M. S. SWAMINATHAN RESEARCH FOUNDATION

1993-94

Fourth Annual Report

Centre for Research on Sustainable Agricultural and Rural Development, Madras.

Front Cover

Top & Bottom

Views of the building and central courtyard of the Research Centre. The courtyard has been landscaped to reflect the five eco-geographic regions of Tamil Nadu described in ***Tolkappiam***

M. S. SWAMINATHAN RESEARCH FOUNDATION

Centre for Research on Sustainable Agricultural and Rural Development

Fourth Annual Report
1993-94

Contents

M. S. SWAMINATHAN RESEARCH FOUNDATION

Centre for Research on Sustainable Agricultural and Rural Development

Third Cross Road

Institutional Area, Tharamani

Madras-600 113, India

Telephone : 91-44-2351229, 2351698

Fax : 91-44-2351319

Designed & Printed at

Reliance Printers

9, Sardar Patel Road

Adyar, Madras - 600 020

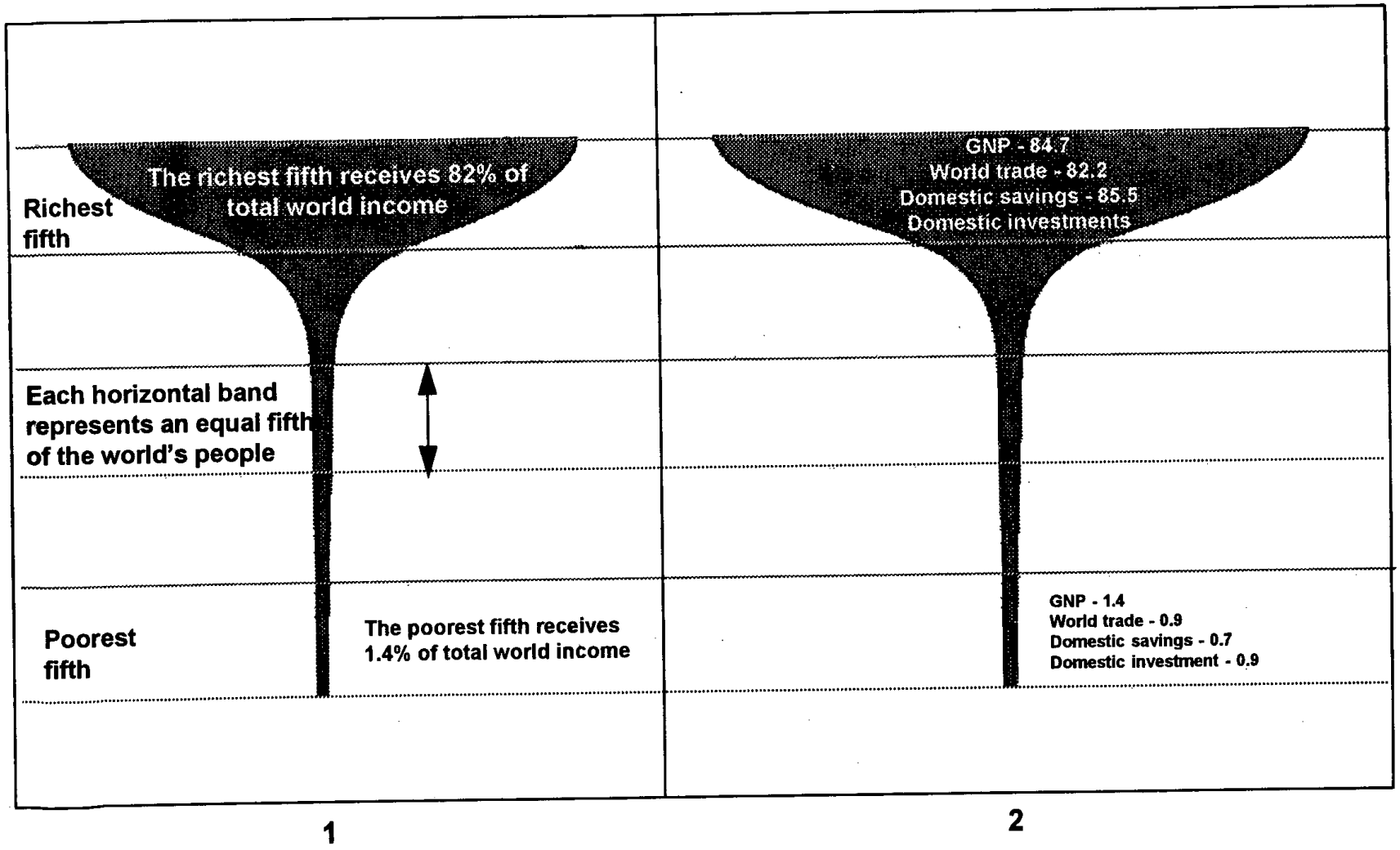
Telephone : 414974, 415346

Introduction

The **M.S. Swaminathan Research Foundation (MSSRF)** was registered as a non-profit, scientific Trust in July 1988 with its initial funds derived from the first World Food Prize awarded to Dr. M.S. Swaminathan in 1987. The major goal of the Foundation is the amelioration of the plight of the rural poor through organisational, technological and economic empowerment in the fields of agriculture and allied activities. The Foundation serves as a resource for innovative and socially dedicated scientists and scholars as well as non-governmental organisations dedicated to the cause of integrating the dimensions of ecology and gender equity with those of economics and employment in technology development and dissemination. To carry out its research and education programmes, MSSRF established the **Centre for Research on Sustainable Agricultural and Rural Development (CRSARD)** at Madras in February, 1990, as a non-profit, scientific, registered Society.

MSSRF and CRSARD started their research and training programmes in a few rented buildings in April 1990. On 14 April, 1993, the Centre moved into its own building constructed on land kindly made available on long-term lease by the Government of Tamil Nadu in the Taramani Institutional Area in Madras. Excerpts from the speeches made on the occasion of the dedication of the new building were included in the third Annual Report. During 1993-94, the specialised facilities and laboratories were put to full use. These include an Informatics Centre and CD ROM Library, a Community Gene Bank, a 10 KV solar power generator, a micro-propagation and tissue culture facility and green houses and mist propagation chambers. The total strength of professional and support staff reached 120 at the end of June 1994.

The central asset of the Foundation is however not just the sum of its facilities or the individual skills of its staff and Trustees. It is rather the whole set of its institutional capacities in the area of identifying and developing empowerment mechanisms and technologies that can make a difference in the lives of the rural poor. It is a matter for satisfaction that the job-led economic growth strategy based on a pro-nature, pro-poor and pro-women orientation to research and development described in our earlier reports has now received widespread international recognition, as for example in UNDP's criteria for fostering sustainable human development. It is clear from the data given in UNDP's Human Development Reports of 1992 and 1994 that the present pattern of economic development has built-in seeds of discrimination against the poor. Twenty percent of the global population receive most of the world's annual income, while the poorest 20 percent as well as the middle classes are getting increasingly impoverished (Figures 1 & 2). Among the poor, the most seriously affected are women and children. The matter hence deserves urgent attention from all sections of society, particularly scientists, technologists, planners, policy makers and political leaders.



Source : *UNDP Human Development Report (1) 1992 (2) 1994*

Figures 1 & 2 : *Global economic disparities*

The dualism in economic well-being, evident in Figures 1 & 2, becomes accentuated in a knowledge-based society. The *information superhighway* which is helping the well-to-do to reach greater levels of prosperity has no room for the poor. This is one reason why MSSRF has placed considerable emphasis on taking the benefits of modern information technology to the rural poor. The World Trade Agreement concluded in April, 1994, places stress on Trade Related Intellectual Property Rights (TRIPS). The Annual Inter-disciplinary Dialogue organised in January 1994 considered methods of recognising and rewarding informal innovation in the field of plant genetic resources conservation. The Dialogue helped to develop a draft Plant Variety Protection Act which provides an implementable mechanism for protecting the following rights :

(a) The rights of breeders/breeding institutions to reward for their contributions resulting in new varieties of crop plants;

(b) The rights of tribal and rural women and men to reward for their contributions to the selection and conservation of plant genetic material which help plant breeders to assemble in new varieties an array of valuable characters; and

(c) The rights of farm families to raise crops from their own seeds and also enter into limited sale/exchange of seeds of new strains in their neighbourhood.

The Madras draft Plant Varieties Recognition and Protection Act, prepared on the basis of discussions at this Dialogue, converts for the first time in the world, the concept of Farmer's Rights developed in the forum of FAO during the past ten years into an operational reality based on transparent and administratively simple procedures.

A few highlights of the work done in the five major programme areas during 1993-94 are given below.

Programme Area 100 : Coastal Systems Research (CSR)

The CSR methodology developed at the Centre provides a mechanism for linking the livelihood security of coastal communities with the ecological security of coastal areas in a mutually reinforcing manner. At Vettaikaran Iruppu, further progress was made in developing and demonstrating agro-forestry systems of land and water management which enhance the income of rural families on an ecologically sustainable basis. Rehabilitation of degraded mangrove ecosystems was undertaken at Muthupettai in the Nagai-Quaid-e-Milleth district and at Pichavaram. Plans were finalised for organising India's first All-Women Aquaculture Estate at Karaikal in collaboration with the Women's Development Corporation and Fisheries Department of the Pondicherry Administration. Technical guidance for the project, supported financially by the Department of Biotechnology of the Government of India, is being provided by the Central Institute for Brackish Water Aquaculture of the Indian Council of Agricultural Research. Coastal aquaculture,

regarded by industrialists as a 'sun rise' enterprise from the point of view of economic return and export potential, is unfortunately getting the reputation of being ecologically destructive and socially disruptive. The aim of this project is to demonstrate how ecological aquaculture can be promoted in such a manner that brackish water aquaculture becomes a sustainable 'sun rise' industry not only for the rich but also for women and men belonging to fisher and landless labour families. The All-Women Aquaculture Estate, Karaikal, will serve as a training centre for creating a cadre of fisheries entrepreneurs who can integrate the principles of ecology and equity in coastal aquaculture projects.

Programme Area 200 : Biological Diversity

MSSRF and CRSARD were the first to initiate a systematic programme for cataloguing and conserving mangrove genetic resources as well as to initiate research on the preparation of molecular linkage maps in mangrove tree species using RFLP, PCR and RAPD techniques. In addition to the conservation of mangrove ecosystems, the other areas which received intensive attention during the year are :

(a) identification and conservation of endangered plant species from the Western and Eastern Ghats,

(b) review of entries in Red Data Books relating to endangered plants for possible additions and deletions,

(c) micro-propagation of species listed in Red Data books, and

(d) standardisation of bioindicators for monitoring the health of ecosystems rich in biological diversity.

A new programme initiated during the year with financial support from the Rajiv Gandhi Foundation was the chronicling of threats to important national parks, protected areas and biosphere reserves. Thus, saving endangered plant species and endangered protected areas both received interdisciplinary attention. The tribal and community biodiversity network and the NGO Biodiversity Alliance were further strengthened. As mentioned in earlier reports, the tribal biodiversity research is designed to bring economic benefits to tribal families from their past and present work in the area of genetic conservation and enhancement. The Tribal Families' Intellectual Property Rights Database currently under development will help in the implementation of any reward system incorporated in Plant Variety Protection Acts developed as per the requirement of the World Trade Agreement concluded on 15 April, 1994.

Conservation of mangrove genetic resources and restoration of degraded mangrove ecosystems continued to receive intensive attention. A proposal for organising a national grid of mangrove genetic resources was prepared and submitted to the Ministry of Environment and Forests for consideration.

Programme Area 300 : Biovillages and Sustainable Agriculture

The biovillage project initiated in 3 villages of Pondicherry for the purpose of learning the scientific and social dimensions of integrating traditional wisdom and technologies with modern biological, space, information and management technologies, made further progress in its primary objective of improving the livelihood security of landless labour and marginal farmer families. The scientific strategy was based on the introduction of a basket of options which can add economic value to the time of the rural poor. Multiple sources of income help to impart both stability and security to the well-being of children, women and men at the household level. Benchmark surveys revealed that women belonging to landless labour households usually earn abou Rs. 300 per month from 20 days of wage labour. The immediate target was to raise their income to Rs. 1000 per month through additional avenues of employment and income. The experience gained during the year showed that this goal can be achieved through a variety of enterprises selected on the basis of opportunities for remunerative marketing. Such options included household mushroom cultivation coupled with vermiculture, purchase of a cow for sale of milk, sericulture, aquaculture, vegetable seed production, and mat, rope and basket weaving. Each woman participant in the programme chose an enterprise mix which best fitted the circumstances of her household. The keys to the success of this programme were first, the service back-up, as for example a fodder bank to support the families which purchased cows, and secondly, its market-driven approach. The programme is being extended to more villages with financial support from UNDP and technical support from the Union Planning Commission and the Pondicherry Administration.

Three special projects in the area of sustainable agriculture were undertaken during this year. One project sponsored by FAO, relates to the collection of systematic information on integrated intensive farming practices in India. Systematic data on the technologies adopted by farmers, who obtain high yields under conditions of mixed farming and multiple cropping and who follow ecologically sound practices, are being compiled.

Under another project sponsored by the Governments of India and Tamil Nadu, with financial support from the Swedish International Development Authority, a detailed action plan was prepared for linking conservation and development in a mutually reinforcing manner in social forestry programmes. It has been suggested that this community-managed social forestry project may cover 500 villages in Tamil Nadu during 1995-96.

The third special project, sponsored by UNDP, helped to undertake a detailed study of the food security issues in the Asia-Pacific region. The study showed that sustainable food security involving physical and economic access to food for all children, women and men, is possible for countries in this region during the next 25 years. This is because of the large untapped yield reservoir available in most farming systems

in this region even at currently available levels of technology. However, steps to protect and strengthen the ecological foundations essential for sustainable advances in agricultural productivity are urgently needed. Also, steps to diversify and enlarge opportunities for gainful self-employment are essential to convert the concept of *food for all* into reality. In the ultimate analysis, sustainable food and nutrition security at the household level will depend upon success in limiting population growth to the human carrying capacity of land and water.

