of lichen species within the Walayar reserve forest. *Bacidia beckhausii* Korb, *Heterodermia dissecta* var. koyana Kurok, *Physcia tribacoides* Nyl, *Parmotrema grayanum* (Hue) Hale and *Parmotrema planatilobatum* Hale, selected on the basis of their distribution pattern from polluted and unpolluted sites, were analysed for quantitative elemental deposition levels using Proton induced X-ray emission spectroscopy (PIXE) with reference standard IAEA-336 used for error calibration. Due to the over accumulation of calcium, lichens feel the stress in this region. Chlorophyll degradation and its comparison through analysis of phaeophytinisation quotient for key lichen species *Bacidia beckhausii*, *Heterodermia dissecta* var. koyana Kurok, *Physcia tribacoides* Nyl, *Parmotrema grayanum* (Hue) Hale and *Parmotrema planatilobatum* Hale indicated that the cell membranes of lichens from polluted areas have undergone damage. Lichen samples *Bacidia beckhausii* Körb., *Heterodermia dissecta* var. koyana Kurok, *Parmotrema tinctorum* Nyl. and *Physcia tribacoides* Nyl. were analysed by Atomic Absorption Spectroscopy (F-AAS) for elemental analysis. Lichen diversity and distribution pattern in the Madukkarai-Walayar region will provide vital information on the environmental degradation due to limestone mining and cement production through the kilns. Multivariate statistical analysis will provide information on the impact of pollution on lichen diversity in the polluted and unpolluted regions of the Walayar reserve forest.

Sub Programme Area 202

Molecular Mapping

202.1 Sex determination in dioecious *Pandanus fascicularis L.* (Pandanaceae)

Pandanus fascicularis (Kewra) (syn. *P. odorattisimus*) belongs to the Genus *Pandanus*, comprising about 500-600 sps distributed mainly in sub-tropical and tropical regions, with a 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, tiny, white, pendant and arranged in racemes or clusters with large white bracts. They are exclusively used to isolate a perfumed oil (Kewra oil) containing 2-phenylethyl-methylether (β-phenyl ethyl methyl ether, 60 to 80 %); minor components are the free alcohol, 2-phenylethanol (β-phenyl ethyl alcohol) and its acetic acid ester. In addition, the presence of terpinene-4-ol (up to 15 %), β-terpineol, β-terpinene and dipentene further contributes to the fragrance. The economic viability of these flowers, used extensively in the perfume industry, makes it lucrative to grow only the male plants. Lack of morphological descriptors to distinguish male and female plants makes their identification difficult till flowering begins, which takes 6-7 years from the initial seedling stage.

With the aim of identifying gender specific DNA elements, DNA based molecular markers like random amplification of polymorphic DNA (RAPD) and unanchored inter-simple sequences repeats were employed (ISSR). One RAPD marker OPO-08 (5'–CCTCCAGTGT- 3') consistently amplified a polymorphic fragment (1,263 bp) in the males, which was absent in the female plants. This male-specific fragment was then converted into a Sequence Characterised Amplified Region (SCAR) marker by performing gel elution, cloning and sequencing. Finally, a set of longer specific primers (18mer) was designed internal to the 1263bp sequence. This SCAR marker was named MSSRF-01 (male-specific sequence related fragment) and it continued to amplify a 976-basepair region present only in the males but absent in all the female genotypes collected for this study. Performing genomic Southern hybridization further corroborated this result, strongly suggesting that MSSRF-01 is located on a chromosomal region specific to the males. With no information available on the presence of sex chromosomes in *Pandanus*, this marker can be used to differentiate the sexes.

202.2 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 many edible members of tribe Phaseoleae (*Phaseolus, Vigna, Cajanus*, Lablab etc.), *Cajanus cajan* is the only

domesticated species under Cajaninae. A study was initiated to understand the extent of diversity among the local land races of *C. cajan*, their resistance to drought stress and susceptibility to *Helicoverpa armigera*, using molecular marker techniques.

More than 100 samples of *Cajanus cajan* were collected from five districts in Orissa (Koraput, Raigada, Malkangiri, Nabarangpur and Kalahandi), where local land races of *C. cajan* are traditionally cultivated. Nuclear DNA has been isolated from 50 accessions. AFLP analysis of the isolated DNA is being carried out to study the genetic relationship and further analysis will be done to identify diversity among these accessions, genotype resistance to drought and susceptibility to *Helicoverpa*, which will ultimately lead to the identification of elite land races for conservation.

Sub Programme Area 203

Genetic Enhancement

203.1 Introgression of transgenes *AmSOD* and *Ferritin* into local varieties of rice

From the population of 200 BC_2F_1 plants in each variety of rice, the positive plants (50 %) which possess the transgene were identified initially by PCR analysis and among them those plants with a higher resemblance to the respective local variety were identified by phenotypic selection and tagged, and the presence of the gene was confirmed by Southern blot analysis. The expression of the gene was confirmed through the Isozyme analysis in the case of *AmSOD*. Such plants were used as the female parent; pollen from the respective local variety was dusted and BC_3F_1 seeds were obtained. The BC_3F_1 plants were screened as per the same procedure followed for BC_2F_1 plants, crossing was done and BC_4F_1 seeds were obtained. BC_4F_1 plants are being screened through PCR analysis for identification and selection of positive plants to serve as female parents for crossing.

In addition, a few panicles in the BC3F1 plants, used as female parents for crossing, were selfed and the seeds were collected. These seeds were sown to get the BC3F2 generation. Twenty plants are maintained in the BC3F2 generation and the expected Mendelian ratio of 3:1 was observed with respect to the corresponding transgene. Homozygous plants will be identified in the next generation and subjected to stringent screening for salinity and drought stress tolerance.

203.2 Tissue specific expression of ferritin gene in rice for iron fortification and ectopic expression in tobacco for mitigation of oxidative stress

Three billion people in developing countries are suffering from hidden hunger, known as micro-nutrient malnutrition. Among these, iron deficiency is the most common nutritional disorder, estimated to be present in about one third of the world's population. Ferritin is a ubiquitous multimeric iron storage protein and its tissue specific expression will enhance the iron content in rice grains. Last year,

homozygous rice plants transformed with ferritin gene were obtained. Transgene has stably inherited over generations, and showed stable accumulation of the ferritin protein in rice grains. Iron-specific histochemical analysis revealed temporal and spatial accumulation of iron in rice seeds. Iron content in transgenic grains showed two-fold increase compared to the nontransformed control grains.

Ferritin plays a central role in preventing iron toxicity because of its ability to sequester several thousands of iron atoms in its central cavity, thereby preventing the formation of lethal hydroxyl radicals. Earlier, we had isolated a ferritin gene from the mangrove plant *Avicennia marina*. Further, *AmFer1* cDNA including the chloroplast targeting transit peptide was successfully transformed into tobacco plants. The transgene (*AmFer1*) has stably integrated into tobacco genome. Immunoblot analysis revealed the stable expression of AmFER1 protein in transgenic lines. *AmFer1* overexpressed transgenic plants revealed improved tolerance to various oxidative stresses such as iron, H_2O_2, and methyl viologen by scavenging detrimental ferrous iron and thereby preventing the formation of hydroxyl radicals. The present study therefore suggests that a plant transformed with ferritin gene is also conferred with abiotic stress tolerance in addition to increased nutrient content.

203.3 Gene characterisation studies with *AmDHN* gene from *A. marina*

*Am*DHN1 was cloned in the binary vector pCAMBIA 2301 under the 35S CaMV promoter and mobilised into *Nicotiana tabacum* c.v. Petit Havana using *Agrobacterium* mediated transformation. Southern analysis was done to identify the integration of the transgene within the T-DNA. Digestion of the genomic DNA of *AmDHN1*-integrated tobacco lines with *Bam*HI would lead to the release of the *AmDHN1* gene from the T-DNA of approximately 1 kb in size. Southern analysis using full length *AmDHN1* as a probe identified a 1 kb band in lines 2 and 3.

Northern analysis has revealed a diurnal day/ night regulation in the leaf transcript profile of the *AmDHN* gene. Total chlorophyll degradation was done with the control, untransformed plant and the transgenic plants. A set of leaf discs was placed in water and another in 100 mM NaCl and kept in continuous white light for 48 hours. In un-stressed control, 82 % chlorophyll degradation was observed while in the *AmDHN1*-expressing lines the percentage of degradation was much less and varied between 34 and 66 %. This suggests that the *AmDHN1*-expressing lines show more tolerance to salinity as compared to untransformed control.

In order to determine the intracellular localisation of *AmDHN,* it was translationally fused to the green fluorescent protein *mGFP6*. This was done by removing the stop codon of *AmDHN1* and introducing an in-frame *Hind* III site at the 3¢ end of DHN. This *AmDHN-GFP* fusion protein was cloned in pCAMBIA 1301 under the control of the enhanced (2X) 35S Cauliflower Mosaic Virus promoter. This

construct was transformed into tobacco using *Agrobacterium* via the leaf disc method. GUS positive plants were obtained and these were screened for GFP fluorescence, using an epifluorescent microscope. Of these, two independently transformed lines, A and M, showed brightest fluorescence and these callus cell images were captured using a confocal microscope. The green fluorescence was seen to be brighter and stronger within the nucleus and cytoplasm in the callus cells raised from the midrib of tobacco and in the guard cell in the tobacco epidermal peel. The green fluorescence was less pronounced within the tobacco plants expressing GFP alone. In order to confirm the presence of the fluorescence within the nuclei of the guard cells, DAPI staining was done. Total protein was isolated from the regenerated callus cells of the 2 transgenic lines, A and M. Immunoblot analysis was performed separately using anti – DHN and anti – phosphoserine as primary antibody. In both cases, a distinct band of 51 kDa representing the *AmDHN-GFP* fusion protein was observed.

The spliced and unspliced variants of the dehydrin were both present in the cDNA library of *A. marina*. The spliced dehydrin *AmDHN* is 908 bp in length and codes for a 195 amino acid protein and the unspliced dehydrin *AmDHN1* is 1014 bp in length and has a retained intron of 104 bp. The unspliced variant of the dehydrin *AmDHN1* contains 1 Y segment, a serine tract interrupted by an intron and 2 K segments. The genomic clone was found to be identical to that of the unspliced variant *AmDHN1.*

In order to confirm whether *AmDHN1* is an example of intron retention, an alternative splicing event, quantitative RT-PCR, was undertaken. Using control and treated messenger RNA as a template, primers flanking the intron were used to amplify a 179 bp fragment. This 179 bp fragment was cloned into TA vector and sequenced to reveal an intron-less nucleotide sequence. This could be due to aberrant splicing rather than an alternative splicing event.

AmDHN shows the highest homology to a dehydrin from *Coffea canephora* (TBLASTX results with an e-value of 3e-15). The primary sequence of the protein has a pI of 5.72 and a theoretical molecular mass of 19.82 kDa. The primary sequence of AmDHN protein is enriched in hydrophilic (39.5 %) and charged residues (21.5 %), which is reflected in its hydropathy profile (Kyte and Doolittle, 1982). The AmDHN sequence is also glycine-rich (25 %).

203.4 Co-expression of Active Oxygen Species (AOS) Scavenging Genes in Tobacco and Rice and Evaluation of the Same for Increased Salinity Tolerance

The genomic clone characterisation of *Am-APX* revealed the presence of 8 introns with 9 exons and the size of the genomic clone is 3951bp, whereas the size of *Am-MDAR* genomic clone is 6058 bp with 15 introns and 16 exons. Among the fifteen individual transformants of *Am-APX*, lines 4, 11, 31, 32, 34, 35, 36, 37 and 38 showed higher expression of *Am-APX* in Northern analysis.

In *Am – MDAR*, among the eighteen transformants of tobacco lines, only 5 lines (1,2 9,16 and 19) gave higher expression of MDAR in Northern analysis. Analysis of thirty-three individual transformants of pCAM (*Am-APX* and *Am-MDAR*) transgenic tobacco revealed that the lines 2b, 6a, 6b, 7, 9, 12, 13, 23, 24, 29, 31 and 32 showed higher expression of both *Am-APX* and *Am-MDAR* in Northern analysis.

The tobacco plants were analysed for the integration of the *Am-APX + Am-MDAR* by Southern hybridization. Digestion of the genomic DNA of tobacco lines transformed with both *Am-APX + Am-MDAR* with *EcoRI* releases the *Am-MDAR* gene from the T-DNA of approximately 2.1 kb in size. Southern analysis using full length *Am-MDAR* as a probe identified a 2.1 kb band in lines 23, 24, 28, 29 and 31. This 2.1 kb fragment was not detected in the untransformed control plant. For testing the copy number of transgene integration, lines 28, 29, 31 and 32 plants were digested with *XhoI* enzyme and probed with full length *Am-APX*. The lines 29 and 32 showed single copy integration whereas line 31 showed double copy integration.

The 5' upstream region (promoter) of *Am-APX* (1.616Kb) and *Am-MDAR* (1.167Kb) was isolated from *A. marina* genomic DNA by TAIL–PCR and cloned in pCAMBIA 1391Z vector and tobacco transformation is underway. GFP was fused with the open reading frame of *Am-APX* at N- terminus by SOE–PCR and transformed into tobacco. Localization experiment revealed that *Am-APX* is localized in the peroxisomal region. Similarly GFP was fused with the open reading frame of *Am-MDAR* at C-terminus and transformation in tobacco is in progress.

203.5 Characterisation of the PR244 gene from the *A. marina* library

PR244, a salt inducible gene from the mangrove *A. marina* is homologous to *rci2a* and *rci2b* from *Arabidopsis.* The effect of a short salinity stress (0.5 M NaCl) and mannitol stress (0.8 M) on PR244 induction was examined in leaves and roots of two-month-old *A. marina* seedlings. The seedlings were acclimatized in 0.5 X MS and then transferred for two to three days either to 0.5 M NaCl or 0.8 M mannitol. In the leaf tissue of *A. marina* seedlings, there was a marginal induction of Am244 transcript seen at 20 min of NaCl application that increased at 30 min and was sustained at 60 min. At 2 h of NaCl application, the up-regulation of the Am244 transcript was four-fold, which was sustained upto 6 h of stress. In the root tissue, the basal levels of expression of the Am244 transcript were higher than in leaf tissue. Upon application of stress, a two-fold induction of the transcript was seen at 1 h of stress that was sustained upto 6 h. With respect to mannitol stress, in the leaf tissue of *A. marina* seedlings, there was a three-fold induction of the Am244 transcript at 12 h of mannitol treatment. Upon withdrawal of mannitol from the medium, transcript levels were seen to decline but not to basal levels (i.e. prior to mannitol application). In the root tissue, mannitol treatment led to a two-fold increase in the Am244 transcript that was

maintained at 24 h. Upon withdrawal of the mannitol from the medium, the transcript levels dropped below basal levels.

Genomic DNA (40 mg) isolated from 16 c-myc tagged PR244 lines and control (untransformed tobacco cv. *Petit Havana*) was digested with Hind III, run in a 0.8 % agarose gel (1X TBE) and transferred to nylon membrane. The pMyc-PR244 T-DNA has a single Hind III site flanking the 35S CaMV promoter driving the expression of myc-tagged PR244 cDNA. Digestion of the genomic DNA obtained from GUS positive Myc-PR244 transformed lines with Hind III would thus help in the identification of single copy insertions of the pMyc-PR244 T-DNA in the tobacco plants examined. Southern analysis of Myc-PR244 transformed lines revealed that there were single copy insertions of the Myc-PR244 cDNA in Lines 1, 6, 7, 8, 11 and 17. Northern analysis of the single copy insertion lines using full length PR244 cDNA as a probe, revealed transcript expression in all lines examined with line 7 showing maximum expression. Stress analysis of the single copy lines is currently underway.

Isolation of the promoter element upstream of the PR244 gene

The 5 min upstream region of PR244 was isolated using Adapter-Ligated genomic DNA from *A. marina*. The isolated promoter including the 5 min UTR, (1.67 Kb) was amplified from *A. marina*, sequenced and cloned into pCAMBIA 1319*Z* at the *Eco R*I and *Bam H*I sites. The promoter construct was transformed into tobacco (cv. *Petit havana*) *via Agrobacterium* mediated transformation. Preliminary screening of transformed plants was carried out using *GUS* expression driven by the PR244 promoter. Putative cis-acting elements in the promoter sequence were identified using the programme PLACE. Based on this analysis and the arrangement of the cis-acting elements in the sequence, two deletion constructs (5 min end) were prepared. Specific primers that included restriction sites were used to amplify the deletion fragments (1.22 and 0.874 Kb) and these were sequenced and cloned in pCAMBIA 1319*Z*. Transformation of this construct into tobacco (cv. *Petit havana*) is currently underway.

In situ hybridization was done to see the tissue-localised expression of the PR244 gene in the leaves and roots of *A. marina*. The plants were subjected to stress (0.5M NaCl) and samples were harvested at regular time intervals (6, 12, 24, 36, 48 h). The samples were fixed, wax infiltrated and probed with digoxigenin-labeled RNA (antisense and sense probes). At the sixth hour of NaCl application, PR244 expression was detectable in the non-glandular leaf hair (indumentums) found only on the lower surface of the leaves of *A. marina*. No signal was detected in the sense (negative control).

For transformation of c-*myc* tagged PR244 into rice, *Indica* variety IR20 was used. 12-day old scutellum-derived embryogenic calli were raised on MS medium containing 2,4D (2 mg/

ml), and co-cultivated with Agrobacterium carrying the plasmid pMYC-PR244. After three rounds of selection on MS medium with 2,4 D and also containing Cefotaxime and Hygromycin (50 mg/ml), the calli were transferred to MS medium containing 2, 4 D (2 mg/ml), NAA (1 mg/ml), BAP (0.5 mg/ml) and casein hydrolysate (0.3 g/l). Callus multiplication was observed on regeneration medium and regeneration of the calli are underway.

203.6 Isolation and Characterisation of Stress Inducible Transcription Factors from *A. marina*

Fifteen putative transcription factor cDNA clones were identified from the sequenced *A. marina* ESTs (Mehta PA et al., 2005). These transcription factors can be divided into five major groups including the MYB, NAC, AP2/ EREBP, WRKY and ZINC finger proteins and are known to have roles in abiotic and biotic stress tolerance. The cDNAs of clones PA272 (MYB), PD126 (NAC), PC222 (ERF) and PR344 (Zinc finger protein) were completely sequenced and NCBI BLASTX search revealed that PA272, PC222, PR344 and PD126 code for full-length proteins including 5¢ UTRs. PA272 (1046 bp) and PR344 (830bp) coding for MYB and Zinc finger transcription factors respectively were chosen for further functional characterisation.

Northern analysis was done to further characterise the two cDNAs PA272 and PR344. For Northern analysis, one-month-old *A. marina* seedlings (four-leaf stage) were acclimatized for 3 days under 16 h light/8 h dark cycle in a growth chamber in 0.5X MS medium. The acclimatized plants were then transferred to 0.5X MS medium supplemented with 250 mM NaCl. The partial *AmDREB* transcription factor (PR84) was found to be upregulated at 12 and 48 h of salinity stress, dropping upon withdrawal of NaCl from the medium. No detectable transcript for *AmDREB* was observed at 12 and 24 h. Northern analysis for PA272 (MYB) revealed that there was a higher accumulation of transcript, peaking at 12 h and dropping thereafter at 24 and 48 h and upon withdrawal of NaCl from the nutrient medium. PR344 (Zinc finger) transcript accumulation was enhanced at 6 h and dropped thereafter at 12 h. Transcript accumulation increased at 24 h and 48 h and upon withdrawal of NaCl from the nutrient medium.

To express the *Am*MYB ORF in *E.coli*, the ORF was amplified using specific primers and cloned in the *E. coli* expression vector ProEXHT. Expression studies in *E. coli* are underway. Cloning of the *Am*MYB ORF in the pET vector will also be carried out for higher expression levels. Subsequently, these genes will be transformed into model system, tobacco and local varieties of rice under the control of both constitutive 35S CaMV and stress inducible (RD29A) from *Arabidopsis thaliana* promoters.

203.7 Bioprospecting for Drought Tolerant Genes from *Prosopis juliflora*

A glutathione s transferase (GST) from *Prosopis juliflora*, *Pj* GST1, was cloned in

pCAMBIA 1301 and transformed into tobacco. These transgenic tobacco were subjected to drought, salt and cadmium stresses and the ability of the transgenic plants to confer tolerance to the stress conditions was proved.

The *PjGST1* ORF was fused to the coding region of GFP at its N-terminus and transformed into tobacco. The GUS positive lines obtained were screened for green fluorescence and line N7 showed bright green fluorescence in the chloroplast that co-localised with red chlorophyll auto-fluorescence. This suggests that the *Pj* GST1 protein localises to the chloroplast where it may have a possible redox function. *Pj GST1* was cloned into pET28a expression vector and over-expressed in *E. coli* BL21 cells following IPTG induction. Glutathione transferase and glutathione peroxidase activities were measured in induced cells as compared to vector transformed control cells. *PjGST1* transformants were found to have higher GST and GPX activity than control vector transformed cells, thereby proving that *Pj GST1* is indeed a Glutathione S-transferase with GPX activity.

A vacuolar GTPase from *P. juliflora*, Pj Rab7 was cloned and transformed into tobacco. The *Pj Rab7* transgenic tobacco leaf discs showed less chlorophyll degradation and electrolyte leakage during chlorophyll degradation assay and electrolyte leakage assay respectively. Transgenic plants under salt, drought and cadmium stress conditions fared better and showed better shoot and root formation in comparison to control un-transformed plants. The experiments demonstrated the protective role of *PjRab* during the stress conditions analysed.

As a part of the ongoing efforts to generate location specific crop plants for tolerance to water stress conditions, the genes described above (*Pj GST1* and *Pj Rab7*) have also been mobilised into the important cereal crop species, rice (*Oryza sativa*). The putative positive transgenic rice lines in Indica rice varieties have also been obtained. These plants are currently in T_2 generation and are being currently evaluated for their genetic, molecular and morphological characteristics as well as response to the stress conditions. These transgenic approaches, it is envisaged, will provide an answer to sustaining productivity under stress conditions.

The three most abundant genes found in *the P. juliflora* EST library, Pj 124, a lipid transfer protein coding gene, Pj 340, an atypical LEA protein coding gene and Pj 543, a gene coding for photosystem II protein PsbR, were characterised by *in silico* and Northern analysis. The transcript level of Pj 124 in leaves was found to be upregulated in 25 % PEG and 90 mM H_2O_2 stress. A 929 bp fragment upstream of the putative translation start site of Pj 124 was isolated using TAIL-PCR and several putative cis-acting DNA elements were identified in it, using the program PLACE. The transcript level of Pj 340 in leaves was found to be upregulated in 25 % PEG and 90 mM H_2O_2 stress. A 1573 bp fragment upstream of the putative translation start site of Pj 340 was isolated using TAIL- PCR and the putative

promoter was analysed in silico. Northern analysis for Pj 543 in *P. juliflora* leaves under 25 % PEG stress showed steady decrease in transcript level at all time points analysed, compared to the pre-stress level. Under 90 mM H_2O_2 stress, an increased transcript level over control was observed at 24 h of stress application. A 1714 bp fragment upstream of the putative translation start site of Pj 543 was isolated using TAIL-PCR and several putative cis-acting DNA elements were identified in it using the programme PLACE. The isolation of promoters of Pj 124 Pj 340 and Pj 543 is of utmost importance in the creation of plant transformation vectors. After further characterisation such as identification of the transcription start site, deletion analysis and ability to drive reporter gene expression in transgenic plants, these promoters could be used as a part of expression vectors for stress-induced over-expression of transgene(s) in other economically important plant systems.

203.8 Characterisation of different types of metallothionein genes and transformation of type II metallothionein from *Prosopis juliflora* into tobacco for heavy metal accumulation

The process of phytoremediation can be improved through genetic engineering for better performance of the plants under toxic soil conditions. Metallothionein, a small protein, is found to be suitable for accumulation of heavy metals like cadmium, zinc, copper etc from the polluted soil. To study and characterise the function of the metallothionein (MT) gene *PjMT2* was transformed into tobacco *cv.* Petit Havana.

As a part of characterisation of different types of genes, genomic clones of three types of MTs revealed the presence of one intron each for *PjMT1 and PjMT2* and two introns for *PjMT3.* This is similar to other MTs identified from plants. To study the promoter elements that drive the *PjMT2* gene, a 1.2 kb 5¢ upstream region of *PjMT2* was isolated using TAIL-PCR. Metal responsive elements were absent in the cis-acting elements.

PjMT2 ORF was cloned in frame with thioredoxin tag in a pET32a expression vector. This construct, pETMT2, was transformed into *E. coli* BL21. The ability of the PjMT2 protein to bind heavy metals was tested in the prokaryotic system. Control cells (pET32a) and pETMT2 transformed cells were grown in 0.6mM $CdSO_4$ for 7 h and the growth was measured (at an absorbance of OD_{600}) every hour up to 6 h after the induction of cells with 1mM IPTG. Cells expressing PjMT2 were able to grow in $CdSO_4$ whereas the growth of control cells declined compared to transformed cells at the sixth hour. This shows that *PjMT2* binds cadmium and hence prevents formation of free oxygen radicals. The metal binding affinity of *PjMT2* was detected using atomic absorption spectrometry. At equimolar concentrations of cadmium and zinc, accumulation of cadmium was higher than zinc in the cells.

To study the effect of over-expression of *PjMT2* in tobacco, *PjMT2* was cloned in the plant binary vector pCAMBIA 1301 under the control

of the Cauliflower Mosaic Virus (CaMV) promoter. This was mobilised into *Nicotiana tabacum* cv. Petit Havana and analysed for the integration of the *PjMT2* by PCR and Southern hybridization. Expression of the gene in the transformants was confirmed at mRNA level by Northern analysis.

Transgenic plants were analysed for the ability to tolerate heavy metal stress. Leaf disc assay was performed with leaves from non-transformant and transgenic plants. The leaf discs were floated in different concentrations of cadmium and zinc in continuous light at 26 ± 2ºC for 5 days.

The amount of chlorophyll retained was measured pectrophotometrically. Line 6 and line 4 showed greater chlorophyll retention compared to untransformed plants in cadmium stress, whereas in zinc sulphate solution, both transformed and wild type leaf discs showed similar necrosis by the seventh day of stress.

Sixty day old untransformed and transformed (*PjMT2)* tobacco plants (lines 4 and 6) were acclimated in liquid MS for four days and then subjected to 300˜M $CdSO_4$ stress. Atomic absorption spectrophotometer was used to analyse cadmium accumulation in the plants. Transgenic plants accumulated cadmium four times more than the untransformed control plants. Future work will focus on the transformation of this gene into *Brassica juncea*, a hyperaccumulator plant for efficient phytoremediation.

203.9 Transgenic Plants Overexpressing the Tonoplast Na/H antiporter from *P.coarctata*

Tonoplast enriched membrane fractions were isolated from the leaves of greenhouse-grown control and transgenic plants. Approximately 30 gms of the enriched protein from transgenic and control plants was resolved on 12% non-reducing SDS-PAGE and transferred to nitrocellulose membrane. The blot was probed with an appropriate dilution of polyclonal antibody raised against C-terminal peptide of HvNHX1 (*Hordeum vulgare NHX1*).The immunoblot detected *PcNHX1* only in the tonoplast-enriched fractions from transgenic plants.

Leaf disc senescence assay of untransformed versus transgenic T_o generation plants was performed as a bioassay for estimation of salt tolerance potential. The extent of chlorosis as measured by chlorophyll content was used to assess the level of tolerance to different concentrations of NaCl. The leaf discs from control plants showed extensive bleaching and 82 % decrease in chlorophyll content was seen at 200 mM NaCl compared to the untreated control samples whereas the decrease in chlorophyll content was 75 %, 55 % and 63 % in transgenic lines 1,3 and 9 respectively.

To show the salt inducible expression of *PcNHX* promoter, transgenic tobacco plants carrying a single copy of the *PcNHX-GUS* fusion were analysed. The plants were transferred to half strength MS media containing 200 mM NaCl and leaves were

harvested at regular intervals. Equal amount of RNA was resolved in a 1.5 % formaldehyde gel and blotted on to a nylon membrane. Full length GUS gene was used as a probe and the GUS mRNA was upregulated under NaCl stress.

The tissue specific expression of the GUS gene driven by PCNHX promoter was analysed using histochemical GUS assay. The expression of GUS gene was mainly concentrated on the vascular tissues. Hand sections of the GUS stained stem and leaf were taken and observed under light microscope. The tissues surrounding the external and internal phloem were stained blue.

203.10 Understanding Salinity Tolerance Mechanisms in *Sesuvium portulacastrum* L. a Mangrove Associated Halophyte

Sesuvium portulacastrum, commonly called 'sea purslane' and 'vangaravasi' in Tamil, grows in a wide range of soils including salt-affected lands. It is also being used for landscaping purposes since it requires minimal watering and care. Besides, *S. portulacastrum* can be used as a leafy vegetable and has been reported to have better nutritional qualities than spinach. The characteristics mentioned above make it an important plant for scientific investigations, particularly pertaining to the understanding of its salinity tolerance mechanisms.

A study of the uniquely regulated transcripts was one of the investigations carried out for the past five years. Two cDNA libraries, one representing genes which are expressed *only* during sodium chloride treatment and another 'enriched' for genes expressed during salt treatment (containing full-length cDNA) but having genes that are not regulated by salt, were constructed. In order to confirm and further understand transcripts regulated by salt, Northern analysis for randomly selected clones from the subtracted library was performed. The results indicate that a majority of them have some role to play in photosynthesis. It may be suggested from this observation that, in *S. portulacastrum*, one of the mechanisms employed to overcome the toxic effects of sodium chloride could be the readjustment happening in the photosynthetic machinery.

203.11 Gene Mining from Lichen species

The growth of lichens in extreme environments, their vibrant defence mechanism in the form of secondary compounds for biotic and abiotic stresses and ability to live in symbiotic state with unrelated algae and cyanobacteria, exhibit the distinctiveness of their genetic make up. Hence, screening of lichen genome will provide novel genetic material to combat abiotic and biotic stress in agriculture, human health and environment.

The programme aims at germplasm characterisation of three lichen species *Dirinaria applanata, Pyxine cocoes* and *Physcia tribacoides* using molecular marker systems. cDNA library construction and large scale EST sequencing through microarray analysis are underway. The ongoing studies on *Dirinaria applanata, Pyxine cocoes* and *Physcia tribacoides* such as germplasm

characterisation and development of axenic culture have been completed for *Dirinaria applanata* and *Pyxine cocoes.*

Internally Transcribed Spacer region of the nuclear ribosomal DNA has been characterised and sequenced in order to establish the species identity of cultured lichen thalli with the natural thalli collected from the specific target ecosystem. ITS rDNA based fungal specific PCR in *Pyxine cocoes* natural (collected from Walayar reserve forest, Western Ghats) and culture thallus have been completed and the sequence information will be validated and submitted to the NCBI nucleotide Genebank database. Multi locus analysis of protein-coding genes specific to b-tubulin, Chitin synthase (CHS) and RNA polymerase subunit (RPB2) and non-coding loci such as micro satellites within the mycobiont genome is ongoing and this would provide significant leads on functional genes and proteins enabling desiccation tolerance namely hydrophobins.

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 are very scarce for the successful cloning, functional and expression analysis of these genes, which will be the basis for engineering to tap potential products. The understanding of 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).

The expression studies of PKS genes from the RNA isolated from culture samples grown under different stress conditions (UV, osmotic stress, drought) through Northern blot experiments are underway.

203.12: Identification of Genes that are Uniquely Regulated during Oil Biosynthesis in *Jatropha curcas* Seeds

Based on the experience obtained from our studies on differentially expressed genes during salinity stress in plants, a new study has been initiated to identify genes that are uniquely regulated during oil biosynthesis in the 'biodiesel' plant *J. curcas*. The study aims at improving seed oil content in the plant through metabolic engineering, once the genes involved at critical points of oil biosynthetic pathway are identified. In this regard, studies have been started to identify different stages of seeds and purify RNA. cDNA subtraction library would be prepared from seeds to obtain information on genes that are upregulated immediately before active oil accumulation into mature seeds.

Sub Programme Area 204

Bioprospecting for Novel Compounds

204.1 Lichen Species

This programme aims at harnessing the antimicrobial potentials of the secondary compounds of selected lichen species (symbiotic fungi with algae or cyanobacteria for nutritional requirements) *viz*. *Roccella montagnei, Parmotrema praesorediosum, Dirinaria applanata, Ramalina pollinaria* and *Usnea complanata*. 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 compounds, which exhibited antimicrobial properties, were further chemically characterised in collaboration with the Organic Chemistry Laboratory and Sophisticated Analytical Instrumentation Facility (SAIF), Indian Institute of Technology, Chennai. As a prerequisite for drug development, these potential compounds were subjected to cytotoxic and genotoxic studies on Swiss Albino mice and Wister rats in collaboration with the Department of Pharmacology & Environmental Toxicology and Genetics, PGIBMS, University of Madras.