During the year, Prof. S. Jayaraj joined the Foundation as an ICAR National Professor, for organising field research-cum-demonstration programmes on integrated pest management (IPM) in soyabean, cotton and groundnut. IPM is an important component of sustainable agricultural practices and hence research in the area of location-specific packaging and delivery of environmentally safe pest control methods needs intensification. This is now possible under the leadership of Prof. Jayaraj.

Programme Area 400 : Reaching the Unreached

Political, social and technological empowerment is essential for the socially and economically underprivileged to improve the security of their livelihood. The four different approaches to empowerment adopted under this programme started making an impact during the year. First, the project relating to Action for Child Care and Education Strategies and Services (ACCESS) made further progress in the organisation of self-financed child care centres, promoting parental involvement in balwadi improvement and supporting employer financed creches in industrial estates. Action research programmes were initiated to assess the child care needs of women in the unorganised sector and to develop appropriate strategies to provide/strengthen child care services. Training programmes were organised to help other voluntary organisations in the setting up of child care centres. At the organisational level, the Tamil Nadu Forum for Creche and Child Care Services served as an effective collaborative network and advocacy group. Preparation of training modules and documentation were the other activities.

Second, the Tamil Nadu Council for Sustainable Livelihoods undertook the task of preparing a detailed strategy for eradicating endemic hunger (i.e., undernutrition) from the Dharmapuri district. This programme titled "Hunger Free District Programme" aims at the introduction of an integrated and multipronged approach to bring about the end of chronic hunger in the district. These include: primary education, primary health care, safe drinking water, improving the status of women, special attention to the girl child, opportunities for increased household income through a basket of enterprises and attention to gender equity at the intra-household level in nutrition and child care. Improvement of the productivity of farm and non-farm enterprises and attention to the working of the Public Distribution System are the other aspects of this programme. After studying the available government and non-governmental programmes relating to the eradication of poverty, major gaps have been identified for remedial action.

A third programme related to the establishment of household nutrition gardens and training rural women and men in ecological horticulture and in raising nurseries of horticultural plants. The trainees in turn assisted other farmers in the respective villages to take to environmentally safe and nutritionally desirable horticultural practices. The training programmes were organised in collaboration with the International Agricultural Training Programme of the United Kingdom.

Finally, the project for taking the benefits of modern agri-business to resource poor farm families made good progress. The project proposals for Dharmapuri district and the Union Territory of Pondicherry were completed and were forwarded to the Small Farmers' Agri-business Consortium set up by the Ministry of Agriculture, Government of India, for further action. Good progress was also made in the preparation of projects for Ernakulam, Dharwar, Ganjam, Valsad, Bikaner and Pithoragarh districts. The key elements of these projects are the identification of market-driven enterprises and the empowerment of small farm families through organisational and management structures responsive to their needs and responsible to them administratively.

Programme Area 500 : Education, Communication and Training

A wide range of seminars and workshops were organised during the year, including special workshops on Eradication of Poverty and on the Mangrove Ecosystem Information Service (MEIS). Dr. B.C.Y. Freezailah, Executive Director of the International Tropical Timber Organization (ITTO) dedicated the MEIS to the mangrove research and development workers of the world. Prof. G.T. Scarascia-Mugnozza, President of the Italian National Science Academy dedicated the Community Gene Bank to rural and tribal women. As mentioned earlier, the annual inter-disciplinary dialogue was on methods of recognising and rewarding informal innovation in the conservation of plant genetic resources. The Foundation organised a Policy Makers' Workshop on Biodiversity for the eastern region at Guwahati in February, 1994. The Foundation co-sponsored with the National Academy of Agricultural Sciences of India the second Asia-Pacific Conference on Agricultural Biotechnology at Madras in March, 1994. In collaboration with the National Commission for Women, a workshop on "Women, Biodiversity and the Seed Industry" was organised in June, 94. This workshop recommended a new social contract between rural women and the private sector seed industry, so that seeds tailored to markets can be produced.

A unique project initiated during 1993 for the empowerment of women related to the use of the theatre to enable women to voice their views and experiences. This project titled "Voicing Silence" developed two plays during this year, and is becoming a powerful medium for reaching the unreached. Support for folk theatre groups in developing and performing plays on the theme of sustainable development in the traditional *koothu* form was continued. An interaction between scientists and folk theatre artists to explore ways in which traditional media could communicate development-related concepts was a step forward in this direction.

The training programmes organised by the different Project Leaders were held both in Madras and at other places in Tamil Nadu and Kerala. On Tamil New Year Day, 14 April, 1994, a training programme on Soil Health Care was organised for farm men and women from Chengai-MGR district, with funds derived from the endowment of Rs. 5 lakhs kindly provided by the Hon. Chief Minister of Tamil Nadu.

On 13 April, 1994, a *deepasthambham* generously donated by Shri M.A. Parthasarathy of Bangalore was installed in the pool in the centre of the courtyard. Special seminars/ lectures were organised during the following dedication ceremonies :

- Sambasivan Auditorium on 7 August, 1993
- Ramkrishna Bajaj Hall on 18 October, 1993
- Honda Informatics Centre on 17 December, 1993
- Bhoothalingam Library on 6 January, 1994
- Scarascia-Mugnozza Community Gene Bank on 28 January, 1994
- Barwale Biodiversity Centre on 28 January, 1994
- Narayanaswami Hall on 13 April, 1994

We are indebted to Mr. C. Subramaniam, Chairman, National Foundation of India, Dr. M. Channa Reddy, Governor of Tamil Nadu, Dr. Balram Jakhar, Minister for Agriculture, Government of India, and Dr. Malcom Adiseshaiah, Chairman, Madras Institute of Development Studies, for dedicating the various halls.

The completion of the research and training infrastructure during the year was made possible through generous financial assistance from the Swedish International Development Authority.

It is obvious that the work summarised in this report would not have been possible but for the generous support of many individuals, institutions, universities and organisations, both national and international. They are mentioned separately at the end of this report. The Indian Bank and the State Bank of India have been extremely supportive. We cannot thank them adequately. We can only assure all donors and supporters that we shall continue to try our best to prove worthy of their trust.

An effective research institution is ultimately the product of interaction between good scientists and good management and facilities. The Foundation has been fortunate to have attracted young scientists and scholars with a commitment to professional excellence, personal integrity and social dedication. It has been the endeavour of the Foundation that these young professionals and supporting staff comprising of 45 women and 75 men get adequate opportunities for professional growth.

Finally, we are indebted to Dr. Nandhini Iyengar and Dr. V. Balaji for their competent editing of this report and to ***Frontline*** for the cover design.

PROGRAMME AREA 100

Coastal Systems Research

Sub Programme Area 101

Establishment of a Model Integrated Coastal Ecosystem

Activities under this programme are designed to strengthen the livelihood security of the coastal families on an ecologically sustainable basis. The work initiated in 1992 in the coastal village of Vettaikaran Iruppu, especially in coastal forestry, agroforestry and animal husbandry has made good progress. The aim of the programme, as mentioned in the previous Annual Report, is to establish a model pilot coastal ecosystem which could serve as a base for technology transfer besides demonstrating sustainable management of natural resources.

Climate and Rainfall

A major constraint faced by farmers is the climatic uncertainty which makes it difficult for the farmer to plan in advance his agricultural operations. While the rainfall during 1992 was low, it was very high in 1993, causing floods during November-December (Table 1.l).

Table 1.1

Rainfall pattern (in mm)

Rainfall	October	November	December	Total
Normal	287	477	327	1091
During 1992	159	280	169	608
During 1993	244.4	647.5	446.7	1338.6

Note : *Since the maximum rainfall is received during the above 3 months, details of rainfall are furnished only for these 3 months.*

Apart from the very heavy rainfall, there was a cyclonic storm on 3/4 December 1993 with wind speed of about 120 km per hour. This caused severe inundation and the rain water had not drained even 45 days after the cyclone, causing damage to the experimental plots. When preparatory cultivation was about to commence, there was heavy rainfall during February 1994 (101.4 mm in 5 days) which was rather unusual. This caused further postponement of sowing by about one month, besides causing damage to freshly sown crops. Due to the above circumstances, the sowing/planting operations for the year 1993-94 were delayed. Instead of December, the sowings could be taken up only in March 1994. However due to increased availability of water, it is proposed to introduce a suitable second crop this year, which is not normally the practice in this coastal village.

Technological Interventions

Agroforestry

During 1993, only one agricultural crop could be cultivated as a mixture in the casuarina (*Casuarina equisetifolia*) plantation due to paucity of water. However two crops are planned for the year 1994 taking advantage of heavy rainfall received during December 1993.

In one plot CO-7 ragi (*Eleusine coracana*) will be planted after groundnut (*Arachis hypogaea*) and in the other plot VRI-3 groundnut and CO-7 ragi will be planted after the ICPH-8 redgram (*Cajanus cajan*). Since there had been water stagnation, the sowing of the first crop itself was delayed by more than 2 months. The casuarina crop had not lodged but yellowing of the leaves was noticed due to prolonged stagnation of water. The side branches of the casuarina were pruned on 26.11.93 and 27.11.93 before the cyclone to facilitate intercropping, and this probably saved the crop from lodging.

During mid 1993, casuarina plants were seen dying due to severe moisture stress. To avoid mortality of casuarina plants under such conditions, an experiment was laid out wherein dry casuarina needles and coconut husks (6 to 7 nos.) were buried around each casuarina plant and covered with soil (Figure 1.1). The survival rate and growth of plants would be studied during next summer.

ICPH-8 red gram was sown on 1.3.94 and VRI-2 groundnut was sown on 15.3.94 as mixture with casuarina. The stand of the crop is good.

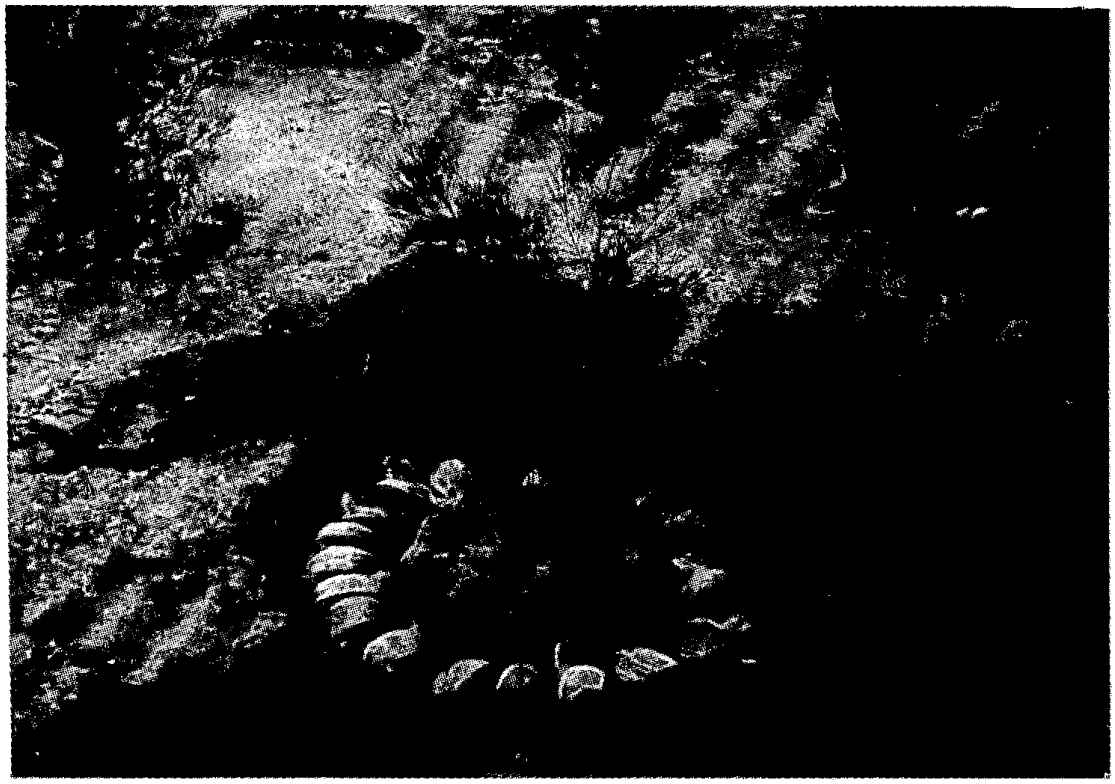


***Figure 1.1** : Mulching casuarina with casuarina needle and coconut hulk*

Sylvi-horticulture

The summer of 1993 was very severe and high incidence of mortality in mango grafts (*Mangifera indica*) was noticed in spite of timely irrigation. Therefore, the pitcher method of irrigation was introduced.

An annual variety of drumstick (*Moringa pterigosperma*) planted around the field yielded 15,238 fruits from 70 trees netting a revenue of Rs. 4406.05. The successful crop resulted in great public demand and 178 seedlings were distributed to the villagers.

Soyabean (*Glycine max*), VRI-3 groundnut, and ICPH-8 redgram were sown in the month of January 1993 and the yields obtained are given in Table 1.2. The soyabean did not perform as well as the other crops.

Table 1.2

Yield details of crops

Name of the crop	Area cultivated (ha)	Yield of grain (kg)	Yield of biomass (kg)
Soyabean	0.10	45.50	31.50
VRI-3 Groundnut	0.20	378.25	133.00
ICPH-8 Redgram	0.20	106.00	94.00
ADT-3 Blackgram	—	31.50	—

During June 1993, both VRI-2 and VRI-3 groundnut were cultivated for seed purposes and harvested in September 1993. The yield details are given below in Table 1.3.