Qualitative and quantitative extraction of lichen secondary metabolites and subsequent antimicrobial screening provided the basis for the identification of two novel compounds from *Roccella montagnei* and *Parmotrema praesorediosum*. Patent applications for these compounds have been filed.

Crude hexane extract of *D. applanata* exhibited antimicrobial activity and this extract was subjected to further fractionation and subsequent bioassays. Out of the five fractions of the above lichen, two fractions showed antimicrobial 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 *Ramalina pollinaria* and *Usnea complanata* were found to be bioactive.

Different solvent extracts of the lichen *Roccella montagnei* (Roccellaceae) were screened for mosquito larvicidal activity against the 3rd instar larvae of the filarial vector, *Culex quinquefasciatus* Say. The dichloromethane (DCM) extract showed highest toxic effect followed by Ethyl acetate (EtoAc) and hexane extract showed least effect. DCM extract showed significantly low ranges of LC_{50} 126.16 at 24 h and 83.72 at 48 h. This study is the first to report on the larvicidal activity of crude extracts of *R. montagnei* lichen species against *C. quinquefasciatus*. Further fractionation of bioactive Ethyl acetate extract resulted in five fractions. Fractions 2 and 4 produced b type and stellate crystals respectively. The compound level characterisation of both the crystals is underway.

The crude extracts of lichen *Parmotrema praesorediosum* were also screened against

filarial mosquito vector *C. quinquefasciatus*. The results showed that ethyl acetate extract has highest toxic effect against *C. quinquefasciatus* and further fractionation of ethyl acetate extract is underway.

Lichen culture for secondary compound production is considered a vital component of the conservation of the lichen species in their habitat and sustainable utilisation of these novel resources industrially. On these lines, the protocols for *in vitro* culture for the production of secondary compounds through lichen whole thallus, fungal and photosynthetic partners for *Roccella montagnei, Parmotrema praesorediosum*, *Dirinaria applanata, Ramalina pollinaria* and *Usnea complanata* were standardised. Apart from these lichen species, other lichen species such as *Dirinaria applanata, Ramalina pollinaria, Usnea complanata, Lecanora allophana, Graphis scripta, Trypethelium eluteriae, Graphina obtecta, Gyrostomum scyphuliferum, Heterodermia leucomela, Caloplaca cerina, Physcia sp.* and *Lecanora subimmersa* were also cultured *in vitro*.

The successful culture of these species was achieved by standardising protocols such as selecting the suitable inoculum depending upon the target species; sterilization to remove the endophytic fungi and bacteria; various nutrient poor primary and nutrient rich secondary media compositions for successful initiation and continuous growth; and environmental conditions based on the habitat conditions of the target species such as light, temperature, humidity and bark pH. One-way ANOVA analyses indicated significant levels of correlation between biomass and compound (atranorin) production with the age of cultures in lichen *Dirinaria applanata*.

The characterisation of lichen compound production in both cultured and natural thallus using Thin Layer Chromatography (TLC) resulted in Atranorin, divaricatic acid and an unknown compound in *Dirinaria applanata*; Evernic acid in *Ramalina pollinaria*; Salazinic acid and Usnic acid in *Usnea complanata* and High Performance Liquid Chromatography (HPLC) analysis of methanol extract of cultured tissues of *Dirinaria applanata* showed two unknown compounds.

204.2 *Excoecaria agallocha*

The field efficacy of 1 % and 3 % formulations of crude hexane extract of *E. agallocha* against *H. armigera* was well demonstrated in Bhindi, Chickpea, Pigeon pea and Cotton. Hence, further toxicity testing was carried out.

Toxicity Assays with E. agallocha formulations

In the brine shrimp lethality assay, crude methanol extract of *E. agallocha* leaf at 1,000 ppm exhibited maximum mortality of 100 % within 5 h of incubation, followed by hexane and EtOAc extracts, 74 % and 58 % respectively. The effects of the crude hexane extracts (0.5 and 1 %) of the root, stem and leaf of *E. agallocha* were tested on six beneficial bacterial species. Crude hexane extract of roots exhibited marginal bacteriostasis. Nevertheless, none of the

extracts showed any toxicity at the tested concentrations.

Histochemical studies in E. agallocha

Comparative histochemical analysis of seed raised and micropropagated plants of *E. agallocha* was done to localise the distribution of the phytochemicals. Transverse sections (T. S) of the root and stem of the seed raised plant stained with 10 % vanillin-perchloric acid showed the accumulation of terpenoids in the cork-cambium as reddish-pink layers when compared with the unstained sections that were colourless. Unstained stem sections did not show any colour except mild pink spots that were sparsely distributed in the cortex due to polyphenols. Sections of the roots stained with potassium iodide revealed the presence of starch granules as intense black spots. Alkaloids were localized in the root sections using Dragendorf's reagent as brownish-red patches in the cork cells. Peeled cortex bits of tissue cultured plants stained with KI_2 revealed the presence of starch granules that were comparable with those in seed raised plants. Staining of the leaf sections with $FeCl_2$ suggested that the presence of tannins in the micropropagated plants was marginally more than in seed raised plants.

Histopathological analysis of H. armigera larva

Transverse sections of the whole 3rd instar larva of *H. armigera* treated with *E. agallocha* column fractions of crude hexane extract were compared with the larva reared on plain diet and hexane control. Midgut of the larva treated with the fractions exhibited conspicuous shrinkage when compared with that of the controls. Shrinkage of the gut was generally observed during starvation of insect larvae. But in the present study, larva fed with the treated diet did not exhibit any prolonged starvation. The diameter of the gut was drastically reduced to one-sixth of the normal larva. The contour of the gut wall was irregular compared with the clear circular contour observed in the controls. Lysis of the gut wall was observed leading to release of the secretions and the micronuclei. The exocrine secretions from the gut epithelium were visible in the normal midgut sections but were poor in the treated ones. Apart from the midgut observations, disorganisation of the muscle strands around the gut was predominantly observed in the treated larva when compared with the control.

Sub Programme Area 205

Bioprospecting for Novel Micro-Organisms

205.1 Field Testing and Product Development of Plant Growth Promoting Bacteria in the Coastal Agri-ecosystem

The four efficient biocontrol strains of *Pseudomonas fluorescens* for which field-testing was completed in Aduthurai and Tirur rice research stations were further tested in the farmers' fields in Keelamanakudi and Manikollai in Chidambaram in a participatory mode. The results of the first trial were encouraging and an overall disease reduction

of 50-63 % of bacterial blight and 40-50 % of sheath blight disease in rice was observed, in addition to 20-30 % increase in yield. The second field trial is in progress in Chidambaram. One of the *P. fluorescens* MSP 393 strains submitted to the International Institute of Biotechnology and Toxicology, Padappai, Tamil Nadu for the toxicological analysis has been certified non-toxic as per the Central Insecticide Board (CIB) standards. The strains have been handed over to entrepreneurs for formulations and large-scale production and release.

The formulated product of the efficient strains of *P. fluorescens*, phosphobacteria and *Azospirillum* were supplied free of cost to the farmers of Manikollai, Chidambaram for use in 20 ha of tsunami-affected agricultural land, for two subsequent seasons. The farmers were satisfied with the performance of the biofertilisers and biocontrol agents and asked for them to be supplied.

205.2 Diversity Analysis of Bacterial Population, Plant Growth-promoting Bacteria and Soil DNA from Mangrove Forests (16S r DNA) Using PCR- SSCP.

The population of rhizosphere microbes with functional properties such as nitrogen fixation, phosphate solubilization and biocontrol potential were evaluated. The phosphate solubilisers were low, possibly due to the low content of phosphate in the mangrove soils, as reported by many researchers earlier. A potential strain exhibiting antibacterial and antifungal activity against chilly pathogen, *Colletotrichum capsici* and rice pathogen *Xanthomonas oryzae* pv. *oryzicola* was isolated from mangroves and identified as *Bacillus licheniformis* using a polyphasic approach. A novel filamentous fluorescent endophytic *Bacillus* has been isolated from wild rice, *Porteresia coarctata* and 16S rDNA partial full length sequence deposited in NCBI (Acc. No. AY 941162). The strain needs to be characterised further. *Vibrio porteresiae* sp. nov. a nitrogen fixing bacterium from wild rice was isolated, characterised and deposited in DSMZ Germany (DSMZ 19223^T) and in LMG Belgium (24061^T). A total of 50 different samples of soil DNA were extracted from five mangrove (*Avicennia marina, Rhizophora mucronata, Excoecaria agallocha, Porteresia coarctata and Sonneratia apetala) rhizospheres.* All the extracted DNA samples were subjected to PCR amplification of 16S rDNA, *nifD* and *nifH* genes of soil microbes. After the PCR amplification, these genes were analysed by PCR-RFLP-SSCP to understand the genetic diversity among the DNA samples. The genes need to be cloned, sequenced and characterised to assess the microbial diversity. SSCP-heteroduplex analysis is being performed to study the sequence similarity and dissimilarity in the 16S rDNA, *nif* D and *nif* H genes of 50 DNA samples.

A total of 45 marine red-pigmented *Vibrio* spp. were isolated from *Porteresia coarctata* and *Avicennia marina*. Based on the Rep-PCR analysis these 45 isolates have been grouped into four clusters, depending on their banding pattern. Further investigations resulted in identifying new species. *viz.*, a potential novel

red-pigmented bacterium, with nitrogen fixing, PGP and antibacterial activity was identified and named as *Vibrio rhizosphaerae* sp. nov. It inhibited the growth of various plant pathogens (*Xanthomonas oryzae*, *Xanthomonas campestris*, *Erwinia* carotavora, *Pseudomonas syringea*), in the presence of NaCl. *V. rhizosphaerae* sp. nov has been deposited in DSMZ Germany (DSM 18581^T), and LMG Belgium (LMG 23790^T) and reported as a novel species.

SSCP and DGGE analyses based on culture independent method revealed enormous unidentified bacterial diversity of the mangrove rhizospheres. For SSCP, single-stranded DNA is formed during a denaturing step immediately before electrophoretic analysis. The electrophoretic separation is conducted under nondenaturing conditions. Since primer Com2-Ph contained a 5'-terminal phosphate group, the phosphorylated strands of the PCR products were selectively digested with lambda exonuclease. The bacterial community structures of different rhizosphere samples harvested from intra and inter sites were easily differentiated because the number of bands detected on the polyacrylamide gels was distinct.

205.3 Genetic Diversity of Soil DNA from SRI and Non SRI Soil Samples

A comparative study was carried out to examine the structure of the bacterial community population in the SRI and non-SRI systems of rice cultivation in Chidambaram. Soil samples were collected at different durations *viz.*,1, 15 and 30 days by using culture independent methods. The universal primers Com I and Com 2 (Positions 519 to 536 and 907 to 926 *Escherichia coli*) were used for the amplification of the V4 and V5 regions of the rhizosphere soil DNA. A total of 175 FPs, 100 BNFs and 50 phosphate solubilisers were isolated by dilution technique in KB, LGI and NBRIP media, respectively from the SRI and non-SRI rhizosphere soil samples. The 16S rDNA was amplified using primer fD1 (forward) 5'-AGA GTT TGA TCC TGG CTC AG-3' positions 7 to 26 in *E. coli* and rP2 (reverse) 5'-ACG GCT ACC TTG TTA CGA CTT-3' positions 1513 TO 1494 in *E. coli*. The PCR amplification resulted in amplified product of around 1450 bp. The amplified products were digested with *MspI*, *TaqI* and *Hae III* four-base recognising enzymes (Amersham Pharmacia Biotech, UK). All the enzymes gave polymorphic banding patterns. With each enzyme, 4 to 7 restriction fragments were resolved. *MspI*, *TaqI* showed at least 8 restriction patterns. The *Hae III* showed least polymorphism showing 4-restriction patterns. In the Cluster analysis (UPGMA), 50 % of major genetic similarity could be identified based on the number of restriction sites in the 16S rDNA.

The antagonistic potential of the 175 cultures of *Pseudomonas fluorescens* isolated from the rhizosphere and non-rhizosphere soil samples were screened for their antagonistic potential against *R. solani* and *X. oryzae* pv. *oryzae*. Two efficient strains MSC 103 and MSC 104 of *Pseudomonas fluorescens* exhibited maximum growth inhibition of more than 2 cm against

R. solani and only one strain MSC 69 inhibited growth of *X. oryzae* pv. *oryzicola* producing an inhibition zone of about 1.7 cm.

205.4 Biological Control of Finger Millet Blast

Continuing the activities begun last year, the rhizosphere soil samples of blast disease-affected finger millet were collected from different regions of Tiruvannamalai, Villupuram and Krishnagiri districts. Monoconidia of *Magnaporthe* grisea were isolated from infected leaf and neck parts. The finger millet rhizosphere soil samples were serially diluted and plated on Kings' B and Nutrient agar plates. The PGPRs *ie.* fluorescent pseudomonads, nitrogen fixers and phosphate solubilisers associated with finger millet rhizosphere were estimated. The results revealed that the population of the fluorescent pseudomonads was high compared to the nitrogen fixers and phosphate solubilisers. The fluorescent pseudomonads isolated, were screened for their antagonistic potential by dual plate assay against *M. grisea.* The plates were incubated at room temperature (28 ± 2ºC) for 4 days and the inhibition of the mycelial growth was recorded. Of the180 fluorescent pseudomonads tested, only 19 showed antagonistic activity of which 5 strains showed a prominent inhibition zone with a maximum inhibition percentage of 60-64 %. The efficient strains were characterised by biochemical tests and the biocontrol mechanism was deduced. Some of the strains were found to produce iron-chelating compounds in addition to hydrogen cyanide.

The 16SrDNA of the fluorescent pseudomonads, nitrogen fixers and phosphate solubilisers were amplified using the primers fD1 (forward) 5'-AGA GTT TGA TCC TGG CTC AG-3' positions 7 to 26 in *E. coli* (Brosius *et al.*, 1981) and rP2 (reverse) 5'-ACG GCT ACC TTG TTA CGA CTT-3' positions 1513 to 1494 in *E. coli*. The amplified 16S rDNA was digested with digestion enzymes *Taq1, Hae III* and *Msp I* and the dendrogram was constructed using clustered analysis by UPGMA.

205.5 Diversity Analysis of *Xanthomonas oryzae* pv. *oryzicola* and Biological Control of the Pathogen Using Fluorescent Pseudomonas

The rice fields in the Keelamanakudi and Manikollai villages were severely affected by bacterial leaf streak pathogen *Xanthomonas oryzae* pv. *oryzicola*. Application of pseudomonas for the control of the same was recommended and the formulated products were supplied to the farmers and further spread of the disease was arrested.

A total of 180 strains of X. *oryzae* pv. *oryzicola* were isolated from infected leaf samples. The colony of *X. oryzae* pv. *oryzicola* is characteristically pale yellow, glistening and mucoid. The colonies have regular margins and can be distinguished from several other fast growing bacterial contaminants of yellow colony by slow growth and production of copious amount of extracellular polysaccharides. The strains of *X. oryzae* pv. *oryzicola* were differentiated from *X. oryzae* pv.

oryzicola by the production of Acetoin (Xoo–, Xoc+), growth on L-alanine as sole carbon source (Xoo–, Xoc+). The genetic polymorphism in the pathogen was detected among the pathogen population of the isolated strains of *X. oryzae* pv. *oryzicola* using the primers of JEL1- (5' CTC AGG TCA GGT CGC C 3') and JEL2- (5'GCT CTA CAA TCG TCC GC 3') for the IS1112 element (of *X. oryzae* pv. *oryzicola* DNA) in PCR amplification.

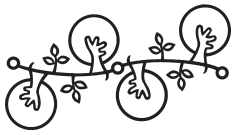
A total of 260 fluorescent pseudomonas strains were isolated from the rhizosphere soil sample collected from the farmers' fields which were naturally affected by *X. oryzae* pv. *oryzicola* causing the leaf streak disease. Twenty isolates exhibiting an inhibition zone of above 1cm were short-listed. All the 20 strains of fluorescent pseudomonas showed positive reactions for siderophore production in PIPES agar. PCR amplification of the antibiotic coding genes using specific primers revealed the presence of Plt C gene in 11 isolates of Pseudomonas, but DAPG gene amplification using Primer *Phl2a* (20-mer 5'-GAGGACGTCGAAGACCACCA) and *Phl2b* (20-mer 3'-ACCGCAGCATCGTGTATGAG-5') was not observed. The PCR amplification of the 16S rDNA using GC bacterial primers resulted in PCR product of approximately 400bp. The 45 strains showed plant growth promotion in BPT and CO 43 rice seeds with a commensurate increase in root and shoot length compared to control.

205.6 Low-cost Biofertiliser Unit as an Enterprise

Six members of the Manimegalai SHG were trained in the production of *Azospirillum* and phosphobacteria at the Microbiology lab at the Foundation for three days to establish the unit at Puduchery. The training methodology was the same as for the first unit(SPA 400).

The production unit has been set up at Keelsathamangalam and is run by the Manimegalai SHG. The unit was inaugurated on 19 April and has initiated the production of *Azospirillum*. Vermicompost was chosen to be the carrier material taking into consideration the cost and availability. Vermicompost also offers other advantages, as it is rich in organic inputs that would aid in improving soil health and is also a nutrient input for the biofertiliser strains when applied in the field. A vermicompost pit of the capacity of 1,200 tons was built and members were trained to produce vermicompost by using locally available farmyard, kitchen and animal wastes. This not only reduced the production cost but also served as an additional income generating activity.

Programme Area 300



BIODIVERSITY

The community biodiversity conservation movement was further strengthened in Tamil Nadu, Kerala and Orissa. The Biju Patnaik Medicinal Plants Garden and Research Centre was inaugurated during the year. Kalajeera *cultivation has now been entrusted to the* Kalajeera *Growers Association. Upscaling production of millets and medicinal plants involving local communities has been initiated.*

Programme Area 300

Biodiversity

The biodiversity programme has been focusing on community based natural resource management systems in areas rich in bioresources in the States of TN, Kerala and Orissa. Chronicling bioresources, documenting biological diversity, creating an economic stake in conservation efforts, promoting gross root institutions and empowering the local communities in participatory management of bioresources are the major initiatives being undertaken.

The programme is operational in three sites, Kolli Hills (TN), Wayanad (Kerala) and Jeypore (Orissa). The CAbC at Kalpetta has completed 10 years of operation. The activities in Orissa have been further strengthened with the establishment of the Tribal Agrobiodiversity Centre and Biju Patnaik Medicinal Plants Garden and Research Centre at Jeypore.

The ongoing programme of linking conservation with poverty reduction entered its third phase with the objective of consolidating the various activities undertaken during the last few years, as well as integrating them with proven areas of intervention in addressing issues of food security and livelihood enhancement. This integration is being attempted in a few selected villages in Jeypore region as a PAN–MSSRF approach by pooling the key learnings across programmes and testing them here.

Sub Programme Area 301

Kolli Hills

The ongoing millet production programme using the approach of participatory plant breeding was upscaled and new pathways of marketing have been attempted in addition to the earlier Food World, Chennai, outlet explored for Kolli Hills communities to derive a sustainable income, leading to poverty reduction.

The 30 Self Help Groups (SHGs) in Kolli Hills, facilitated by the Foundation have been grouped into 4 clusters named Chenbagam, Mullai, Roja, and Malligai. The 30 SHGs consist of 19 exclusively women, 5 exclusively men and 6 mixed groups. Participatory appraisal in April 2006 and discussions on new opportunities for value addition in the light of upscaled quality millet production suggest that the SHGs could be enabled to take up value addition in a systematic way, including necessary quality standards of production.

To help large scale production of little millet on which emphasis was placed earlier, the formation of four farmers' clubs was facilitated with the support of NABARD in four villages namely, Aripalapatti, Periakovilur, Padasolai, and Thirupuli in March 2007 involving 67 farm families, in coordination with Panchayat Raj Institutions(PRI'S) and WSHGs.

In a meeting to network various institutions during 2006, 14 active Panchayats at Kolli Hills agreed to collaborate on upscaling sevaral

interventions. They suggested that tribal residential schools and teachers could act as partners in spreading awareness on millets. Nature clubs/Genome clubs in different zones could also play a vital role. The NGOs already coordinating with SHGs and community based institutions were chosen as potential partners in project interventions

Upscaling cultivation of millets

Before framing an activity plan for upscaled cultivation, it was found necessary to assess the current status of little millet (*Panicum sumatrense L.)* cultivation in the area and the view of farming families on expanding its cultivation. A meeting with millet growing farmers, SHG members and Panchayat leaders who visited millet growing farms using modified cultivation methods, brought to light the following points:

- Little millet land races such as *vella-perunsamai, perunsamai, malliasamai, kattavettisamai, and sadansamai, thirikula-samai,* are cultivated by 61 farmers in 7 panchayats covering an area of 85 acres.
- *Vellaperunsamai* is the preferred land-race followed by *kattavettisamai* and *perunsamai*.
- The key traits that are used to determine the choice of millet races are the duration of the crop, yield, suitability to the soil, taste of the grain and fodder value.
- A food recipe survey conducted among millet farmers indicated that *Samai* is consumed as rice, *kanji* (gruel) and *uppuma*. Occasionally, *murukku*, *kashayam* and ghee porridge are also prepared and consumed.

On the basis of this information, three hamlets in Devanur Nadu were chosen for consolidating the modified method of millet cultivation demonstrated earlier. Attention was paid to large areas under little millet cultivation, the presence of millet farmers with traditional knowledge and SHGs interested in value addition and marketing. Fourteen farmers thus identified were given training and the following steps in modified cultivation were adopted by the farmers:

- Selection of well-filled seeds by soaking in water
- Well-prepared soil in medium land (patta land)
- Planting soaked seeds directly in rows spaced at 22.5 cm with 10 cm plant-to-plant spacing or transplanting 20-25 day old seedlings in rows similarly spaced, with 10 cm spacing between seedlings
- Weeding before flowering once and once or twice later as needed
- Sowing in north-south rows to get maximum sunlight

Detailed agronomic and yield-related characters have been taken and the data are under analysis. Based on the results, the planting schedule for the next season would be drawn up. Farmers participating in the trial agreed to allot 20 % of seeds for distribution to a large group of farmers during Kharif, 2007.

Farmers observed the following advantages of the modified method during the participatory trials of Kharif, 2006:

- Controlled weed population and infestation by rats (maybe due to more exposure because of space unlike in dense sowing), reduced drudgery in weeding, provided healthy biomass and helped easy harvesting
- Number of tillers and panicles were higher
- Easy selection of quality seeds was possible.

To create an awareness of the nutritional value of traditional millets, the need to conserve them and market advantages of large scale production of millets using organic methods, a campaign was conducted with the active participation of SHGs, volunteers and tribal farmers during the *Adi* 18 festival in Kolli Hills. Pamphlets containing information on millets were distributed to educate the public, and millet products were exhibited and marketed by SHGs. They received the Best Stall Award for disseminating the theme.

In September 2006, one representative of *Nanbargal* SHG in Kolli Hills participated in the SARAS exhibition held at Dilli Haat, New Delhi, for marketing minor millet products. This visit enabled SHGs to understand the potential of markets across other States.

In December 2006, a "Millet Road Show" was organised in association with Golden Palace Hotel and the Catering Technology and Research Institute and another in the premises of Kanna and Srinivasa Chain Supermarkets at Namakkal. The road shows resulted in the promotion of millet products and considerably increased purchase of millets by urban consumers. Exposure visits to various fora including an exhibition held at TNAU, Coimbatore, helped SHGs to gain a better understanding of the consumption and marketing of millets.

Linking production with a gainful market

In the earlier market link with the Food World, super market chain in chennai, SHGs faced two constraints, delayed payment and return of unsold stock many months after purchase. In the process, the unsold packets could neither be sold at the originating end nor could they be processed as value-added products. SHGs could not bear the consequent loss of income. It was therefore essential to explore other avenues; hence local markets at Namakkal and in cities like Coimbatore, Madurai and Salem were contacted. There was a positive response from Namakkal supermarkets but they prefer assured supplies every month while they would pay and purchase the requirements. This would require not only upscaled cultivation of millets but safe storage of grains, as little millet can be produced at Kolli Hills only during the Kharif season. Some other dealers identified are Varthagam Farm Products, Coimbatore, Guruthevar Matric School, Karur, Blessing Organic Products, Madurai, Namvali Nalonavu Angadi, Salem, and Mary Green Organic Products, Chennai. Extensive marketing of little millet products like samai rice and samai flour,

and others like *thinai* rice and *thinai* flour fetched the SHGs Rs 12,500 during the year.

Training and Capacity Building

More than 800 trainee days were generated during the year to provide a series of training and capacity building programmes like millet food preparations, productive cultivation of millets, seed selection, millet product processing and packing, which were attended by 104 men and 159 women. In addition, several visitors were provided information and student interns were provided facilities to execute their plan of work.

Sub Programme Area 302

Wayanad

302.1 Knowledge empowerment of the local communities for Integrated Management of Bioresources

A Village Resource Centre(VRC) at CAbC and Village Knowledge Centres (VKCs) at the villages have been established for supporting the tribal community to access modern knowledge for increasing their livelihood options. Socio-economic analysis and baseline survey were undertaken in four villages of Meenangadi Panchayat.

A need assessment survey was carried out separately for all tribal communities to understand the demand for knowledge, which indicates that the *Kurumas* require more information about the possible measures to enhance the crop production and optimum utilisation of the land they possess. They are also in need of dynamic information like weather details and market information. The *Paniyas* in the Pannimunda colony are more concerned about the details of various schemes for tribal promotion, employment, education and health. They are also interested in strengthening their home gardens to tackle the food insecurity that they are facing. The inhabitants of Panchamikkunnu colony belong to the *Kattunaikka* and *Paniya* tribes, and 50 families occupy 17.6 ha of land. They require information on crops suitable to that locality, land entitlement, sources of quality seeds, agrotechniques and soil and water conservation methods. The women in all the three sites enquired about training programmes.

Case studies were prepared on *veliyan* rice variety conserved by the *Kurichiya* tribes of Wayanad and on the role of the *Kurichiya* and the *Kuruma* tribes in conserving the traditional rice varieties of Wayanad.

In view of the presence of several tribal communities and the support of the Grama Panchayat, Thachampath tribal hamlet was identified for establishing a VKC. A series of awareness campaigns was organised in the village for sensitising the people about VKCs. Entry point intervention was initiated in the village. A Village Development Committee (VDC), a Youth Club and four SHGs have been formed in the hamlets.

302.2 Nutritional and Livelihood Improvement Programmes for the most Marginalised Tribal Groups of Wayanad District

A pilot nutritional survey was conducted in selected *Paniya* and *Kattunaikka* tribal hamlets of Wayanad with help from the Food Security Program to quantify the extent of the problem of malnutrition among children below three years and their mothers. A total of 8 tribal hamlets in 5 locations was selected at random for the survey. Out of the 48 children studied, 38% were normal. The rest (62 %) were undernourished, of whom 25 % were in the first grade of malnutrition, 27 % in the second grade and 10 % severely malnourished. The study revealed that consumption of all the wild edibles is on the decline, directly affecting the health and nutrition status of the communities. The minimum body weight of mothers was found to be 30 kg and the maximum was 47 kg with an average body weight of 38 kg as against the recommended body weight of 50 kg.

A programme to cultivate tuber crops was initiated among 35 tribal families (20 *Paniyas* and 15 *Kattunaikkas*) for livelihood improvement. Three mixed tribal groups including 24 women and 11 men were formed in Judgikkunnu, Muthanga and Panchamikkunnu colonies for implementing this programme. Nutritional gardens with traditional and wild varieties of dioscorea, colocasia, elephant foot yam, leafy greens and legumes were established to help 75 families in five *Kattunaikka* and *Paniya* hamlets. As a part of this programme CAbC supplied planting materials of dioscorea (500 kg), colocasia (50 kg), amorphophallus (240 kg), papaya (95 seedlings) legumes (seeds of 5 varieties) and asparagus (100 seedlings). Nine species/ varieties of indigenous traditional legumes were collected and are being multiplied. The members harvested 2,224 kg of dioscorea. Members of 10 tribal hamlets harvested and marketed 1,124 kg of honey through the apiary programme, selling it at a price of Rs.100/kg.

302.3 Bioresource Complex for Women

Members of 15 SHGs possessing land have initiated trial cultivation of medicinal plants required for herbal formulations. One of the groups has started cultivating brahmi *Bacopa monnieri* and thirty farmers are growing *kattupadavalam* (*Trichosanthes lobata*) for seed production.

The activities are being implemented in collaboration with Vanamoolika, a community based organisation at Pulpally, Wayanad Social Service Society (WSSS), an NGO, St. Mary's Spices and Condiments, an establishment set up in the district for value addition of pepper, a Trichy-based private firm engaged in the production and marketing of herbal products and JEEVANI, a consortium of farmers interested in medicinal plant conservation. Training on traditional healthcare practices was given to 110 women belonging to 20 Vana Samrakshana Samithees (VSS) operating in Mananthawady. Awareness camps were conducted on traditional healthcare practices

and conservation, as well as good cultivation, collection, processing and storage practices of medicinal plants, for various groups of people, including housewives, tribal NTFP collectors, farmers and agricultural officers of Malabar region. Classes on biodiversity conservation and the need for documentation were conducted for school and college students and teachers. 2,500 seedlings belonging to 25 species of medicinal plants have been raised for distribution to farmers and medical practitioners. A database of 630 medicinal plants with scientific name, local name, common English name, habitat, distribution and utility patterns has been prepared.

302.4 Livelihood Improvement of Marginalised Men and Women with Focus on SC/STs through NRM Intensified Micro Enterprise Activities

This programme aims at empowering marginalised men and women (with special focus on SC/ST) to build their economic base through training and capacity building, to imbibe various biological software inputs to become self reliant through launching village level micro enterprise activities and exposing the tribal communities to advanced technological skills and reinforcing and broadening the span of organic farming.

Identification of partners: Partners were identified with the help of PRIs, NGOs, SHGs and farmers' groups in the district. Training was given to the target communities on vermicompost, *Trichogramma* and *Trichoderma* production.

Vermicompost units: Three field units have been established in Bathery, Vythiry and Mananthavady taluks of Wayanad district. The methodology developed by CPCRI, Kasaragod, using *Eudrillus euginiae* was adopted for composting. The nutrient composition of the compost samples was analysed, as detailed in Table 3.1.

Compost from the first harvest was sold at Rs. 5/- per kg. Since the conversion rate was very low, a second training programme was conducted to solve problems faced during the period of composting. Composting units were refilled for the second set of composting.

Trichoderma: Two species of *Trichoderma* were isolated from different parts of Wayanad and identified as *T. viride* and *T. harzianum*. Diseased plant parts of pepper and cardamom were collected and the fungal pathogens were identified and dual cultured against the above species. *T. harzianum* showed better results. Locally available carrier materials like coir pith, coffee husk and neem cake were used for mass multiplication. Among these, coir pith was found to be the cheapest. A *Trichoderma* stock culture unit has been established. Colony forming unit (cfu) count of pathogens like *Fusarium sp*, *Phytophthora* sp and *Pythium* sp was found to reduce when *T. harzianum* with various organic amendments was applied to pepper and ginger. Mother cultures of *Trichoderma harzianum* P26 (licensed strain) were procured from Indian Institute of Spices Research (IISR). Mass multiplication was started and a field unit initiated by a SHG.

Trichogramma: A partner group for the production of the wasp from the area has been formed. Viability test for *Trichogramma japonicum* showed that the project is viable in Wayanad climatic conditions. In addition, the viability of *Trichogramma kleine* is being attempted.

Market outlet: A market outlet has been identified in Kalpetta and registered under the Partnership Act. Farmer groups were contacted to ensure supply of organic vegetables and fruits as well as locally made products. A market survey conducted among 350 people indicated the high demand for organic products and consumers' preparedness to pay a higher price for genuine products.

Organic farming: Fourteen farms were visited to collect basic information on the status of farming in the area. One hundred farmers were sensitised to undertake organic vegetable cultivation, with a buy back arrangement with the market outlet. Mushroom (*Pleurotus*) spawns were distributed at an average of 50 kg per month to the various partners.

302.5 Medicinal and Speciality Rices of Kerala: Validation, Value addition, Organic Cultivation and Market Development

Detailed field surveys and motivation exercises carried out over the years have resulted in 23 farmers taking up cultivation of speciality rice. Considering that farmers are withdrawing largely from rice cultivation, only one cluster with seven members could be formed during the period. They have undertaken *Navara* cultivation in one hectare. 428 kg of seeds of all the four rice varieties, *navara, gandhkasala, chennellu and mullanchenna* were supplied to farmers for raising in community plots. By collecting twice the amount of seeds supplied to the farmers, the seed requirement of the next season is being ensured. The area proposed for speciality rice cultivation is 6.24 ha involving 23 farmers. A traditional rice variety (*Arupatham cheera*) with a short duration of 60 days was identified. An interesting strain traditionally known as *kaliyan* was collected and is being purified along with *veliyan*. A trial plot is being maintained at Puthoorvayal (0.40 ha) for detailed

Table: 3.1- Conversion rate and nutrient composition of vermicompost (%)

Unit	Raw material used	Conversion rate	Nitrogen	Organic Carbon	Phosphorus	Potassium
Mananthavady	Grass from paddy fields	24.67	0.61	2.45	0.37	0.80
Choothupara	Banana pseudo-stem, paddy straw	54.55	1.49	0.99	0.33	0.85
Kallumala	Leaves and grass	20.00	0.44	2.18	0.38	0.78

characterisation, using 22 characters following IRRI's rice descriptor.