Table 1.3

Yield details of crops

Name of the crop	Date of sowing	Yield (kg)	
		Pods	Biomass
Groundnut VRI 3 (0.125 ha)	14.06.93	181.5	227.5
Groundnut VRI 2 (0.125 ha)	15.06.93	108.25	392.00

Soyabean and VRI-2 groundnut were sown again on 24.1.94 and 26.1.94 in one plot and VRI-3 groundnut, soyabean and ICPH-8 redgram were sown in another plot on 3.3.94, 4.3.94 and 5.3.94 inside a mango plantation. The yield was good.

The annual drumstick plants yielded a good crop. As their duration is only 1 year, they are ideal for coastal areas. The nursery should be raised during October/ November and the seedlings planted at the end of December after the rainy season. They will start yielding after 4 months and can be uprooted just before the onset of

the next rainy season or cyclone. VRI-3 groundnut is another good yielder when compared to local varieties. ICPH-8 redgram performed well under flood irrigated conditions. Pitcher method of watering proved to be ideal for watering fruit plants in coastal sandy tracts.

Groundwater Irrigation

As in the last year, ground water from the small ponds available in the experimental plots were used for raising crops. VRI-2 groundnut in one plot was sown on 2.12.93 and CO-7 ragi in another plot on 21.1.94. Here again the concept of raising two crops will be put into action on account of the water availability. The stand of the crop was good though the groundnut sown in upland suffered due to excessive moisture. Both the crops have since been harvested and the yield details are furnished in Table 1.4.

Table 1.4

Yield details of crops

Name of the crop	Date of sowing	Date of harvest	Yield (Kg)	
			Pods	Biomass
Groundnut VRI 2 (0.10 ha)	02.12.93	17.03.94	142.50	169.00
Ragi CO 7 (0.05 ha)	21.01.94	18.03.94	28.80	67.20

After the harvest of CO-7 ragi, VRI-3 groundnut in one plot and CO-5 redgram and sunflower in another plot were sown on 27.3.94 and 31.3.94 respectively. Due to abundant moisture, vegetative growth in the groundnut crop was prominent. Though there were only 16 pods per plant on an average, the pods were well filled and big sized.

Another notable feature was the replication of last year's model of growing paddy nursery (*Oryza sativa*) inside an old casuarina plantation. CR-1009 paddy nursery was raised in 2.5 cents during September 1993 in a 7 year old casuarina plantation with success. The seedlings were robust and healthy. Many farmers visited this plot and there is great demand for the seedlings. It is programmed to raise the *Kuruvai* (short term) paddy nursery in the month of June itself to find out whether it would be available for transplanting to the mainland paddy growers by the end of July. If early transplanting is done in July, the *Kuruvai* paddy crop could be saved from the adverse impact of the October/November monsoon rains.

Reclamation of Problem Soil

Last year's treatments were repeated. The results obtained from the plot, 270 sq.m. in area, where paddy ADT-39 variety was grown, are given in Table 1.5.

Table 1.5

Yield details (Paddy)

Treatment details	Date of planing	Date of harvest	Yield of grain in kg	Yield of straw in kg
1. Casuarina needle + gypsum + Farmyard manure (FYM)	11.11.93	18.02.93	123.75	220.25
2. Mahua leaves (*Madhuca longifolia*) + gypsum + FYM	11.11.93	18.02.93	126.50	215.75
3. Control gypsum + FYM	11.11.93	18.02.93	115.75	215.00

It is seen that the plot applied with mahua leaves had given 9.29% increased yield over the control. After the paddy was harvested, TMV-3 gingelly (*Sesamum indicum*) was sown as a second crop on 4.3.94. Soil samples have been collected. On analysis, it is seen that there is a slight improvement as detailed below in Table 1.6.

Table 1.6

Details of pH

Name of the farmer	pH during 1992 before cropping	pH during 1993 before cropping	pH during 1993 after harvest
Balakrishnan	8.5	8.5	8.25
Natarajan	8.6	8.4	—

Kitchen Garden

Different varieties of vegetables were planted and they came up well in one plot whereas in another plot the entire crop was lost due to flooding. During this year, cole crops were introduced for the first time and cauliflower (*Brassica oleracea var. botrytis*) and knol khol (*Brassica caulorapa*) crops performed reasonably well.

A mushroom demonstration was also conducted on 18.11.93 and 0.250 kg of oyster mushroom was harvested. The women of the village are greatly interested in growing mushroom.

High Density Forestry

The closely planted casuarina and subabul (*Leucaena leucocephala*) plants were under water for more than 50 days. On account of this, yellowing of leaves was noticed in casuarina. Subabul plants withered and died due to continuous stagnation of water but the casuarina plants survived the floods.

Soil and Water Conservation

Bunds were formed 15 m apart to a height of 45 cm. and width of 30 cm. at the top to conserve water and soil. Crops were raised in the plots in between the bunds. Due to acute water scarcity, a second crop could not be grown during 1993. While the VRI-2 groundnut in plot 1 performed well, the redgram and blackgram (*Phaseolus mungo*) in plot 2 performed badly.

During the current year VRI-2 groundnut and CO-7 ragi have been planted and they are coming up well though, due to abundant moisture, there is too much vegetative growth. In another plot blackgram and redgram were sown. While the blackgram has been harvested, the redgram has been affected by too much of moisture. Blackgram gave an yield of 62.75 kg from 0.08 ha. Up to 77 pods were counted per plant which was appreciated by the villagers.

Rearing Goats Under Stallfed Conditions

The performance of the Jamnapari goats which are being reared since 1992, is satisfactory and the details of feeding are given in Tables 1.7 and 1.8.

Table 1.7

Details of feeding

Name of feed	Quantity issued (kg)	Quantity consumed (kg)	Balance collected as left over (kg)
Casuarina	1.50	0.90	0.60
Neem (*Azadirachta indica*)	0.70	0.35	0.35
Ipomoea sepiaria	2.10	1.00	1.10
Prosopis pods	0.75	0.70	0.05
Groundnut oilcake	0.45	0.45	—
Total	5.50	3.40	2.10

Table 1.8

Details of feeding

Name of feed	Quantity issued (kg)	Quantity consumed (kg)	Balance collected as left over (kg)
Casuarina	3.10	2.00	1.10
Neem (*Azadirachta indica*)	0.60	0.25	0.35
Ipomoea sepiaria	0.70	0.60	0.10
Groundnut oilcake	0.20	0.20	—
Total	4.60	3.05	1.55

It was seen that 34% to 38% of the fodder supplied was left over as twigs which was used as fuel. The goats relish a judicious combination of casuarina and subabul leaves. In the first instance the goat has gained 16 kg and in the second, 4.5 kg.

Restoring the Fertility of the Saline Soil in Coastal Areas

A research scholar has formulated a study to restore the fertility of the saline soils in coastal areas. The details are as follows.

Coastal areas are noted for saline soils. To reclaim saline soils, a farmer's field was identified and a trial was carried out with the following treatments:

Treatment details

Crop	- Paddy	Variety	- ADT-37
Design	- Split plot design	Replications	- 3
Date of sowing	- 24.12.93	Date of planting	- 19.01.94

Main plot treatment

M1 - Control

M2 - 50% Gypsum requirement

Sub plot treatment

S1	- FYM	@	15t/ha
S2	- Pressmud	@	10t/ha
S3	- Pyrite	@	10t/ha
S4	- Composted coir pith	@	10t/ha
S5	- Raw coir pith	@	10t/ha
S6	- Green leaf manure	@	5t/ha
S7	- Casuarina needles	@	5t/ha
S8	- Neem leaves	@	5t/ha (*Azadirachta indica*)
S9	- Cashew leaves	@	5t/ha (*Anacardium occidentale*)
S10	- Mango leaves	@	5t/ha

In addition to the field trial to characterise the fertility status of the coastal saline soil, a two phase programme was formulated. In the first phase, soil samples were collected from 3 depths i.e. 0-30 cm, 30-60 cm and 60-90 cm. The entire village of Vettaikaran Iruppu was divided into 5 distinct zones on the basis of cropping pattern. From each zone 6 soil samples at 3 different depths were collected.

In the second phase, a soil profile study was carried out. Five profile pits were excavated in each zone and a detailed study was made.

The soil samples collected from various survey numbers for the first phase and profile samples from the second phase are under chemical analysis.

As far as the trial plot is concerned, on visual observation, the plot applied with pyrite @ 10t/ha with gypsum shows good growth when compared to the other treatments.

The details and results of the 8 interventions mentioned earlier are summarised in Table 1.9.

Table 1.9

Technological interventions

Agroforestry *Cajanus cajan* (redgram) and *Arachis hypogaea* (groundnut) were tried again as mixed crop with casuarina. *Phaseolus mungo* (black gram) was also dibbled in between the redgram rows.	Coconut husks and casuarina needles were buried around casuarina plants to know the effects on moisture retentive capacity. This can be assessed only next summer.
Sylvi-horticulture Zizyphus (seb and gola varieties) *Punica granatum* (pomegranate), *Mangifera indica* (mango) *and Leucaena leucocephala* (subabul) were grown in the main field. *Moringa pterigosperma* (drumstick) was planted along the borders. Groundnut, redgram, blackgram and *Glycine hispida* (soya bean) were grown as intercrops.	Casualty in fruit plants was minimised by adopting pitcher method of irrigation. VRI 3 groundnut yielded well. 15238 drumstick fruits were harvested from 70 plants.
Groundwater Irrigation With the water available, crops like *Eleusine coracana* (ragi), *Oryza sativa* (paddy) nursery vegetables and groundnut were grown.	The paddy nursery that was grown under an old casuarina plantation performed well drawing the attention of the people. Since there was excess moisture in one plot, ragi was planted instead of groundnut.
Reclamation of Problem Soils Gypsum was applied and apart from farm yard manure, casuarina needles, *Madhuca longifolia* (mahua leaves) and mango leaves were applied. CO-7 ragi and ADT 39 paddy were grown.	The plot where gypsum and mahua leaves were applied gave a yield of 9.29% more than the control. In the case of ragi, the plot applied with mahua and mango leaves gave 20.69% increased yield over the control.
Kitchen Garden Improved varieties of *Carica papaya* (papaya), drumstick and hybrid vegetables were grown.	In one field the vegetables performed well whereas in another field there was inundation. Cole crops, introduced for the first time, performed reasonably well.
High Density Forestry The growth of casuarina and subabul planted during last year was monitored.	Both the plots were severely affected by the cyclonic storm.

Table 1.9 (Contd.,)

Soil and Water Conservation Redgram-blackgram mixture and VRI-2 groundnut were grown.	The crops were affected by the rains. The blackgram (ADT-3) has performed very well. Vegetative growth is seen in the case of groundnut.
Goat Rearing Under Stallfed Conditions Goats were fed with casuarina needles, neem leaves, *Ipomoea sepiaria* and also subabul.	Normally, 62 to 66% of the green matter is consumed leaving 38 to 34% of dry matter which is collected and used as fuel by the women.

Training Programmes

Officials of the Animal Husbandry Department conducted a training programme on coastal livestock management and on feeding techniques with particular reference to goats. A training programme on *Anacardium occidentale* (cashew) cultivation was conducted by the Associate Professor of Horticulture of the Tamil Nadu Agricultural University. These training programmes were well attended.

Specialists from the Tamil Nadu Agricultural University (TNAU) visited the village on 28.9.93 and gave their expert opinion on water-management and correcting problem soils.

Field Days were organised on 12.10.93 and on 5.03.94 for discussions with farmers.

Conclusions

Based on the year's experiments, the following observations are made:

- It is advisable that all sowings in coastal villages are taken up after the north east monsoon recedes, when the soil will be in an ideal condition.
- The annual variety of drumstick can be recommended to be planted in homestead gardens and around the fields in coastal areas. It can be planted after the monsoon rains every year and can be uprooted before the next rainy season.
- VRI-3 groundnut variety is found to be ideal for the coastal villages since it comes up well in sandy soil.
- Paddy nursery can be successfully grown under older casuarina plantations and it is worthwhile to study whether large scale nurseries can be raised early (ie. in June) to meet the requirement of inland farmers in Nagai Qaid-e-milleth district for their *kuruvai* paddy cultivation.
- Subabul is an ideal fodder and could be recommended for growing in uplands where water stagnation is minimum.

Sub-Programme Area 102

Natural Resources Utilization by Coastal Communities

Many development programmes often have an unintended adverse impact on the ecological and economic security of the local inhabitants. It is therefore becoming important to protect, conserve and manage the available natural resources by sustainable utilization. The three main factors of sustainable development namely, ecology, economics and equity are integrated in the Sustainable Livelihood Security Index (SLSI) described in earlier Annual Reports. A total of 733 households, distributed over the 15 hamlets were surveyed (see Table 1.10). Data was analysed to arrive at the SLSI.

Table. 1.10.