Networking

In order to bring concerted action among *navara* researchers, linkages have been established with Arya Vaidya Sala, Kottakkal; Central Research Institute (CRI) Cheruthuruthy; Institute of Applied Dermatology, Kasaragod; Malabar Botanical Garden, Kozhikode; Regional Agricultural Research Station, Pattambi; KAU and Govt Victoria College, Palghat.

302.6 On-farm Conservation of Yam (*Dioscorea*) Diversity in Malabar Eco Region

During the year, 2,500 kg of yam (*Dioscorea alata* and *D. esculenta*) and 1037 kg of other tubers were distributed to 128 families, identified as most deprived in 7 colonies in Wayanad district. 200 kg of 6 different varieties were distributed to 5 SHGs and 100 kg planting material of 3 different varieties was supplied to the Rural Agency for Social and Technical Advancement (RASTA) and WSSS. Tubers harvested by the farmer groups, formed in 2006, were distributed among new farmer groups in the five districts by increasing the area under cultivation to 42 ha. A survey was conducted in the traditional yam cultivation areas of Alappuzha, Kottayam and Ernakulam districts. *Kippan kachil*, *pala kachil*, *vazha vadakkan*, *chuvappan kachil* and *vella kachil* varieties were collected and planted at the conservation plot in the CAbC campus, which now has a total collection of 21 cultivated varieties of 4 species and 18 wild species. Biochemical and nutritional analyses were conducted on 15 cultivated and 7 wild yam samples. Twenty-five accessions of *Dioscorea* were analysed at the CTCRI for various biochemical characteristics. The results indicate wide variability in the dry matter content ranging from 15 % to 38 % for INCH-I and HECK, which is quite high and promising. The starch content on dry weight basis varied from 54 % to 77 %. On fresh weight basis the highest values were obtained for INCH-I, VAVN, HECK and BJKA, which are very similar to cassava. The crude protein content ranged widely and accessions MKN, PNKA, NORY and NAKN showed values of over 10 % on dry weight basis, which is also encouraging. Fat, ash and sugar content were in the normal range. The high energy value content was very high for PNKA (401 Kcal/100 g DM), followed by NAKN (398 KCal/100 g DM) and NKNA (393 Kcal/100 g DM), indicating that these varieties could be considered a good source of energy. Visual documentation of the different field plots, as well as harvesting and experience sharing of farmers, was completed in July 2006. Appad, Madathuvayal and Thachambath colonies were selected for distributing planting material. Training programmes for 150 farmers from 5 districts were conducted on conservation, developing planting material, production of traditional yam food products and processing of yam.

302.7 Every Child a Scientist Programme

This programme aims to promote knowledge on biodiversity heritage, create awareness

among tribal and rural youth, explore and document bio-resources and their value to the community, identify pathways to conserve medicinal plants and herbal resources, generate a scientific temper and foster a cadre of youth for the Bioresources Conservation and Development movement. A team consisting of 25 youth was identified for inventorying natural diversity and chronicling the traditional knowledge of biological resources. Wild food plants, host plants of butterflies and medicinal plants were collected. Resource materials in the form of simple databases and printed booklets were prepared on all the major bioresources of Wayanad, especially medicinal plants, rare and endangered plants, wild foods and the tribal communities' knowledge of conservation. Through this programme, 60 schools have been covered. The project involved teachers from the local educational institutions in order to build their capacity to recognise and study the biodiversity. Children were exposed to some basic techniques of knowledge documentation, plant identification and propagation and they were familiarised with the cultural and ethno-botanical aspects of tree species that are sacred to the native communities and were given the responsibility to collect available information and to raise nurseries of these species for the purpose of planting in the school/college/temple campuses. Six nature camps were conducted, in which the parents, teachers and the Agrobiodiversity Conservation Corps(ACC) members participated. Star watching, trekking, bird watching and butterfly watching were among the various activities undertaken.

302.8 Conserving 80 Threatened Species by Creating 8 Research Fellowships in Systematic Botany

In commemoration of the 80th birthday of Dr. M.S. Swaminathan, a project was launched to create 8 Research Fellowships in the discipline of Systematic Botany to address the issue of conservation of endangered species. It proposes an integrated conservation approach to save 80 rare, endemic and threatened flowering plant species of southern Western Ghats by facilitating collaboration among organisations that promote off-site and on-site conservation.The institutions participating in this initiative include the Kerala Forest Research Institute, Peechi; CMPR, Aryavaidyasala, Kottakkal; SNM College, Maliankara and the Centre for Indigenous Knowledge, Science and Culture, Calicut. Each Research Fellow has been entrusted with the conservation of 10 RET species. Familiarization of the target species was attempted by examining the available specimens. Digitalization of authentic herbarium specimens has also been undertaken.The natural population of 62 target species is located in Kerala. Seedlings of 4 endangered trees, 7 woody climbers, 6 medicinal trees, 7 narrow endemic species, 8 rare Syzygium species, 6 endemic and rare plants, 7 rare monocotyledons and 7 endemic species were raised. Vegetative propagation of six target species was attempted and a total of 1,450 seedlings has been raised. Micropropagation of 5 target species was also initiated at the tissue culture laboratory in Chennai. Orientation/training programmes

were organised for the Research Fellows on practical plant taxonomy and conservation methods, phytosociology, pollination biology, vegetative propagation methods and pollination ecology. A brochure on the programme defining the objectives, activities and expected outcome and a draft copy of a handbook on 80 target species have been prepared. Registration for the Ph. D programme has been done at the University of Madras, Chennai; Mahatma Gandhi University, Kottayam and Kannur University, Kannur.

302.9 A Preliminary Study on the Biodiversity Conservation Practices of Wayanadan Chetty – A Traditional Community of Wayand District, Kerala

The Wayanadan Chetty community of Wayanad district in Kerala is one of the early settlers in the district. A study was undertaken to get an insight into their life and culture and efforts to disseminate the value and sustainable use of natural resources. Random sampling was used for the survey involving 301 families. This community has become highly organised with the formation of the society known as Wayanadan Chetty Service Society (WCSS) in 1972. The Society looks after the developmental activities of the community through local units. The study was conducted with the participation of WCSS. The community is characterised by matriclan which is exogamous at the clan level, though the community as a whole is endogamous. In one local unit there could be different *vamsams* (clans). 23.06 % of the community are in the range of 11-20 years of age and those aged between 61-90 are only 7.54 %. The population of the community in the district is 16, 970. Nenmeni panchayat is most populated and Muttil is the least populated. W.Chetties have settled in Mananthavady, Kalpetta and Vythiri panchayats. In TN this community is settled only in Gudallore and Panthalore. An important observation is that 30 % of the community is affected by sickle cell anemia. From the study it is learnt that there are not many differences in the educational status of the two genders. Most of the community members are educated only up to high school level. The younger generation is now receiving better education. The sources of income are agriculture (81 %), jobs (3 %), labour (6 %) and dairying (10 %). The community is highly religious. Their deities are *malakkari, athiralan, kariyathan, kalimalathamppuran, Thampuratty* and *Bammathan.* The customs and beliefs of this community play a big role in the conservation of plant species as well as water resources. It is found that most of their religious ceremonies are related to water and most of their *kavus* (temples) are associated with ponds. Almost all the functions are associated with ponds or streams. Most of the ponds are situated in paddy fields, but these are rarely used for irrigating crops as they are considered divine. Of the 54 *kavus,* 24 still have ponds. Some of them have sacred groves as the community depends on medicinal plants for healing. They use some 140 species of medicinal plants. They conserve a particular kind of musa species which is locally known as *paduvan vazha*, which is associated with their beliefs with regard to death and worship. It can be

seen that only some communities are engaged in paddy cultivation, mainly for their own consumption. They are facing many difficulties in continuing the paddy cultivation. It was found that 24 traditional paddy varieties are being cultivated by individual families. In addition to traditional varieties, they also cultivate hybrid varieties. About 76 % of the farmers are small holders having less than one acre of land. Only 1% have comparatively large holdings of above 5 acres. They prefer organic farming practices and sustainable use of biodiversity. The community is highly male dominated. It is very clear that the decision-making power relating to cultivation, family matters, marriage and religion is entrusted to the males. The elderly women have a role only in rituals and tradition. The major recommendation arising from the study is to extend help to this community to continue the paddy cultivation and gain recognition for their efforts in the conservation of the traditional varieties of rice. The landholdings, especially paddy fields, will continue to be retained as paddy fields if proper support is given. A detailed socio economic, culture and gender roles study is also recommended .

302.10 Library

The CAbC Library has a wealth of 2,116 reference materials, including books, research reports, proceedings and CDs. During the year 217 new books were added to the library. The books are mainly on subjects like Agriculture, Biotechnology, Microbiology, Child Development, Education, Food Security, Gender, Sociology and Watershed Management. The library subscribes to 30 journals/periodicals, including two new journals (Economic and Political Weekly and Indian Journal of Botanical Research (CMRA)). 13 Journals are in English while the remaining are in Malayalam. The library has a database that enables quick and easy location of books. It is open to all and the facilities are used by the staff of CAbC, students, researchers and farmers from all parts of the state. A total of 116 visitors benefited from the library during the year.

Sub Programme Area 303

Jeypore

This year, the *Panchavati Gramya Unnayana Samiti*, an organisation of tribal communities of Jeypore, was awarded the *Genome Saviour Award* by the Protection of Plant Variety and Farmers' Rights Authority (PPVFRA) of the Government of India. The tribal communities received this award at a formal function in New Delhi in February 2007.

303.1 Participatory Management of Biodiversity for Elimination of Hunger and Poverty

As already stated in the introductory section, building on the experiences gained from work on biodiversity conservation and poverty alleviation, it was decided to bring interventions for sustainable development across programme areas into play in a focused manner in selected villages to develop a holistic model for sustainable rural development.

Table 3.2. Details of villages where baseline survey was conducted

Village	Gram Panchayat	Block	No. of households	
			Total	Surveyed
Boliguda	Chandrapada	Boipariguda	86	16
Kashiguda	Chandrapada	Boipariguda	70	14
Gunthaguda	Lima	Kundura	80	15
Nuaguda	Lima	Kundura	34	06
Doraguda	Chandrapada	Boipariguda	120	24
Total			**390**	**75**

A baseline survey was conducted in some villages (Table3.2) taking about 20 % of the households in each village at random, using a questionnaire on interventions.

Based on the survey and analysis, Nuaguda, Gunthaguda and Boliguda were selected for implementation of activities. To establish partnership with the village level institutions, various entry level activities were initiated in the selected villages.

- In Gunthaguda, a Central Village Committee (CVC) was formed with an Executive Committee consisting of a President, Vice President, Secretary and Assistant Secretary.
- The CVC at Boliguda was restructured and the Executive Committee now has gendered representation from all the sections of the village.
- One volunteer from each of the three villages was selected and given orientation on their roles and responsibilities, in implementing various interventions.

Conservation of biodiversity, strengthening of livelihoods and food security, and information empowerment through VKCs are the ongoing interventions. Work under the food security component has been highlighted in detail in SPA 501.2. The site has been identified for setting up the VKC and need assessment surveys are in progress.

303.1.1 Biodiversity Conservation, Utilisation and Enhancement (BCUE)

Upscaled Cultivation of Kalajeera

The aromatic non-basmati rice landrace *kalajeera*, which has reached commercial cultivation after 7 years' work using participatory plant breeding, gained further recognition as more villages opted to grow it. 123 farm families from 27 villages in 7 GPs and 3 blocks of Koraput district cultivated *kalajeera*, covering a total area of 98.75 acres.

Farmers used pure seeds stored from last year, to raise their crop this year. Interested farmers were given seeds from the Village Seed Banks (VSBs) either at a cost of Rs. 15/- a kg or on

condition that they give 1.5 times the seed after harvest, a decision taken with the active involvement of the CVC. Orientation on modified methods of cultivation was given to the farmers. Repeated visits were made to guide farmers on rouging, seed selection, collection and other management practices. Despite unseasonal rains at flowering, the total production was around 95 tons. After storing for their needs, farmers offered 30 tons of grain for sale to NAFED at the rate of Rs. 10/- per kg of paddy. This mode of marketing for the second successive year has motivated more farmers to take up *kalajeera* cultivation.

To explore alternative marketing avenues, a local market survey for *kalajeera* rice/grain was organised jointly with representatives from four villages. The team met progressive farmers, Agriculture Department officials, traders and millers to understand the market potential. Kotpad, about 40 km from Jeypore, was found to be a possible local market, but it could offer a price of only Rs. 7 to 8 a kg with no guarantee for one-time payment of the total cost.

Kalajeera Export

A tripartite agreement between the Foundation, Tilda Riceland Pvt. Ltd and the Govt. of Orissa for a two-year evaluation of *Kalajeera* for its export potential was signed in September 2006.

Forty samples of *kalajeera* harvested from the Kharif crop of 2005 and plots of PPB and non-PPB farmers spread over 9 villages were analysed for quality parameters under this agreement, and DNA profiling of these samples was done by Tilda Riceland. The analysis showed that there is seed homogeneity in plots within and between the growing areas, suggesting that large scale production can be achieved. Superior bulk density, cooking time and shelling percent of milled rice, as well as high aroma were found when compared with Assam *Kalajeera* and a basmati strain, HBC-19, showing there is potential for export of *Kalajeera*.

Field trial of Kalanamak accessions and Kalajeera variants

It has been reported that *Kalajeera* is grown in several regions of Orissa, but the origin, identity and seed quality are not clear. To compare Jeypore *Kalajeera* with others, 18 black aromatic rice strains grown as *Kalajeera* or names resembling it were collected from several districts of Orissa in 2005. Only 14 of those germinated, and these were grown along with Jeypore *Kalajeera*. In addition, 37 *kalanamak* accessions having black husk colour, collected from G. B. Pant University of Agriculture and Technology, Pantnagar, were also grown. Data on diagnostic traits have been collected and are being analysed.

Participatory Conservation and Selection of Landraces

One line each of seventy rice landraces collected from Jeypore and adjoining regions was grown at Nuaguda and was put to selection by farm families. Twenty-five men and 41 women from 6 villages were involved in participatory landrace selection at Nuaguda. Views of farmers on the landraces were

collected using a pre-designed format. The results are under collation and analysis.The regenerated landraces have been stored at Jeypore and one set of samples has been stored at the Gene bank in Chennai, for replenishing the seed stock.

303.1.2 Biovillage Programme

As a prerequisite for the successful implementation of the project, the community was mobilised and made aware of the concept of Biovillage and the objectives, and focus of the project activities. Resource mapping of bioresources was done to understand the quantity, period of availability, traditional utilisation practices and the existing marketing channels for the products. The activities initiated are given below.

Individual/ group activities: Income generating activities like mushroom production and leaf plate making and infrastructure development to promote livelihoods were started. A group of 8 women in Boliguda, who were physically handicapped or aged with no other occupational avenue were encouraged to take up leaf plate stitching. Each of them is able to produce about 100 leaf plates everyday during the 4 hours they spend on this activity. These leaf plates are sold at the local market for Rs. 25/ 100 plates.

Bamboo craft production at Boliguda by a group of 9 women has been taken up as a feasibility model for promotion. Bamboo craft items have a limited market. The craft produced are sold during exhibitions organised by government agencies and during community festivals. Bringing in new designs, like flower baskets and linkages with specialised market avenues, such as handicrafts and linking with fair trade, could be an option to encourage entrepreneurial activities. Providing credit facilities to these women and opening up an outlet for display would be helpful in encouraging the continuation of this activity by the individuals.

Commercial vegetable production as second season crop after paddy harvest was taken up by 10 households at Nuaguda and 17 households at Gunthaguda, covering a total area of 14.5 ha. Such initiatives are being attempted by the community for the first time in low lands. Quality seeds were provided raising bitter gourd, tomato, brinjal and pumpkin. The produce was sold in the weekly market at Pradhaniguda, Kundura, Boipariguda and Doraguda. Additional income (profit) to each individual farmer ranged from Rs. 2,500 to 5,000 per annum. Commercial vegetable cultivation has been taken up in the June – July season in the upland, with the participation of 16 households at Nuaguda, 13 households at Gunthaguda and 21 households from Boliguda on 0.2 ha land per individual. Quality seeds for crops such as tomato, brinjal, chilli, radish, leafy vegetables, beans, papaya and drumstick have been provided under the project.

Mushroom production as a group activity was started during the current reporting period. Oyster (*Pleurotus sp.*) and straw (*Volvariella sp.*) mushroom cultivation provides an opportunity for value addition to paddy straw

and the mushroom waste is used in vermicompost production. This is a new initiative and has been implemented in all the 3 project villages. Oyster mushroom production was taken up by 18 women as a group activity. Income from the sale of these mushrooms was Rs. 7,505; in addition 31 kg of mushroom was utilised by the group for home consumption. Currently 43 individuals from the project villages are cultivating straw mushroom and the encouraging results have prompted 25 individuals from nearby villages to take up this activity on their own. It is estimated that each individual would be getting a profit of above Rs. 500 month under the current scale of operations. Each individual spends less than an hour each day for this activity. For the production of oyster mushroom, the project has facilitated the construction of a mushroom shed at Nuaguda with a capacity of 140 beds and for the production of straw mushroom plastic sheets have been provided.

Vermicompost units were earlier set up as an individual activity in 10 households at Nuaguda, with the support of Spices Board. 75% of the produce from these pits was utilised by the individuals themselves in their backyard garden and agricultural field and the remaining was sold at Rs. 4/ kg to farmers from neighbouring villages. During this project phase, this activity has been strengthened and up-scaled with the construction of 12 additional vermicompost units on a cost sharing basis making the community partners in the process. Construction of each unit costs Rs. 2,000. The contribution from the community is Rs. 1,500 (75 %) by way of material and labour. The produce of these new units managed by a group of 11 women, would be sold commercially. The production capacity of each unit is 500 kg / 2 month cycle. It is estimated that this activity could bring in an additional individual income of Rs. 800/ month. Training on vermicompost has been initiated for interested individuals from Boliguda and Gunthaguda, as a preparatory step for establishing such units.

For *value addition in tamarind*, group activities involving 18 women have been taken up on a trial basis at Nuaguda. The group has procured 1,500 kg of tamarind during the season and are now in the process of de-seeding and storing. The processed materials would be sold when market prices would be at the peak. This would help in identifying areas that would help in taking up this activity on a larger scale.

Supporting activities

Currently 40 households are involved in groundnut cultivation in an area of 13 ha, introduced in an earlier phase of this project. Productivity is currently estimated at 800 kg/ acre, leaving scope for further improvement. Net profit is estimated at Rs. 5,000/ acre. This activity has provided an employment opportunity for agriculture labourers. The vegetative parts of the plants are being used as fodder for cattle.

Facilitation for *cultivating green gram* after paddy harvest using existing soil moisture has been attempted among 11 households covering 3.12 ha at Nuaguda. This is a new

initiative and aims to maximize production per unit of land and water.

Planting of papaya has been taken up as an additional activity. 326 papaya seedlings, gifted by the Range Officer, Boipariguda have been distributed among 22 households at Nuaguda, and 75% of the plants have survived so far.

For the purpose of initiating integrated dairy activities at the project site, 14 women and 7 men from Nuaguda and Gunthaguda villages were taken on an exposure visit to Central Cattle Breading Farm, Similiguda and the activity is being discussed in detail as a prerequisite to developing a business plan.

Infrastructure development: A water harvesting structure was renovated at Boliguda in November – December 2006, with one day labour contribution from each household. It is proposed to develop the area around the structure as a community garden which would be managed by the landless individuals.

A community vegetable garden was initiated as community activity on 1 acre of common land at Nuaguda for the purpose of carrying out trials and demonstration of new techniques and/ or cultivation of new crops. The crops cultivated were tomato, brinjal, carrot and greens. 150 papaya seedlings procured from FD have also been planted. The income from this garden, which is presently Rs. 4,500 has been pooled into the community fund managed by the Central Village Committee for village development.

303.2 Biju Patnaik Medicinal Plants Garden and Research Centre (BPMGRC)

Koraput and adjoining regions in the State of Orissa are rich in genetic resources of medicinal rices and other medicinal plants. The tribal populations are poor but their bioresources endowment is rich. Very little research has been done so far in the area of conservation, sustainable and value-added use, and equitable sharing of benefits with reference to the medicinal plant heritage of Koraput. A Research and Development Centre was set up in Jeypore for undertaking an intensive and integrated study on medicinal and aromatic plant species of the region, thereby creating an era of biohappiness for the tribal communities of the region, with an overall objective of helping the communities to overcome the prevailing dichotomy of the poverty of the people and the prosperity of Nature.

The Centre is being developed in such a manner that the tribal families develop a sense of ownership of the living gene bank and participate actively in all aspects of the work of the centre, namely conservation, enhancement through participatory breeding, cultivation and chronicling of dying wisdom and vanishing crops. The centre is helping farm women and men to protect their intellectual property rights under the provisions of the PPVFRA (2001) and Biodiversity Act (2002) and in the documentation and analysis of ethno-botanical diversity. Community level training and capacity building on *ex-situ* conservation, development

of genetic garden, large scale cultivation, preservation and promotion of medicinal plants used in the traditional healthcare system of tribal communities are among the activities being initiated.

This centre with a well designed garden as well as a research and training facility was formally inaugurated and dedicated to the nation in April 2007 by the Hon'ble Chief Minster of Orissa Shri Naveen Patnaik in the presence of many dignitaries from the State and Central government as well as representatives of the tribal and rural communities of Koraput region.

The facility includes an office cum laboratory complex, a tribal hut (*milana kutira*), plant production facilities (3 polyhouses, 2 shade net houses) and a water harvesting structure. Facilities have been developed for conservation and evaluation of landraces of rice through terraced rice fields.

Mapping of the tribal distribution and their population was carried out through collection of secondary information. Based on the distribution profiles, nine major tribal groups were selected for participation in the activities of the Centre. Nine Tribal Medicinal Plants Gardens for 9 major tribes of southern Orissa (*Bhatra, Bhumia, Bonda, Gadaba, Gond, Kandha, Koya, Paroja and Saora)* have been developed in an aesthetically designed landscape. Each garden has been planted with the medicinal plants used by the respective tribe. In all, the gardens now have more than 3,000 medicinal plants representing 183 species.

All the medicinal plants thus collected by different tribal groups have also been planted in the medicinal plant genetic resource centre. Around 186 medicinal plants have been planted so far. In addition, one of the gardens in the research centre has plants used exclusively by women for their health care needs.

A man-made sacred grove is under planting at the centre to conserve the sacred as well as medicinal plants used by the tribal community of Koraput region. Around 43 medicinal and sacred plants were planted for linking cultural diversity with biodiversity. A study of the linkage between the Cultural Diversity and Biodiversity of the paroja tribe was carried out in collaboration with the Academy of Tribal Dialect and Culture (ATDC), Govt. of Orissa and Council of Analytical Tribal Studies (COATS), Koraput. A booklet on this was published and released by the Hon'ble Chief Minister of Orissa. A similar study involving 8 other major tribes of the region is being undertaken. The centre is working in a network mode with organisations/ agencies with similar objectives. Personal, institutional and virtual linkages have been established at the national level, State level and regional level. A group of 23 NGOs from 6 districts of southern Orissa has been involved in these efforts.

Demonstration on Cultivation of Medicinal plants

Of the total 256 medicinal plants documented from five tribal districts of Orissa, a nursery for 143 medicinal plants is being raised at BPMGRC to conserve, propagate and multiply

the plants. Demonstration on cultivation of 10 medicinal plants prioritised by the National Medicinal Plants Board was conducted in 10 different plots of size 25 X 75 ft to standardise the agro-technological methodologies as well as for training and demonstration. This demonstration will help to assess the best-suited medicinal plants for each agro-climatic zone.

Seeds of 33 medicinal plant species, particularly herbs and shrubs, were collected from the Agri-Horticultural Society of India, Kolkata and from the National Research Centre on Medicinal Plants, Anand, Gujarat. These seeds were put in nursery beds for raising the seedlings and planted in plots at the centre.

Capacity building

Training of trainers is being conducted at BPMPGRC site from October 2005 by involving 17 youths from 5 villages of 2 GPs of Jeypore and Kundura CD Blocks, on land preparation, nursery raising, care and maintenance of seedlings, cultivation, agro-technological packages and harvesting. Five consultations were held, involving 200 THPs and TBAs across 4 districts of Orissa. Exposure visits were conducted for 109 healthcare practitioners representing 9 tribes from 3 blocks.

303.3 Quantitative Assessment and Mapping of Plant Resources of Eastern Ghats of India

The activities aim at a 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.

The Foundation is a partner in this multi-institutional project being coordinated by Sri Krishnadeva Ray University, Anantapur, AP. The Eastern Ghats region in Orissa has been divided into two parts: studies on the northern part are being carried out by the Regional Plant Resource Centre, Bhubaneswar while the Foundation has been assigned the southern parts and adjoining regions of AP; Kalahandi, Nabarangpur, Koraput, Malkangiri, Rayagada and Gajapati districts of Orissa and Srikakulam and Vizianagaram districts of AP will be surveyed. The entire Eastern Ghats has been divided into several grids.

These grids were located with the help of the toposheet map of the Survey of India. Each grid consists of an area of 6.25 x 6.25 km. In each grid there will be a transect of 100 x 5m, where tree species having 10-30 cm girth at breast height (gbh) will be recorded and plants having 30 cm gbh will be measured and the height of the plant will be recorded. Regeneration plots of 5 X 5m area, both at the beginning and end of the transect will be marked, where shrubs, climbers and tree species will be counted and recorded. For

herbs there will be plots of 1 x 1m area inside each transect at any suitable point, where all the herbs will be counted and recorded. Locations were marked in the form of latitude, longitude, altitude and direction through the use of GPS.

Till now 65 grids with 85 transects have been covered in 3 districts of Orissa *viz*, Koraput, Nabarangpur and Kalahandi. There are around 317 identified species recorded, of which 114 are trees, 58 are shrubs, 93 are herbs, 47 are lianers and 5 are grasses /others. About 47 unidentified plant species were collected; 86 herbarium specimens have been prepared and photographs of more than 100 plant species have been compiled in a database. During the survey 2 rare, 3 endemic and 7 threatened plants were recorded from these 3 districts.

Sub Programme Area 304

Community Gene Bank

The Community Gene Bank (CGB) functions under the umbrella of Scarascia Mugnozza Community Genetic Resource Centre, and over the years it has focused on collecting, conserving and documenting important germplasm from the tribal and rural areas rich in biodiversity in the States of Kerala, TN and Orissa. This gene bank is a medium term storage facility where controlled temperature and humidity are maintained. The mission of the gene bank is to strengthen agro biodiversity conservation and enhance the conservation ethos of tribal and rural families through promoting a system of social and economic reward for their invaluable contributions to genetic resources conservation and to nutrition and health security. Another important function of the gene bank is to facilitate access to Farmers' Rights provided in the Indian Legislation on Protection of Plant Varieties and Farmers' Rights. The CGB has 1,037 accessions consisting of paddy, minor millets, pulses and a few cucurbits. Among these paddy has the highest number of varieties, followed by millets and pulses.

During the year, 278 accessions/collections of paddy, 22 varieties of millets and a few varieties of pulses and cucurbits were characterised using internationally followed descriptor standards. Characterisation of paddy collected from Kerala, Tamil Nadu and Orissa was carried out using 43 attributes comprising 25 qualitative and 18 quantitative traits observed at different stages of plant growth and development. These farmers' varieties of the crops studied showed very high variation in many of the important qualitative and quantitative attributes.

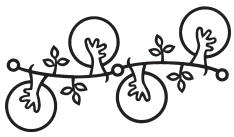
Among the 278 paddy collections, the plant height varied from 58 to 189 cm with 75 per cent of the varieties having height between 81-140 cm. Similarly the days to 50 % flowering showed variation from 40 days to 166 days with 22 varieties falling under early maturity, 153 varieties falling under medium maturity and the rest of the varieties in the mid late, late and very late characterisation of maturity. The very late varieties have 50 % flowering in about 170 days.

The panicle length varied from 12 to 36 cm with 68 per cent having a length of 21 to 30 cm. The number of grains per panicle varied from 24 to 258 with 32 % falling between 81 and 110 grains, followed by 21 % falling under 51 to 80 grains and 16 % under 111 to 140 grains. In the case of 1000-grain weight, 93 % of the varieties fell within 10 to 39 g class interval.

Two of the varieties such as *badamakada* and *bandabarka* showed highest yield of 68 g and 95 g respectively. The attributes of the variety *badamakada* were 137 cm plant height, 20 cm panicle length, 90 grain yield per panicle and 24 g of 1000-grain weight, while it was 128 cm plant height, 23 cm panicle length, 83 grain yield per panicle and 19 g of 1000-grain weight for the variety *bandabarka*.

Similarly, results on grain yield per plant and 1,000 g weight of 19 varieties of finger millet (ragi) are reported. The grain yield per plant varied from 2.60 to 7.96 g with 47 % of the varieties having a yield of 4 to 6 g. The 1,000-grain weight showed variation between 2.30 to 3.20 g with 74 per cent of the varieties having 1,000-grain weight between 2 to 3 g. True to its name, the variety *Aruvatham kelvaragu* has come to maturity within 60 days. Some of the minor millet varieties characterised were found to possess good agronomic attributes including high yielding ability. These studies are under progress.

Programme Area 400



ECOTECHNOLOGY

Work was initiated towards the establishment of the Fish for All *Centre and the implementation of the Bioindustrial Watershed Programme at five sites. More than 30,000 trainee days were completed during the year. Work at Community Learner Centres was recognized as a best practice by UNESCO.*

Programme Area 400

Ecotechnology

Work was initiated towards the establishment of the *Fish for All* movement at Poompuhar and the implementation of the *Bio-industrial Watershed* programme at three sites, namely Pudukottai, Puduchery and Jeypore as part of the second phase of support for the Sustainable Management of Natural Resources for Food Security and Environmental Quality, while strengthening the role-change activities at Kannivadi and Kendrapara. The two new initiatives gave an opportunity to integrate the key learning of the last decade in the areas of human-centred rural development and holistic approach.

Sub Programme Area 401

Coastal Region

401.1 Chidambaram

Participatory on-farm trials and adoption

The activities carried out at Chidambaram in the past ten years in relation to on-farm demonstrations in terms of IIFS, SRI, multiplication of BARC varieties of pulses (green gram and black gram), increased use of biological inputs to promote good agricultural practices, efficient utilisation and recycling of available water through Manikollai Small Farmers Lift Irrigation Federation (MSFLIF) and economic activities of women SHGs have led to key learning on the adoption of such activities. The replication of SRI, which was demonstrated a couple of years ago, has been very slow, because during the initial stage, farmers spend too much money on labour to carefully remove the seedlings from the nursery bed and keep them moist. To overcome this, the use of the drum seeder for sowing seeds with a spacing of 20x20 cm was tested this year in a farmer's field. This has been adopted by 12 farmers over 6 ha. This year, a participatory demonstration was conducted to study the comparative performance of SRI, the conventional method and improved direct sowing method at Kuriyamangalam. This helped to compare the agronomic practice, biometric observation, cost of cultivation, economic efficiency and productivity in a participatory manner. The comparison of cost:benefit ratio of the three methods revealed that the improved method of direct sowing gives Rs 3.10 per rupee invested and also drastically reduces the use of surface water. Hence the farmers are greatly impressed by this method of cultivation. The other activities like IIFS and diversification of crops in terms of adoption of the BARC varieties of pulses have gone into an auto replication mode.

Since there is a great demand for fodder, a training programme was conducted on fodder cultivation and related activities. Planting materials were obtained from Puduchery Biocentre. After attending the training programme, the SHGs have set up a community fodder bank and a total of 16,350

kg of green fodder has been harvested between September 2006 and April 2007. More than 45 families have collected saplings for planting in their backyard and field.

The use of biological inputs such as *Azospirillum*, *Phosphobacterium*, *Pseudomonas*, *panchakaviya* and botanical pesticides by the farmers has also increased. Some of the biological inputs were produced by five farmers for the first time and botanical pesticides were produced and sold to several farmers. On the whole, 196 farmers used both biofertilisers and biocontrol agents for paddy cultivation in an area of 76.5 ha.

Integrated Biological Management of Water Hyacinth by Grass Carp and Weevil

Experiments were conducted on integrated biological management of water hyacinth by grass carp and weevil. The prime aim of the experiments was to find the efficiency of the different sizes of the grass carp in the biological management of the weed. The initial biomass of the weed stocked in each pond was 2 kg. The initial morphometric measurements were taken before it was stocked in the pond. Fish of different sizes were raised and stocked after recording their length and weight.

The result shows that the grass carp of 1,000 g is the most efficient in controlling the weed. In the control pond the weed grew upto 143 kg, while it was found that in the pond with 1,000 g fish with weevil, the weed biomass was only 20 g. This was observed to be the most efficient combination. Other parameters like number of leaves, number of plants, shoot length and root length were also recorded at the end of the experiment. The final growth of the fish was measured at the end of the experiment.

Grassroot Institutions

Thenkoodu Federation has 42 SHGs with 626 members from 20 panchayats. There are three major sources of credit available to them, namely Nationalised Bank (NB), Community Bank (CB), and Internal credit (IL). Totally Rs 86.47 lakhs were obtained as loan from NB and CB. Indian Bank is the main source of financial assistance and had lent Rs 27.86 lakhs followed by IOB, PNB and Canara Bank. Up to December 2006 repayment of loan was 61 %, including subsidy. A milch programme has been initiated as an economic activity and there are presently 237 milch animals managed by 237 women from different SHGs in various panchayats. The total loan amount for this is Rs 23.70 lakhs, of which Rs 16.59 lakhs was repaid to the financial institutions. At present every milch animal owner is getting a gross income of Rs 9,989 and a net income of Rs 6,076 and an additional income of Rs. 750 by way of selling of FYM per annum. Also, 48 women in various panchayats are rearing 240 goats. An average of Rs. 3,500 is earned as net income by each of them. One of the most significant programmes of the SHGs is that 82 SC and MBC women have taken 27.06 acres of land on lease for three years. They cultivate paddy, pulses, bitter gourd, cucumber and cotton.

Manikollai Lift Irrigation Project

The lift irrigation project has had a great impact in Manikollai village, as it has achieved its goal of assured irrigation for paddy cultivation, increased the labour absorption, changed the cropping pattern for the better and helped reduce migration. Traditionally the farmers were cultivating rice followed by black gram. After the introduction of the lift irrigation project, they are able to sow black gram/green gram about 10 days before the rice harvest. Some farmers are adopting line sowing of cotton in the paddy harvested field where pulses are already sown. About 40 farmers with an area of 20 ha are going for a third crop that requires less water, like finger millet (4.7 ha) sorghum (8 ha) /sunflower (5 ha).

Before the implementation of the project, 102 (66 men and 36 women) labourers used to migrate to neighbouring cities and States in search of work and 165 women labourers were recorded as going to nearby villages for transplanting, weeding and harvesting. After the introduction of the lift irrigation project, they are able to find work in their village itself. In fact there is a reversal of trend now and 467 women labourers from neighbouring villages are coming to Manikollai to work. Similarly, labourers who had migrated to the cities and the nearby States have returned and are able to get work in the village itself and be with their families.

Community Pond Aquaculture - Cuddalore and Nagapattinam Districts, Tamil Nadu

In Nagapattinam district, 2 community ponds (Pudukuppam and Thenpathi) covering 1.75 acres are being effectively utilised by 2 women SHGs. The ponds have been stocked with composite fish culture *viz.*, rohu, catla, mirigal, grass carp, silver carp and common carp. It was observed that under favourable conditions, fish weighing 500 to 750 gm can be obtained in 3 to 4 months. The fishes were harvested and sold locally at the rate of about Rs.40/kg. The groups from Pudukuppam and Thenpathi got a profit of Rs. 19,000 and Rs. 4,000 respectively in 4 months. In Cuddalore district 6 community ponds covering 4 ha have been effectively utilised by 2 women and 4 men SHGs. As many as 135 members are involved in aquaculture activities.

Backyard Ornamental Fish Breeding

In the ornamental fish-breeding unit, live bearers like guppies, mollies and platties are being cultured. The tanks were stocked with 15-20 mother fishes each. The young ones were raised in separate tanks. The fishes were fed with locally manufactured pellet feed. The income from the ornamental fish breeding is about Rs. 300 to 500 per month.

Goldfish Culture

Goldfish culture is one of the activities initiated at Vandurayanpattu village, Melabhuvanagiri block, Cuddalore district. Ten SHG members have been involved in this. Ten thousand numbers of the candidate species *Carracius auratus* were stocked in the common pond of 30 cents. Fingerlings were collected from Chennai and Madurai at the rate of Re.1/piece. The fishes were harvested and a profit of 12,500 was got in three months.

Training

Various training programmes were conducted to introduce the participants to leadership qualities, micro-enterprises, fodder cultivation, maintaining accounts, dairy management, rodent control and freshwater culture in community ponds. A total of 944 man days of training has been conducted for 495 women and 449 men.

401.2 Fish for All *Training Centre*

The activities related to the establishment of a *Fish for All* centre, conceptualised to function as a training and demonstration centre for the fisher men/women (non-traditional fishermen, fish vendors, fishing labourers and fisher women) on a KVK model (learning by doing) were initiated at Poompuhar, TN to help in strengthening and diversifying the existing livelihoods and identifying alternative livelihoods for the resource poor to add value to the chain from "Capture/Culture to Consumption". A Knowledge Centre to enhance the training through ICT-based options is also being planned. To upgrade the quality of the harvest and increase its value, the proposed centre will also have a state of the art pre-processing unit. It is proposed to develop a co-management model over the years through social mobilisation, participatory planning and adequate capacity building of the communities dependent on fishery as a livelihood source in the region which will serve as a pilot initiative of its kind.

The project was initiated last year with a need-based survey conducted through a series of interactions with the community from the tsunami-affected areas. Poompuhar was selected on the basis of various factors such as existing infrastructure support, the volume of catch at the landing centres, the number of households, the interest of the community and the PRI to partner this programme. Also, the site has a historic significance in TN and therefore it was thought that value added products from the pre-processing centre could have a geographic indication. Extensive interactions have been held with the people, the concept has been presented to them and plans have been drawn with their complete participation at every stage. Two acres of land has been purchased and registered. Plans for the buildings have been finalised and approval has been obtained from the elected Panchayat President and the traditional Panchayat members. Discussions have been held with women groups to get their feedback on the designs of the pre-processing centre. A great deal of attention has been paid to following the Coastal Zone Regulation norms and the building will come up beyond the stipulated 500m from the coastal line. Bhoomi pooja was performed in February 2007 in the presence of the District Collector of Nagapattinam and a vast gathering of community members. This was followed by an extensive interaction with the Press. The land use pattern has been finalised digitally along with ground truthing. The baseline data collection is being carried out through a structured questionnaire with interactions and focus group discussions with the different stakeholders, time line and transect walk; time use is also being

documented. It is proposed to dedicate the facility this year, the third year post-tsunami.

401.3 Kendrapara, Orissa

The activities were targeted at consolidating and moving towards a role change in the 11 villages, namely Manitiri, Niyamatpur, Padagayaspur, Khardasahi and Patana of Rajagarh Gram Panchayat (GP); Anduli, Basaghara and Ghantiapalli of Balipala GP of Mahakalapara block and Nembera, Narendrapur and Balia villages of Kuhudi GP in Marsaghai block.

Participatory Demonstration and Replication

The approach adopted for the activities at the site helped to integrate interventions for sustainable livelihood options at the individual household level with community based group activities. All activities were carried out in a participatory mode with the SHGs. The Aquaculture based Integrated Intensive Farming System (AqIIFS) model farm established in 0.6 ha of common community land at Manitiri village in June 2004 has now spread to the adjacent community pond and covers 1 ha. This was possible as most of the households of Manitiri village are participating in and benefiting from the AqIIFS complex.

The AqIIFS model farm was established to demonstrate the effective utilisation of land and water resources through a process of integrated interventions for maximising production per unit area. The AqIIFS model at Manitiri village integrates water harvesting, cultivation of horticultural and floricultural crops on bunds, composite fish culture in the pond, nursery (including agroforestry), mushroom cultivation, dairy with biogas unit, poultry and duckery. Crops such as tapioca, colocacia, elephant foot yam, sweet potato, turmeric, ginger and betel vine were introduced in the AqIIFS complex during the year to determine their suitability and economic feasibility. Ten species of medicinal plants have also been introduced for creating general awareness about the use of herbal medicine. Training booklets were brought out on Concise Package and Practices on Crop Cultivation (in Oriya), Crop Calendar (in Oriya and English) and Coastal Biovillage Toolkit (Oriya).

Aquaculture as a separate component of the AqIIFS was initiated for the sole purpose of imparting specialized skills to individuals, especially those belonging to the underprivileged section of society. Traditionally, fishes were harvested from local ponds without any management practices. Through this programme 207 individuals were trained and were provided access to the community pond for taking up aquaculture as a group activity. The activity is continuing in 8 community ponds in 6 villages, covering a total area of 3 ha acres. The net income from this model is estimated at Rs. 47,500/ ha/ year, which will be shared by the SHG members.

Duckery as a component was introduced this year into the AqIIFS complex for the purpose of determining its suitability, currently there are 15 - 25 ducks. The waste from the ducks forms the supplement for fish food and plankton

development in the pond. The sale of ducks and eggs brings an additional income of Rs. 600/ month from the complex. Vermicompost was introduced as part of the Integrated Nutrient Management practices in the AqIIFS model and for the purpose of creating awareness among the farming community. There are now 9 functional units at the household level in 5 villages and production capacity is estimated as 4 qtls/ year /unit. *Azolla* production was also introduced as part of the Integrated Nutrient Management practices component in the AqIIFS model. 219 farmers have incorporated *Azolla* in their paddy fields and are interested in continuing this practice. Biological software as an intervention was introduced to promote the practice of Integrated Pest Management in the region. The IPM packages include release of *Trichogramma* parasitoids in paddy fields for the control of paddy stem borer, *Bracon* for the control of blackheaded caterpillar in coconut, pheromone traps for control of brinjal shoot and fruit borer and *Trichoderma viride* for control of soil borne fungal infection. Field observations have shown a reduction of about 13% in crop damage.

Dairying as an intervention was identified as one of the activities for up-scaling and as a component of biovillage activities. This is a SHG cluster-mediated, individual activity facilitated during the year with Orissa Milk Federation (OMFED) setting up a milk collection point at Nembera, which has increased dairy activities in Nembera village. Financial assistance for the purchase of 44 cows was provided under the Community Banking Programme. The milk collection is estimated at 400 l/ day. Dairy activities supported earlier at Niyamatpur village are continuing.

Sunflower was introduced as second season crop following paddy and to demonstrate the feasibility of cultivating this crop under slightly saline conditions, which are unfavourable for paddy and pulse cultivation. 156 farmers have taken up sunflower cultivation during the rabi season, covering 25 ha in 7 villages. The yield is estimated at 6.5 qtls/ acre. Apiculture was introduced to enhance the pollination of sunflower crops. 7 functional units are being maintained in 5 villages as group activity. Honey production is estimated as 4.5 kg/ beehive/ year and is sold at the local market at Rs. 200/ kg. Oyster and straw mushroom cultivation was popularised for bringing additional income at the household level. There are 119 functional units in 7 villages. Average yield is estimated at 2 kg/ bed for oyster mushroom and 1 kg/ bed for straw mushroom. The local market rate for oyster mushroom is Rs. 40/ kg and Rs. 50/ kg for straw mushroom.

Poultry has also been introduced as part of the AqIIFS model. Turkey rearing has been introduced recently at the project site. There are 87 functional units at the household level in 7 villages. The local market rate is Rs. 60/ kg. It is estimated that on an average the household gross income from poultry is Rs. 600 per month for 10 birds. Backyard kitchen garden was introduced at the site as part of enhancing the household food and nutrition security and to bring in the habit of

maximising the utilisation of space. Quality seeds and good management practices were disseminated. 372 households are maintaining backyard kitchen gardens. The average household area is about 1.5 cent and the yield is estimated at 3 qtls/ year/ household and the produce are used for home consumption with the surplus being sold locally. It is also being practised as a group activity in the community land at Ghantiapalli and Padagayaspur villages.

SRI techniques were introduced for the purpose of studying the feasibility of adopting this practice and large scale replication. 28 farmers from 7 villages participated in on-farm trials and demonstration during the last kharif season; 86 farmers have adopted this practice covering a total area of 34 acres. The SRI technique demonstration has shown 18% increase in yield when compared to farmers' practice and is suitable for medium land.

Paddy seed production was initiated to ensure availability of quality seeds to the farmers and for the purpose of capacity building among the farmers for seed multiplication. 75 kg of paddy breeder seed varieties such as Uphar, Pratikhya and scented varieties such as Basua Bhoga, Geetanjali, Dhusara, Ketaki Joha and *Kalajeera* were brought for multiplication. 29 farmers participated in this programme during the last Kharif season, covering an area of 1.5 ha. The Foundation seeds harvested from the last season would be used in the coming Kharif season for further seed multiplication. Subsequently the seeds would be distributed to the farmers as Truthful Labelled (TL) seeds.

Information and Communication Technology was introduced as a component and a Computer Training Centre was established to create awareness and skill development in computer application. The Computer Training Centre at Nembera is maintained by a SHG cluster, consisting of 11 SHGs from Nembera, Narendrapur and Balia. As on date 32 SHG members have received basic computer training. This facility is now open to the public on a payment basis. The trained SHG members have taken up computer coaching for school children. The first batch of 15 students is currently undergoing training. A nominal charge of Rs.15/month is being charged by the Centre for this service. The Centre has also initiated the task of providing information on pest and weather forecasting, and information from line departments.

Income Generating Activities (IGA)

Existing and new entrepreneurial activities identified during project implementation are provided with technical and financial support. The activities are being carried out either individually or as a group activity.

Training and Capacity Building

The Kendrapara field site has 41 SHGs with 77 male and 521 women members. 5,014 trainee days have been completed during the reporting period. The 41 SHGs are grouped into three clusters, based on the geographical distribution. Jeevan Jyothi Sangha comprises 25 SHGs from the Rajagarh GP, Narishakti Mahila Sangha comprises 11 SHGs from Kuhudi GP and Jhansi Rani Women's

Federation comprises 5 SHGs from the Balipala GP. The groups are active and are involved in community development activities such as supervision of mid-day meal distribution, representing common issues of grievance to authorities, mobilising resources and supporting relief operations during floods.

Network and Partnership

The project activities have attracted the attention of other agencies and institutions working in the development sector. Financial assistance to the tune of Rs. 60,000 was received from the Government of Orissa by the SHGs for infrastructure development of the AqIIFS complex at Manitiri.

As part of the NABARD supported project, three two-day workshops on *Aquaculture based Integrated Intensive Farming System for Coastal Biovillages* were organised at Kendrapara; 271 participants, including representatives from agro industries, banks, DRDA, Farmers' Clubs, KVK, NABARD, NGOs, officials from Line Departments (Agriculture, Fishery, Forestry, Horticulture, Soil Conservation and Veterinary) and Orissa University of Agriculture and Technology (OUAT) attended the workshops.

401.4 Puduchery

Strengthening Biovillage Council (BVC) and Community Banking

In collaboration with all the stakeholders, more than 330 SHGs were mobilised in Puduchery, comprising 4,600 individuals, including women and men. Fifty new SHGs were formed and credit facilities arranged for various enterprises. Special attention was given to men SHG formation and 4 men SHGs were formed.

For easy operations, continuous support and regular monitoring, the 330 SHGs which come under the BVC have been grouped into six clusters and leaders have been identified for decentralised operations and implementation of programmes. Six new BVC members have been identified from Kodathur, Manaveli, Kaikilaipet, Uttharavanipet and Mannadipet villages. Fourteen BVC members have been identified as NVA Fellows and two BVC members received MUPP certificates.

The Community Banking spearheaded by the BVC has been strengthened, with contributions from the members reaching Rs 2 lakhs. Three groups, which had defaulted, have been motivated to repay the entire amount. The Kodathur women SHG repaid the seed money of Rs. 1.5 lakhs to the Community Bank. A credit of Rs. 87 lakhs was arranged for various income generating programme and other activities. A two-day exclusive training programme on leadership development and capacity building of elected Panchayat leaders and BVC members was organised for local area planning and development.

Micro-enterprises

Pseudomonas: Vinayagam WSHG of Kodathur has received Quality Certificate from the Department of Plant Pathology, TNAU, Coimbatore. The product was branded in the name of BIOCARE - *Pseudomonas fluorescens* for better marketing prospects.

The group sold the product to farmers and private agents initially and now has a marketing tie-up with Puduchery Agro Service Industries Corporation (PASIC), Govt. of Puduchery. It supplied 1 ton of BIOCARE in March 2007 to PASIC at the cost of Rs.42 /kg. Another ton has been supplied to Nithya Bio Products.

Establishment of low cost biofertliser unit: As a group enterprise activity, a low cost biofertiliser production unit was established at Keezhsathamangalam village. Extensive training programmes were conducted along with exposure visits to units functioning at Kannivadi. Now the trial production is in progress and soon the unit will go for mass production. As part of the biofertiliser production unit, a vermicompost unit has also been established. An exotic sp (*Perionyx excavatus*) of earthworm was introduced in the vermi bed and a pure culture of Azolla microphyla was newly inoculated in the Azolla pit. About 200 SHG members developed backyard kitchen gardens with the support of the Horticulture Department.

Fodder cultivation: About 6 ha of land has been converted to fodder plots. Special attention was given to all the demo plots at the Biocentre. Rs.17,000 worth of floriculture seedlings were produced and Rs. 60,000 mobilised from different activities at the Biocentre.

Training

About 3,120 trainee days were organised by the Biocentre for SHG members, SHG leaders, cluster level leaders, farmers and other stakeholders. External training and special training on IGP were also carried out. Orientation on the Biovillage model was given to grassroot NGO officials, bank managers and students of national and international universities. A training module on micro-enterprises for SHGs was prepared. A video documentary on *Biovillage Women in Puduchery Panchayat* was prepared, and screened on International Women's Day.

Bio industrial watershed

An explorative field visit was made to find out the feasibility of selecting the micro-watershed within Nallavur watershed in the Kalley valley region. Three micro watersheds *viz* Vanur, Thuruvai and Kenipattu have been shortlisted using the criteria such as total area of catchments, area under rainfed farming, number of small and marginal farmers, social structure of the local people and cropping systems.

Initially, Kenipattu micro watershed was visited and interaction was held with the local communities. It consists of three hamlets with 281 households. Of these, 111 belong to Scheduled Caste, 165 to Backward Caste and 5 to Most Backward Communities. The cropping system is paddy during the rainy season using canal water, and paddy, sugarcane and groundnut by tapping underground water, supplemented by perennial crops like cashew, casuarina and palmyrah. There are two tanks covering an area of around 38ha but the outlets/sluices in both the tanks are damaged and three quarters of the tank area is covered by vegetation and

encroachment. Similar ground verification and interaction with the local community is being planned for Thuruvai and Vanur to finalise the site for implementation.

Sub Programme Area 402

Semi-Arid Region

402.1 Kannivadi

The activities focused on skill building in sustainable agriculture, demystification of technologies, promotion of multiple livelihoods and use of ICT for community development. The role change, initiated in 2006, is being continued through institutionalising activities with grassroot institutions. Three dimensions, institutional/organisational, human resource and financial aspects were considered for the promotion of self-sustainability of grassroot institutions. For organisational sustainability, leadership building, network and linkages, a transparent management system and governance were the focus through training and capacity building, cross learning visits and discussion. For financial sustainability, a joint action plan was carried out with grassroot institutions and strategies were designed and implemented. In addition, need-based technical capacity building programmes are also being conducted.

Grassroot institutions: *Kulumai*, a federation of around 150 SHGs, and Reddiyarchatram Seed Growers Association (RSGA) with 90 members, are the two grassroot institutions functioning since 2000-01. During 2005-06, two more registered organisations, namely *Thonimalai Thottakkalai Vivasaikal Suyavudhavi Sangam*, an organic farmers' group and Oddanchatram Vegetable Traders Welfare Association, an export orientated group at Oddanchataram vegetable market, started functioning.

Farmers' association: As per the role change plan, three outcome-based leadership cum conflict resolution programmes were organised and the recommendations of the programmes are being addressed. Efforts were taken to strengthen the thematic groups (seven) and two Vikas Volunteer Vahini clubs were approved by NABARD. Need-based training and capacity building programmes and cross learning visits were organised for the thematic groups. To illustrate the point further, the banana group farmers were taken to a region where tissue culture of banana seedlings and drip irrigation system were followed successfully. The farmers interacted with the practising farmers and are now practising both the techniques. The organisation facilitated three demonstrations, *viz*. rice cultivation using SRI method, drip irrigation and use of plant growth promoters in the farmers' fields. One of the demonstration fields received the Best Farmer Award from the Joint Director of Agriculture, Dindigul district. The association is working closely with the Department of Agriculture in linking the farmers with relevant access to schemes like biofertiliser and micro nutrient application, vermicompost production, SRI planting and seed production of vegetables. The institution is acting as a centre for training and capacity building and

information for local farmers and emerging as a farmer-managed resource centre for the region.

The hub of VKC, a decentralised weather station, disseminates medium range weather forecast for the region and manages a market website in collaboration with local commission agents to expand the forward market links with local traders. It also disseminates the local cropping system-based advisories to farmers through other VKCs and bulletin boards. Steps have been taken to install a public address system to reach more farmers. The local newspaper *'Seithisolai'* provides seasonal and local cropping system-based information, which is successfully adapted to the region, and helps farmers to access the schemes of the agricultural extension department in the region. The experience of using Open and Distance Learning (ODL) for sustainable agriculture through local farmers' associations was shared at the Pan Commonwealth Forum 4 organised by Commonwealth of Learning. In addition, Tamil Nadu Open University has shown interest to offer community development ODL courses to the informal group of farmers and agricultural labourers by recognising this association as a local centre. In order to strengthen the cultivation of fruit trees and vegetable crops in the region, the Association extended its support to the Department of Horticulture in completing the village level survey in five villages. The Association is negotiating with the Departments of Horticulture and Agriculture and drip irrigation companies to increase the area under drip irrigation.

***Kulumai - SHG Federation*:** The federation with its strength of 150 SHGs continued its efforts to strengthen the organisational and financial management systems of the individual SHGs and the federation. Its major focus is on strengthening the capacity of the SHGs, facilitating credit support from community banking activities and linkages from formal financial institutions like banks. It also promotes the formation of new SHGs, facilitating entrepreneurship training and SHG managed enterprises. A Management Information System (MIS) was developed and monthly statements are being prepared and community banking operations are being carried out using special accounting software. Five new groups from economically and socially disadvantaged communities were started. The annual turnover of the federation is Rs. 2.5 crores with a repayment of more than 90 %. *Kulumai* mobilised around Rs 39,00,000, of which Rs 28,80,000 was through commercial banks and Rs 11,05,000 from government departments. Nearly 72.5 % of the groups belong to backward communities, 24.17 % are SC, and 1.34 % are ST. The utilisation of microcredit to strengthen/initiate livelihood activities like agriculture, livestock, petty business and microenterprise has increased from 57 % to 74 %. Nearly 10 % is used for educational purpose, 11 % on medical expenses and 7 % on housing; expenses on festivals was reduced from 9.5 % to 8 %.

In order to improve the financial transactions of both Federation and individual SHGs, a formal audit was carried out by professional auditors and audited statements were

presented in the group meetings. Non-uniformity in accounts writing and not maintaining proper vouchers were found to be the problems and were addressed through training of SHG leaders from each cluster on accounting rules, new cash books and ledger format, hands-on experience on accounts writing in the new format and preparation of financial statements. The Federation supported six members through its partner-agent model risk cover schemes.

The governance structure of the Federation was revised and election was carried out, giving more than 60 % representation to women members. Efforts are underway to promote women members for key positions. The animators of the federation were trained on enterprise development and business plan preparations and initiated business development services for its members. Three SHGs initiated sericulture and one SHG started a silk reeling unit with the technical support of the Department of Sericulture.

Kulumai has been recognised by the DRDA to conduct training programmes on enterprise development and it organised training on vermicomposting to SHG members promoted by Tamil Nadu Women's Development Corporation. Efforts were continued to develop partnerships with NGOs, other SHG federations, farmers' associations, academic and financial institutions and line departments. It organised two livestock camps and an eye camp with the support of a private hospital based at Trichy. In order to strengthen its self-sustainability, the Federation purchased land in Dharmathupatty on its own and financial support for building construction was requested from Friends of MSSRF. The base plan, soil testing, local building structures and surrounding environment were taken into consideration and the plan was drawn up with inputs from the executive committee members of the Federation.

Community Informatics: VKCs functioning in seven villages continued to provide need-based locale-specific information on market trends, government entitlement schemes, educational opportunities, agriculture, pest management and weather forecast. Of the seven VKCs, five centres are facilitating functional literacy, one is involved in managing the weather station and one the market website. Nearly 10,433 members visited the centre during the year for various purposes of which nearly 63% were men and the remaining 37 % were women. 15,904 trainee days were organised in the five centres covering nearly 150 learners, of whom 117 were women.

With the help of the State Resource Centre, Chennai, a special training programme on capacity building, leadership, institutional management and content generation was organised for VKC animators. To create an awareness on the recently enacted 'Right to Information Act', special training was organised and efforts were taken to make available the necessary forms at the Centre. Elaborate photo documentation was carried out by the UNESCO, Delhi office. The experiences of the use of ICT for community development were consolidated by UNESCO with the involvement

of partner agencies to publish it as a 'resource pack'. In addition, the experiences of functional literates were consolidated in the form of a monograph for wide dissemination.

Ecoenterprises for livelihood security

Ecoenterprises such as production of handmade paper from agricultural and hosiery waste, biofungicides like *Trichoderma viride* and *Pseudomonas fluorescens*, biopesticides like *Trichogramma chilonis* and biofertilisers like *Azospirillum*, phosphobacteria and *Arbuscular Mycorrhiza* (AM) were carried out by women SHGs. These enterprises were initiated in the last four years and considering the role change process, efforts were taken to strengthen the managerial skills of the members especially in the day-to day management of the units and equipment, sourcing of raw materials and dealing with market agencies. These entrepreneurial activities are being institutionalised through *Kulumai* at the federation level. The technologies were customised and members have gained the skill to produce quality products. In *Trichogramma* production, inputs on production techniques were taken from other successfully functioning units and the process was standardised.

Multiple marketing strategies were evolved and efforts have been taken to increase the local trade by contacting the plantation estates in Adalur hills as well as local farmers, apart from the regional level markets. VKCs, other SHG members and farmers associations are extending their support to market the products.

In the handmade paper production unit efforts were continued to strengthen the market linkages and the capacity to produce quality paper and value added products. The unit generated 1,000 labour days and produced new products like non-absorbent white board and paper balls. The *Trichoderma viride* production unit produced 3,000 kg and refined the production of *Paeciliomyces* (Bionematicide). The *Pseudomonas fluorescens* production unit produced nearly 4,000 kg and generated nearly 1,000 labour days. Two groups have taken up *Trichogramma* production and produced nearly 500 cc and generated 250 labour days. The biofertiliser production unit produced 2,000 kg of *Azospirillum* and 2,000 kg of phosphobacteria and generated 640 labour days. Techniques for the decentralised production of AM were simplified and refined to meet the local conditions and the unit was designed with an annual capacity of 10,000 kg in six batches. The production of the first batch was started and 1,800 kg in March 2007.

402.2 Pudukkottai

The watershed development programme was initiated with the aim of soil, crop and water management to enhance food production at Ariyamuthupatti and Maringipatti. The Vellar river basin was selected and the details of Thalinji and Ennai villages were collected.

Prior to the implementation of the activities, the following participatory demonstrations were conducted.

Green gram

BARC variety of green gram was sown at Ariyamuthupatti and the yield recorded was 338 kg/acre. Because of the intermittent drizzling the crop was pulled out hurriedly after the second picking even though there were clusters of pods under different stages of maturity. On the 38th day, pods were found in clusters and the first picking was done on the 52nd day. A Field Day was conducted and the farmers observed that the crop was free from pests and diseases and felt happy about the short duration and high yields.

Black gram

As a rainfed crop BARC variety of black gram was sown by 10 farmers in the Ennai Panchayat (Meiyakoundanpatti village) in 6.2 acres and the grain yield was 64.5 to 92.0 kg/ acre. The variance in yield is due to different dates of sowing.

Groundnut

Participatory demonstration of the scientific way of groundnut cultivation was taken up at Ennai Panchayat by 13 farmers. Soil samples were collected and analysed for the macro and micro nutrients. Based on the soil test report fertilisers were applied along with the micro organisms *Rhizobium* and *Phosphobacterium* and gypsum was applied @ 200 kg/acre. The crop was sown at the end of August and germination was normal. Since there were no backup showers the crop was about to wither. During September and October there was a good rainfall of 355 mm in 20 rainy days and the crop came up well with profuse vegetative growth and flowering. But in November 2006, there was 316.4 mm rainfall in 22 rainy days and in December 2006, 336 mm in 20 rainy days and the pods were unable to mature. Hence the crop was harvested. The kernels were puny and wrinkled and the yield ranged from 100 to 230 kg of pods per acre.

Forage Crops

Forage crops (4 varieties of Guinea grass and 4 varieties of Cumbu Napier grass) were planted at Edayapatti. The farmers of Edayapatti, Ennai and the surrounding villages observed the lush and robust growth within a short period of 45 days. So far, three cuttings have been made. The cattle are relishing the tender Cumbu Napier grass and hence there is no wastage.

The successful raising of forage crops was observed by the villagers of Ennai and 10 farmers have replicated it in small areas of 3 to 5 cents and even in their backyards.

Other enterprises

A rice farmer has introduced 500 fingerlings in the trenches and harvested 70 kg of fish within six months.

Earthworm breeding was demonstrated at Ennai Panchayat. Sixteen farmers attended the training programme and 7 farmers have adopted it.

The farmer-friendly model of livestock-based integrated farming system was introduced at Ennai. The studies indicate that this venture is feasible as the waste from the cattle can be utilised as base material for vermiculture.

Five WSHGs have produced 31,070 Tricho cards to the value of Rs. 5,90,330. This is about 20% more than that of the previous year. A soft loan of Rs. 35,000 was arranged to increase production. Four more entrepreneurs came forward to start their own enterprise in Trichy.

Training

During the year 7 inhouse training programmes and four exposure trips were conducted. They were attended by 339 women and 57 men.

Sub Programme Area 403

Hill Region

403.1 Thonimalai

Thonimalai and Pulayar Colony are geographically isolated villages in the western slopes of the Lower Palani Hills. Socially disadvantaged communities, Pulayars and Mannadiyars, the inhabitants of the villages, are small and marginal farmers. The multi-tiered cropping of coffee, lemon, pepper and banana along with a few trees of jack/sweet orange/sour orange/ pomegranate is their basic livelihood. Backyard goat rearing is their secondary livelihood. In addition, during the agricultural season, they work as agricultural labourers in nearby estates. The VKC located in the school building offers functional literacy classes to adult learners as well as computer education to school children and caters to the information needs like market prices of agricultural products, good agricultural practices and techniques and entitlement schemes to local women and men. Apart from this the Centre is coordinating small holders' organic certification and maintanance of Internal Control System (ICS) records.

***Organic farming*:** Considering the traditional organic farming practices *vis-a vis* changes in the trade and market scenario, certified organic farming was adopted as a strategy to enhance the farm income of small and marginal holders. Organic certification has been given by IMO Control Pvt Ltd, Bangalore and two field inspections were completed for 110 households. The certificate was received for the year 2007 in accordance with the requirements of India's NPOP standards and the Commission Regulation (EEC) 2092/2091 and regulation (EC) 1788/2001 for products such as coffee (arabica and robusta cherries), black pepper, lemon, banana, orange and sour orange. During the year 97.79 ha was certified as 'fully organic' and 118.44 ha as 'organic in conversion since 2005'. In order to further strengthen the ICS documentation system, an intensive training programme was organised with the support of the certification agency. Prospective buyers were identified and samples and potential prices were communicated to establish the market links. The process of identifying other buyers is being taken up to reach both national and international markets.

To enhance the production and quality of the products, efforts were taken to provide adequate training and capacity building to farmers on production technologies. The focus

was on agronomic practices like shade management, pruning, nutrient management, pest management and post harvest processing in coffee. It is being done with the technical support of the Coffee Board, Horticultural College and Research Institute and State Horticultural Department. Discussions with the farmers revealed that shade management is a social problem as people cut shade trees to feed the goats and efforts are not taken to plant adequate tree species to ensure proper shade. In coffee cultivation, the provision of adequate shade canopy is essential to protect the plant from light intensity, temperature and low soil moisture.

Through focus group discussions with the farmers, six different multiple use, locally relevant tree species were prioritised and around 4,000 trees were planted. To improve the plant nutrients and soil health, biodynamic soil activator BD-500 and vermiculture-based composting are being promoted. Efforts have been taken to manage pests and diseases, especially bug and twig die back in lemon, berry borer in coffee, wilt in pepper and stem weevil and bunchy top in banana. Also, to promote the use of organic seedlings, a local nursery was established by a SHG and during the year the group produced 20,000 seedlings and supplied them to the farmers in three hamlets.

Thonimalai Thottakalai farmers association is continuing to play the role of local implementing agency to facilitate organic farming. The association is maintaining all the farmers' registers and ICS documents. To improve the post harvest processing of coffee berries, the association has taken the initiative with the technical and financial support of the Coffee Board, Thandikudi, to set up facilities like community pulper machine, pulper shed, storage room cum meeting hall and sprayer equipment.