Indices of three of the four variables representing the major components of the SLSI at household level

Name of the hamlet / village	No. of households surveyed	Income status/ capital	Rank	Asset ownership status/capital	Rank	Educational status	Rank
Fishing hamlets							
Killai Fishermen colony	70	0.0609	10	0.0122	9	0.0980	1
Mudasalodai	60	0.0884	6	0.0093	12	0.0564	7
Muzhukkuthurai	50	0.0644	7	0.0120	10	0.0628	5
Pillumedu	22	0.0636	8	0.0483	1	0.0470	11
Nadumudasalodai	44	0.0564	11	0.0118	11	0.0690	3
M.G.R thittu	50	0.1220	2	0.0138	7	0.0768	2
Chinnavaikkal	72	0.0533	12	0.0086	13	0.0377	14
Kannaginagar	23	0.1049	3	0.0144	6	0.0454	13
Farming hamlets							
Singarakuppam	50	0.0957	4	0.0312	3	0.0640	4
Killai Thirunalthoppu	50	0.0446	15	0.0069	14	0.0594	6
Thaikkal	41	0.0450	14	0.0198	4	0.0519	9
T.S. Pettai	50	0.0519	13	0.0196	5	0.0516	10
Kucchipalayam	50	0.0944	5	0.0328	2	0.0498	9
Ponnanthittu	50	0.0613	9	0.0136	8	0.0462	12
C. Manambadi	50	0.1319	1	0.0059	15	0.0348	15

Results of the Individual Components of the SLSI for the 15 Hamlets

Results of three of the four essential components are summarised in Table.1.10. The results indicate that the income status is the highest in C. Manambadi and M.G.R. Thittu and lowest in Killai Tirunalthoppu. For asset ownership status, Pillumedu ranks first and C.Manambadi ranks last. Educational status is found to be high in Killai Fishermen Colony and lowest in C. Manambadi. Educational status in the present study indicates a maximum of plus two level. The methodology for assessing the nutritional status is being developed.

Land Use Pattern in Pichavaram

The present scenario in Pichavaram is that of increasing population, low per capita land availability, and shortage of fuel, forage and fodder. The root cause for the shortages is extensive biomass removal for subsistence by the local people themselves. The pace of forest degradation is causing not only economic distress and shortage of biomass supply but also increased salinity of water and soil. To begin with, the prevailing situation necessitates the conservation of fuel and fodder yielding plant species so as to reduce the biomass famine.

With a population density of 547.4 per sq. km, it is seen that the major anthropogenic pressures and impact on the estuarine forests is collection of fuel wood and fodder, Table.1.11 shows the percentage of land under cultivation and unused land, to the total available land area. These include the mangrove forest land and the lands of the surrounding hamlets which were surveyed.

Table.1.11

Land use pattern in Pichavaram

REGION		Total available land (ha)	Area under cultivation (%)	Unused land (%)
Killai (North)	Dryland area	360.875	63.93	36.07
	Wetland area	31.355	53.31	46.69
Killai (South)	Dryland area	13.260	73.51	26.49
	Wetland area	299.915	100.00	-
Unauthorised	Dryland area	304.600	100.00	-
occupation	Wetland area	-	-	
T.S. Pettai	Dryland area	206.325	51.16	48.84
	Wetland area	190.170	-	-
Pichavaram	Forest			
	Dense mangroves	241.000		
	Sparse mangroves	593.500		
	Mudflats	262.500		
	Saline area	1238.500		
	Dryland area	365.995	71.21	28.79
	Wetland area	194.375	62.77	37.23

Agriculture is mostly rainfed with emphasis on food crops. Productivity is generally low. Therefore food production receives the highest priority compared to any other land use.

Intended Interventions

Agroforestry

Planting of Casuarina has already been taken up by the Tamil Nadu Forest Department. Casuarina plantations are also common among a sizeable tree ownership population adjacent to the coast as indicated by the socio-economic survey.

Another common feature is that paddy lands are being converted to rainfed groundnut crops by both fishing and farming communities. According to the local sources, as soil is becoming saline and the groundwater is being depleted, a shift from irrigated paddy to rainfed groundnut is desirable.

Animal Husbandry : Significance of Livestock and Poultry in the Rural Economy

Integration of livestock with farming assumes special significance compost and FYM can be relied upon increasingly to maintain soil fertility. Mixed farming with livestock and more intensive use of agricultural land through agroforestry for fodder production are possible approaches for tackling the problem of shrinking land man ratio :

With respect to the present study, livestock includes cattle, buffaloes, sheep, goat, pig and poultry. Table.1.12. reveals the total livestock population of the 15 hamlets. The agroforestry programme deals with fodder production for ruminant livestock.

Table.1.12

Total livestock population of the 15 hamlets under study

Cows	55079
Buffaloes	12500
Sheep	3021
Goats	17774
Pigs	1021
Chicken	61577

It is seen that the cattle population is the highest and therefore emphasis will be on the production of fodder grasses. In a given region, livestock is of special significance in the economy and well being of the people, particularly the landless and small farmers. The benefits are :

- Food : source of milk and meat.
- Draught power : used for ploughing, lifting water for irrigation, transport of agricultural produce and the residues.
- Organic manure : contribute FYM which improves soil health. Presently it is noticed that the paddy fields have already been converted to or are being converted to rainfed groundnut. In such a situation, addition of organic manure is of special value.
- Employment : Unemployment is a major problem in villages. Stallfed cattle rearing is technically simple though labour intensive. In the hamlets under study, however, stall feeding is yet to be introduced. Scientifically designed mixed farming systems will help to increase both income and nutrition at the household level.

Livestock productivity in the hamlets studied is low. Partly, this arises from inadequate and low quality nutrition. Fodder banks involving grass and legume mixtures will help to raise productivity.

Eco-restoration of mangrove species has been initiated on the following lines :

- Rehabilitation of the mangroves with the locally available species
- Reintroduction of the disappeared species of mangroves
- Active involvement of the local communities in eco-restoration,

which is described in detail under Sub Programme Area 103.

Sub Programme Area 103

Restoration of Degraded Mangrove Ecosystems

Ecological and economic benefits of mangrove forests are well established. However, due to stresses resulting from unsustainable exploitation, mangroves are being degraded both in terms of species diversity and biomass. Continuous degradation of this important and critical coastal ecosystem will not only affect the coastal biodiversity and fishery productivity but also deprive coastal people of security against natural calamities. Though various steps have been taken in recent years to prevent degradation of mangroves as part of a conservation programme, very little is being done to restore degraded mangrove habitats. The need to arrest further damage to mangrove ecosystems and to restore the degraded areas is therefore urgent. Last year three areas, namely Pichavaram, Adyar and Ennore, were selected for restoration and studies were continued this year. Table 1.13 gives the water and soil quality of these areas.

Table 1. 13

Characteristics of plantation areas

Parameter		Pichavaram	Adyar	Ennore
pH	Water	7.50	6.18	8.2
	Soil	7.41	6.75	7.14
Salinity (ppt)	Water	19.80	18.00	15.40
	Soil	5.60	4.10	3.60
Soil N	(mg/g)	0.991	1.326	0.816
Soil P	(mg/g)	0.191	0.257	0.094

Pichavaram

The Pichavaram mangrove, which is degraded mainly due to cattle grazing and felling was selected for the present restoration programme with the following objectives :

- to create an awareness of the ecological and economic benefits of mangroves among rural families and school children of the villages located around Pichavaram mangroves,
- to reintroduce the species that were the original inhabitants of Pichavaram mangroves,
- to regenerate the species whose population is fast depleting, and
- to introduce a few economically important species of mangroves.

To achieve the first objective, a booklet in Tamil, explaining the unique features of mangrove plants as well as the ecological and economic benefits of the mangrove ecosystem was prepared. The booklet also explains the causes of degradation and how rural people can play an active role in avoiding further degradation of Pichavaram mangroves.

To realize objectives two to four, species indicated in Table 1.14 were selected for rehabilitation, regeneration and introduction.

Table 1.14

Species selected for rehabilitation, regeneration and introduction in Pichavaram

Species selected for rehabilitation	Species selected for restoration	Species selected for introduction
Xylocarpus granatum	*Rhizophora apiculata*	*Heritiera fomes*
Sonneratia apetala	*Rhizophora mucronata*	*Nypa fruticans*
Kandelia candel	*Rhizophora x lamarckii*	
	Ceriops decandra	
	Bruguiera gymnorrizha	

Since the propagules of *Rhizophora spp.* are available in large quantities in Pichavaram mangrove itself, they will be used for direct plantation. Nursery grown seedlings will be used for the plantation of *Xylocarpus granatum, Sonneratia apetala, Heritiera fomes, Ceriops decandra, Bruguiera gymnorrhiza* and *Kandelia candel.* As *Nypa fruticans* is salt and wave action tolerant and economically important and H. fomes a good timber species is these two mangroves have been chosen for introduction in Pichavaram.

10 ha of degraded mangrove forest was selected for restoration and the ground is being prepared for plantation. For the purpose of regeneration of *Rhizophora spp.*, 2 ha of recently formed mud flat, where the ecological conditions are favourable for immediate plantation, was selected. The planting will be completed by the end of 1994.

Initial plantation trials were carried out in January 1993 in Peria Guda islands in Pichavaram, utilizing the channels cut by the Forest Department to increase the intertidal areas. Two such artificial creeks, each representing a plot of an area of about 500 m in length and 2 m across, were taken for plantation and planted with *Rhizophora* propagules. From a comparative study of the two plots (Table 1.15), it may be seen that Plot I shows better growth performance than Plot II in terms of plant height and percent survival.

In addition to regular plantation in natural intertidal areas, 4 test plots, 25 sq.m. in size, were laid on degraded areas vegetated with *Suaeda.* Each plot was cleared of *Suaeda* and divided into four subplots and planted with four species of mangroves during the monsoon. Unfortunately due to heavy rains the plots were flooded for more than a week. Propagules of *A. marina, B. cylindrica* and *C. decandra* perished due to prolonged submergence and propagules of *R. mucronata* were the only survivors.

Adyar

The Adyar river originates from the Guduvancheri hills and runs about 40 km along the southern zone of Madras. It receives domestic as well as industrial effluents from 58 drainage outlets and also detergents, mostly from the Saidapet area of Madras. The Adyar estuary is located at the northern boundary of the Theosophical Society. Along the Adyar estuary, plantations were started in the month of February 1993 in 5 plots. Growth performance of plants in individual plots is given in Table 1.15. It is seen that Plots III and IV show better growth performance, and these zones are recommended for future plantation.

Ennore

The Ennore backwater is located approximately 30 km north of Madras city. Many industries are situated in and around the Ennore area. Treated and untreated effluents from these industries are discharged into the Ennore backwaters. In the Ennore creek, the plantation was initiated in January 1993 in seven plots of which four plots have shown some success. The area and number of propagules planted varied according to availability of suitable space and the growth of the plantation is given in Table 1.15. Plots II and III show better survival capacity when compared with other plots.

Table 1. 15

Growth performance of seedlings of Rhizophora planted in different areas

Area		No. planted	Survival (%)	Av. height (cm)	Total no. of leaves	Total. leaf area (cm^2)
Pichavaram						
Plot	I	100	55.00	32.0	262	4083.77
	II	189	51.00	32.3	223	3836.09
Adyar						
Plot	I	25	0.00	*	*	*
	II	11	49.50	28.12	24	273.0
	III	210	45.85	27.72	271	5337.4
	IV	150	39.00	31.67	333	7468.85
	V	81	19.66	22.76	58	871.28
Ennore						
Plot	I	72	9.72	13.25	37	357.03
	II	60	55.00	22.26	199	4502.10
	III	60	60.00	19.29	87	1845.54
	IV	35	0.00	*	*	*
	V	100	29.00	28.65	98	2390.51
	VI	68	27.50	32.32	126	2190.11
	VII	309	0.00	*	*	*

* *propagules did not survive*

At Ennore, there was low mortality in the initial months. However four months after plantation, a rapid decline in survival was observed. At the end of a year, Adyar estuary possesses a greater number of *Rhizophora* plants than Ennore creek, where most of the plants perished at the onset of the monsoon, due to flooding and suffocation by algal blooms. Since the plants in the Pichavaram plantation were planted along man made channels they were not under total submergence during the monsoon; moreover, there is less incidence of algal suffocation in Pichavaram in comparison to Adyar and so the plants show better growth characteristics.

In addtion to direct plantations in the three areas, some nursery grown mangroves were also transplanted, details of which are given in Table 1. 16. Survival and growth performance of these plants are under study.

Table 1. 16

Plants transplanted from nursery in the plantation areas

Plant Name	Adyar	Ennore	Pichavaram
R. apiculata	++	++	++
R. mucronata	++	++	++
B. cylindrica	++		++
B. gymnorrhiza	++		++
C. tagal	++		++
C. decandra	++		++
A. ilicifolius		++	
H. fomes	++		++
X. granatum	++		++

Vegetative Propagation Techniques of Mangroves

Excoecaria agallocha, belonging to the Euphorbiaceae family, is not grazed upon by cattle. A fence of this plant will act as a natural barrier to grazers and may help in protecting young plantations which are most vulnerable to grazing. Seeds of *E. agallocha* are eaten by various insects. They are hence not available in sufficient number to plant in nurseries. *Avicennia marina* propagules are also food material for mangrove fauna and it was observed that natural regeneration of this plant is absent in both Adyar and Pichavaram. Young plants raised in nurseries are prone to insect attacks and do not survive on transplantation. Hence it became essential to apply horticultural methods to obtain good planting stock. Horticultural practices of establishment of shoot cuttings were tried out on *E. agallocha* and *A. marina* collected from Adyar estuary. Obliquely cut shoot cuttings were moistened with water and dipped in a commercial rooting medium Keradix, and planted in garden soil. Earlier sprouting of shoots and larger root volume were observed in the treated Excoecaria plants. These plants will be transplanted in the Adyar estuary in the monsoon season. Such rooted plants can be easily developed on a large scale in mangrove nurseries and ultilised in plantation programmes. *A. marina* shoot cuttings have not responded to the treatement and modifications of techniques are under study.

Sub Programme Area 104

Modelling the Impact of Sealevel Rise on Estuarine Ecosystems

The Foundation has, since its inception, been conducting anticipatory research on the impact of sealevel rise on mangrove ecosystems, to evolve strategies for mitigating the adverse consequences. Since July 94, the Foundation has also initiated a research programme to evolve forecasting models that would help understand the impact of sealevel rise on water quality, environmental parameters and biological diversity in estuarine ecosystems. The computer modelling programme, conceived of by Prof. R. Natarajan, distinguished marine biologist, is a hybrid of three sub-models, concerned with economic activities, hydrodynamics, and chemistry and biology of the estuarine ecosystem. To start with, separate sub-models are being developed, while interactive features would be incorporated at subsequent stages. This programme is supported by the Council of Scientific and Industrial Research (CSIR) through the Emeritus Scientist Scheme.