Also, to ensure access to quality biological products and promote entrepreneurship among women farmers, a women SHG consisting of 15 members came forward to take up the commercial production of bio inputs. The group underwent an intensive hands-on training on the mass production of *Beauveria bassiana* (fungal species) and *Cephalonomia* (Mexican beetle). Subsequently, a business proposal was developed and steps are being taken to obtain financial assistance from the Coffee Board and banks.

Application of Geographic Information System (GIS) in farm and village level planning: The GIS tool was applied to develop a farm-level map of Thonimalai, covering 99 farms in an area of 220 ha to plan for the optimal management of natural resources at the farm level. Field verification of the boundaries was cross checked with Global Positioning System and thematic maps were prepared to initiate the interventions. Individual farm sketches are linked to a farmer database, which has socio-economic and farming details, including the farm history for organic farming. A tool kit on the preparation of field level maps using the GIS tool has been developed.

***Apiculture – an ecoenterprise*:** The forest dwelling Pulayar communities in Pulayar

Colony strengthened their apiculture activities with technical support and training from Keystone Foundation, Kothagiri, The Nilgiris. Each group member is managing three production units, and during the year, domestication of bees increased to nearly 75 %, compared to 60 % last year. The groups gained confidence to tackle constraints like disease, mass mortality and absconding of bees, through intensive hands-on training in the field at Kothagiri as well as at Pulayar Colony. Nearly 50 % of the hives have reached the honey extraction stage. An agreement was made with Keystone Foundation for regular technical support and need-based training. A local animator was appointed by the group to support the members in the effective management of the hives. In addition to apiculture, goat farming is being taken up as a multiple livelihood promotional activity. Discussions were held with them to plant more forage based trees to meet the needs of additional small ruminant populations.

403.2 Koraput

Initiatives for the development of watersheds through community managed bio-industrial activities were taken up at Koraput during the year. The Tolla micro-watershed of the Kukuda Nala sub-watershed that drains into the Kolab River has been identified as a potential site for implementing the project activities. The site covers a geographical area of 638.21 ha. The selected area has an additional advantage of a watershed development programme under a Pilot Programme of the Indo-Danish Comprehensive Watershed Development Project (IDCWDP) implemented in this region (phased out during 1999-2000), and there is a Community Nursery covering an area of 2 ha. The project site falls under the Mouli Panchayat of Boipariguda Block. It is proposed to initiate activities at Tolla village and its hamlets, covering about 159 households. The project activities would be extended subsequently to neighbouring villages within the same micro-watershed.

Sub Programme Area 404

Sesame Seed Village

The Sesame Seed Village project was initiated in August 2004 as an explorative Public-Private Partnership project with Idhayam Group, Virudhunagar, with a focus on improving sesame productivity and quality, through capacity building of the farmers through a facilitation process strengthening the exchange of information, techniques and management practices between various stakeholders. The project continued its field activities in Poolampatti (Salem district), where participatory trials in the farmers' fields were conducted under irrigated condition during April – June 2006. Twenty-nine farmers participated and the area covered was 93 acres. During June – August 2006, field trials were conducted along with 46 farmers under rainfed condition, covering an area of 101 acres. During December 2006 – March 2007, an assignment of conducting a Front Line Demonstration on sesame cultivation as part of the All India Coordinated Project on Sesame

and Niger (ICAR) at Tindivanam (Villupuram district) was carried out with the technical support of the Oilseeds Research Station, Tindivanam. Twenty farmers participated in this programme, covering an area of 8 ha. In all the field trials, yield increase over farmers' practice was observed. For the purpose of ensuring availability of quality seeds, the project has been carrying out seed multiplication activities, for which breeder seeds (SVRP1) are procured from Cotton Research Station (TNAU), Srivilliputtur. This year 50 kg of seeds was procured and distributed to 25 farmers for the purpose of seed multiplication. Around 5 ha have been identified and registered for the production of certified seeds by the Department of Agriculture, Salem district. The project has also been continuing its awareness programme among sesame cultivating farmers at Thirukoviloor (Villupuram district) and Maliampady (Erode district), through periodic visits and interaction with farmers during the cultivating season; 135 farmers have participated in such programmes. A Farmers' Meet was organised in April 2007, to facilitate an interaction between scientists from TNAU and farmers; 350 farmers participated in this programme at Avalpoonthurai (Erode district).

Sub Programme Area 405

Chennai

The activities carried out in the Biopesticide Laboratory at Chennai during the year were in the area of bioassay of medicinal plants (crude and fractions) predominantly against plant pathogens, bioremediation of toxic pesticides using microbes, mass multiplication of biocontrol agents, field trials, training and technical support.

Bioassay of medicinal plants

Antifungal activity of the crude and extract solvent fractions of *Cipadessa baccifera*, *Clausena dentata*, *Dodonaea angustifolia* and *Melia dubia* was studied against selective plant pathogens (*Alternaria alternata*, *Fusarium oxysporum*, *Fusarium udum* and *Rhizoctonia solani*). The results proved that among the different crude extracts tested, chloroform extract of *Cipadessa baccifera* and *Dodonaea angustifolia* suppressed the growth of *Fusarium udum* and *Fusarium oxysporum*. In *Clausena dentata*, acetone extract caused higher growth inhibition in *Rhizoctonia solani* and *F. oxysporum*. The maximum inhibition of *R. solani* was observed in 5 % chloroform extract of *Melia dubia.*

Among the primary fractions, 5th chloroform fraction of *C. baccifera* was effective against *Alternaria alternata*, while 1st fraction of *C. dentata* caused higher inhibition in *R. solani*. *F. oxysporum* was highly susceptible to 2nd chloroform fraction of *D. angustifolia* whereas 2nd hexane fraction of *M. dubia* was effective against *R. solani*.

The Thin Layer Chromatography (TLC) of the active fractions *viz*., Fraction 4 of *C. baccifera*, fraction 1 of *C. dentata* and fraction 2 of *D. angustifolia* and *M. dubia* showed the presence of ice-blue spot. The identification of active compound behind the activity is underway.

Mass multiplication of biocontrol agents: Chrysoperla carnea: Green lacewing, *Chrysoperla carnea,* a brilliant predator with a wide range of prey, has been multiplied successfully. Till date, 13 generations have been completed. The chrysopids were released in the cotton fields at Kannivadi for the management of cotton aphid, *Aphis gossypii* as a demonstration. Participatory field studies have to be conducted to confirm the test results. After sufficient testing at laboratory levels (including demystification) a decentralised low-cost production unit at the field level would be considered.

Laboratory host for Cephalonomia stephanoderis

Mass multiplication of mexican beetle, *Cephalonomia stephanoderis,* for the management of coffee berry borer, *Hypothenemus hampei* is the need of the hour. However, mass multiplication of *H. hampei* at the laboratory itself is a real challenge. Rearing them on a semi-synthetic diet is a new initiative, which reduces dependence on the collection of live borer from the field. Continuous rearing of *H. hampei* would help to breed its parasitoid. Various feed were tried and a semi-synthetic diet for berry borer multiplication has been standardised. Demystification of such

Table 4.1 ***Major pests and diseases noticed in this region and management practices***

Crop	Pest / Disease	Management	Source
Coffee	Berry borer	Mexican beetle release, *Beauveria* spray	Coffee Board, Excel company
	Leaf rust	*Pseudomonas* spray	MSSRF
Citrus	Canker	Botanicals *(Allium sativum,* Cipadessa baccifera, Clausena dentata, *Dodonaea angustifolia and Melia dubia*)	MSSRF
	Powdery mildew	Fire – Bioproduct	Kaveri Agri Tech
	Lemon bug	*Metarrhizium,* Beauveria	Excel company
	Leaf miner	Botanicals *(Allium sativum,* Cipadessa baccifera, Clausena dentata, *Dodonaea angustifolia and Melia dubia)*	MSSRF
Pepper	Wilt	*Paecilomyces lilacinus* and *Trichoderma viride*	MSSRF
Banana	Bunchy top	Mechanical removal, neem cake, neem oil	MSSRF
	Fusarium wilt	Mechanical removal, neem cake, neem oil	MSSRF
	Stem weevil	Stem trap, neem cake, neem oil	MSSRF

technology would be strengthened and later would be transferred to field level production, which could turn into a viable microenterprise in the future.

Field trials

Support services for organic farming at Thonimalai by way of field survey and identification of pests and diseases were provided with guidance for application of IPM packages suitable to the cropping system. The major pests and diseases observed at Thonimalai are given in Table 4.1.

The biofertilisers produced by women SHGs in Kannivadi, and biopesticides (botanicals- *Cipadessa baccifera*, *Clausena dentata*, *Dodonaea angustifolia* and *Melia dubia*) tested at the laboratory in Chennai for the management of pests and diseases, were used wherever feasible. For specific management packages, such as release of mexican beetle, setting up of berry borer traps and spraying entomopathogen, technical inputs from local research stations and institutes working in similar areas were initiated.

Preliminary observations on the ovicidal, larvicidal and growth inhibitory activities of *Cipadessa baccifera*, *Clausena dentata*, *Dodonaea angustifolia* and *Melia dubia* at the laboratory against two major pests namely *Helicoverpa armigera* and *Spodoptera litura* and the earlier field trials against *H. armigera* on rose and *Earias vitella* on cotton encouraged the team to extend the field studies to new ecosystems against new pests and diseases.

Field trial 1: Target pests: Citrus leaf miner and canker; Site:Thonimalai

The experiment (Randomized Block Design) was conducted in 6 acres with the participation of 11 women and men SHGs. Three sprays at weekly intervals of 10 % water extract of leaves of *C. baccifera, C. dentata, D. angustifolia* and *M. dubia* with 5 % garlic pulp extract and 3 % neem oil at weekly intervals were carried out against the citrus canker and leaf miner problems. 2 % *Pseudomonas fluorescens* was sprayed specifically for canker. Applications were given at recommended dose/ tree in a plot size of 12 m^2. Three replications were maintained for each treatment.

In addition to the botanical spray, light traps were set to capture leaf miner moths. Mechanical pruning of dried and infected plant parts was also carried out to prevent further infestation.

Before this intervention, the prevalence of citrus canker and leaf miner was the major problem, resulting in a loss of Rs. 10,000 – 15, 000 / year / acre. After the intervention the loss has been reduced by 35 %-40 %. The percent damage (mean of 3 sprays of 3 replications) was the least (10.5 %) in the plots sprayed with *Cipadessa* extract followed by 11.7 % in *Pseudomonas* treated ones compared to control (untreated) plots, where it was 43.6 %. Among the different extracts tested, 10 % *Dodonaea* leaf extract was far superior, resulting in only 0.3% damage after the cumulative effect of three sprays. This was followed by 10 % *Melia* extract which resulted in 3.8 % damage as against 27.5 % in

untreated plots. The effect of *Melia, Cipadessa, Clausena* and garlic extracts on pest suppression was on par, while no pest suppression was found in the control plots. Based on the observations over a period of 3 months the farmers are convinced and they continue spraying these extracts regularly.

Such IPM packages would definitely help to improve the quality of the organic produce, which in turn would fetch a premium price for the farmers.

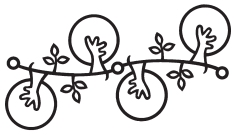
Field trial 2: Target pest: Brinjal shoot and fruit borer; Site: Biocentre, Pillayarkuppam

10 % water extract of *C. baccifera, C. dentata, D. angustifolia* and *M. dubia* leaves alone and in combination were sprayed at weekly intervals (totally 4 sprays were given) against the brinjal shoot and fruit borer, *Leucinodes orbonalis*. The experiment (RBD) was conducted at the Biocentre with the participation of the field staff. Treatments were replicated three times in a plot of 12 m^2 and the data statistically analysed.

In addition to the botanical spray, light traps were set to capture adult moths. Mechanical collection and destruction of larvae and damaged fruits were also carried out to prevent further infestation.

The damage was nil in plots sprayed with *Cipadessa* + *Dodonaea*, *Clausena* + *Dodonaea*, *Cipadessa* + *Clausena* + *Dodonaea* and *Cipadessa* + *Clausena* + *Melia* followed by *Dodonaea* alone (3.7 %) after the 4th spray compared to control (untreated) plots, where it was 91.6 %. Among the different extracts tested, 10 % *Cipadessa* + *Dodonaea* leaf extract was far superior and showed only 4.7 % damage after three sprays. This was followed by 10 % *Clausena* + *Dodonaea* + Melia extract which resulted in 9.5 % damage as against 83.3 % in untreated plots . Close monitoring, consistent technical support and need-based training were provided to already established *Trichogramma* units in the field sites (Kannivadi – Dharmathupatti and Velanservaikaranpatti; Puduchery - Pillyarkuppam and Kakayanthope). An exposure visit was undertaken to the Tittagudi *Corcyra* production unit of M/s Rainbow Biotech. A slight modification in the preparation of *Corcyra* diet was adapted, based on the discussion during the visit. This has resulted in a positive impact in the growth and development of the host insect and increased productivity. In-depth training to women and men on ecofriendly ways of plant protection against major pests and diseases of plantation crops at Thonimalai (203 trainee days), Integrated Pest Management (IPM) and *Trichogramma* (140 trainee days) at Kannivadi and oyster mushroom (270 trainee days) in coastal villages of Puduchery were organised.

Programme Area 500



Food Security

Public food delivery systems is the focal theme of the Report on State of Food Insecurity in Rural India that is nearing completion. The methodology for diet survey was standardised and survey conducted in three villages in Orissa, to provide a base for nutrition awareness and education programmes. A workshop on gender concerns in Food Security was conducted for college faculty and students. A site office has been opened in Wardha, Maharashtra. The focus of activities is on education and livelihood rehabilitation support for farmer suicide affected families and steps to alleviate agrarian distress.

Sub Programme Area 500

Food Security

The Food Security initiatives of the Foundation are being implemented under the aegis of the BV Rao Centre for Sustainable Food Security and the Ford Foundation Chair for Women and Sustainable Food Security.

Sub Programme Area 501

B V Rao Centre for Sustainable Food Security

The activities of the Centre focused on the Report on Food Security in Rural India, coordinating and overseeing the implementation of the initiatives on food and nutrition security at the field level, advocacy and dissemination.

501.1 Technical Resource Centre (TRC) on Food Security

The TRC is engaged in preparing the Report on the State of Food Insecurity in Rural India. Training manuals in English and Oriya on Community Food Banks were finalised and printed. Evaluation of the CFB experience in six project villages in Orissa and two in TN is underway. The Centre also organised conferences and workshops related to food and nutrition security in India.

In addition, the TRC is currently coordinating the food and nutrition security component at Jeypore, Orissa and the activities related to using markets to promote the sustainable utilisation of crop genetic resources, centred on a case study of minor millets in selected areas of TN.

Report on State of Food Insecurity in India

The Report on the State of Food Insecurity in Rural India is nearing completion. The Report analyses the issues, concepts, strategy and policy related to food and nutrition security. It places special emphasis on the evolution of food security policies in India and attempts to identify indicators to measure food insecurity, using the latest data available from the National Sample Survey and National Family Health Survey Reports.

The focal theme of the Report is the public food delivery systems in India. The Report will provide analyses of the three major programmes *viz*., Public Distribution System, Midday Meal Scheme and Integrated Child Development Services.

Advocacy

As a part of advocacy and dissemination, the proceedings and recommendations of the Annual Dialogue organised in April 2006 on the theme *Mission 2007: Hunger Free India,* were printed and widely distributed. The TRC and other centres of the Foundation collaborated in organising the following workshops:

- Research Methodology course on *Gender Studies*, 20-24 November, 2006 in collaboration with Uttara Devi Resource Centre for Gender and Development

- Media Workshop with The HMRC on *Food Security and Human Security* to commemorate the centenary of Mahatma Gandhi's non-violent satyagraha movement, 8 December, 2006 (SPA 606)
- Consultation on *Food Insecurity: A great threat to Human Security*, 29 January - 1 February, 2007 with International Student Young Pugwash (SPA 606)

Community Foodgrain Banks

As part of the evaluation of the CFB experience gained from foodgrain banks started in five hamlets in Koraput district in 2002, one hamlet in Kalahandi district in 2003 in Orissa and two villages in Kalrayan Hills in TN in 2003, the necessary field-level data have been collected and tabulated. Analysis of the same and report writing are underway.

A survey visit to Jawahar block of Thane district of Maharashtra was undertaken in August 2006 to understand the problems of malnutrition and transient hunger in that area. The Bharatiya Agro-Industries Foundation (BAIF) assisted in this. In May 2007, a visit was undertaken to the field areas of Gene Campaign (GC) in Ranchi district in Jharkhand to study the need for foodgrain banks. GC is working on biodiversity conservation and has set up community gene and seed banks in clusters of villages. Work has been initiated to assist GC to set up CFBs in their field area.

Training programmes on foodgrain banks for various groups of stakeholders are being planned based on the Training Manual on Community Foodgrain Banks. It is planned to bring out the manual in Tamil and Hindi.

In all, 22 Community Gene-Seed-Grain Bank initiatives have been started in the field areas in Koraput, Kalahandi and Kandhamal district under different projects at different points of time. It is proposed to undertake a review of all such initiatives from the point of view of management and sustainability of operations.

501.2 Food Security Interventions in PAN–MSSRF Project Villages in Jeypore

House-listing Survey

House-listing survey was conducted in three villages *viz* Nuaguda, Boliguda and Gunthaguda, using a pre-designed format. The information collected on population, livestock and occupation has been tabulated and analysed.

Community Grain Banks (CGB)

Under the food security theme, the ongoing interventions include addressing the immediate problem of transient hunger through the community foodgrain banks, understanding the ground level situation with regard to nutrition and initiating measures to address it. Of the three villages, community grain banks were already in existence in Boliguda and Nuaguda villages. The existing CGB management committee in Boliguda was reorganised. Both Boliguda and Nuaguda management committees were oriented on management aspects, rules and responsibilities. Measures have been initiated to strengthen their capacity. Participatory micro plans have been developed with the people in both villages.

In Gunthaguda, where there was no grain bank, eight members from the village, including four women, were taken on an exposure visit to existing grain banks in nearby villages. Following that, a management committee consisting of 3 women and 2 men has been formed and a participatory microplan prepared. One villager has donated land for the construction of a grain bank storehouse which is under progress. Of the 80 households 68 contributed 10 kg each to the grain bank corpus. A village development fund has been started with each household contributing Rs.2 per month.

The stock of paddy in the Nuaguda and Boliguda grain banks was 1.8 tons and 2.8 tons respectively in February 2007. The rate of interest charged by the banks is 25 %. It is planned to include ragi and pulses in all the banks, to promote their consumption.

Diet Survey

A diet survey has been completed in all the 3 villages to provide a basis for planning an intervention from the Food and Nutrition Security perspective, and to promote a holistic understanding and approach. A purposive sampling of households with children below three years and adolescent girls was taken for the survey. The survey attempts to establish baseline information on (a) the extent of dietary diversity in the selected households, (b) the quantity of food and nutrient intake among the members, (c) the nutritional status of mothers, children below three years and adolescent girls, and (d) the intrahousehold distribution of food among the household members, from a gender perspective.

The preliminary step consisted of standardising the methodology for the estimation of household food and nutrient intake. A set of measures and utensils used by the community for cooking and serving was purchased and the quantity of the various cooked food items when served in these vessels was estimated in six different households. The raw food taken for cooking was measured. Afterwards, the weight of the cooked food was taken and the conversion from cooked to raw food was arrived at. About 80 households with adolescent girls (13 to 18 years) and children below 3 years of age were identified in the three project villages. A questionnaire was developed, field tested by the survey team and modified for recording the food habits and food intake of the family.

The survey has provided several leads for intervention to be taken up in a synergistic manner in various areas. It was observed that ragi is as much a staple as rice and attention to cultivation of ragi would be beneficial to the overall household food and nutrition security. Men and women, it was found, are engaged in hard physical labour throughout the day from collecting fuel to walking long distances to markets and doing household work. Interventions for drudgery reduction would help in saving energy expenditure.

The data entry of the completed survey questionnaires for Nuaguda has been made. Analysis will be taken up shortly and a suitable plan of action drawn up for intervention.

Promotion of kitchen garden

Fifty-four households in Boliguda village were provided with seeds of tomato, *palak* and amaranthus for planting around their house. Discussions were held with the Horticulture Officer, Jeypore block, for further collaboration.

The entitlement card in Oriya listing all the extant government schemes on food and nutrition is being updated. Information has also been collected on the food and nutrition value of different food items consumed by tribal communities in the area.

501.3 Using Markets to Promote Sustainable Utilisation of Millets

A Case study on minor millets in Kolli Hills and Dharmapuri plains, Tamil Nadu, India, was undertaken to understand the use of markets to promote the sustainable utilisation of crop genetic resources. This is a follow up of the research programme initiated by the Agricultural and Development Economics Division (ESA) of the FAO in 2004 on agricultural markets and their relationship to farm level decisions on utilising crop genetic resources.

The programme was motivated by the need for policy-makers in developing countries to respond to commitments made under the International Treaty on Plant Genetic Resources to promote the sustainable utilisation of plant genetic resources. This research programme is designed to support and inform strategies to meet this commitment. The programme builds upon considerable work that has already been done by the FAO, the CGIAR centres and others on seed systems, agricultural biodiversity and farmer livelihoods.

India was selected as one of the case study countries under this project because improving access to seeds and varieties and maintaining local diversity are important issues in the current agricultural development and biodiversity strategies of the country. Moreover, India has the unique distinction of having passed pioneering legislation on the Protection of PPVFRA in 2001, incorporating farmers' rights in a centralised manner.

Ultimately, the goal of the project is to identify ways to promote the sustainable utilisation of crop genetic resources, which is a primary objective of the International Treaty on Plant Genetic Resources for Food and Agriculture and the 111 countries which are parties to it. The major objective of this research project is to assess empirically how agricultural markets affect the ways in which farmers utilise crop genetic resources, and to identify possible interventions that the public sector could undertake to improve the market-stimulated farmer incentives to use these resources in a sustainable way.

The project methodology has been designed to answer three main research questions via case studies. The questions are:

- How do we measure farmer access to crop genetic resources(CGRs), especially in relation to crop genetic diversity, in local markets?

- How does access to CGRs in markets affect farmers' decisions to participate in markets for seeds, and what impact does this have on farm levels of welfare and on-farm crop biodiversity?
- How do policies and seed system interventions such as emergency seed relief, seed sector regulation and seed and diversity fairs affect farmer access to CGR in local markets?

Study Areas

Kolli Hills: Situated in Namakkal district of Tamil Nadu, it has a genetically diverse pool of minor millet varieties being grown by the tribal farming communities to meet their food needs; they are self-sufficient in terms of their seed needs. Most of these minor crops are not traded outside the farming communities, though it is now happening on a limited scale in the local and urban markets as a result of recent interventions. Despite a consumption preference among the local farming communities for minor millets, in the recent past the acreage under minor millet crops had declined considerably due to the availability of substitute crops such as cassava, rain fed rice, pineapple and coffee, which were grown exclusively for market purposes. The Foundation has been leading targeted conservation cum commercialisation intervention programmes over the last 8 years in Kolli Hills, with the objective of increasing the marketing potential of these minor millet crops by adding value to them and facilitating the farming communities in maintaining the existing diversity among the minor millet crops by providing economic incentives for their conservation efforts.

In Dharmapuri, the district adjacent to Kolli Hills, minor millets such as finger and little millet are grown mostly under semi-arid, plain conditions, on a large acreage with the existence of fairly developed market centres located in Pennagaram, Harur and Dharmapuri. The farm households also specialise in other grain crops (rice) although minor millets are still considered important for supplementing their food needs. The grains that are traded in the market centres are sent to neighbouring states such as Andhra Pradesh and Karnataka and also to some states in North India. The district also has an agricultural research station located in Paiyur that conducts research on the improvement of millet crops in TN. Thus, compared to Kolli Hills, a market for grains exists but there is no well-developed market for seed. Sometimes seeds of improved or modern varieties of finger and little millet are provided through either government subsidy programmes or through field demonstrations of agricultural research stations. There are no specific or key interventions undertaken by any civil society or government institutions to support marketing of minor millets in the plains. Preliminary visits and discussions with vendors in major market centres and farm households that grow minor millets in Dharmapuri district revealed that farmers in these semi-arid, marginal environments choose to grow different types and varieties of minor millets (finger, little and fox-tail millet). The varieties include both traditional (mostly little and fox-tail millet) and

modern varieties (finger millet). It is not clear whether the diversity that exists at the farm level is transmitted to the markets.

The India case study on minor millets therefore provides an example of comparing two different agro-ecological niches namely plains and hills, with focus on minor millets supplementing food security at the individual household level (subsistence households) with varied degrees of market participation both for seed and grain. Further, the findings of this research on the economic impact of minor millets (both seeds and value added outputs) will have an impact on promoting nutrition-enhanced food security through enhancing the value chain for minor and small grains in India.

As part of the study, household survey in Kolli Hills and Pennagaram, market survey in Dharmapuri region and value chain analysis of millet flour, millet seed and grain sample collections and Geo Positioning Survey (GPS) in markets and millet farmers' fields were undertaken. The details of the process and findings are furnished below.

Household surveys: Farm households from two sets of communities, 'treated' and 'control', were sampled. In Kolli Hills, communities that have undergone various interventions through the Foundation or any other source that benefited the target crops namely minor millets constitute the 'treated group'. This group was compared to the other, 'control' group, which is far away from the treated communities in the same eco-system.

Millet seed and grain survey in markets: In the case of Dharmapuri plains, the definition of 'treated' *vis-à-vis* control is based on market participation – the farms (households) which participate in the market for both seeds and grains vis-à-vis those which do not participate, as there are no visible interventions that influence the target crops in the region.

The markets that have been sampled in Dharmapuri district and the effects of participation in markets on farm-level diversity, as well as the effects of variation in market diversity on individual farmers, are being tested.

Value Chain Analysis (VCA): As a part of the study to identify the input and output value chains of millet crops, the market structure, conduct and performance, several focus group discussions, key informant interviews and traders' surveys were conducted.

Millet sample collection and characterisation: Millet samples were collected in different regions, namely Kolli Hills, Dharmapuri and markets in southern Tamil Nadu.

501.4 Nutrition Security Initiatives

The Centre steered the diet survey work in the three villages in Orissa. This was preceded by standardisation of the methodology, described in detail in SPA 501.2. Guidance was given for a pilot nutritional survuy in selected tribal hamlets of Wayanad (SPA 302.2). Content development for the VKCs and assessment of on the nutrition curriculum of colleges, were the other main areas of work.

Nutrition Curriculum Assessment Workshop

In the last two decades, the South Asian countries have been facing the paradox of increase in per capita food availability and reasonably rapid economic growth coexisting with high levels of childhood under-nutrition. Some sections of the Indian population also seem to be undergoing a morbidity transition whereby under-nutrition coexists with life style diseases such as obesity and coronary heart disease. There have been changes in food consumption patterns, such as decreased consumption of nutritious millets and shift to polished rice. The linkages between food consumption pattern, agricultural production, distribution mechanisms and nutrition security have become increasingly complex, highlighting the need for interdisciplinary dialogue and action. This has led to the recognition that food security at the national level has to be translated into nutrition security at the community level for every man, woman and child.

Since the nutrition curricula of academic institutions have to reflect these changes, as a first step, a one-day brainstorming workshop of nutritionists and agriculture scientists was organised on 29 March, 2007, to assess the nutrition curricula offered at the undergraduate and postgraduate levels. The purpose of this workshop was to bring together nutritionists and agricultural scientists in Nutrition departments of colleges to discuss the scope and extent of the curricula at the undergraduate and postgraduate levels in the context of the current socio-economic and nutritional scenario, to identify the need if any for revising the curricula and formulating a plan of action for working such a revision.

Senior nutritionists from eleven academic institutions in TN participated in the workshop. The lacunae as well as the difficulties in transacting the curricula were discussed. The participants formed two groups and discussed the UG and PG curricula respectively. The group deliberations were then presented and discussed. The highlights of the discussion included the following points.

- The science of nutrition has made tremendous strides. In upgrading the curriculum one has to be selective to see that the technical content of the course has practical application in the community. Therefore, the relevant themes should be identified (e.g. What is the relevance and application of food toxicology?). The link between classroom and field should be maintained.
- In identifying gaps, the resource facilities available within the institution (such as infrastructure and manpower) for transacting the curriculum should be taken into account. One could begin by improving the quality of the content before thinking of filling the gaps, which is more ambitious and needs more money and personnel.
- In the identification of gaps the policy issues in Food and Nutrition security have been left out. It is important to sensitise the students about the existing social

differentiation, which determines the nutritional status of the community.

- A separate paper on Food and Nutrition Security could be introduced in the second or third semester or as an 'add on' course. It should be mainstreamed into the curriculum.
- Once the curriculum has been revised, it should be presented to the University Board of Studies. The Foundation could facilitate the process.

The workshop concluded up with the understanding that.

- The participants would keep the network alive through constant exchange of ideas.
- A second workshop would be held in September to move forward with strengthening the curriculum.

Content Development in Nutrition for Village Knowledge Centres

Development of the nutrition content for dissemination through VKCs was achieved by seeking answers to the following questions:

- For whom should the content be developed?
- What should be the scope of the content?
- How would the knowledge workers disseminate the content?
- What mechanism should be developed for feedback on the utility of the content and its enhancement through local or easily accessible resources?

Discussion with the project staff and analysis of user registers revealed that the users of the centres were from several sections of the community, including farmers, students, children and educated unemployed youth. Since the needs of multiple users cannot be met through a single document, it was decided to focus on a particular group of users. Available data on the nutrition status reveal that nearly 46% of children below three years in India are undernourished. The period of 0-3 years is one of the most vulnerable in the life cycle, since any setback at this age will cause irreversible damage. Improvement of the nutritional status of young children is closely related to household feeding practices, health care facilities and the empowerment of mothers. Hence it was decided to generate content on the feeding and care of children below three years, by the families of young children, with support from knowledge workers.

An outline was developed, which included details of growth and development of children below three years, food given to them, feeding methods, psycho social aspects of feeding, support to mothers by the family, community, local self government and the State. Content testing was done in two stages. In the first stage, a two-day workshop was held for the knowledge workers of Annavasal VRC, Pudukkottai, in May 2006, on the content. The workshop began by discussing the existing food habits of families in Tamil Nadu and the feeding practices, based on research data and the experiences of the participants. At the end of the workshop the participants were requested to observe the feeding practices in

some families in their villages. The participants' feedback pointed out the need for a basic nutrition literacy primer in addition to the content on the feeding and care of children below three years.

A second two-day workshop on communication was held for the knowledge workers a month later. On the basis of their experiences, the knowledge workers selected twelve key messages which they felt were relevant to their community. They also chose to hold an exhibition at the centres during the 'Breastfeeding Week' in August 2006. Inputs were given on basic communication techniques and the participants produced and presented songs, skits, stories and posters on the chosen themes. The content of the presentations was verified. The local ICDS staff, including the Child Development Project Officers, Training Officers and Anganwadi workers, participated in the workshop and contributed to refining the content. Links between Knowledge Centre staff and ICDS personnel were established to help the knowledge workers to improve the content and take follow up action if any after the event.

An exhibition and cultural programmes were held in all the villages of Annavasal. Testing of the preliminary outline has provided the basis for the content, which now consists of two sections: the nutrition literacy primer and a manual for the feeding and care of children below three years, as well as a training manual for the delivery of the content. It has been decided to train the NVA Fellows as master trainers for training the knowledge workers.

501.5 The Sustainability of Farming Systems : A Village Study of the Rice Farming System in North-Eastern Tamil Nadu

The objectives of the research study were to examine current farm productivity in rice based farming systems and identify the ecological, economic and social constraints to obtaining higher farm productivity through these systems and the socio-economic factors and management strategies which have enabled farmers to integrate conservation practices with the economics of farming.

Farm plots located in a village were randomly selected and interpreted for ecosystem health and economic viability. Data were gathered through primary surveys for the crop year 2005-2006. Indicators for ecosystem structure and functioning included species count and density, crop diversification, on-farm material flow, livestock, legume integration and soil quality. Economic viability was interpreted using farm productivity indicators such as yield, water productivity in the farms, N-productivity in rice, profits and labour productivity. Average figures from the farm plots within the same farming system but under different farm management practices were compared. The predominant practices were paddy-dominated legume rotation, organic management of paddy with legume rotation, integrated nutrient management of paddy with legume rotation and livestock-aquaculture-paddy integrated with legume rotation.

It was found from the study that the greater

the degree of on-farm integration, diversification and intensification of farm operations within the farm, the greater the ecosystem complexity, and the better the potential to improve ecosystem health by conserving water, soil health and bio-diversity. The more complex the ecosystem, the greater the farm outputs per unit land and resources, resulting in better profits. Several socio-economic and institutional factors made it possible for households to adopt sound management practices such as access to and ownership of land and water resources, access to institutional support for inputs, timely credit, availability of gender specific labour, skill based training and contribution of family entrepreneurial labour. Strengthening State support to agriculture through extension, credit and post-harvest technology was found to be critical to sustain farmers' initiatives.