PROGRAMME AREA 200

Biological Diversity

Sub Programme Area 201

N. I. Vavilov Centre for Research and Training in Sustainable Management of Biological Diversity

I Community Biodiversity Programme

India is a mega-diversity area by virtue of the wide range of agro-climatic and socio-cultural conditions prevailing in the country. Increasingly this genetic wealth is being eroded due to a variety of causes, the most important of which is the diversion of habitats rich in biodiversity for other uses like human rehabilitation, hydel and irrigation projects, industry, agriculture and aquaculture. Such threats and the consequent genetic losses must be arrested by formulating policies, well planned actions and an effective role played by voluntary organisations to arouse public awareness. Action at the grassroot level alone can save biodiversity. People have to feel that biodiversity is wealth and be empowered to conserve it.

Non-governmental groups can function as vital catalysts at the community level. This would result in a convergent and synergic effort to conserve species and variability and their habitats rich in biological wealth. An NGO Biodiversity Forum representing academic institutions, community leaders, activists and non-governmental organisations was organised at the M.S.Swaminathan Research Foundation on 12 and 13 June,1993 to assess the progress of the actions initiated. Suggestions were made to improve upon them and further strengthen the community biodiversity network.

The main objectives of this programme are:

- raising the awareness of and promoting community support for biodiversity conservation through education and community participation programmes, and
- promoting the conservation and sustainable utilisation of biological resources through the joint effort of policy makers, activists, scientists, rural women and men.

The objectives were achieved through the following programmes:

1. Trainers' Training Programmes on biodiversity conservation for selected N.G.O. representatives from the states of Tamil Nadu and Kerala during September 1993

at Coimbatore and November 1993 at Thrissur respectively.(See Programme Area 500 for details). The aim of these programmes was to train grassroot level workers on various aspects of biodiversity conservation. They would in turn train rural women and men in their respective villages on biodiversity conservation. The training programmes were designed to equip the participants with knowledge and skill and give them confidence to conduct similar programmes in their own villages.

The trained representatives conducted suitably structured training programmes for rural women, students, youth leaders and tribal people. These trained rural people are being brought under a community biodiversity network to help coordinated and concerted action in areas rich in genetic wealth.

2. The Northeastern region of India is rich in genetic resources of crops and many medicinal plants. Conservation of this biological diversity and its conversion into economic wealth through appropriate technologies should therefore occupy a very high place in the political, economic and scientific agenda of states in the Northeastern region. In response to this need, a Policy Makers' workshop for the conservation and sustainable management of biodiversity of the Northeastern region was organised at Guwahati in collaboration with the Ministry of Environment and Forests, Government of N.E. States. This regional consultation was attended by Chief Secretaries, Secretaries to Government of India, Principal Chief Conservators of Forests, Directors of National Institutions, scientists and N.G.Os. High level policy makers from eight Northeastern states participated in the consultation.

   Deliberations on the various aspects and issues of biodiversity conservation were conducted for three consecutive days and the discussions led to the identification of ten priority goals (see Sub Programme Area 502 for details). The regional consultation also discussed in detail the issues raised by the Union Ministry of Environment and Forests with regard to the implementation of the Global Biodiversity Convention.

   The recommendations of the consultation were published and circulated through the Ministry of Environment and Forests, Government of India.

3. The concept of sacred groves is very old in India and is a part of the conservation ethic of this land. This traditional practice is slowly dying and sacred groves in many parts of the country are in a threatened state. Hence there is an urgent need for the conservation and protection of sacred groves as a measure to strengthen the human-nature relationship and emphasise its cultural and biological significance to the local community as a strategy towards biodiversity conservation.

   The sacred grove at St. Thomas Mount, Madras, established in 1992, is being protected and maintained. This year rehabilitation of the Soundararaja Perumal Temple of Thadicombu village of Dindigul district was done with the joint effort of Krishi Vigyan Kendra of Gandhigram and the Rotary Club of Dindigul West.

4. Work on conservation studies and developing strategies for conserving biodiversity in hot spot areas was continued. Key areas of the Western Ghats and eastern coast which are floristically very diverse and rich were studied and collections of many land races, primitive cultivars and threatened species were made for multiplication as well as for the herbarium at the Foundation.

   A collaborative research programme was started with the Kerala Forest Research Institute (K.F.R.I) for a further strengthening of the conservation studies in the Western Ghats.

5. Ethnobotanical studies were continued in tribal areas for studying the traditional farming practices of the tribals and rural communities with specific reference to their ecological prudence and the role they play in the conservation of land races.

   These studies were conducted by a team consisting of ethnobotanists, anthropologists and ecologists in remote tribal pockets inhabited by Irulas, Kadars, Malasar, Malaimalasar, Malayalis, Paliyars and Pulayars in Coimbatore, Dharmapuri, Dindigul-Anna and North Arcot Ambedkar districts in Tamil Nadu. The traditional knowledge of these indigenous tribal communities is being documented with emphasis on the conservation and use of plant genetic resources.

6. Folk/traditional media were mobilised to spread conservation messages among rural communities. This process was carried a step further by employing a consultant in folk art communication. Subsequently, dialogues were arranged between traditional folk artists, scientists and government officials to further strengthen these efforts through necessary actions.

II. Tribal Area Biodiversity Conservation Programme

Living in harmony with nature has been both a way of life and a means to livelihood among tribal families. This has led them to evolve a unique system of knowledge about the utilization and conservation of plant genetic resources by way of trial and error. This traditional knowledge has been passed on from generation to generation by word of mouth and is still retained by the tribal communities. Unfortunately, this knowledge is likely to be lost due to various developmental activities that are adversely affecting the cultural and traditional life of these groups.The unique knowledge available with the tribal people should therefore be properly documented and integrated with modern scientific values before it is lost for ever.

A detailed study was conducted on human-nature relationships, and information was collected on ethnobotany of wild edible and medicinal plants, traditional farming practices, role of women in the conservation of plant genetic resources and sacred grove method of genetic conservation in seven tribal areas from the state of Tamil Nadu. The following tribes were studied:

Malayalis	-	Nellivasalnadu (Javadu hills, North Arcot-Ambedkar dt.) and Sitteri (Kalrayan hills, Dharmapuri dt.)
Irulaș	-	Palamalai (Palamalai hills, Coimbatore dt.)
Kadars	-	Yerumaparai (Anamalai hills, Coimbatore dt.)
Malasar	-	Kozhikamuthi (Anamalai hills, Coimbatore dt.)
Malaimalasar	-	Koomatti (Anamalai hills, Coimbatore dt.)
Paliyars	-	Bommaikadu, Varagaraparai (Palani hills, Dindigul-Anna dt.)
Pulayars	-	Kottakombu, Pachalur (Palani hills, Dindigul-Anna dt.)

Ethnobotany in the Conservation of Plant Genetic Resources

Ethnobotany is the study of utilisation and conservation of plant species by the tribal communities. The tribal people living in close association with nature utilize plant species for different purposes like food, fodder, fibre, human and veterinary medicine, house construction, agricultural implements, domestic appliances, manure, fish poison, insect repellents, magico-religious beliefs, etc. The utilization of plants by tribal families do not cause any depletion to the flora or habitat as they have clear concepts of ecological inter-dependence, seasonal variations and effective/ sustainable utilization of forest produce.

Field Studies

Intensive field studies were conducted in eighteen tribal hamlets of the study area which resulted in the collection, identification and documentation of first hand information on 218 plant species belonging to 79 families (Table 2.1). During the field study the tribal medicine men were taken into forest areas for collecting information on plant species used by them. Their conservation practices were also properly documented.

Table 2.1

Number of plant species used by the tribal families studied

Total number of plant species used	218*
Number of wild edible plants	100
Number of wild plant species used for medicine	148
Number of plant species used in material culture	32

* *a species may be used in more than one way. Hence total does not tally.*

Edible Fruits, Corms and Tubers

Tribal people depend on many plant species for edible fruits (*Bridelia crenulata, Carissa carandas, Clausena heptaphylla, Cordia obliqua, Memecylon edule* and *Premna tomentosa*), seeds (*Cycas circinalis, Dolichos trilobus, Entada pursaetha* and *Xylia xylocarpa.* pods (*Lablab purpureus*), leaves (*Cansjeera rheedii, Cassia tora, Desmodium triflorum, Hibiscus furcatus and Mimosa intsia*), tubers (*Dioscorea alata, Dioscorea bulbifera, Dioscorea oppositifolia, Dioscorea pentaphylla* and *Dioscorea tomentosa*), corms, (*Colocasia esculenta*) rhizome, (*Canna indica*), etc. They use distinct methods for harvesting the edible part of each species as well as for processing and in certain cases preparing the edible part for off-season consumption. For example, the yams of *Dioscorea spp.* are thoroughly washed and processed to eliminate the chemical content responsible for producing giddiness.

Some tribal groups, particularly Kadars, have a conservative way of harvesting the tubers of *Dioscorea* species which reveals their ecological prudence. Before harvesting the tubers they check that the leaves on the vine are yellow, which is an indication of mature tubers. The selection of tubers before digging reduces the disturbance to associated species. If the harvested tuber is large, it is shared among the group, thereby preventing over-harvesting of tubers The upper portion of the harvested tuber along with the vine is placed back in the pit to allow it to regenerate. It is observed that the tribals leave the soil around the tuber very loose so as to allow easy aeration for the growing tuber, making sure of its regeneration, irrespective of whoever may harvest it in the next season.

It was observed that the use of plant species by the tribal groups is always conservation- oriented. For example plant species like *Bridelia retusa, Canthium dicoccum, Diospyros ferrea var. buxifolia, Ficus racemosa, Glycosmis pentaphylla, Madhuca longifolia var latifolia, Palaquim ellipticum, Phoenix sylvestris, Phyllanthus emblica, Polyalthia cerasoides, Premna tomentosa, Schleichera oleosa, Terminalia bellerica, Xylia xylocarpa, Zizyphus mauritiana,* etc., are commonly used only for their edible fruits or seeds and not for other basic purposes like house construction, agricultural implements, etc.

Edible Greens and Vegetables

Plant species like *Allmania nodiflora, Amaranthus spp., Boerhavia diffusa, Cansjeera rheedii, Cocculus hirsutus, Colocasia esculenta, Commelina benghalensis, Lycianthes laevis, Mukia maderaspatana, Portulaca oleracea, Rhaphidophora pertusa, Talinum cuneifolium* and *Trichosanthes nervifolia* are consumed by tribal groups as edible greens. These plant species grow in the forest areas and also near their hamlets as weeds. This method of utilizing more plant species increases their choice of food plants.

Medicinal Plants

The tribal families studied use a total number of 148 plant species for medicine. Of these, eighteen plant species are used by more than one tribe for different ailments which establishes the authenticity of the therapeutic value of these plant species. Each tribe has its own way of collecting the plants and preparing and applying the medicine. The dosage and duration of medication depend on the age of the patient and the intensity of the disease. Most people, including young children, are aware of the medicinal uses of plant species for minor external injuries like cuts and wounds and for ailments like cold, headache, etc. However, whenever the medicine is used in high dosage and for long duration, experienced elderly people are consulted.

There are specialists for serious diseases, disorders and preventive medicine e.g. abortion, antifertility, chronic ulcers, jaundice, malaria, etc. in each tribal community. It is also observed that the same plant species is used for different diseases, e.g. *Calotropis gigantea* (vermicide & antiseptic), *Canna indica* (menstrual disorders & stomach pain), and *Cassia fistula* (abortifacient & body pains). Moreover in curing certain diseases a combination of different plants is used, e.g. *Albizzia lebbeck* together with Cassia fistula and *Euphorbia hirta* is used for urinary disorders, and *Capparis zeylanica* along with *Pongamia pinnata, Cissus quadrangularis* and *Toddalia asiatica* is used for venereal diseases.

Their knowledge of plant-based birth control mechanisms is greatly needed in the present-day situation. Some of the prominent examples include :

Anogeissus latifolia	used	for	antifertility	by	Kadars
Azadirachta indica	used	for	antifertility	by	Malayalis
Cassia fistula	used	for	abortion	by	Malasar
Mimosa pudica	used	for	contraception	by	Kadars
	and	for	abortion and antifertility	by	Malasar
Mukia maderaspatana	used	for	antifertility	by	Malasar

Leaves of a few plant species are used by the tribals as lactagogue for cattle and goats viz., *Artocarpus heterophyllus, Phyllanthus reticulatus, Pongamia pinnata* and *Ventilago denticulata.* Likewise *Cardiospermum halicacabum* is used for veterinary diseases. About fifty-four plant species are used for different purposes like house construction, thatching, making agricultural implements, household articles, musical instruments, etc. *Themeda cymbaria,* a grass species, is used for thatching, as this keeps the house cool during summer and warm in winter.

Plants Used for Stupefying Fish

It is also observed that the tribals use a few species of plants as stupefying agents. Fruits of *Catunaregam spinosa* and *Hydnocarpus laurifolius* and leaves of

Diospyros chloroxylon and *Diospyros ebenum* are used as fish poison. It is interesting to observe that the tribals use fruits only if they are big in size, and that they use leaves when the fruits of that tree are small.

Malaimalasars and Malasars make a small pond in the stream by constructing bunds, and mix the pounded fruits or ground leaves. When this mixture dissolves in water, the fish become stupefied and float. The tribals collect only the large fish and leave the small ones. The active principle responsible for stupefication can be used as a biofriendly agent for large-scale fishing to harvest the mature fish. The process will help in reducing the indiscriminate exploitation in large-scale fishing in stagnant ponds and rivers.