Sub Programme Area 502

Ford Foundation Chair for Women and Sustainable Food Security

502.1 Workshop on Gender Concerns in Food Security (26 – 27 February 2007)

A workshop on gender concerns in food security was held for the faculty members and research students of various colleges. This followed an assessment of the need for the inclusion of topics related to women's food security concerns in the Social Sciences curriculum of colleges. A systematic study of the curriculum of Social Sciences and special courses on gender studies /women studies was undertaken in selected city colleges and followed up with discussions with the Heads of Departments and faculty members teaching gender related topics and with other institutions surveying the women study centres in the state of TN. Our findings clearly indicated that contemporary issues and developments related to women's food security concerns in India are not fully reflected in the curriculum of either social sciences or women/gender studies. The second important finding was that a number of college teachers as well as the heads of the institutions were interested in learning more about these issues and willing to introduce them in the curriculum.

The University Grants Commission's regional office at Hyderabad as well as the Ministry of Women and Child development, New Delhi, which are both interested in bringing contemporary women's issues into the curriculum of higher education were approached for funding support. The Ministry of Women and Child Development granted funds for a two-day workshop which was held on 26 and 27 February, 2007. The response was overwhelming and we had to limit the number of participants had to be limited to one hundred. The workshop sought to bring gender equity concerns into the realm of higher education and make teachers and students aware of the food security concerns of women in India today.

The report of the workshop is being finalised. The short, two-day workshop could cover only a limited number of issues, leaving a large

number of other relevant issues unaddressed. However, this workshop is the first step in creating awareness and enthusiasm about women's food security problems.

Resource Persons and Participants

There were 15 resource persons, including the Chairs of the sessions, drawn from all over India. Most of them are researchers and eminent personalities who have headed various committees and commissions to influence public policy related to women. Some of them are also activists with grassroot level experience. A painter was inspired by the workshop idea and painted a special painting for the occasion depicting the current role of rural women. The workshop was split into four technical sessions, with an eminent chairperson and three distinguished speakers in each session, except the first session that had only two speakers due to time constraint and was devoted to macroeconomic implications of gender discrimination.

Prof M S Swaminathan, Chairman, MSSRF, touched upon all the aspects of women's concerns and set the tone for the workshop in his inaugural address, emphasising that a National Action and Policy Research Network on Women and Food Security is needed to deal with all the links of the food chain including the four Cs that women play a role in - Conservation, Cultivation, Consumption and Commercialisation. He said it was important to adopt a women-centric approach in well-funded schemes such as the National Horticulture Mission, Bharat Nirman and the National Rural Health Mission. "There should be focus on women's contributions as well as their needs", he said, pointing out that while women account for 34 % of principal agricultural workers and 89 % of subsidiary workers, they were often deprived of tools such as land ownership, credit and market linkages and livelihood alternatives.

Dr C K Gariyali, Secretary to the Governor of Tamil Nadu, was the chief guest. She pointed out Panchayat-level federations (PLFs) of self-help groups as an example of the participatory approach needed in governance and the framing of guidelines.

The workshop participants appreciated the unique opportunity provided to them to get exposure to various aspects of women's concerns in food security. They actively participated in the discussions following the presentations. A number of colleges both autonomous as well as those affiliated to the Madras University expressed their desire to have a compulsory paper on gender concerns so that the students become aware of the situation.

The workshop was divided into 4 technical sessions. Macro - Economic Implications of Gender discrimination, Gender Concerns in Food Production, Sustainability and Availability, Gender Concerns in Food Access and Livelihood Access and Gender Concerns in Nutrition, Child Care and Healthcare.

The workshop concluded with a discussion between the organisers and the participants. Some issues that were highlighted by the participants include the need for similar

workshops at periodic intervals, the development of a curriculum framework, the need for academic institutions to liaise with NGOs on a continuing basis for hands on experience of the field level problems, areas of possible joint collaborative research on nutrition, a compulsory course on Gender Studies for all students of pure sciences/social sciences for awareness of gender issues and a workshop for teachers of Women's Studies to study the scope and location of the subject among Social Sciences.

502.2 Bearing the Brunt: Unequal Sharing of Economic Distress by Women

The Ford Foundation Chair has been studying the spreading rural distress arising out of the near collapse of agriculture and rural livelihoods at the turn of the century. An attempt is being made to put together the information currently available on this phenomenon. The gender concerns are being set in the food security framework to facilitate more systematic analysis. The focus of the study is on gender inequity in the development process to achieve total food security. The study looks into the current position of women in various situations and brings out the underlying inequity. The analysis of the situation is based mostly on statistical data. It is supplemented by case studies of a qualitative nature as and when the data are inadequate to explain the situation. It has four core chapters, one on each aspect of food security: food availability concerns, livelihood concerns and nutrition and healthcare concerns.

The final chapter summarises the existing gender inequalities with the help of a gender inequality index for India and across the States.

502.3 Advocacy

A number of lectures were given and papers presented at Workshops and Seminars to disseminate the existing information on women's food security concerns. These are highlighted in the section on participation in conferences and workshops.

Sub Programme Area 503

Initiatives in Vidarbha

Following the field visit of the National Commission on Farmers under the chairmanship of Professor Swaminathan to the Vidarbha region of Maharashtra in October 2005, it was decided to initiate some activities to help alleviate farmers' distress under the aegis of the Foundation.

Two Village Resource Centres (VRC) with satellite connectivity were set up with ISRO collaboration in Jan 2006, in Waifad village in Wardha district and in Anandwan, Warora, Chandrapur district. Subsequently on 1 May, 2006 (Maharashtra Day), programmes for educational support of children and livelihood rehabilitation of widows were launched at a meeting held at the College of Agriculture, Nagpur.

The Foundation opened an office in Wardha in November 2006. The following is a brief

Table 5.1 ***Disbursement of Instalments: (amt in Rs.)***

	Primary	Middle	High	Junior College
Class	I-IV	V-VII	VIII-X	XI-XII
No. of children	18	24	27	8
Month				
June	500	1000	1200	1500
Oct	500	500	800	1000
Feb	500	500	500	500
Total	**1500**	**2000**	**2500**	**3000**

report on the activities in the region and future plans.

VRC/VKC network

Further to the two VRCs, three Village Knowledge Centres (VKC) were set up between Dec 2006 and Feb 2007. The first was inaugurated in Lonsavli village, about 5 km from Waifad, on 17 Dec, 2006. The second was inaugurated in Chinora village, 1.5 km from Anandwan on 19 Dec, 2006. On 26 Feb, 2007, a third VKC was setup in Sonegaon Ambaji village in Deoli block of Wardha district. The State Bank of India proposed this village and the bank provided the computers of required specification and furniture for the VKC. The respective Gram Panchayats provided the space for all the three VKCs.

Three more VRCs are to be set up – one each in Yavatmal, Washim and Amravati district in the coming months. The site for the one at Yavatmal has already been identified. At least ten more VKCs will also be set up during the year. Senior officials of both State Bank of India and Bank of India have visited the VRC at Waifad. State Bank of India has expressed a desire to collaborate in the "Every Village a Knowledge Centre" initiative in a big way and have a VKC in all the villages in their service area.

Education Support Programme for Children of Farmers who Committed Suicide

77 children from 37 families spread across the 8 blocks of Wardha district are being supported under the programme. June 2006 was the cut-off date for families considered for coverage under the programme. Accounts have been opened in the names of the mother and child in sub-post offices and the amount is disbursed in three instalments (Table 5.1).

The work is being coordinated by a local committee with Shri J L Salway, chairman of the Wardha District Land Development Bank as chairperson and Shri Atul Sharma, Project Officer, Community Polytechnic, Pipri, Wardha as Secretary. There is an executive committee comprising Prof Jaju of Sewagram Medical College, Shri Joshi, Executive Secretary, Bajaj Foundation and Smt Bharati Thakre, advocate,

to give guidance to the programme. The District Collector and Dr. Ramesh Thakre, agricultural consultant based in Nagpur, are advisors to the programme. Periodic visits are undertaken to the families to talk to them and get their feedback. After the disbursement of the second instalment, feedback was also sought from the headmaster/headmistress of the schools on each child's performance, in a prescribed form.

An overnight camp was held on Feb 10-11 at the Community Polytechnic in Pipri, Wardha, with the mothers of the children being supported under the programme. 24 out of the 37 came. The objective was to have an interaction with them, collect information about them and their families and how they are coping and find out their needs. Faculty members of Tata Institute of Social Sciences (TISS), Mumbai also participated in the camp and information from the women was collected through a questionnaire. This is being analysed and will help determine the future course of action, especially with regard to livelihood rehabilitation programmes for the widows.

One major concern with regard to the children is about their future after they complete class XII. It is planned to expose the children in high school to available vocational training options.

Financial Inclusion Programme

The Foundation is playing a facilitator role in working with the banks operating in Wardha district to bring the entire population under the formal banking system. Bank of India with 20 branches is the lead bank in the district and has been requested to take the lead role in steering the process. State Bank of India is the other major presence in the district coming close behind Bank of India with a network of 18 branches. The SBI has setup a Financial Inclusion Project Team with a nodal officer in charge to focus on making all the villages in their service area 100 per cent financially inclusive. No-frill accounts with a minimum deposit of rupees fifty are being opened in villages at late night meetings where the team goes with account opening forms and a photographer.

A meeting of the District Consultative Committee on Banking (DCCB) chaired by the District Collector was held on 16 Dec, 2006 and the Collector has promised all support for the initiative. Bank of India opened a Credit Counseling Centre in Wardha under the *Abhay* Trust formed by it. A dedicated officer is in charge of the Centre. He has been requested to visit the VRC on a regular basis for providing counseling to farmers.

Sub Programme Area 600

Information, Education and Communication

Under the NVA, 14 Village Resource Centres and 80 Village Knowledge Centres have been set up so far. A five day introductory course on Research Methodology in Women's Studies was organised in Nov 2006. Several conferences and workshops were organised.

Sub Programme Area 601

Jamsetji Tata National Virtual Academy

Three major activities of the Foundation, namely, the intra / internet network, the Village Resource Centres (VRC) and Village Knowledge Centres (VKCs) and the programme of the Jamsetji Tata Training School for Leadership in Rural Knowledge Connectivity (JTS) are being taken care of by the Jamsetji Tata National Virtual Academy for Rural Prosperity (NVA). JTS provides the necessary training to NVA Fellows and Knowledge Workers, apart from developing functional literacy courses and organising thematic workshops based on the needs of VRCs and VKCs. The ICT-enabled development activities of the Foundation are being carried out under the umbrella of NVA. NVA develops locale-specific, demand-driven content, based on the need-assessment surveys through different participatory knowledge management techniques, organises training and awareness programmes and establishes links with several expert institutions / organisations for translating the content into action. Under the NVA, 14 VRCs and 80 VKCs have been set up. The details are given in Table 6.1.

Awareness and Training Programmes, Knowledge Dissemination and Action

A number of need-based awareness, training and knowledge dissemination programmes for farming and fishing communities, including SHGs, were facilitated through networking with various research organisations.

Ninety-seven training programmes were held at different places in Tamil Nadu, Puduchery

Table 6.1 ***Current status of VRCs' and VKCs'***

Year	State / Union Territory	VRCs	VKCs
1998	Puduchery	1	2
1999	Puduchery	-	2
2000	Puduchery	-	1
2001	Puduchery	-	1
2003	Tamil Nadu	1	2
2004	Tamil Nadu	3	1
2005	Puduchery	3	23
2006	Puduchery, Tamil Nadu, Rajasthan , Orissa Maharashtra	5	34
2007 (up to April)	Tamil Nadu, Kerala and Maharashtra	1	14
	Total	**14**	**80**

and Maharashtra (Vidarbha region) from March 2006 to March 2007 with the help of strategic partners. In all 1,834 men and 3,689 women took part in these programmes.

Fisheries

In the fisheries sector, VRCs conducted training awareness programmes on MPEDA fishing boat registration, subsidy for buying GPS, fixing and using GPS and eco-sounder, book binding, sea shell ornamental training, hygienic seafood export, quality maintenance during fishing, hygienic handling of fishes, nutritional components of fish and dry fish preservation and processing.

Health

The VRCs conducted training / awareness programmes on women's health and importance and significance of a balanced diet for the child.

Livelihood

In the livelihood sector, VRCs conducted training / awareness programmes on diesel engine mechanism (including dismantling and assembling of parts of diesel and petrol engines, tailoring, handicrafts, preparation on phenyl, soap oil and blue water, preparation of fish and prawn pickle, importance of sea foods, different methods of fish preservation, candle making and fruit processing.

Agriculture

Training / awareness programmes were conducted on selection of seeds, organic manure, weeding, pest management, cultivation practices of pulses and cereals, details of subsidies, pest management in coconut, System of Rice Intensification, preparation of vermicompost, *panchakaviya* and *amirthakaraisal*, organic inputs / pesticides, rat control, effective utilisation of water for irrigation and methods of saving water.

Livestock

The VRCs conducted training / awareness programmes on organic farming and herbal healing for livestock, general veterinary health camps, clean milk production, quality milk procurement and fodder management.

Other Programmes

Several orientation programmes were conducted for Panchayat Raj members, policy makers, research institutions and SHG members. The GIS Lab provided training to coastal VRCs on wave height mapping using GIS tools.

A series of training programmes for knowledge workers, and meetings with boundary partners regarding the setting up of VKCs and with strategic partners regarding content and capacity building were held. Meetings were also held with SHG members regarding maintenance of accounts, documenting minutes, loan procedures and micro-enterprises. In Waifad, with the help of Sevagram, *charkha* training to SHG members and awareness meetings on agricultural schemes, were organised.

Different Dissemination Technologies

The NVA is using both modern and traditional technologies such as notice boards, wireless public address system, satellite-based video conferencing, WiFi based network, community newspapers ("News of our Village"), mobile jeeps, cable TV, off line audio CDs, videos, K-Yan PCs and the telephone to disseminate information. The community newspaper reaches more than 400 villages in Tamil Nadu, Puduchery, Kerala and Maharashtra. In June 2007, NVA initiated Internet Radio.

Several video conferencing programmes were organised on topics such as the use of medicinal plants, global opportunities for SHG products, soil management, dry land farming, the concept of gene banks and conservation of traditional varieties of paddy seeds, jasmine cultivation practices and System of Rice Intensification.

ICT-based curriculum

The Microsoft Unlimited Potential Programme (MUPP) curriculum is followed in all the VRCs and VKCs. The duration of the course is 120 hours (60 hrs of theory and 60 hrs of hands on training). The successful candidates get Microsoft certificates. The target audiences are the SHG members, women and men from farming and fishing communities, unemployed youth, school teachers, employers from different organisations and school children. From June 2006 to March 2007, 1173 rural women and men were trained in eight VRCs. Two ICT-based programmes for children namely, Computer Aided Learning Programme (CALP) and Intel Learn Programme were conducted, using interactive CDs (62) produced by Azim Premji Foundation. More than 250 schools have been covered by this programme. The target audience are the students studying in classes iii to viii. Technology literacy, critical thinking and collaboration are the topics included in the programme.

Tele-ophthalmology Mobile Van

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 mobile van for this purpose. The mobile unit has necessary ophthalmic equipment for diagnosis of eye related problems and is equipped with spectacle grinding and frame fitting facilities, to provide spectacles then and there at a reasonable and affordable price to the rural community. Between April and June 2007 more than 3500 patients were treated in 6 VRCs through this mobile service.

Monitoring and Evaluation

The NVA has developed several methods to monitor the different activities of the VRCs and VKCs and documented case studies of NVA Fellows, MUPP trainees, and users of VRCs and VKCs. It has also documented the occupation of the users, frequency of the visitors and the purpose of their visit.

NVA Fellows

Rural women and men are rich in traditional knowledge and wisdom derived from working

with nature and natural resources. If rural transformation is to take place, the contributions of the grassroots academicians are essential since they know the problems of rural communities and also the potential solutions. It is important to identify and elect suitable rural women and men who have shown leadership qualities as Fellows of NVA, so that they become role models in their respective villages.

Based on this concept, 458 Fellows have so far been selected from the States of Andhra Pradesh, Assam, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Puduchery, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttaranchal and West Bengal.

Through different regional level workshops, the NVA has prepared a directory of Master Fellows (458) which includes the profiles of Fellows, index of "Cue Words" to identify the NVA Fellows and expectations of NVA Fellows.

During September 1-2, 2006, NVA organised a training programme for developing locale-specific content using a virtual platform at Pillyarkuppam VRC, Puduchery. The main aim of the training was to develop locale-specific content using the expertise of NVA Fellows and share the content among themselves using the virtual platform. Aspects such as existing skills of NVA Fellows and their interest in content development, concept of virtual platform, difference between knowledge and information, introducing Wikipedia, "A-Tutor Learning Management System to Content Development", management of virtual platform, interview techniques, methods of collecting local content and its presentation techniques and audio content development were included.

The NVA uses the Fellows as resource persons for some of the training and awareness programmes to evaluate VRC and VKC activities.

Sub Programme Area 602

Uttara Devi Resource Centre for Gender and Development

This year, it was decided that the responsibility for the internal mandate of bringing a gender perspective into all the activities and programmes of the Foundation will be shared by all the units, projects and programmes of the Foundation, and the Resource Centre will be concerned mainly with the external mandate.

Visiting Fellow

Dr.Maithreyi Krishnaraj, a distinguished scholar in women's studies, and formerly Professor and Director of the Women's Studies Centre at SNDT University, Mumbai, was invited to be the Visiting Fellow for 2007. In this capacity, she edited a volume of essays by several scholars on the theme of *Gender, Food Security and Rural Livelihoods,* including some of the papers presented at the seminar on **Gender, Rice and Food Security** held in September 2004 as part of the activities of the

International Year of Rice. Some of these had earlier been published in a special issue of the *Economic and Political Weekly.*

In addition, Dr. Krishnaraj played a leading role in designing and conducting the Introductory Course on Research Methodology in Women's Studies described below and delivered two lectures during the course.

Women's Studies

In November 2006, a five-day Introductory Course on Research Methodology in Women's Studies was organised, intended for post-graduate research scholars (doctoral and M.Phil) in Women's Studies. Applications were invited from over 30 institutions of higher education in Tamil Nadu and Puduchery and 16 scholars were selected.

The objectives of the workshop were to provide

- exposure to the major trends and concepts relating to gender issues in the political, economic, social and cultural fields, as well as to research methods
- a forum for the scholars to present their ongoing work to an audience of both peers and experts, to get critical feed back
- an opportunity to get some guidance on an individual basis from experts.

The course was structured as a series of lectures in the morning and group discussions in the afternoon. During the morning sessions, ten eminent senior scholars from various disciplines delivered lectures on the different dimensions of the subject. In the afternoon sessions, the participants presented their research proposal, which was then critiqued and discussed in depth by some of the Resource Persons and the other participants. These discussions were found by the participants to be very illuminating and helpful. On the last day, there was a brief evaluation session, after which certificates of attendance were distributed.

The lectures given during the course have been brought together in a volume (on CD) and are being distributed to all interested persons on request.

Voicing Silence

The major activity this year was the completion of the second and concluding phase of the research study titled "Imagining and Performing Gender by Male and Female Artists of Tamil Theatre Genres", by Ms. Perundevi Srinivasan. The first part of the study had concentrated on male artists(*penn vesham* or female impersonators) belonging to the *koothu* genre, and completed in 2003-04. The second part of the study, carried out this year, is concerned with female impersonators in other genres, and women artists playing male roles. During the course of her field work between June and September 2006, she interviewed 28 artists in depth, seven of whom were women. The research questions used during the interviews were more or less the same as those used in the first part, and were intended to explore how the artists conceived of and internalised the "masculine" and "feminine" categories on stage and in real life, whether and how these affected gender relations,

whether the categories were stable or allowed for slippage, and how and to what extent they were affected by audience reactions and expectations. An additional question taken up this time was the impact of Tamil films, actors and styles. A report giving a glimpse into some of the findings as well as the audio-tapes containing recorded interviews in full are now available with the Foundation. Several papers are expected to come out of this new exploration of the gender discourse in Tamil theatre, and to be published in appropriate academic journals. It is expected that this study will make a theoretical contribution to the discourse on the conceptualisation of gender, taking gender as performance and countering the earlier "naturalistic" and "essentialist" understanding of gender.

During the year, a number of performances were given of the plays earlier developed by *Voicing Silence* by various groups of women. These included performances of *Pani-t-thee* and *Manimekalai* by a group of traditional performers, and the two plays *Manasin Azhaippu* and *Urayaatha Ninaivugal* developed in 2004 and 2005 for *Kannadi Kalai Kuzhu,* the theatre group set up by some *aravanis.* The latter has now established itself as an independent group with its own sources of funding, meeting our objective of nurturing such women's groups and enabling them to stand on their own feet. However, the traditional artists' group was not able to sustain itself as an independent unit beyond one year, because of the enormous financial burden of managing a professional theatre group in the highly commercialised world of Tamil traditional theatre. They continue to give performances of the new plays when invited and sponsored.

Sub Programme Area 603

The Hindu Media Resource Centre

The Hindu Media Resource Centre (THMRC) disseminates information on sustainable agriculture and rural development using mass media as a technological tool to reach the masses. It is a professional body which 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 THMRC has consistently organised media workshops, public fora, public lectures, media tours and Press interactions on relevant scientific issues. The activities of the year are given below.

Networking and partnership

All the events organised by THMRC are targeted towards research scholars, post graduate students and academicians, in addition to the mainstream media professionals and emerging Community Radio Stations. Based on the theme of the workshop/ lecture/brainstorm, the above target groups are invited to participate in the event. The events are structured to give scope for interaction and dialoguing. The consistent efforts in organising events have resulted in establishing a network among Arts, Science and Engineering colleges

Media Workshops

Date	Title
2 May, 2006	*Agrarian Crisis – The Way Forward*
8 December, 2006	*Food Security and Human Security*
26 December, 2006	*Science and Tsunami: Two Years Later*

Public Lectures

Date	Title
22 May, 2006	*Protecting Biodiversity in Dry Lands*
5 June, 2006	*Desert and Desertification – Don't Desert Dry Lands*
16 June, 2006	*Ethics and Public Health Policies: Universal Salt Iodisation Programme - A Case Study*

Public Fora

Date	Title
28 July, 2006	*Mission 2007: Every Village a Knowledge Centre – A Road Map*
4 October, 2006	*Biotechnology and Global Public Good*

Press Interactions

Date	Title
11 May, 2006	National Technology Day
22 April, 2006	Launch of Initiative on *"Ending Child Hunger"*
24 June, 2006	Colloquium on Industry-Institute-Government Collaboration in Fisheries Development and Professional Fisheries Graduate Forum Awards Programme
26 June, 2006	National Commission on Farmers Meet on draft policy statement for Farmers
17 July, 2006	Enlarging Food Basket: Role of Ragi, Bajra, Jowar and Millet in Public Distribution System

27 July, 2006	Third Convention of the National Alliance for Mission 2007: Every Village a Knowledge Centre
28 July, 2006	Announcement of Mission 2007: Rural Incubation Fund
28 August, 2006	Draft policy of the National Commission on Farmers
10 October, 2006	International Workshop on Nanotechnology and Water Development
8 December, 2006	Food Security and Human Security
26 December, 2006	Science and Tsunami: Two Years Later
3 March, 2006	Coffee, a healthful drink

Training and Communication Workshops

Date	Title
30 August, 2006	Effectiveness of the strategies and communication formats while creating awareness (Pudukkottai)
2 September, 2006	Local content collection and presentation techniques (Puduchery)
23 November, 2006	Community newspaper content writing,
	Producing Radio Programmes and designing content (Thangachimadam)
4 February, 2006	Radio Programming - Community Radio (Anna University, Chennai)

and media houses. Fifteen such colleges were added to the network this year.

Event management and impact

During the year THMRC organised 36 events. A total of 320 media professionals attended them, and 418 feature stories were published. It was found that each event was attended by eight journalists on an average and around 40 news and feature stories have been 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 the grassroot academicians of the NVA in the workshops organised at Puduchery, Nagapattinam and Thangachimadam.

Visual documentation

Two documentary films, *Science and Tsunami-Two Years Later* and *From Concern to Confidence* were produced.

Science and Tsunami-Two Years Later documents the initiatives taken by the Foundation after the tsunami and their impact. *From Concern to Confidence* portrays the Participatory Plant Breeding (PPB) technique, which is one of the pathways in the conservation, enhancement and sustainable utilisation of traditional rice varieties.

Development of visual resource material

The NVA has felicitated the knowledge workers as grassroot academicians. At the inauguration of the Jemsetji Tata Training School (JTS), the visual resource material developed by THMRC in coordination with the NVA was released. Their wisdom, innovative practices and success stories were visually recorded and developed as multi media kits for possible use as resource material by JTS.

Website

To increase the user friendly features in the website www.mssrf.org an audio corner, video corner, photo gallery, info ticker, and power point presentations were added. The feedback from the journalists confirms their usefulness. Media tracking substantiates the increased number of publications in the newspapers and magazines using the audio from the website. The Video Corner possesses two films, *Science and Tsunami-Two Years Later* and *We Shall Overcome*. Both the films can be downloaded into any multi media-enabled mobile phones. The regular monitoring of web hits shows that both the films are viewed 50 times on an average per month and 700 pages are viewed 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. Four hundred and eighteen 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 the Foundation. 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 THMRC.

Video Catalogue: To make effective use of the 35 documentary films so far produced by THMRC, a video catalogue containing details about free access, concept, format, and availability of the film 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 data base 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: The Foundation receives visitors from all walks of life including Government officials, delegates, scientists, research scholars and students from schools and colleges. There were nearly 1200 visitors to the Foundation this year.

Sub Programme 604

Every Child a Scientist Programme

The *Every Child a Scientist* (ECAS) programme has been functional since August 2002 in Chennai and has evolved considerably in these past five years. This programme targets, largely, students from Corporation schools within a five-kilometer radius, and from other schools with economically underprivileged students. The center is equipped with fifteen computers and resource material in multimedia format to add another dimension to education. Since its inception we have had different approaches from three month (long term) to fifteen-day (short term) modules with about twenty students in each batch. This year, we had short-term programmes for all batches of students with an option of a repeat programme. Also, this last year, programmes for students from Corporation Zone IX were included with support from the Zonal supervisor in addition to Zone X. A two-day orientation for all teachers from Zone IX was held to explain the concept behind the ECAS programme. Twenty teachers, many of whom teach Biology, were very happy to update themselves with current topics in Biodiversity and Biotechnology. At the end of the meeting, a calendar for the next five months was drawn up. There has also been a request to have a special programme for the teachers, which is being worked out. The duration of each batch was 15 days. A gap of 3 or 4 days between batches was used to develop additional resource material and catalogue the activities of the earlier batch.

The topics covered during these sessions included Biotechnology, Biodiversity, Information Technology, Health, Global Warming and Greenhouse Effect, Pollution and Rainwater Harvesting. Four hundred students from nine schools participated in this programme during the year 2006 – 2007. At the end of each module, the students submitted projects on different topics and expressed their ideas in the form of assignments, charts and models. They prepared models on rain water harvesting, deforestation and types of pollution and charts on the importance of water, food chain, effect on ozone depletion and plant morphology. These charts and models act as a source of information to subsequent batches of students. Some of these charts are also on display in their respective schools and serve the twin purposes of recognising merit and encouraging other students to participate in the ECAS programme. In March 2007, a one-day workshop was conducted for students from various schools. Sixty students attended this programme.

Touch and Smell Garden

This garden was developed to help the visually impaired to experience the joy of nature and learn by exploration through the senses of touch and smell. Children from schools for the blind, NIVH (Dehradun, Uttaranchal and Poonamallee, Chennai) and various NGOs, visit this garden regularly. The garden forms part of the curriculum for all teachers passing out of the NIVH, Chennai. A herbarium (Botanical name and the medicinal uses) of various plants in the Touch and Smell garden has been developed in the current year to facilitate learning about the types of plants and their medicinal value. This year, additional species of medicinal plants like *Hemidesmus indicus, Centella asiatica, Strobilanthes kunthiana, Talinum triangulare, Bacopa monnieri, Coleus vettiveroides and Eupatorium triplinerve* were added to the garden. A CD with detailed information on nearly 75 plants has been developed. The Braille embosser generates resource material in Braille for easy access to the visually impaired and the software also allows them to use the PC with minimal help.

Sub Programme Area 605

Library and Information Services

The Foundation has a well organised library which fulfills the needs of its scientists as well as others from various research and educational institutions.

The library has 15,623 books of which 583 were included this year. In addition, it also holds 230 CDs, 120 journals, 165 newspaper clippings for the year 2006-2007 and 2,151 bound volumes of journals. The existing collection of books was further enriched by adding current and important scientific and technical books. It also has a precious collection of technical reports, and Annual Reports from various institutions.

There are also digests of information downloaded from the Internet. It also offers alert services tailored to suit individual researchers at the Foundation.

The following services are given to the end users:

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

The Web based Open Access Archives (OAA) benefits scholars from across the globe.

The Library provides assistance to research students working in the areas of Biotechnology, Agricultural Sciences and Life Sciences. During the year, around 800 students from various national and international Universities made use of the resources.

Sub Programme Area 606

Conferences and Workshops

Brief details of some of the major conferences/ workshops organised during the year are highlighted in this section.

Environmental Day Programme, 5-7 June, 2006, MSSRF, CAbC, Wayanad

A three-day workshop for students and tribals of Kallumala Colony was conducted in connection with World Environment Day. Wild food, leafy vegetables and medicinal plants were planted. 340 students from various schools and 50 members from CAbC participated.

Workshop on "Creating and Networking of Village Knowledge Centres", 6-7 June, 2006, Pillayarkuppam VRC, Puduchery

The main aim of the workshop was to share the experiences of Village Resource Centers (VRCs) and Village Knowledge Centers (VKCs) with NGOs. 53 participants from 41 NGOs, one Farmers' club and one Panchayat leader participated. This workshop was supported by the Ramon Magsaysay Award Foundation, International Development Research Centre (IDRC), Canadian International Development Agency (CIDA), Jamsetji Tata National Virtual Academy for Rural Prosperity (NVA), Microsoft and NASSCOM Foundation. The concept of VRCs and VKCs, steps involved in their establishment, the importance of connectivity, content development, capacity building, care and management of the centres, opportunities and constraints of NGOs establishing VKCs, were some of the topics that were dealt with.

Reality Check Workshops on Measures of Impact of Science and Technology in India: Agriculture and Rural Development, May-June, 2006, Dehradun

Reality Check Workshops were organised on 16 May and 6 June, 2006 in Anand Agricultural University, Anand and the Forest Research Institute, Dehradun, respectively. The main purpose of the workshop was to present the draft report of the study, "Measures of Impact of Science and Technology in India: Agriculture and Rural Development" for discussion among experts. Though the entire draft report was presented in both the places, the main agenda was to discuss the chapter on Animal Husbandry in Anand and Forestry in Dehradun. About 50 experts in the relevant fields attended each of the workshops. The approach and methodology adopted in the study as well as the findings were discussed at length and several useful comments and suggestions were received.

Workshop on Biodiversity: Conservation of medicinal plants and revitalization of traditional healthcare systems of Kerala, 10 – 11 June, 2006, Irinjalakkuda

A two-day workshop was organised jointly by the MSSRF Community Agrobiodiversity Centre at Kalpetta and Interdisciplinary Scientific and Development Organisation (ISRDO), Irinjalakuda, at Christ College, Irinjalakuda, on the conservation of medicinal

plants and revitalisation of primary healthcare systems of Kerala. Fifty-five college teachers and students participated in the workshop which focused on the various aspects of medicinal plants.

Brainstorming meeting on "Technology Options for Natural Resource Management and Improving the Livelihood of SC/ST populations", 24-25 July, 2006, Jeypore, Orissa

The brainstorming session was organised at Jeypore as the region represents the largest concentration of tribal people with a low economic profile and the least development initiative. At the same time, the region is home to internationally recognised biodiversity heritage systems and many crop and non-crop species. The region is also recognised as a secondary centre of origin of rice and many traditional landraces are either lost or are on the verge of being lost. The meeting focused on various biological/biotechnological interventions in the coastal regions of the country and regions with a large population of SC/ST and people from weaker sections of society.

There were 52 participants, including 4 DBT Task Force members and the member secretary, representatives from government, NGOs and experts in various fields.

Papers were presented on the themes of Natural Resource Management, Medicinal Plants and Marketing and Livelihood and highlighted the current status and possible areas of intervention for sustainable natural resource management and livelihood enhancement.

The meeting recommended that the Department of Biotechnology should initiate special programmes in a network mode. It would be ideal to take up a cluster approach focused on need-based intervention, taking into account the existing natural resources, scope for value addition and marketing. The priority areas were identified as agriculture/ biodiversity, soil and water resources, medicinal plants, health and nutrition and livelihood options for both landholders and landless people.