The prudence exhibited by these tribal groups in utilising plants *in toto* reveals their wisdom on the food and economic value of plant species which is the intellectual component of their contribution to contemporary knowledge on food and health security. This would form an alternative resource base, thereby extending the base of our food security system. The rationale behind the conservation of plant genetic resources by the tribal people is due to their total dependence on natural biological resources. Their concept of conservation in certain aspects transcends science and enters the realm of ethics and spirituality.

Studies on the Farming Practices of Malayali and Irula Tribes of Tamil Nadu and their Lessons for Sustainable Agriculture

Tribal communities, over the millennia, have developed numerous crop genetic strains. They are also responsible for the *in situ* conservation of a number of economically important plant species and land races of cultivated species. The genetic strains of crop plants developed by the tribal communities today serve as basic raw material for many crop improvement programmes. Apart from this, the resource-based farming methods of the tribal people can be a model to develop a sound sustainable agricultural system. Based on these observations, the traditional farming practices and cultivars of some of the tribal communities of Tamil Nadu were studied and documented.

The objectives of the study were:

- to collect and preserve the traditional cultivars with passport details;
- to document the ecological, economical and social prudence of the tribal communities in their farming practices and preservation of crop genetic resources.

Both the Malayali and Irula tribes practise terrace cultivation in their dry lands which lack any irrigation facility. Their cultivation is entirely dependent on monsoon rains.

The principal crops of both Malayalis and Irulas are minor millets. They cultivate a wide variety of little millet, finger millet, pearl millet etc. along with pulses and

cash crops. So far, a total of thirty-four cultivars have been identified from the Malayalis, of which fifteen are minor millets and three are varieties of paddy. Thirty traditional varieties have so far been identified from the Irula community of Palamalai. Many of these cultivars have been collected with passport details and preserved *ex situ* in the Community Gene Bank at the Foundation. (See Table 2.2).

The farming practices of the Malayali and Irula tribes are well suited to their socio-economic conditions and nutritional habits and also show their ecological, economical and social prudence in utilising and conserving the crop genetic resources. For example, the Government agencies classified the entire agricultural lands of the Malayali tribe as dry lands but the Malayalis divided their lands into three types - uplands, fine sandy lands and wetlands based on soil and hydrological conditions. Such an understanding of the environmental characters of their cultivable lands make these tribal people select and conserve different cultivars. Traditionally Malayalis utilise the uplands only for the cultivation of minor millets and fine sandy lands mostly for a variety of little millet and paddy. They use wetlands only for cultivation of paddy.

Apart from the traditional classification system, the mixed cropping method practised by the Malayali and Irula tribes reveals their knowledge of the ecology of their cultivable lands and the physiological traits of their cultivars. Mixed cropping is practised in the uplands where different combinations of minor millets, pulses and cash crops are cultivated in such a way that different crops are harvested in different periods of a year to meet their food requirement and economic needs. The mixed cropping method also allows the Malayalis and Irulas to utilise the available land, water and soil nutrients in an effective manner to generate maximum yield. The fibrous roots of the minor millets utilise the water and nutrients present in the top layer of the soil whereas the tap roots of the pulses and cash crops utilise the water and nutrients of the bottom layer of the soil. Thus, they have developed cropping patterns which can help to extract moisture from different depths of the soil profile.

Traditional use of organic manure and the method of manuring are interesting features observed in the farming practices of the Malayali and Irula tribes. The most common forms of organic manure used are cattle refuse, green manure and domestic waste. The leaves of plant species viz. *Cassia javanica, Pongamia glabra, Azadirachta indica* and *Calotropis gigantea* are commonly used as green manure. The first two species which are leguminous plants are used to enrich the soil nitrogen and the last two species are used also to serve as biological pest repellents.

Based on the present study it can be concluded that the genetic strains conserved by the Malayali and Irula tribes in the form of traditional cultivars can be a source of basic material for future crop improvement programmes since most of them are exposed to various biotic and abiotic stresses. Secondly, the prudence of these tribals in selecting different cultivars of a single crop for different cropping

systems and different land types enhances the gene pool of the crop plants. Thirdly, the low-input, resource-based agriculture methods and practices followed by the tribals reveal their indigenous knowledge in utilising the available resources like land, water and nutrients in an efficient manner.

The farming practices of the tribal families provide the following lessons for developing an ecologically sustainable agriculture system:

- Preserve genetic heterogenity in economic plants, since genetic homogenity enhances the prospects of pest development.
- Adopt low-risk agronomy, such as mixed cropping to avoid total crop failure under adverse weather conditions.
- Develop systems of soil fertility restoration based on organic and green manures and biological nitrogen fixation.
- Conserve the ecological foundations, namely, soil, water and biodiversity, essential for sustainable agriculture.
- Select crops which are adapted to local agro-ecological and socio-cultural conditions and which do not require either chemical pesticides or inorganic fertiliser.
- Cultivate crop mixtures which can help to optimise the benefits from the moisture available in a cubic volume of soil.
- Cultivate crops which are nutritionally superior and at the same time have good organoleptic properties.
- Practice *in situ* conservation of intra-specific variability in economic plants.
- Never live on the capital - always keep planting material for the next crop.

Role of Tribal Women in the Conservation of Plant Genetic Resources

Tribal women play a significant, albeit little recognised role as managers of biodiversity. They possess extensive knowledge of their local natural resource base and have the ability to recognise multipurpose utility of various plant species that are available in their surroundings. Their prudence is revealed in sustainably using a wide diversity of plant genetic resources to meet their day-to-day requirements like food, fuel, fodder, medicine etc. The tribal conservation practices, which are often based on their cultural practices, religious traditions and belief systems, ensure that they reap long term benefits.

Malayalis of North Arcot and Dharmapuri districts and Irulas of Palamalai in Coimbatore district are traditionally agriculturists. They are primarily subsistence

farmers. Along with the men of the household, the women are also involved in almost all the agricultural activities. They play a crucial role in preserving and conserving grains for household consumption and seed material for the following season. It is the sole responsibility of the women to select and conserve the seed material for different crops. Soon after the harvest, the required quantity of healthy and viable grains is selected to be utilised as seed material. Chaffy grains, weed seeds and less viable grains are eliminated during the winnowing process. They also make sure that the seed material has a low moisture content by uniformly and thinly spreading seed material in the hot sun. The seed material is stored in earthen pots or in a good cloth or gunny bag.

Traditionally women have been the seed selectors and conservers thereby contributing to the preservation of genetic diversity and self-renewability of food crops, thus ensuring food security at the household level. The selected seed material, once kept aside, is generally not used for consumption even if they run out of food grains at their disposal. The women involve their daughters in various agricultural activities, especially in seed processing and conservation, as soon as they are old enough to understand and handle the task. No formal training is given. Like any other socialisation process the girls learn to do it along with other household and farming activities by observing their mothers at work. Since seed selection and its conservation require care and careful handling, this task has been usually carried out by the women of the household. Many of the land races of today would not have existed but for these tribal women.

Since women shoulder the responsibility of providing food to the household they are aware of the nutrient content of the various food grains, pot herbs and vegetables available in their localities. They recognise the nutritional values of various greens available in their surroundings and consume them often along with their regular food. They do not generally waste the greens that grow as weeds in their cultivated fields. They usually cook more than one variety of greens, mixing the different varieties to supplement each other's nutritional value. Some greens are not only used in their day-to-day diet but also for medicinal purposes: for example, *Pannai keerai* (*Digera muricata*) among the Malayalis and Irulas, *Paluvi keerai* or *Theembli keerai* (*Cansjeera rheedii*) among the Pulayars and Paliyars, *Neeri mulli keerai* or *Mullang keerai* (*Amaranthus spinosus*) and *Kol thagarai* (*Cassia occidentalis*) among all the tribal groups studied.

Tribal women train their girl children (sometimes even male children are involved, for e.g. among Kadars) at an early age of seven or eight to identify and collect greens. Care is taken to instruct the children to pluck the tender leaves without uprooting the whole plant.

Both men and women (especially among Kadars, Malai Malasars, Malasars) are involved in the collection of wild tubers/roots and fruits like *Koova kizhangu* (*Canna indica*), *Kasturi manjal* (*Curcuma aromatica*) and *Kakkang kottai* (*Entada pursaetha*)

(among Kadars and Malai Malasars). But the process involved (which is time consuming and requires patience) in removing the high alkaloid and phenolic compound in the wild tubers and fruits, is mainly carried out by the womenfolk of the household. While collecting and gathering these tubers/fruits, the tribal people make sure that the surrounding vegetation is not disturbed.

Women are also knowledgeable about plant species that are used for treating various diseases and ailments. Among a few tribes like Kadars, young children are informally trained to identify plants that are used to treat certain common diseases. Gradually, they learn the process by observing the elders at work. The children are told to collect only the required portion of the plant species. Though generally the traditional medicinal knowledge especially in treating major diseases rests with the male members (who usually do not share their knowledge with other people), there are also a few traditional medicinel women among Paliyars and Malasars.

Tribal people especially women raise a few important medicinal plants that are generally required to treat common diseases as well as chronic ones. Among the Kadars, it is common to find *Kattukothamalli* (*Chenopodium ambrosioides*) being grown in their house premises which is used to treat children suffering from fever and headache. Among the Pulayars, it was noticed that a few households were raising *Semmara kolinju* (*Coleus sp.*) which is widely used for treating different ailments like jaundice, stomach ache, fever and chest pain. Its leaves are also believed to keep away evil spirits and prevent the spread of cholera. *Thonimalai marundu* (*Blepharis maderaspatensis*) which some 15-20 years ago was widely available has become almost extinct in Thandikudy area of Palani hills due to deforestation. According to the Paliyars and Pulayars of this region, *Thonimalai marundu* possesses immense medicinal value in treating bone fracture, even the serious type. Recognising the high medicinal value of this plant, a few Pulayar women took the trouble of securing a few of these plant saplings from their friends living in nearby areas and are growing them in their backyard to save them from extinction and to serve in times of need.

III. Conservation of Sacred Groves

Setting aside pockets of forest lands has been the practice for centuries in India. To protect these biological resources more meaningfully, a religious tag is attached, which has served over the years as a key factor in genetic conservation through the mechanism of sacred groves. The religious tags in the form of 'do's' and 'don'ts' vary from place to place, largely based on the beliefs of the local community. Sacred groves represent a tradition of nature conservation by the people much prior to the modern concept of 'Wildlife Reserves'. However, due to reasons like population pressure and development programmes, the sacred groves in many parts of the country are undergoing heavy destruction. There is an urgent need for community-oriented action in order to maintain this conservation culture for sustainable ecological and social benefits.

To this effect, a research project in collaboration with WWF was implemented at St. Thomas Mount, a historical site of Madras. The underlying objective of this project is to bring about improvement of environment in order to (i) create a sanctuary of selected plant species and (ii) provide a source of germplasm of local species. It is intended to facilitate attitudinal changes about conservation among the local community. Around 100 saplings were planted and maintained with adequate protection and care.

Secondly, rehabilitation work was started at the Soundaraja Perumal temple of Thadicombu village of Dindugul-Anna district of Tamil Nadu. This temple is of historical importance and dates back many centuries. Rehabilitation of the sacred grove was jointly taken up with the Krishi Vigyan Kendra of Gandhigram and the Rotary club of Dindugul-Anna West. About 600 saplings, of a wide range of vegetative composition, were planted around the temple. A series of meetings were conducted to sensitise the people living around the temple and to stress the importance of conservation practices. These meetings were very successful and the local community showed a great deal of interest and commitment. A detailed monitoring and evaluation programme to assess the progress of the rehabilitation, and community participation is also being worked out.

It is also proposed to select a few more sacred groves which are on the verge of destruction and rehabilitate them with the help of the local NGOs, communities and school children in the coming year.

Research work is underway to bring out an inventory of the existing sacred groves in the tribal areas of Salem, North Arcot-Ambedkar, Coimbatore, Dindugal, and Chengai-MGR districts of Tamil Nadu. So far, 10 sacred groves have been identified and studied in these areas. Local people were interviewed about the current status and indicator species of the sacred groves in the vicinity. The more promising ones were studied for floristic composition. This work will be further extended to other districts in the coming year.

IV. Community Gene Bank

The Community Gene Bank at the MSSRF has been commissioned for farmer conserved and farmer developed strains, referred to as "folk seed" or "folk varieties" on the basis of UNESCO's definition of folklore as the knowledge of the common people. The community gene bank has been named after Prof. G.T. Scarascia-Mugnozza the great Italian plant geneticist and conservationist and a world leader international cooperation in arresting gene erosion and in harvesting plant genetic resources for national food security.

Gene Bank Design Features

The total storage capacity of the gene bank is 1.5 million gm of seeds with a maximum residual moisture content of 8 % by weight. Medium Term Storage

has two cooling units, one of 4.5 tonnes cooling capacity, and the other of 3.0 tonnes. There are three dehumidifiers each operating at a maximum (electrical) load of 7.5 kw while one dehumidifier operates at 3.0 kw maximum (electrical) load. The storage unit is single with no partitions, and has a net floor area of 27.1 sq.m. Seeds can be stored in a viable condition for about 5 to 7 years at 4 degree Celsius and 25% relative humidity in the community gene bank. The coolant used in this design is Freon-13 which is known to be 100 times less polluting in terms of contribution to green house effect. The coolant was identified and supplied by M/S. Blue Star India Ltd. The schematic diagram of the Community gene bank is given in Fig. 2.1.

Gene Bank Activities

The gene bank aims at cataloguing, evaluation, conservation and utilisation of plant genetic resources which are not being preserved by other agencies. The collections will be crop plants and land races from tribal and rural communities. These land races are uniquely adapted and are genetically diverse forms of cultivated plants and hence serve as repositories of valuable genes, particularly for tolerance to a wide range of biotic and abiotic stresses. The collections also include rare and endangered medicinal plants. Duplicate samples will be deposited with the National Bureau of Plant Genetic Resources (NBPGR). Samples will be distributed freely on request to scientists working in the Foundation and elsewhere. The information collected will form the basis for creating a database.

Processing

The gene bank manager Ms. Geetha Rani has been trained at the International Crops Research Institute for the Semi Arid Tropics (ICRISAT), Hyderabad in methods of processing and storage of materials. The processing of seeds for storage includes several steps such as registration, cleaning, drying, packing, storage, and regeneration.

Collection

List of accessions collected through the community biodiversity network is given in Table 2.2. Besides, twenty six accessions of rice (from International Rice Research Institute & International Institute of Tropical Agriculture) and ten accessions of coloured linted cotton (from the Central Institute for Cotton Research Nagpur, India) are available. An accession register is being maintained. Herbarium sheets and other essential information are maintained. The *ex situ* preservation efforts will be supported where appropriate by screening and multiplication using micropropagation methods. Green house and mist propagation facilities also exist. Germplasm will be used to evaluate the landraces for useful traits.

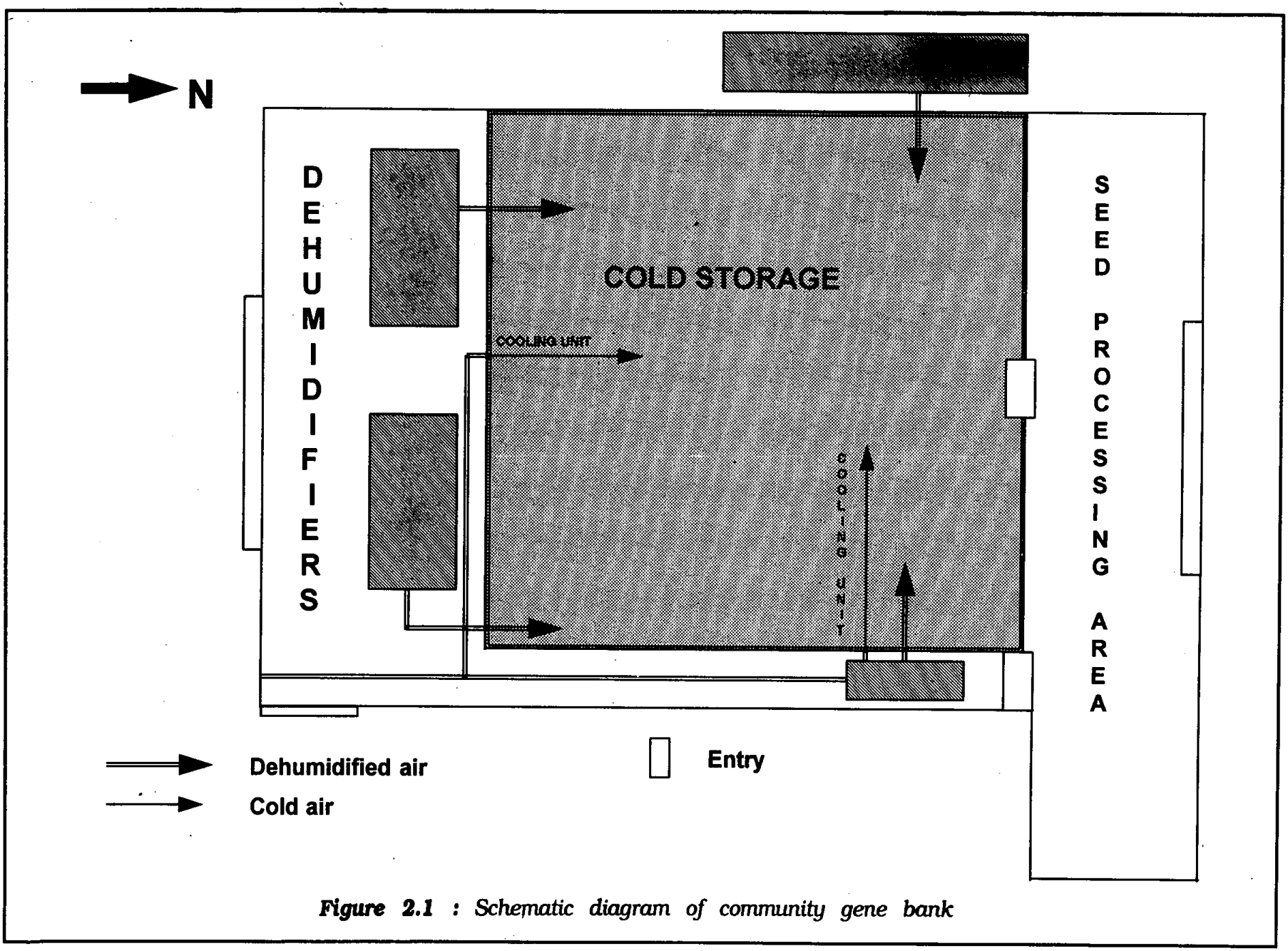


Figure 2.1 *: Schematic diagram of community gene bank*

Table 2.2

Accessions maintained in the community gene bank at MSSRF*

ACCESSION	CULTIVAR/VARIETY	PLACE OF COLLECTION	SOURCE
RICE			
MSR 0027	GANDHAKA SALA	KERALA	KURUMBAR
MSR 0028	VELIYAN	KERALA	KURUMBAR
MSR 0029	THONDI	KERALA	KURUMBAR
MSR 0030	BASABHOG	ORISSA	KOYAS
MSR 0031	BAYAGUNDA	ORISSA	KOYAS
MSR 0032	KOKERAL	ORISSA	KOYAS SUB.GROUP
MSR 0033	ASAM CHUDI	ORISSA	KOYAS
MSR 0034	RATNA CHUDI	ORISSA	KOYAS
MSR 0035	BAVANGI	ORISSA	KOYAS
MSR 0036	CHIKILA KOTI	ORISSA	KOYAS
MSR 0037	MACHA GONDA	ORISSA	KOYAS
MSR 0038	KENDU	ORISSA	KOYAS
MSR 0039	CHUDI	ORISSA	KOYAS
MSR 0040	BATA CHUDI	ORISSA	KOYAS
MSR 0041	BATA KABIRI	ORISSA	KOYAS
MSR 0042	SAMBALPURI	ORISSA	KOYAS
MSR 0043	KALAJIRI	ORISSA	KOYAS
MSR 0044	PUSH BANDA	ORISSA	KOYAS
MSR 0045	CHUDI	ORISSA	KOYAS
MSR 0046	ASAM CHUDI	ORISSA	KOYAS
MSR 0047	KAKUDI MANJI	ORISSA	KOYAS
MSR 0048	BAYAGUNDA	ORISSA	KOYAS
MSR 0049	CHATKHA	ORISSA	KOYAS
MSR 0050	MACHHKARTA	ORISSA	KOYAS
MSR 0051	BHATA	ORISSA	KANDHA
MSR 0052	BODIDHAR	ORISSA	KANDHA
MSR 0053	RANGA LOCHAI	ORISSA	KANDHA
MSR 0054	CHIPTI	ORISSA	KANDHA
MSR 0055	KERANDI	ORISSA	KANDHA

* *Collected through the community biodiversity network programme*

ACCESSION	CULTIVAR/VARIETY	PLACE OF COLLECTION	SOURCE
MSR 0056	LOCHAI	ORISSA	KANDHA
MSR 0057	SWAPUR LOCHAI	ORISSA	KANDHA
MSR 0058	UMERIA CHUDI	ORISSA	KANDHA
MSR 0059	PERU NELLU	N.AMBD.DT	MALAYALIS
MSR 0060	OOR MUNDUKAN	KERALA	
MSR 0061	MARA NELLU	DHARMAPURI	IRULAS
MSR 0062	KAGGA	KANNADA	PATGAR COMMUNITY
MSR 0063	SAMBA NELLU	SALEM	MALAYALIS
MSR 0064	PULIDIKALU NELLU	SALEM	MALAYALIS
PULSES			
MSPL 0001	KOLLU	N.AMBD.DT	MALAYALIS
MSPL 0002	MOCCHAI	N.AMBD.DT	MALAYALIS
MSPL 0003	AVARAI	N.AMBT.DT	MALAYALIS
MSPL 0004	AVARAI	DHARMAPURI	MALAYALIS
MSPL 0006	KARU MOCHAI	SALEM	MALAYALIS
MSPL 0007	SIVAPPU MOCHAI	SALEM	MALAYALIS
MILLETS			
MSL 0001	VELLA SAMAI	N.AMBD.DT	MALAYALIS
MSL 0002	KARUN SAMAI	N.AMBD.DT	MALAYALIS
MSL 0003	SAMAI	SALEM	MALAYALIS
MSL 0004	KOTHU SAMAI	SALEM	MALAYALIS
MSL 0005	MALAI SAMAI	SALEM	MALAYALIS
MSL 0006	THIRIKULA SAMAI	SALEM	MALAYALIS
MSL 0007	SADA SAMAI	SALEM	MALAYALIS
MSL 0008	PERUN SAMAI	SALEM	MALAYALIS
MSI 0001	THINAI	N.AMBD.DT	MALAYALIS
MSI 0002	THINAI	SALEM	MALAYALIS
MSF 0001	PER ARIYAM	N.AMBD.DT	MALAYALIS
MSF 0002	MALA KEVURU	SALEM	MALAYALIS
MSF 0003	RAAYI	SALEM	MALAYALIS
MSF 0004	PERUN KEVURU	SALEM	MALAYALIS
MSF 0005	SAMBA KEVURU	SALEM	MALAYALIS
MSM 0001	PANI VARAVU	N.AMBD.DT	MALAYALIS
MSP 0001	MALAI KAMBU	N.AMBD.DT	MALAYALIS

Sub Programme Area 202

Nutrient Dynamics in Mangroves of Pichavaram

The litterfall of the mangrove plants provides the basis for a detrital food web, which not only cycles the nutrients but is an economically important step that sustains coastal fisheries. The ecosystem is very dynamic with constant fluctuations in water levels flooding the estuary. The litter falling in the intertidal areas is washed into the water body and is transported away from the place of origin, getting decomposed in the process. The decomposition of the above-ground biomass is initially carried out by crustaceans and copepods who break down the litter into smaller fragments which is then colonised by microalgae and fungi for intracellular decomposition.

The study was begun in August 1992 and continued to complete a cycle of one full year. The results show that there are two periods of high production. One appears in the monsoon months from September to December and the other appears in the summer months of April and May. This is mostly due to increase in floral and fruit fall during the monsoon and leaf fall during summer.

The trend of litterfall in a comparison between the species is
R. apiculata > *C. decandra* (=) *A. officinalis* > *B. cylindrica*

The general trend of components of litterfall is
Leaves > Flowers > Fruits > Stipules > Twigs > Misc.

A major factor affecting the whole mangrove ecosystem is the tide. They not only play a part in zonation and maintenance of mangrove vegetation but are also responsible for the exchange of nutrients in the ecosystem. Three locations were chosen for the study of tides encompassing nearly all variations in the area. One was at the mouth (Coleroon), another in the mangrove forest (Peria Guda), and the third was the mixing point of estuarine and fresh water (Nadu Odum). The average tidal amplitude in Pichavaram mangrove forest is very low and variable. In a comparative study of Pichavaram area there are wide variations in the floating litter biomass, spread and amplitude of tide (Table 2.3). The results show the complex nature of nutrient mixing within the system and give numerical evidence to the hypothesis that mangroves are a nutrient sink, and that nearly equal amounts of macro nutrients (floating litter) are present in each incoming and outgoing tide of the Peria Guda islands of Pichavaram.

Dissolved organic matter in natural waters function as organic substrates and they are of direct importance in the nutrition of filter feeders and juveniles of many species. To obtain a primary picture of nutrient cycles in Pichavaram mangroves it is essential to find the rate and amount of nutrients released into the environment during litter decomposition.

Table 2.3

Movement of litter under the influence of tides in different areas of Pichavaram

Area in Pichavaram	Outgoing litter ($g/m^2/3hr$)	Incoming litter ($g/m^2/3hr$)	Tidal spread (cm)	Tidal amplitude (cm)
Coleroon	810	332 512	238 300	24
Nadu Odum	624	479 299	161 299	21
Peria Guda	922	679 939	292 523	32

In order to study the rate of decomposition of the fallen leaf litter, bags made of two different sized mesh were used. The results are given in Table 2.4.

Table 2.4

Rate of decomposition of leaf litter kept in two types of nylon nets

Plant name	Days of decomposition					Half Life
	6	12	18	24	33	
R. apiculata						
A	-0.434	0.449	0.103	0.189	0.239	33
B	0.606	0.281	0.143	0.292	0.272	33
A. officinalis						
A	-0.363	0.474	0.101	0.324	0.492	21
B	-0.665	0.541	0.295	0.153	0.246	21
C. decandra						
A	-0.558	0.355	0.187	0.020	0.270	33
B	-0.470	0.295	0.394	0.301	0.221	24
B. cylindrica						
A	-0.449	0.526	0.301	-0.301	0.066	27
B	-0.966	0.375	0.366	0.383	0.375	24

A : mesh size = 0.25 cm^2 B : mesh size = 1 cm^2

The triple interface of estuarine water, detritus mud and mangrove plants makes the production cycling and transport of nutrients more complex for us to understand. The most important components of the living system are oxygen, carbon, hydrogen and nitrogen. The other components are phosphorus, sodium and potassium which are of less importance. Since the ecosystem is partially under water, some elements are in the oxidised or reduced state due to physical and chemical reactions. The two important elements under such influences are iron and manganese. Copper and zinc are two biologically important elements as they are a part of many enzymes and vitamins. The inputs of these elements into the ecosystem through the plant litter are described below.