Interaction meeting on introducing the concept of Every Child A Scientist (ECAS) Programme with SSA teachers of Wayanad, 11-13 October, 2006, MSSRF CAbC, Wayanad

A three-day interaction meeting was organised with *Sarva Siksha Abhiyan* (SSA) teachers to introduce the ECAS concept. 60 teachers participated. The concept of Logical Framework Analysis was introduced and teachers discussed activities based on the needs of the children and parents. A district level ECAS programme linked to SSA was launched.

Consultative Meeting on "Reward and Recognition under Farmers' Rights in the PPVFR Act," 4 November, 2006, Jeypore, Orissa

In November 2005, the Government of India implemented certain sections of the Protection of Plant Variety and Farmers' Rights (PPVFR)

Act for the purpose of establishing the PPVFR Authority, which is competent to implement the PPVFR Act. This Authority is currently engaged in developing the framework and regulations for implementing the remaining sections of the Act for the purpose of registration of crop species. As part of this process, the PPVFR Authority organised a multi-stakeholder national consultation on FR along with the Foundation to develop guidelines for implementing the three important aspects of FR provided in the Act. The consultation was attended by about 85 participants from different parts of the country, representing tribal communities, farmers, panchayat representatives, NGOs, scientists, legal experts and government officials. Prof. M. S. Swaminathan (Chairman, MSSRF) and Dr. S. Nagarajan (Chairman, PPVFR Authority) co-chaired the discussions which included the Farmers' Right of recognition and reward to a farmer/ farm community for significant contributions to the conservation of land races and wild relatives of economic plants and their improvement through selection and value addition, the procedure for the registration of farmers' varieties and compensation to farm families when the seeds of a registered plant variety they had procured had not performed on the lines claimed by the concerned public/private sector agency.

A set of recommendations called the '*Koraput Declaration on Farmers' Rights*' resulted from the meeting. Details of the recommendations were published in the 10 March 2007 issue of *Current Science.* One of the most significant recommendations was the institution of the Genome Saviour Awards for recognising the contribution of primary conservers of plant varieties by the PPVFR Authority.

Workshop on Food Security and Human Security, 8 December, MSSRF, Chennai

A one-day media workshop was organised by *The Hindu* Media Resource Centre and the B V Rao Centre for Sustainable Food Security, to commemorate the Centenary of Mahatma Gandhi's non-violent *Satyagraha* movement.

Prof M S Swaminathan in his keynote address highlighted the 'Action Plan for Making Hunger History', proposed by the National Commission on Farmers. Eminent Gandhian Shri L C Jain delivered the inaugural address. He recommended the Gandhian model of development and the need for bottom-up grassroot development with the people taking the initiative. Professor Venkatesh Athreya, MSSRF, highlighted the reforms needed to end endemic hunger; Dr A S Abhiraman, Executive Director, Hindustan Lever Research Centre, explained the role of industry in addressing hunger and food insecurity; Dr Swarna S Vepa, MSSRF, discussed the causes and cures of food insecurity in rural India; Dr Rukmani, MSSRF, highlighted challenges to urban food security; Mr Basant Bal, WFP State Director, Orissa, described the WFP programmes on ending hunger; Ms R V Bhavani, MSSRF, explained the decentralised models of Community Food Security Systems to address hunger and Dr Sudha Nair spoke on the role of bio-villages in ensuring sustainable livelihoods.

A discussion with media representatives followed the presentations. The audience of about 75 comprised students, media personnel, academicians and general public.

Travelling workshop on Pro-Poor, Pro-Women Use of Information and Communication Technologies (ICT) for Social Development, 10-18 December, 2006

The aim of the travelling workshop was to provide information to the Sri Lankan participants, including women community leaders / organisers from the plantation community, Information and Communication Technology Agency (ICTA) of Sri Lanka, agencies managing the telecentre in Nuwara Eliya and Badulla districts, plantation management / concerned staff of the Plantation Human Development Trust, about VRCs and VKCs. The participants visited the VRCs and VKCs at Pillayarkuppam, Sempatti, Embalam, Veerampattinam and K C Patti (tribal area) and had discussions with knowledge workers, NVA Fellows and staff.

Consultation on Food Insecurity: A Great Threat to Human Security, 29 Jan – 1 Feb 2007, MSSRF, Chennai

The international consultation was organised in collaboration with International Young Student Pugwash, with support from WFP, IFPRI, SDC, UNDP and UN Foundation. The meet brought together 70 participants from India and abroad, drawn largely from academia, civil society and the student community, including 10 from International Young Student Pugwash.

Drawing on the prevailing scenario of world poverty and hunger and commitments made at various fora from the World Food Summit to the UN MDG 1, the three-day event came out with the *Chennai Declaration on Making Hunger History*. The participants went on a field trip to MSSRF project sites on the fourth and last day.

The consultation strongly emphasized that the attack on hunger has to be a global commitment. The first step in this enterprise has to be an unambiguous delineation of the objective. This Consultation recommended that the goal should be abolition of hunger by 2015, and not halving the proportion or the number of the hungry in relation to any chosen base year. A global coalition for a hunger-free world needs to be built up immediately.

The following five steps were recommended to achieve the goal of a hunger-free world by 2015.

- All Member States of the UN should make the right to a balanced diet, clean drinking water, environmental sanitation, primary health care and primary education a basic human right. The UN should set up a Statutory Body to provide political oversight to the global and national efforts to achieve the goal of a Hunger-free world by 2015. Such a Body should comprise representations of G8 and G20 nations, drawn particularly from food surplus and food needy nations.
- The annual global requirement of foodgrains to ensure that 820 million

children, women and men do not go to bed hungry will be about 200 million metric tonnes or about 10% of the current global foodgrain production. The untapped production reservoir, even with the technologies currently on the shelf, is high in most cropping systems in most developing countries. Therefore by enabling developing countries to improve small farm productivity on the one hand, and by encouraging industrialised countries to launch a special "Making Hunger History Production Drive" on the other, it should not be beyond our technological and economic capability to produce the needed quantities of foodgrains. -The challenge will be to get the needed food to the right person at the right time and place.

- The World Food Programme (WFP) currently allots 90% of food grains available to it for emergency relief, with the rest going to Food for Development programmes. A third window should be opened in WFP for achieving the goal of freedom from Hunger through *a Universal Food Guarantee Programme*, which combines the features of Food for Work and Food for Human Development programmes, with priority attention to pregnant and nursing mothers, infants and children and old and infirm persons. All nations should together contribute 200 million tonnes of food grains annually for implementing the Food Guarantee Programme. The proposed UN Body for a Hunger-free world can coordinate the efforts in this area with WFP.
- The Doha Round of WTO negotiations should make the following two commitments for ensuring the successful accomplishment of a hunger-free world by 2015:
- All technologies which can contribute to enhancing human nutrition and health security should be open for the compulsory licensing of rights, so that there is social inclusion in access to life saving technologies protected by intellectual property rights.
- Nations where over 50 % of the population depend upon crop and animal husbandry, fishery, forestry and agro-processing as the primary source of work and income security in rural areas should have the right to impose quantities restrictions on the import of commodities which can result in destroying local livelihoods/jobs. Safeguarding and strengthening local livelihoods should be the bottom line of all trade policies. This is essential since the famine of work or sustainable livelihood opportunities is now the predominant cause of chronic hunger.
- Predominantly rural and agricultural countries should promote decentralised community managed food and water security systems, which involve the organisation by the community field gene banks to conserve local grains, seed banks, food banks and water banks. This will help to enlarge the food basket by including a wide range of nutritious but underutilised crops in the domestic diets. Today, global

food security systems depend upon less than ten major crops. This is potentially dangerous, particularly in the context of impending adverse changes in temperature, precipitation and sea level as a result of climate change. Conserving agro-biodiversity and linking conservation, cultivation, consumption and commerce in the form of local level food and nutrition security systems will help to strengthen both food and livelihood security.

Workshop on Planting Material Production and Processing of Yam, 13 February, 2007, MSSRF CAbC, Wayanad

The one-day workshop was attended by 120 farmers from 5 districts of Kerala. An interactive session with the farmers was also organised.

Workshop on Gender Concerns in Food Security, 26 – 27 February, 2007, MSSRF, Chennai

The workshop was held for the faculty members and research students of various colleges in Chennai, with resource persons drawn from across the country. It was supported by the Ministry of Women and Child Welfare, Government of India. (The detailed report is under SPA 502).

Consultation on Developing Mobile Fisheries Application, 22 March, 2007, MSSRF, Chennai

NVA organised an interaction meeting for the fishing communities with experts from Central Institute of Brackish water Aquaculture (CIBA), Indian National Centre for Ocean (INCOIS), International Collective in Support of Fishworkers (ICSF), Tata Teleservices Ltd., Fisheries Coordinator (FAO) – United Nations Team for Recovery Support, and CMFRI. NGOs working with fishers in Tamil Nadu and representatives from fishing communities from the Union Territory of Puduchery and Chidambaram, Nagapattinam, Ramanathapuram and Kanyakumari districts of Tamil Nadu participated. The participants gave several suggestions on relevant information that could be disseminated through mobile phones.

Nutrition Curriculum Assessment Workshop, 29 March, 2007, MSSRF, Chennai

A one-day brainstorming workshop was held for nutritionists and agriculture scientists, to assess the nutrition curricula offered at the undergraduate and postgraduate levels. (The detailed report is under SPA 501.4).

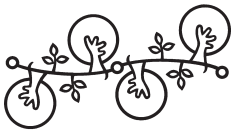
Workshop on Microsoft Unlimited Potential Programme (MUPP) NGO partners meeting, 18-20 April, 2007, MSSRF, Chennai

The main aim of the workshop was to bring together UP NGO partners from across the country to discuss issues of mutual interest relating to UP implementation and/or ICT4D share learning and best practices. The outcome was the identification of the strengths as well as areas for improvement for the UP programme, which can ultimately lead to enhancing its efficacy and reach. The event

was intended for operational-level project staff such as UP project coordinators, lead UP trainers or CTLC managers. The emphasis was on various aspects of field implementation.

The workshop included presentations on the organisation and methodology of setting up of CTLCs, group exercises on issues and needs related to implementing the CTLC curriculum and a discussion with various VRC UP trainees through video conferencing. On the last day the participants visited the VRC at Puduchery and two VKCs.

Sub Programme Area 700



Special Projects

The final report on the Measures of Impact of Science and Technology in India was submitted in Jan 2007. Work initiated in the tsunami affected areas was evaluated. A Vulnerability Assessment tool has been developed based on a few critical indicators that influence climate change.

Sub Programme Area 701

Measures of Impact of Science and Technology in India: Agriculture and Rural Development

The study was undertaken with the principal objective of analysing significant technologies, developed in the public research system and pertaining to the major sectors of the rural economy of India in the post-Independence period. Crop husbandry, animal husbandry, fisheries, forestry, irrigation, health, drinking water and energy have been the areas of concern of this study. The study was initiated in March 2004 and the final report was brought out in January 2007.

The final report comprises 10 chapters dealing with 8 major sectors relating to agriculture and rural development. While each one of the sectors considered in the study has benefited from a large number of technological interventions during the post-Independence period in India, the emphasis here has been on a few significant technological interventions that have helped in bringing about rapid transformation in each sector. Such significant technologies, referred to as catalytic technologies, have been identified and various dimensions of technological achievement such as development diffusion, and the outcome or impact triggered by the catalytic technology have been described. In crop husbandry, animal husbandry and fisheries the attempt has been to analyse technologies that have brought about significant changes in output, whereas the analysis on health, drinking water and energy pertains to technologies or interventions that have brought down the incidence of various diseases and improved access to drinking water and electricity, respectively.

Chapter 2 is a discussion on developments in the crop husbandry sector. Adoption of modern technology in crop cultivation is a very important feature of agricultural development in independent India. The varietal improvement programme, focusing on development of superior crop varieties through plant breeding, has been a vital component of modern agricultural technology. A detailed analysis of technological interventions has been undertaken with regard to some selected crops such as rice and wheat among major cereals, maize and sorghum among nutritious millets, soybean and sunflower among oil seeds, potato among vegetables and sugarcane and cotton among non-food crops. A significant achievement in adopting high yielding varieties has been the quantum jump in crop yield, leading to a corresponding increase in agricultural output.

Chapter 3 provides an overview of the development of irrigation since the 1950s. Expansion of irrigation in the country is in part related to a conscious policy decision of the government to invest in irrigation works and in part to the development of technologies such as drilling technology, leading to investment by individual farmers. Over the five decades and more since Independence, the net irrigated

area has more than doubled and this expansion underlies the significant improvement in agricultural production in the country.

Chapter 4 discusses the developments in the dairy and poultry sectors in post-Independent India. To improve milk production in the country, which was perceptibly low in 1960, multi-pronged approaches in breeding, health cover, feeding and marketing were initiated by the government through various development programmes. Cross-breeding and upgradation were done to improve the productivity of indigenous cows and local buffaloes, respectively. Artificial insemination with improved germplasm by using frozen semen has been the most strategic intervention in increasing milk production. Introduction of vaccines against various diseases and several feeding technologies along with the creation of marketing facilities for rural milk contributed to improving milk production to 91 million tons in 2004. As regards the poultry section, the introduction of high-yielding varieties of eggers such as Rhode Island Red, White Leg Horn and Babcock during the 1970s and broilers such as Cobb and Ross in the 1980s has been a benchmark in its development.

Chapter 5 sets out the technological and institutional interventions with regard to fisheries. Over the years, the fish production system in India has been subjected to several technological interventions pertaining to production, processing, product formulation, packaging and storage. Intensification of fish culture with biotechnological tools, diagnosis and control of diseases that affect fish, improvement in fish nutrition from feed formulation to encapsulation, and assessment of water quality are some of the technological interventions that have been developed over the years. As far as capture fisheries are concerned, the major technological intervention has been the development of different kinds of fishing craft and gear. These developments have paved the way for what is hailed as the Blue Revolution or Aquaplosion in India. The Blue Revolution resulted in an increase in per capita availability of fish in the country, from 3.82 kg/annum in 1986 to 5.55 kg/annum in 2000.

Chapter 6 analyses the technological interventions with regard to forestry. Improvement in the area under forests in India is largely due to interventions in the aspects of conservation and management of the fast dwindling natural forest, protection of endangered flora and fauna, wildlife management and development of high yielding plantations. The impact of satellite technology in forest management has resulted in the appreciation of the status of forests and deforestation. In restoration forestry, significant work in rehabilitation of mangroves and JFM technology are important. In production forestry, the large-scale plantation programme as well as clonal forestry and agro forestry have an outstanding record of application diffusion and achievement both in the public and private sectors. As for wildlife, the Wildlife Institute of India has developed relevant grassroot level technology in wildlife management. Consequent to various measures taken by the

state, the area under forests has registered an increase over the decades since 1950.

Chapter 7 discusses the technical and managerial aspects of various health programmes initiated by the state in the post-Independence period. Major communicable diseases such as malaria, tuberculosis, leprosy, cholera and diarrhoeal disorders and HIV/AIDS as well as vaccine-preventable diseases like poliomyelitis, measles, diphtheria, pertussis, tetanus and preventable blindness are the main focus of the study. The impact of the health programmes is measured using parameters like prevalence, incidence, morbidity and mortality rates of the diseases. Improvement in life expectancy of an average villager in India is taken as a summary measure of achievements in the overall health status of the population. Life expectancy at birth of the average rural Indian in 1970-75 was 48 years and rose to 61.2 years by 1998-2002.

Chapter 8 traces the role of technology in the rural water supply programme and discusses the progress in coverage of habitations with safe drinking water in rural India. Provision of safe drinking water that is free from biological and chemical contamination to all rural habitations continues to remain a challenge in India. In 1986, the National Drinking Water Mission, which was later renamed as the Rajiv Gandhi National Drinking Water Mission (RGNDWM), was launched. This accelerated the pace of several programmes by providing a renewed approach for implementation. There has been rapid growth in coverage of rural drinking water supply from 56.3 % of households in 1985 to 98 % of households by 1999. The introduction of borewell drilling technology and the advent of new and more durable hand-pumps improved the coverage in previously inaccessible areas. A significant number of pump breakdown problems have been taken care of with the introduction of Mark III pumps and a strong back-up by village level operation and maintenance schemes for hand-pumps.

Chapter 9 examines the major technological interventions in thermal, hydro and nuclear as well as renewable energy sources and provides an analysis of progress in supply and improvement in consumption of power in rural India. Power generation has risen impressively in post-Independent India. This has been a consequence of planned investment, successful technology absorption from abroad, indigenous capacity building and modification of technology to suit local conditions. Power reach to rural areas has been made possible by the rural electrification policies, through subsidies and by successfully extending the power grid to remote areas. Village electrification as well as household electrification has made rapid strides in terms of numbers. Agricultural electrification has been a success story considering the difficult terrain and fragmented farmlands and has been a significant factor in increasing productivity. Rural enterprise electrification is still quite low and has not kept pace with the other sectors. However, despite tremendous advances in energy production, demand for power still outstrips the supply.

The study has thus attempted an explication of the perspective that significant technological achievements have been realised by the major sectors of the Indian rural economy. The progress in production with regard to crops, milk, eggs and fish, improvement in health status, and growth in access to electric power and drinking water for India's rural population in the post-Independence period are the result of the proactive role played by the State in promoting R&D that has contributed the technologies crucial for a breakthrough in production and promotion of people's access to basic facilities. However, the analysis covering the period 1950-51 to 2000-01 clearly shows a tapering of growth in the 1990s compared to the 1980s in the major sectors of the rural economy.

The rate of growth of yield of almost all major crops as well as the growth rate of production of milk, eggs and fish declined in the 1990s. The study notes that this trend has very serious implications for the food security of the people and indicates the necessity for State intervention.

The study also points out that the neo-liberal policies pursued by the Government of India since the early 1990s promotes the withdrawal of the State and therefore there is a danger that all the 'achievements' that have been elaborated in this study will be allowed to collapse over the coming years if appropriate measures are not taken to reverse the declining trend in agricultural growth in the country.

Sub Programme Area 702

Tsunami Rehabilitation Measures

702.1 Reviving and Strengthening Livelihoods Through Catalytic Interventions

The tsunami programme has changed its strategy from rehabilitation to development and its focus from disaster management to community-based disaster preparedness. The aim is to prepare the people to respond to disaster and reduce their vulnerability. The measures implemented to achieve this include diversifying livelihoods and crops, promoting new income and employment generating activities, building need-based skills, organising awareness-building programmes, seed storage and establishing linkages with other agencies. The activities were carried out in the same regions of Cuddalore, Nagapattinam and Kanyakumari districts in the State of TN. As in the last two years, the programme borrowed support in terms of expertise and resources from other programme areas of the Foundation. Coordination with the fishing and farming communities, NGOs, government departments and PRI helped to ensure the smooth execution of the project activities and also facilitated mutual learning among these partner groups. The village development councils, farmers' associations and SHGs were the local forums that facilitated and implemented the programmes.

Micro credit programmes for livelihoods

The microcredit programme being implemented in three villages (Samiarpettai and Muzhukuthurai in Cuddalore district and Madavamedu in Nagapattinam district) has been supporting the fishing communities to revive and diversify livelihoods in the post-tsunami context. The internal credit system continued to help the poor fisher women members of around 60 SHGs to meet credit requirements to run traditional enterprises like fish vending. Dry fish processing and vending is the other major activity which received support through the microcredit programme. Other requirements such as asset building, children's education and hospital expenses were also met. Around 750 women received support with a turnover of around Rs. 7.5 lakhs. Rs. 1,07,832 is the interest collected for the last three years. Friends of MSSRF supported one of the clusters operating from Samiarpettai village in Cuddalore district, extending a credit of Rs. 5 lakhs and the cluster returned it 100 % after a year and a half. Based on the request made by the fishermen, four men SHGs were formed in the fishing hamlets and linked with banks. The future plan is to promote access to the available government programmes related to livelihood enhancement.

Promotion of livelihoods through value addition and diversification

Crab fattening, initiated last year, provides a regular profit for the SHG members of the fishing community in Madavamedu village; the group earns around Rs.700 per batch on average from five cages in a fifteen day cycle. Recently the number of cages used for crab fattening was increased from five to ten and the technology was further finetuned to improve the quality of the crabs in the cages. A survey was conducted in the crab landing spots in the region to find the potential of buying more water crabs and to further increase the number of cages. Discussion is going on with the export companies operating in the region to enter into a buy back arrangement. Fish and shrimp pickle making is the other value addition activity that provides employment and income to the fisher women. Two women groups are involved in the activity. A systematic market survey was conducted in the region and the number of individual shops and super markets in the urban centres was identified as regular selling points. The group members were trained to improve the quality and marketing skills. Several methods were adopted to propagate the product in the markets. The production capacity has improved from 50 kgs to 100 kgs per batch with an ensured net income of Rs.10,000 for every batch.

A new enterprise, which is a non-fishery based activity, initiated this year is candle making by the women self help group members in Samiarpettai village. The group members have undergone hands-on training in a private company in Puduchery for five days and established the production unit. A market survey has been conducted and based on the inputs derived from the survey, the different sizes and competitive rates were finalised. The survey also helped to identify local selling points for the product. At present the unit is producing 100 kg of candles, which helps the group to

get around Rs.6,000 per month as net profit. The future plan is to expand the market to urban areas and diversify the product with ornamental finishing which has a great demand in the urban centres and external markets.

Ecoenterprises for employment generation and income enhancement

Based on the cropping pattern and the requirement of the local farmers, VAM biofertiliser unit was established last year in Vettaikaraniruppu village located south of Nagapattinam with training and technology supplied by TNAU. The unit has produced around 1,050 kg of biofertiliser and the product is sold to the local farmers. The net income earned for every cycle is Rs16, 000 and it is planned to have six cycles in a year. A brand name, packing and a simple brochure were designed to reach more farmers in the region. The learnings from this experience helped to support another unit, established by a women SHG in Neithavasal village located north of Nagapattinam. TNAU again extended support to organise an awareness campaign, hands on training and technology support to start the unit and maintain the quality of the product. According to the results, the product has more than 95 % of spore colonization. Strategies like networking with NGOs working on issues related to agriculture and conducting awareness building programmes for biofertiliser application in collaboration with the local farmers' associations have been developed. Discussions have already been held with private companies to buy the product.

The farmers in four tsunami-affected farming villages are producing vermicompost to meet their own requirements and also for sale in the market. The farmers have refined the compost preparation methods according to their own situation and resource availability. Nearly 60 farmers and three women SHGs are involved in the production and during the last year, nearly 200 tonnes of vermicompost worth Rs. 6 lakhs was produced in Vettaikaranirruppu, Vellapallam and Neithavasal villages.

702.2 Agronomic rehabilitation

The other major area of concentration is the agronomic rehabilitation of tsunami ravaged agricultural lands. Instead of disaster relief, a pre-disaster pro-active preparedness method was adopted to promote disaster resilient farming communities. Social mobilisation and promoting area specific Integrated Farming System (IFS) have been adopted as the approach. IFS would help to spread the risk across the different components; hence the farmers would be better equipped to encounter any future disaster. The Foundation has been working directly with four men farmers' associations, three women farmers' groups and two farm labourer groups in the four agricultural hamlets located in Nagapattinam district.

Crop performance

The Foundation continued to collaborate with the four farmers' associations in the four project villages, Anaikoil, Neithavasal, Vettaikarnirrupu and Vellapallam. The practice of summer ploughing, land smoothening wherever needed, green/green leaf manuring, provision

of adequate drainage, application of FYM or vermicompost, use of growth promoters and traditional landraces like *kuzhivedichan* and *kallurundai* were continued as reclamation activities as in the previous year. The total area covered was nearly 24 ha with 67 farmers representing four villages. The crops *viz*, rice and groundnut were harvested. The rice yield in the second year of rehabilitation was affected by drought during the flowering and grain formation stages. The average yield recorded in Vellapallam was very low, ranging from 150-450 kg/acre, followed by 750-1250 kg/acre in Anaikovil and 1,000-1,200 kg/acre in Neithavasal. The groundnut pod yield (1500kg/ha) was comparable with that of the previous year at Anaikovil. In addition to natural factors, rat menace was high during the harvesting period and in some of the fields the damage due to rats was nearly 50 %. In order to tide over the constraint, it is planned to take up community based integrated rat control methods with the support of local panchayats.

Sweet potato, introduced with the support of Central Tuber Crop Research Institute (CTCRI), Tiruvananthapuram, as a contingency crop, has become a regular crop on a small scale. The farmers are self reliant on propagation cutting of different varieties viz. Kanjangad, Sree Rathna, Kanagam, Nandini and Sree Arun and the tubers are marketed locally @ Rs 5/kg. Around 7000 cuttings of Sree Kanjangad, Kanagam, Nandini and Sree Arun were received from CTCRI and 2000 cuttings of Sree Arun and Kanjangad from the last crop which was managed by farmers was planted on an average area of nearly one to two cents depending upon their resources. The average yield recorded was around 12 t/ha. Farmers feel that though the crop is well suited to soil and climatic conditions, large-scale cultivation is limited due to lack of market and demand for the product at the local wholesale vegetable markets. Among the varieties introduced, Sree Arun and Kanjangad are the best suited varieties in terms of productivity, taste, colour and tolerance to weevil menace.

Soil reclamation process

In the post-tsunami context, consistent efforts were made in the recovery process and the detailed soil quality analysis and close monitoring of the affected soils show that soil reaction has improved (Table 7.1).

The soil quality testing shows that in three demonstration sites (Vellapallam, Neithavasal

Table 7.1 ***Improvement in soil quality***

Villages	Jan 2006		April 2006		March 2007	
	pH	EC(dSm-1)	pH	EC(dSm-1)	pH	EC(dSm-1)
Annaikovil	6.90	0.14	7.32	4.06	7.90	0.93
Neithavasal	6.57	0.16	7.45	1.65	7.07	0.40
Vettaikaranirruppu	6.82	0.20	8.20	1.02	7.10	0.37
Vellapallam	6.85	0.02	8.52	1.27	7.43	0.17

and Vettaikaranirruppu) during March 2007 both the pH and EC levels were reduced to normal, as observed in coastal soils before the tsunami and the lands were found suitable for normal crop cultivation. In a few fields in Anaikovil village the soluble salt content was higher during summer but it is below the critical limit of 4 (dSm-1) for normal crop cultivation without any yield loss. The texture of the soil, kind of damage caused and drainage facility of the field play crucial roles in bringing down salinity. Among the selected villages, in Vellapallam, Neithavasal and Vettai-karanirruppu the texture of the soil is sandy and sandy loam with loose friable texture and having considerable drainage facility, whereas Anaikovil fields are sandy clay in texture with poor soil drainage systems. As a long-term strategy a change from 'reclamation' to 'soil health improvement' is essential to improve the soil fertility, considering the vulnerability of the region to other natural hazards like drought and seasonal floods. Efforts such as green manuring, leaching the excess salts using traditional dykes around the field and biofertiliser application wherever possible with vermicompost to manage the soluble salts are essential to continue the practices.

Promotion of area specific Integrated Farming System models

IFS models are being promoted in four villages from different micro agro climatic regions. These villages were identified based on the nature and range of problems caused by the tsunami. The Agronomy Department trained the staff and provided regular technical inputs for the activities implemented in the field.

The main objectives of the IFS model are to reduce risk through diversification, increase the farmers' income and reduce cost of production through more output per unit of land area, efficient use of natural resources, internal recycling of resources and generating year-round employment opportunities. The backward and forward linkages among different allied enterprises help to effectively use/reuse the resources and enhance the soil ecosystem. For example, the straw from the crop goes as feed to the livestock, livestock waste is value added through vermicomposting and used as manure for crop/ forage, milk is sold in the market and consumed at the family level, rainwater is harvested in fish ponds and recycled for paddy cultivation, the poultry unit above the fish pond uses the waste as feed and crop residues are used as feed for poultry; rice bran is used as feed for fish, poultry and livestock. Each of the components/enterprise is linked and efficiently recycled within the farm itself, depending upon the local resources and market opportunity.

The potential crops identified for diversification are sweet potato, *Gloriosa superba*, annual moringa and banana. In order to meet the balanced nutrient requirements of milch animals and stall fed goats, and to reduce open grazing, forage species like cumbu, Napier grass, fodder maize and sorghum, lucerne and stylo were tried. Farm-based allied enterprises like dairy, goat rearing, aquaculture, apiculture and agro-forestry are being integrated with

agriculture. Six allied components were introduced in Vellapallam and Vettaikaranirrupu and seven in Neithavasal and Anaikovil villages. It is planned to have two milch cows in each of the demonstration farms; the animals were purchased at 6 month intervals. Animals were selected from the nearby regions and farmers were involved in the identification process based on the training and inputs from veterinary experts. One male and four female goats of boyar breed were purchased by each farm and 25 cross bred Giriraja poultry chicks were introduced in three farms. Efforts were taken to build the components and establish the forward and backward linkages among them. The major results are increase in farm income, reduced external inputs like nutrients and pesticides and increase in rural employment days. Apart from these, enhanced soil fertility, diversified nutritionally rich food for the family, enhanced productivity, continuous income and employment have also been achieved. Annual farm income during the first year of establishment ranges from Rs. 54,000 to Rs. 62,000 per ha in which fodder and feed cost of livestock and poultry has been reduced by 40 %, which would be further reduced during subsequent years. It helps to create additional labour to the tune of 110 – 130 labour days. The internal recycling of resources also helps to reduce the production costs. For example manure from livestock is value added through vermicomposting that helps to reduce the fertiliser cost to the extent of 60 %. Nearly 120 farmers in the four villages have taken up forage cultivation and vermicompost production.

The activities pertaining to IFS were implemented in partnership with local men and women farmers through the participatory on-farm demonstration model development process. They were involved in the consultation, appraisal and design of the IFS for their respective villages. They were continuously involved in observing and monitoring progress in their village as well as on exchange visits to other villages. The group members share their views and experiences in the monthly meetings and their inputs/ suggestions are being used to strengthen the activity and for further planning. Other stakeholders are also being involved in organising training programmes with the support of technical institutions.

Need-based capacity building and cross learning programmes were organised to enhance the capacity of the farmers and to develop a network among 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, use of biofertilisers, forage cultivation and IPM practices for vegetables. The number of men participants in the different training programmes was around 143 and the number of women participants was around 41, with a total of around 560 for men and 180 for women. The members of the farmers' associations are

slowly emerging as a cadre of local resource persons.

Use of the pedal pump and water management

Farm ponds are the second major irrigation source, especially for vegetable cultivation during the second season; traditionally farmers use earthen pots to lift water from the farm ponds. The alternative water lifting technology for better water use efficiency that was demonstrated with pedal pumps in two villages is working well. In one village it was tried with Gravity Drip Irrigation.

The initiative is now being tried for brinjal cultivation in Vettaikaranirruppu. The initial experience reveals that it helps to reduce water consumption to the tune of around 40 % and the details of water use, man power and crop yield are being recorded regularly.

The high content of soluble salts blocks the performance of the drippers and need-based training cum demonstration programmes were organised to overcome the constraints. *Water for the Third World* offered a weeklong training programme in Kolkata for two farmers, two local masons and a staff member of the Foundation. Based on the training programme, necessary gadgets were purchased to start local production and two pumps were produced and installed in the farmers' ponds. Considering the performance of the pedal pumps and the interest shown by the local farmers to upscale the technology, to 75 such pumps for small and marginal farmers and households headed by women.

Local seed systems and promotion of seed banks

Around 25 traditional varieties suitable 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. A database of farmers who are growing traditional varieties in the project villages was prepared. The traditional gender differential knowledge on the cultivation and post-harvest practices of the local paddy varieties were documented and efforts were taken to involve women farmers in the management of the seed bank. Since the region is prone to different types of natural disasters, steps were intensified to promote utilisation of community based seed banks as a backup storage facility. Nearly 600 kg of paddy seeds were transacted during the year, including two local varieties. During the last harvesting season, five 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.

A brochure and a monograph (both in Tamil and English) on the field experiences and lessons learnt in the last two years were published and shared extensively with other NGOs, INGOs, Government departments and academic institutions. These publications emphasised the need for disaster preparedness for effective response in the

context of agronomic rehabilitation. Both the brochure and the monograph were uploaded in the www.mssrf.org website for wider dissemination.

702.3 Programme for Longterm Educational and Nutritional Support to Tsunami- orphaned Children

Disasters disrupt the education of affected children. Education does not often find a prominent place in the process of rehabilitation. In any post-disaster context, education is ignored in the relief efforts and unfortunately the same continues in the 'relief to rehabilitation continuum' phase also. Ensuring children's access to education should be in the priority list of the rehabilitation measures. Child malnutrition is the other persistent problem in the villages and it predates the tsunami. It is essential to address the food and nutritional security of the affected children in the new unsafe situation where the children have lost their parents and other support systems. Keeping these points in mind, a field- based programme for the tsunami-orphaned children in the worst affected districts is being put in place.

The Foundation has been supporting around 50 tsunami-orphaned children of government and government aided schools from the four fishermen villages of Keelamoovarkarai, Madathukuppam, Naickerkuppam and Thoduvai in Sirkazhi and Kollidam blocks of Nagapattinam district. Guild of Service, an organisation with much experience in child care activities, is continuing its support to implement the programme in the field. These children are identified from relatively neglected villages from the northern part of Nagapattinam. This year another 10 children were added from Kottlepadu and Maramadai villages in Kanyakumari district, in addition to the two children who received support last year from Friends of MSSRF, Japan. A majority of the children are between 11 and 15 years of age and studying in standards 6 to 10.

The children received support for all their educational needs. From the feedback from the schools it is seen that several children have the problem of 'slow learning'. Extra classes were organised to overcome the problem and improve the standard. Since the students belong to different standards the teacher adopts a case-specific approach to address the needs of the children. One of the students who benefited from the programme completed the higher secondary course and joined the Bachelor of Law course in Madurai.

The package for nutritional support has been developed in consultation with a nutrition specialist and the elders of the villages to ensure high protein, fibre and micronutrient supply to the children. Each package contains food materials with balanced nutrition in the form of dry rations including rice, pulses, lentils, nuts, sugar, vegetables, dry fish, and milk powder. The baseline survey conducted at the beginning of the programme shows that the nutritional support helped to improve the health of 75 % of the children. Health camps and promotion of computer literacy are the other

activities carried out with support from 'Every Child a Scientist' programme of Informatics.

The children participating in the programme in Nagapattinam district were organised into four children's clubs in the four project villages. The eldest boy or girl with a sense of responsibility has become the leader and each club has one male and one female mentor identified by the village community to give moral support and need-based practical guidance to the children's clubs. This mechanism helps the children to meet regularly and share their experiences. The forum helps to identify and take care of the individual variations among participating children and also to identify the special needs of individual children and promote freedom of expression.

A one-day training programme for the mentors and leaders of the children's clubs was organised at Chennai. An interactive discussion was facilitated on topics such as listening, style of expression, decision making/planning and implementation. Following the discussion there was an interactive session on what they want to develop in their villages and the support they required.

As a result of the programme 62 children are continuing their education. Thirty children have learned the basics of computer operation. The major learning is that children are inherently vulnerable and the tsunami orphans having lost their family and support systems, need very special attention. It is necessary to develop a holistic as well as case by case rehabilitation package (with gender sensitivity) in close collaboration with the local communities.

702.4. Solar-powered lanterns for energy security to Tsunami victims

Around 830 solar-powered lamps were distributed in two fishing villages (Muzhkuthurai and Madavamedu) and one farming village (Prathamaramapuram), which were worst affected by the tsunami.

These villages were identified for implementing the project based on the extent of the damage and the interest shown by the communities to cooperate. These solar lamps are energy efficient, 100 % solar charged (will get charged even on cloudy and rainy days) with multiple usage, multiple light setting and long life rechargeable batteries (18 to 24 months).

The multi mode, multi purpose lamps are being used very effectively in fishing (this helped the fishermen to replace the kerosene lamp they carry and torch lights with batteries while back water fishing), farming and domestic contexts. These environment friendly lamps help to reduce the expenses for buying kerosene oil. They are also used for domestic purposes such as preparing food and children doing their homework.

The farmers use the lamps as a 'light trap' for pest monitoring and control in the fields. The field staff were trained by Cosmos Ignite Innovations Pvt. Ltd for continuous monitoring and providing technical support when required.

Sub Programme Area 703

Vulnerability Assessment and Enhancing the Adaptive Capacity to Climate Change in Semi Arid Areas of Andhra Pradesh and Rajasthan in India

Our work this year was centred around three main themes under the Climate Change (V&A) project: strengthening capacity to adapt to climate change at the community level; information dissemination; and networking and building partnerships. In a year that saw the community level implementation of several interventions under the V&A project, the Foundation has gained increased exposure and useful insights.

The interventions at the community level were focused on water, agriculture, energy and livestock. Water-related initiatives included lining of irrigation channels, reduction of irrigation intensity, groundwater monitoring and strengthening of water harvesting structures. With regard to land use, efforts are being made to control soil erosion, test options such as System Rice Intensification (SRI), mixed cropping and crop advisories based on weather forecast. Energy initiatives resulted in improved chullahs being designed, tested and put to use at the household level. Health, gender impacts and fuel use efficiency were monitored. Participatory pastureland development and establishment of fodder banks were the other initiatives that were undertaken in the livestock focus area. Locale-specific interventions were designed and implemented in consultation with the communities at the respective project sites (Udaipur in Rajasthan and Mehabubnagar in AP) while considering the possibilities for climate proofing.

Capacity building, awareness generation activities and knowledge management at the community level were the other important ongoing activities.

The Foundation being the lead agency for the project, considerable time was spent in providing technical support, monitoring and managing the project. A mid-term operational plan was drafted to take stock of the past and provide future direction for the project, based on the lessons learnt. On the advice of the project steering committee a Joint Implementation Group (JIG) with representatives from all the project partners was established to discuss the specific issues related to project implementation at regular intervals. Two JIG meetings were convened during the year to sort out implementation issues.

Highlights

- A Vulnerability Assessment tool has been developed (Vulnerability Calculator) based on a few critical indicators that influence climate change. This is being tested.
- A VRC was set up at Jadhol, one of the project sites in Udaipur district of Rajasthan
- A specific cropping system model, based

on climate data analysis for the past thirty years and taking into consideration the crop performances under the three weather codes namely, normal, excessive and deficient, was developed for all the project sites.

- Agro-met observatories were established in all the project sites and a male and female member from the respective communities were trained as climate managers.
- The Foundation worked very closely with a number of stakeholders to disseminate climate relevant messages at different levels.
- An exclusive website on the V&A project was commissioned (http://www.vapro.info)
- The Foundation has been granted official NGO observer status by the United Nations Framework Convention on Climate Change (UNFCCC).
- A series of capacity building workshops involving partner agencies was conducted involving experts on different thematic areas.

Preliminary Insights gained

- Community participation is the key (Rajasthan experience) and has been achieved by a variety of facilitations and interactions.
- Knowledge of past experiences is vital in adapting interventions.
- Generation of social capital through a network of mutually supportive farmers is important for adaptation.
- Effective networking helps to put communities and institutions in touch with each other to share ideas, work collaboratively and build capacity to tackle challenges like climate change.
- Farmers are aware of changes in climate variability but lack the right forecasting information.

Challenges

As this phase saw the transformation from a simple objective-based activities approach to an approach centred on promoting activities based on the formulated hypothesis, there were real challenges of getting across this message clearly to different stakeholders. A series of discussions with various project partners helped to bring some level of clarity on the purpose and benefits of this approach. Bringing conceptual clarity to issues remained a challenge as the messages had to traverse layers of institutions and individuals.

There is uneven progress of the project activities at both project districts because of various local causes. Given the multi-stakeholder institutional set-up, bringing a common conceptual understanding on issues has been difficult. Another important challenge is in translating the key learnings (case studies, best practices, storylines) into effective policy messages and getting them across.

With the release of two important documents this year, namely, IPCC Assessment Report 4 (summary for policy makers) and the Stern Report, highlighting the scientific evidence for

human impacts on the climate system and the economic impacts over the years, it is clearly evident that much has to be done and a developing country like India cannot evade the wakeup call. The coming year assumes more significance as the project enters into a consolidation phase. The ongoing initiatives have to be carefully studied and documented in order to come out with specific case studies/ storylines which could be used to leverage institutions involved in the decision making process. Much of the efforts would be invested in galvanising support from different stakeholders, especially the State agencies.

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Arivudai Nambi, A. 2007. *Inception Workshop for India's Second National Communication to the United Nations Framework Convention on Climate Change*. NATCOM, New Delhi. May 28.

Arivudai Nambi, A. 2007. *Panel Discussion on Climate Change*. USCG-CSM, American Centre, Chennai. June 13.

Asiya, P. 2006. *National Conference on Recent Trends in Mycological Research and 33rd Annual Meeting of the Mycological Society of India*. J. J. College of Arts and Science, Pudukkottai, Tamil Nadu. December 28-29.

Baskar, R. 2006. *State Level Seminar on Tribals, Forest and Futures*. Department of Future Studies, Gandhigram Rural University, Gandhigram. December 11.

Bhavani, R. V. 2007. *Programme Advisory Board of DFID's Research into Use (RIU) Programme, 2006-2011*. Accra. March 13-14.

Biju, K. J., Smita S. Nair, K. A. Sujana, K. Satheesh, K. S. Surabhi and C. S. Dhanya. 2007. *Training on Vegetative Propagation*. Kerala Agricultural University, Ambalavayal. January 24-25.

Choudhury, Amulya Kumar. 2006. *Workshop on Orissa Fisheries Policy*. UNDP and AFPRO, Bhubaneswar. May 25-26.

Dhanya, C. S., K. A. Sujana and Smita S. Nair. 2006. *National Seminar on Wild Life and Biodiversity Conservation*. Pondicherry University, Pondicherry. October 13-14.

Dhanya, C. S. and K. J. Biju. 2007. *Training on Pollination Ecology*. Kalakad Mundanthurai Tiger Reserve, Tirunelveli, Tamil Nadu. February 6-13.

Girigan, G. and T. Manoj Kumar. 2006. *Conference on Marketing Networks for Tiny Enterprises*. ADHWANA, Kerala Forum of Partners in Functional Vocational Training, Trivandrum. December 4.

Gnanappazham. L. 2007. *ISRS South Chapter Meet*. Satyabama Deemed University, Chennai. February 16.

Gnanappazham, L. 2007. *Workshop on Bay of Bengal Biogeographic Information System*. National Institute of Oceanography, Goa, National Institute of Chemical Laboratory, Pune and Centre for Advanced Studies – Marine Biology, Annamalai University, Parangipettai. February 19-20.

Gnanappazham. L. 2007. *Workshop on GIS and Its Role in the 21st Century*. Indian Geoinformatics Centre, Chennai. February 28.

Gupta, Ravi Kumar. 2006. *Second International Conference on Hydrology and Watershed Management with a Focal Theme on Improving Water Productivity in Agriculture: ICHWAM-*

2006. Centre for Water Resources, JNTU Institute of Science and Technology, Jawaharlal Nehru Technological University, Kukatpally, Hyderabad. December 5-8.

Jayakumar, K. 2007. *ISRS Southern Chapter Meet*. Satyabama Deemed University, Chennai. February 16.

John, Joseph. 2007. *National Conference on Mint to Mint*. Indian Institute for Rural Development and South Indian Mint and Aromatic Products, Kanyakumari. January 18.

Kesavan, P. C. 2007. *Advisory Committee Meeting on Reaching the Poorest and Most Food Insecure Beyond the Millennium Development Goals*. Chinese State Council Leading Group Office of Poverty Alleviation and Development (LGOPAD) and the International Food Policy Research Institute (IFPRI), Beijing, China. March 20.

King, E.D. Israel Oliver. 2006. *Green Scientists and Green Layers Forum along with Environmentally Affected Victims*. Tamil Nadu Environmental Counsel (TNEC), Chennai. September 9.

King, E.D. Israel Oliver. 2006. *District Level Environmental Committee Meeting to Combat Pollution*. DRDA, Tamil Nadu Pollution Control Board, Namakkal. September 22.

King, E.D. Israel Oliver. 2006. *International Training and Capacity Building on Medicinal Plants Conservation and Sustainable Utilisation Based on Indian Experience*. FRLHT, Bangalore. October 4-18.

Manoj Kumar, T. 2006. *Training in Computerized Accounting*. Software Solution Integrated, Kalpetta. June 22.

Mathew, Elsy. 2006. *Training Programme on Academy for Initiative in Management*. JC International, Kalpetta. August 5-6.

Mathews, Alishiya and P. Asiya. 2006. *India Organic – 2006*. International Competence Centre for Organic Agriculture, Bangalore. November 10-12.

Mathews, Alishiya and Joseph John. 2006. *National Consultation Workshop on Organic Farming for Mountain States Strategy and Ways Ahead*. GBPIHED, Kosi atarmal, Almora Uttaranchal. July 27-28.

Nair, Sudha. 2006. *Board Meeting of Friends of MSSRF*. Tokyo, Japan. September 9.

Nampoothiri, K. U. K. 2006. *National Seminar on Organic Agriculture*. Reserve Bank of India, Kochi. November 20-21.

Nampoothiri, K. U. K. 2006. *Plantation Crops Symposium (PLACROSYM XVII)*. Indian Society for Plantation Crops, Kochi. December 5-8.

Nampoothiri, K. U. K., V. V. Sivan and Smita S. Nair. 2006. *Awareness Generation on Intellectual Property Rights Protection*. Kannur University, Kannur. November 2.

Parasuraman, N. 2006. *Workshop on Information Technology for the Rural Sector: Village Knowledge Centres – Experimental Sharing*. One Roof USA, Kancheepuram, Tamil Nadu. September 9.

Parasuraman, N. 2006. *Seminar on Malaysia-India Business Opportunities*. Malaysian Business Centre, Chennai. September 15.

Parasuraman, N. 2006. *Seminar on Rising Convergences: Australia, India and East Asia*. Australian High Commission, Hotel Taj Coromandel, Chennai. September 15-16.

Parasuraman, N. 2006. *Third International Forum on Vision and Development: Speeding Up for the Next Milestones*. UNESCO, New Delhi. October 12-13.

Parida, Ajay. 2006. *Programme Advisory Committee Meeting of the HarvestPlus*. CIAT, Cali, Columbia. October 30-31.

Parida, Ajay. 2007. *Programme Advisory Committee Meeting of the HarvestPlus*. IFPRI, Washington D.C. June 14-15.

Prabavathy, V. R. 2007. *Workshop on Management of Intellectual Property Rights in Biotechnology*. BCIL, Chennai. February 22-23.

Prabavathy, V. R 2007. *Training Programme on Paceliomyces Production*. Project Directorate of Biological Control, Bangalore. March 29-31.

Prajeesh, P. 2007. *Nineteenth Kerala Science Congress*. Centre for Water Resources Development and Management, Kozhikode. January 29-31.

Punitha. S. 2006. *International Conference on b-GIS at India*. GIS Engineers Society, Qatar, Department of Geology, University of Kerala and Techno Park, Truvananthapuram. December 7-8.

Punitha. S. 2007. *ISRS Southern Chapter Meet*. Satyabama Deemed University, Chennai. February 16.

Punitha. S. 2007. *Workshop on Bay of Bengal Biogeographic Information System*. National Institute of Oceanography, Goa, National Institute of Chemical Laboratory, Pune and Centre for Advanced Studies – Marine Biology, Annamalai University, Parangipettai. February 19-20.

Rafeek, P. A. Mohammed. 2006. *Fourteenth Triennial Symposium of International Societies for Roots and Tuber Crops*. CTCRI, Thiruvananthapuram. November 20-26.

Rafeek, P. A. Mohammed. 2007. *National Biotechnology Conference – Diamond Jubilee Celebrations*. Sanathana Dharma College, Alappuzha. February 9-11.

Ramasubramanian, R. 2007. *Training on Outcome Mapping*. International Development Research Center (IDRC), Colombo, Sri Lanka. March 5-9.

Rasheed, P. A. 2006. *Karshika Rangam Workshop*. Farm Information Bureau, Regional Office, Vellimadukunnu, Kozhikode. December 7-9.

Rengalakshmi, R. 2006. *Workshop on Community Knowledge Service.* Ecoagriculture Partners, United Nations Development Programme and GTZ. Berlin, Germany. September 7-8.

Rengalakshmi, R. 2006. *International Meeting on Re-Engineering Development: Engendering ICTs - Global Efforts for Local Impact: Moving from Knowledge to Action*. UNESCO, Paris. November 12-14.

Rengalakshmi, R. 2006. *Regional Workshop on ICT for Community Empowerment through Non Formal Education*. United Nations Educational Scientific and Cultural Organisation, Solo, Indonesia. November 20-24.

Rosario, D. 2006. *Training on Watershed Based Land Use Planning for Sustainable Development*. National Bureau of Soil Survey & Land Use Planning, Nagpur. September 18-30.

Santhamurthy, P. 2006. *Entrepreneurial Training on Biofertiliser Production and Quality Control*. TNAU, Coimbatore. October 30-Novemebr 3.

Santhamurthy, P. 2007. *Workshop on Small and Micro Enterprise Competitiveness through Cluster Development Options and Interventions*. TANSTIA, Chennai. February 7-8.

Senthilkumaran, S. 2006. *Stakeholder Meeting CSO/CGIAR Forum*. Washington D.C. December 5-7.

Sivakumar, M. N. 2006. *District Level Discussion on Non Renewable Energy Sources*. Namakkal Collectorate, Namakkal. November 28.

Sivakumar, M. N. 2006. *State Level Seminar on Tribals, Forest and Futures*. Department of Future Studies, Gandhigram Rural University, Gandhigram. December 11.

Sivan, V. V., M. K. Ratheesh Narayanan and Gipson Makil. 2006. *Project Monitoring Training*. Karl Kubel Institute, Coimbatore. November 27-29.

Sivan, V. V. and P. A. Mohammed Rafeek. 2006. *Establishing an Agro Processing Unit in Wayanad*. Taj Residency, Calicut. September 2.

Subbiah, Vijay R. 2007. *Seventh Annual Workshop of Sesame and Niger Research Workers 2007*. All India Coordinated Research Project Sesame and Niger (ICAR), University of Agricultural Sciences (UAS), Dharwad, Karnataka. April 13-14.

Thangavel, P. 2006. *Agaram Programme*. Covenant Centre for Development (CCD), Madurai. October 14.

Awards/Honours

Anil Kumar, N. 2006. *Watson International Fellowship on Environment*. Watson Institute for International Studies, Brown University, USA.

Parasuraman, N. 2007. *The Leader Award* in e-Health from Asia and Beyond. e-Health Asia 2007, Malaysia.

Parida, A. 2007. *Elected Fellow* of the National Academy of Sciences India (NASI), Allahabad, India.

Parida, A. 2007. *Elected Fellow* of the National Academy of Agriculture Sciences (NAAS), New Delhi, India.

Parida, A. 2007. *National Biosciences Award* for Career Development. Department of Biotechnology, Government of India, New Delhi.

Parida, A. 2007. Selected for the *3rd Senior Leadership Programme*. CGIAR and World Bank.

Swaminathan, M. S. 2006. *Life Time Achievement Award for Management*. In recognition of his contribution to sustainable development through mitigation of hunger in India and elsewhere. All India Management Association, New Delhi.

Swaminathan, M. S. 2006. *Sahametrei Medal of the Royal Government of Cambodia (in the grade of Chevalier)*. In recognition of his contributions to the revival of rice research and development in Cambodia and the establishment and strengthening of the Cambodian Agricultural Research and Development Institute (CARDI).

Swaminathan, M. S. 2007. *Honorary Chair in Sustainable Development* to strengthen rural community. Indira Gandhi National Open University (IGNOU), New Delhi.

Swaminathan, M. S. 2007. *Distinguished Global Thinker Award* for his work in the cause of achieving food and agricultural security. Institute for Integrated Learning in Management, New Delhi.

Swaminathan, M. S. 2007. *Member of Parliament (Rajya Sabha)*. Government of India, New Delhi

About the Foundation

M.S.Swaminathan Research Foundation (MSSRF) was registered in 1988 as a non-profit Trust, recognised by the Government of India, Department of Scientific and Industrial Research, New Delhi, and by the Director General of Income Tax Exemptions, for the purpose of exemption of contributions from Income Tax under Section 80G and sections 35(1)(ii) of Income Tax Act, 1961, read with Rule 6 of Income Tax Rules, 1962. The Ministry of Home Affairs, Government of India, has recognised the Foundation for receiving funds from sources abroad under the provisions of Foreign Contribution (Regulation) Act, 1976.

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Ms. Rajam Ashok
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Principal Scientist

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Senior Research Fellow

Ms. Valarmathi R.
Senior Research Fellow

Ms. Trupti Mohapatra
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Bioprospecting, Biopartnership and Micropropagation

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Community Biodiversity Programme

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Community Agrobiodiversity Centre,

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Dr. Malarvannan S.
Scientist

Ms. Pudhumalar Hemavathy M.
Scientist

Dr. Sakthi Vadivel M.
Research Associate, CSIR

Mr. Sekar S.
Technical Assistant

Ms. Geetha S.
Secretary

** Left during the year*
**** Passed away*

Ms. Santhilatha S. Kumar
Secretary

Ms. Roja Rani.D *
Administrative Assistant

Mr. Karthik S.
Lab Assistant

Mr. Mohan S.
Office Attendant

Chidambaram

Dr. Gopalakrishnan A.
Senior Scientist

Mr. Nagaraja C.
Senior Research Fellow

Mr. Magendra Kumar S.
Junior Research Fellow

Mr. Selvaganapathy E.
Technical Assistant

Thiruchengodu

Ms. Shantha Sheela N.
Field Assistant

Kannivadi

Mr. Murugesan S. *
Project Associate

Mr. Seenivasan R.
Scientist

Mr. Selvamukilan B.
Scientist

Poompuhar

Mr. Senthilkumar V.
Scientist

Mr. Saravanakumar S.
Accounts Assistant

Puduchery

Mr. Rosario D.
Principal Scientist

Mr. Santhamurthy P.
Senior Scientist

Ms. Meenakshi G.
Scientist

Dr. Sudarkodi S.
Scientist

Mr. Babu M.
Driver

Mr. Pandurangan V.
Gardener

Ms. Rani R.
Cleaner

Ms. Mangayarkarasi M.
Cleaner

Pudukottai

Dr. Chandrasekaran A. *
Coordinator

Dr. Nageswaran M.
Principal Scientist, Site Coordinator

** Left during the year*

Orissa - Kendrapara

Dr. Maity B.K.
Site Coordinator

Ms. Gitisree Nayak
Scientist

Mr. Amulya Kumar Choudhury *
Technical Assistant

Mr. Jeeva R.
Technical Assistant

Mr. Pradeep Kumar Nayak
Administrative Assistant

Programme Area 500: Food Security

BV Rao Centre for Sustainable Food Security

Dr. Athreya V.B. **
Programme Director - Food Security Studies

Ms. Bhavani R.V.
Project Director

Dr. Rama Narayanan
Advisor

Ms. Anuradha G.
Senior Scientist

Ms. Deepa Varma
Project Associate

Ms. Amrita Jairaj *
Project Associate

Mr. Gopinath R.
Project Associate

Namakkal

Mr. Vedhamoorthy A.
Project Associate

Mr. Sivakumar M.N.
Research Assistant

Mr. Kumar N.
Research Assistant

Mr. Anna Durai A.
Field Assistant

Mr. Senthil Kumar T.
Field Assistant

Mr. Sakthivelan A.
Secretary

Jeypore

Mr. Akshaya Kumar Panda
Project Associate

Mr. Tusar Ranjan Nayak
Project Associate

Ford Foundation Chair for Women & Food Security

Dr. Swarna Sadasivam Vepa
Ford Foundation Chair on Women and Sustainable Food Security

Ms. N. Kritika *
Project Associate

** Left during the year*

*** Woking as Consultant w.e.f. Apr 2, 2007*

Mr. Anand Kumar B.
Technical Assistant

Ms. Chandrakala S.
Technical Assistant

Programme Area 600: Information. Education, NVA and Communication

Jamsetji Tata National Virtual Academy for Rural Prosperity

Mr. Senthilkumaran S.
Programme Director

Prof. Subbiah Arunachalam
Distinguished Fellow

Ms. Tara Gandhi
Advisor

Dr. Vedavalli L.
Consultant

Dr. Balasubramanian K.
Consultant

Ms. Nancy J. Anabel
Programme Coordinator - Capacity Building

Mr. Srinath J.
Programme Coordinator - Content

Ms. Ganga Vidya N.
Coordinator - Mission 2007 Secretariat

Dr. Sophia J.D.
Principal Investigator

Mr. Manikannan S. *
Project Associate/Network Manager

Mr. Rajamanikkam R.
Professional Computer Networking

Mr. Sivakumar P.
Senior Scientist

Mr. Rameswaran K.
Project Associate

Mr. Muthuveeran R.
Project Associate

Mr. Jegan Karuppiah S.
Project Associate

Ms. Sumathi N.
Project Associate

Mr. Kolappa Dhas R.
Technical Assistant

Mr. Sundaram N.
Accounts Assistant

Mr. Balaji P.
Driver

Dindigul

Dr. Nagarajan B.S.
Advisor

Ms. Rupa A. *
Project Associate

Ms. Nirmala R.
Project Associate

Mr. Sundaresan D.
Project Associate

** Left during the year*

Mr. Ananth A.
Technical Assistant

Mr. Britto C.A.S.
Technical Assistant

Thanjavur

Dr. Palaniappan V.
Advisor

Mr. Padmanabhan B.
Project Associate

Mr. Muthukumar M.
Technical Assistant

Mr. Murugan G.
Technical Assistant

Pudukkottai/Annavasal

Mr. Rajkumar Ramasamy
Project Coordinator

Mr. Murugesan M.T.
Project Associate

Mr. Gurumurthy S.
Technical Assistant

Mr. Saravanan R.
Technical Assistant

Nagapattinam

Ms. Velvizhi S.
Senior Scientist

Mr. Balakumar S.
Project Associate

Mr. Mugilnilavan P.
Project Associate

Mr. Suresh P.
Technical Associate

Kovalam

Ms. Rosemeena Amirthanayagam
Project Associate

Chidambaram

Ms. Aruljothi S.
Project Associate

Mr. Aravinthan M.
Project Associate

Mr. Veera Raj D.
Technical Assistant

Mr. Senthamil P.
Technical Assistant

Thangachimadam

Dr. Sivakumar Arunachalam
Project Coordinator

Ms. Sreekirupa R.
Project Associate

Mr. Raju Saravanan
Project Associate

Mr. Abdul Salam K.
Technical Assistant

Mr. Arockia Kevikumar J.
Technical Assistant

** Left during the year*

Puduchery

Dr. Thiagarajan A.R.
Consultant

Mr. Rajamohan K.G. *
Scientist

Ms. Pakkialatchoumy P.
Project Associate

Ms. Josephine Daisy Parimala Rani
Project Associate

Ms. Girija D.S.
Project Associate

Mr. Jayakrishnan G.
Technical Assistant

Ms. Anandalakshmi S.
Technical Assistant

Mr. Lourdessamy Maleappane C.
Technical Assistant

Mr. Thirunavukkarasu V.
Technical Assistant

Mr. Karunakaran B. *
Project Associate

Nagercoil

Mr. Karumalai Kannan R.
Project Associate

Mr. Antony Edward Singh S.
Project Associate

Mr. Yesudhas M.
Technical Associate

Ms. Kavitha A.
Technical Assistant

Wardha

Mr. Vishwanath M. Palled
Project Coordinator

Mr. Tushar Suresh Rao Deshmukh
Project Associate

Mr. Deepak S. Kekan
Project Associate

Mr. Prasanna Prabhakarrao Ghode
Project Associate

Ms. Charushila Thakare
Project Associate

Mr. Sharad P. Sultane
Project Associate

Mr. Pravin Khumbalkar
Technical Assistant

Ms. Sudha J. Bhadane
Technical Assistant

Anandavan

Ms. Sudeshana R. Gajjbhiye
Project Associate

Ms. Mangla J. Meshram
Project Associate

Mr. Avinash Rameshrao Wandile
Technical Assistant

** Left during the year*

Uttara Devi Resource Centre for Gender & Development

Ms. Mina Swaminathan
Advisor - Education, Communication and Gender

Ms. Sheela K.
Senior Secretary

The Hindu Media Resource Centre

Ms. Bhanumathi K.
Coordinator

Ms. Rekha R. *
Programme Associate

Ms. Sukanya Rangarajan
Project Associate

Mr. Suresh Kumar G.
Technical Assistant

Mr. Balakrishnan P.
Consultant

Library and Information Services

Ms. Sylvia Snehalatha **
Manager-Library Science

Mr. Janakiraman A.
Manager-Library Science

Mr. Kuppuswamy.M
Scientist

Mr. Murugan B.
Assistant Librarian

Programme Area 700 : Special Projects

Measures of Impact of Science & Technology in India: Agriculture & Rural Development

Dr. Rukmani R.
Principal Scientist

Ms. Thenmathi N. *
Scientist

Vulnerability & Adaptation to Climate Change

Dr. Arivudai Nambi A.
Project Director

Dr. Balasubramanian T.N.
Consultant

Ms. Veena D. Thirupathi *
Prinicipal Scientist

Dr. Isaac Manuel R.
Research Associate

Mr. Sunder Vadivelu K.
Administrative Associate

Tsunami Rehabilitation Measures

Chidambaram

Mr. Durairaja R.*
Project Associate

Mr. Chinnaraja S.
Research Associate

** Left during the year*

** Woking as Consultant w.e.f. Apr 2, 2007

Mr. Senthilkumar R.
Research Associate

Mr. Balasubramanian P.G.*
Social Worker

Nagapattinam

Mr. Selvarasu T.
Research Associate

Administration & Finance

Dr. Parasuraman N.
Manager - Estate

Mr. Hariharakrishnan S.
Manager, Personnel and Administration

Mr. Parthasarathy C.V.
Executive Secretary

Ms. Udaya Sathyamurthy
Associate Manager (Finance)

Ms. Prathiba Ramakrishnan
Associate Manager (Finance)

Mr. Karthikeyan S. *
Assistant Manager (B&A)

Ms. Latha Murugesan J.
Assistant Manager (A&A)

Ms. Rajalakshmi T.R.
Assistant Manager (P&A)

Ms. Malathy R.
Senior Secretary

Ms. Dilhara Begum Y.
Secretary

Ms. Jayashree R.
Accounts Assistant

Mr. Rukmangathan C.
Accounts Assistant

Mr. Saravanan K.
Accounts Assistant

Ms. Padmavathy G.
Administrative Assistant

Ms. Vijaya Sulochana T.
Administrative Assistant

Mr. Rajakumaran M.
Administrative Assistant

Mr. Suresh K.
Administrative Assistant

Mr. Sivaraj C.
Electrical Supervisor

Mr. Thiruvengadam E.
Electrician

Mr. Muthukumar P.
Electrician

Mr. Sivakumar B.
Electrical Assistant

Ms. Sayeda Habiba Banu Begum
Technical Assistant

Ms. Deepa T.
Assistant (P&A)

Mr. Shanmugam P.
Office Attendant

** Left during the year*

Mr. Gopalakrishnan S.
Driver

Mr. Samuel T.
Gardener

Mr. Lakshmanan P.
Gardener

Mr. Niyas G.
Field Assistant

Ms. Soundari Sundaram
Cleaner

Ms. Lakshmi J.
Cleaner

Mr. Venkateswarlu C.H.
Cleaner

Ms. Vijaya Lakshmi V.
Cleaner

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SOURCES OF PROJECT SUPPORT

Programme Area 100 : Coastal Systems Research

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Reliance Industries Limited, Mumbai	Canadian International Development Agency Canada
Department of Forest, Govt. of Andhra Pradesh, Hyderabad	International Development Research Centre Canada

Programme Area 200 : Biotechnology

Council of Scientific & Industrial Research, New Delhi

Directorate of Forest & Wild Life, Govt. of Puduchery

Department of Biotechnology, New Delhi

Programme Area 300 : Biodiversity

Centre for Environment Education, New Delhi

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Sir Dorabji Tata Trust, Mumbai

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Department of Biotechnology, New Delhi

Department of Science & Technology, New Delhi

International Plant Genetic Resources Institute, Rome

International Food Policy Research Institute, USA

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Programme Area 400 : Ecotechnology

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Planning Commission, New Delhi	Friends of Swaminathan, Australia
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Sir Dorabji Tata Trust, Mumbai	United Nations Educational, Scientific and Cultural Organisation, Thailand
Council for Advancement of People's Action and Rural Technology, Hyderabad	
V.V. Vanniaperumal & Sons, Virudhunagar	
Department of Science & Technology, New Delhi	
Jamsetji Tata Trust, Mumbai	
National Bank for Agriculture and Rural Development, Mumbai	

Programme Area 500: Food Securtiy

Food and Agriculture Organisation of the United Nation, Rome	World Food Programme, Regional Office for South Asia, New Delhi
International Food Policy Research Institute, USA	The Micronutrient Initiative, Canada, New Delhi Office
Friends of Swaminathan, Australia	Department for International Development UK

Programme Area 600 : Information, Education and Communication

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Tata Social Welfare Trust, Mumbai	
Sir Dorabji Tata Trust, Mumbai	
Jamsetji Tata Trust, Mumbai	

National	*International*
Programme Area 700 : Special Projects	
Office of the Principal Scientific Advisor, New Delhi	Swiss Agency for Development and Cooperation, New Delhi
Directorate of Agriculture, Andaman & Nicobar Islands, Port Blair	United Nations Foundation, Washington
Department of Biotechnology, New Delhi	International Food Policy Research Institute USA
Food and Agriculture Organisation of the United Nations, New Delhi	United Nations Development Programme, Colombo
Department of Science & Technology, New Delhi	International Rice Research Institute Philippines
	International Plant Genetic Resources Institute, Italy
	University of Peace, Costa Rica

Address:
M. S. Swaminathan
Research Foundation
III Cross Road
Institutional Area
Taramani
Chennai 600 113, India