Contribution of carbon, nitrogen, phosphorus and mineral elements by leaf litter and other components is given in Tables 2.5. The carbon level is evenly distributed in *R. apiculata* components except in stipules, where it is lower. In *A. officinalis* both leaves and twigs show greater amounts than other components. The flowers and fruits of *C. decandra* contain lesser amounts of carbon than other components. In *B. cylindrica* leaves, fruits and twigs contain greater amounts of carbon. Leaves contribute a larger quantity of carbon to the detrital mud than other components.

Table 2.5

Distribution of some nutrients (mg/g) in litter components of four mangrove species

Plant	C	N	P	Na	K	Fe	Mn	Cu	Zn
R. apiculata									
leaves	406	24.7	0.51	18.0	2.32	5.1	17.2	2.16	1.47
flowers	428	15.1	0.92	14.4	5.6	2.2	5.0	1.09	0.83
fruits	385	8.3	0.66	48.5	2.6	8.8	9.4	2.28	1.56
stipules	334	-	-	36.0	0.9	4.3	9.4	2.15	1.30
misc.	-	14.6	0.94	45.5	1.4	4.4	8.1	2.52	1.68
A. officinalis									
leaves	407	20.4	0.60	14.6	1.72	5.6	6.1	1.69	1.57
flowers	294	15.4	0.85	20.1	5.6	1.4	2.3	1.39	0.89
fruits	324	7.9	0.45	40.4	2.3	2.9	1.8	2.46	1.03
twigs	423	13.7	0.63	16.0	1.5	4.4	-	4.15	1.96
misc.	254	14.9	0.67	5.9	0.7	6.6	9.9	6.50	1.46

Plant	C	N	P	Na	K	Fe	Mn	Cu	Zn
B. cylindrica									
leaves	452	20.0	0.40	13.3	1.39	2.4	3.4	0.61	1.15
flowers	-	18.3	1.00	-	-	-	-	-	-
fruits	439	17.4	1.48	8.1	10.5	2.4	-	1.44	1.50
stipules	343	14.8	0.74	11.4	1.03	4.4	3.6	1.68	1.52
twigs	434	11.0	0.47	9.8	1.1	8.0	4.5	1.92	1.46
misc.	293	14.3	0.77	10.5	2.0	5.8	2.7	1.98	1.78
C. decandra									
leaves	414	18.7	0.42	17.5	1.98	3.9	6.9	0.67	1.64
flowers	353	12.5	0.56	-	-	-	-	1.32	0.46
fruits	353	13.1	0.82	9.4	2.6	2.2	-	1.92	1.16
stipules	408	11.0	0.54	10.2	2.0	2.9	4.5	1.86	1.30
twigs	389	13.9	0.72	9.6	1.30	2.9	7.2	1.50	1.54
misc.	-	9.4	0.48	5.7	1.1	3.6	5.5	1.50	1.18

The contribution of nitrogen is higher from leaves and flowers than from other components for the plants studied. Miscellaneous items (including animal dead parts and unidentified plant parts) also contribute a substantial amount (9.42-14.94 mg per gm).

It is interesting to note that the mangrove leaves contain lower amounts of phosphorus in comparison with other components especially flowers, fruits and miscellaneous items. Thus, phosphorus inputs to the ecosystem will be greater during flowering and fruiting periods.

As the process of decomposition releases nutrients into the environment, it is important to understand the rate of release of some nutrients which are important to plants. Leaf litter decomposed *in situ* was tested for nitrogen and phosphorus content. The levels of nitrogen in the leaves of mangroves decreased at the end of the study period of 33 days. A similar trend of loss in phosphorus was observed during decomposition of mangrove litter (Fig. 2.2 & 2.3).

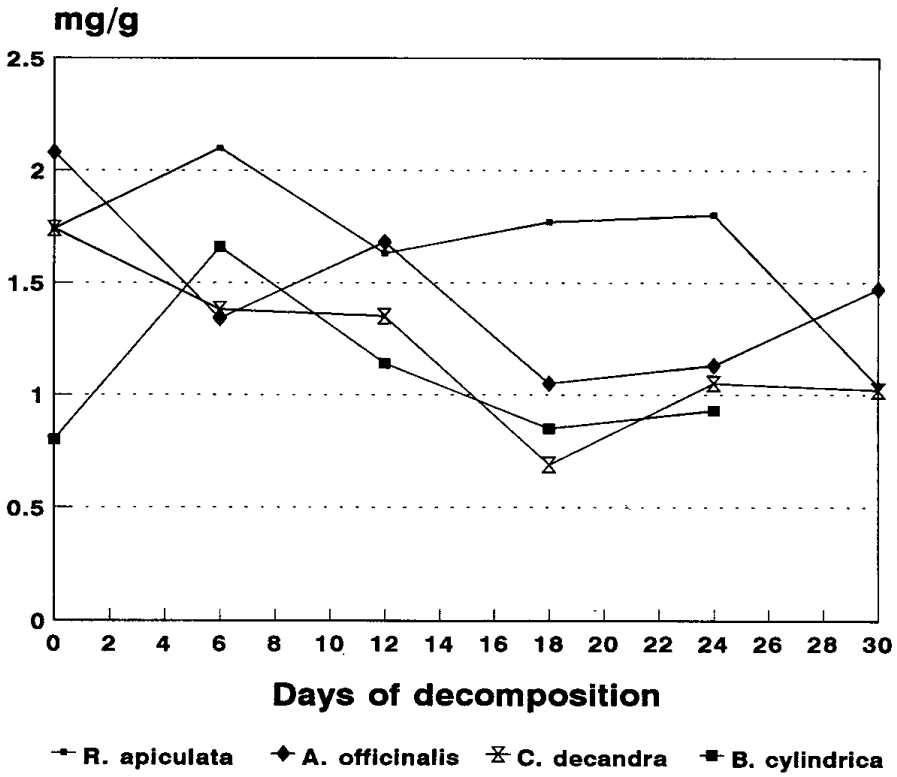


Figure 2.2 *: Nitrogen flux during decomposition*

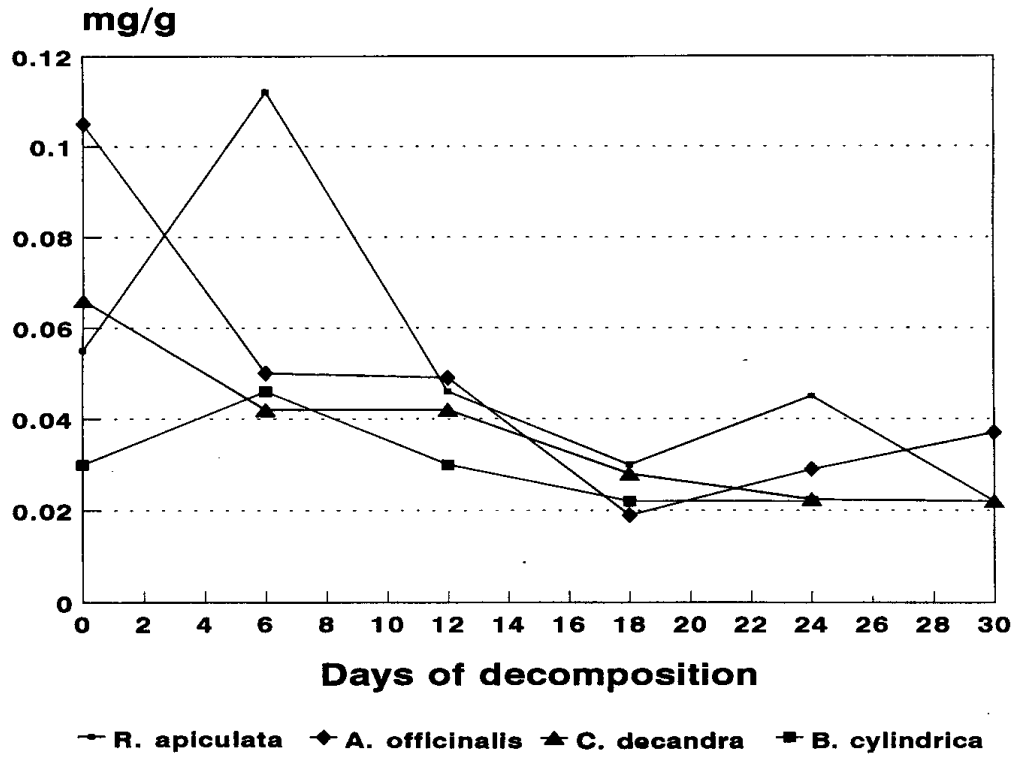


Figure 2.3 *: Phosphorus flux during decomposition*

Sub Programme Area 203

Saving Endangered Species

I. Saving Endangered Plant Species

A survey of threatened plant species which are listed in the Red Data Book of Indian Plants published by the Botanical Survey of India (1987, 1988, 1990) is on. From Tamil Nadu alone there are 171 plant species reported as threatened. Of these 123 species were listed in our First Annual Report (1990-1991). The additional 48 species are listed in Table 2.6.

Table 2.6

Additional list of endangered plants of Tamil Nadu

Species	Family	Status	Distribution
Aerva wightii Hook. f.	Amaranthaceae	Indeterminate	Tirunelveli Hills
Albizia thompsonii Brandis	Fabaceae	Rare	Coimbatore
Acrocephalus palniensis Mukerjee	Lamiaceae	Indeterminate	Upper Palani Hills
Anisochilus wightii Hook. f	Lamiaceae	Rare	Anamalai Hills
Begonia aliciae Fisch.	Begoniaceae	Endangered	Nilgiri Hills
B. cordifolia (Wight) Thw.	Begoniaceae	Rare	South Deccan
B. anamalayana Bedd.	Begoniaceae	Endangered	Peninsula
Commelina indehiscens Barnes	Commelinaceae	Rare	Anamalai Hills
Clematis theobrominae Dunn	Ranunculaceae	Rare	Tamil Nadu
Didymocarpus missionis Wall.ex R.Br.	Gesneriaceae	Rare	Nilgiris
Dicranopteris linearis (Burm.f.) Underw. var. *sebastiana* Panigr. & Dixit	Dicranopteridaceae	Vulnerable	Kanyakumari Nilgiris
Eriolaena lushingtonii Dunn	Sterculiaceae	Vulnerable	
Elaeocarpus blascoi Wiebl.	Elaeocarpaceae	Rare	Ramanathapuram
E. munronii (Wt.) Mast.	Elaeocarpaceae	Rare	Palani Hills, Madurai
E. recurvatus Corner	Elaeocarpaceae	Rare	Western Ghats
Glycosmis macrocarpa Wight	Rutaceae	Rare	Tamil Nadu

Table 2.6 (Contd.,)

Species	Family	Status	Distribution
Ilex gardneriana Wight	Aquifoliaceae	'Extinct'	Kerala and Tamil Nadu
Isonandra villosa Wight	Sapotaceae	Indeterminate	
Hydnocarpus macrocarpa (Bedd.) Warb.	Flacourtiaceae	Endangered	Nilgiris Southern Western Ghats
Kalonchoe olivaceae Dalz	Crassulaceae	Rare	Kanyakumari
Kingiodendron pinnatum (Roxb. ex DC.) Harnes	Fabaceae	Rare	Anamalai Hills Tirunelveli
Kendrickia walkeri (Wight) Hook. f. ex triana	Melastomataceae	Endangered	Anamalai Hills
Hildegardia populifolia (Roxb.) Schott & Endl.	Sterculiaceae	Endangered	Dharmapuri
Lepidagathis barberi Gamble	Acanthaceae	Rare	Ramanathapuram
L. diffusa Clarke	Acanthaceae	Indeterminate	Coimbatore
Memecylon flavescens Gamble	Melastomataceae	Endangered	Nilgiris
M. sisparense Gamble	Melastomataceae	Vulnerable	Nilgiris
Melicope indica Wight	Rutaceae	Indeterminate	Nilgiris
Ochreinauclea missionis (Wll. ex G. Don) Ridsd.	Rubiaceae	Vulnerable	Kanyakumari
Polyalthia rufescens Hook. f. & Thoms.	Annonaceae	Rare	Tirunelveli
Peucedanum anamalayannum Clarke	Apiaceae	Rare	Madurai
Poeciloneuron pauciflorum Bedd.	Bonnetiaceae	Indeterminate	Tirunelveli
Polycarpaea diffusa Wight & Arn.	Caryophyllaceae	Vulnerable	Tuticorin
Plectranthus bishopianus Gamble	Lamiaceae	'Extinct'	Palani Hills
P. bourneae Gamble	Lamiaceae	Indeterminate	Nilgiris
Pogostemon atropurpureus Benth.	Lamiaceae	Rare	Nilgiris
P. nilagiricus Gamble	Lamiaceae	Endangered	Nilgiris
P. paludosus Benth.	Lamiaceae	Endangered	Nilgiris
Pavetta hohenackeri Brem.	Rubiaceae	Vulnerable	Nilgiris
P. wightii Hook. f.	Rubiaceae	'Extinct'	Nilgiris

Table 2.6 (Contd.,)

Species	Family	Status	Distribution
Pterospermum reticulatum Wight & Arn.	Sterculiaceae	Rare	Thiruchirapalli
Pseudocyclosorus gamblei	Thelypteridaceae	Endangered	Nilgiris
P. griseus (Baker) Holttum & Grimes	Thelypteridaceae	Endangered	Palani Hills
Pseudoglochidion anamalayanum Gamble	Euphorbiaceae	Indeterminate	Anamalai Hills
Toxocarpus beddomei Gamble	Asclepiadaceae	Rare	Kanyakumari
Tephrosia barberi Drumm.	Fabaceae	Rare	Tirunelveli
T. calophylla Bedd.	Fabaceae	Rare	North Coimbatore
Utlleria salicifolia Bedd.	Periplocaceae	Endangered	Anamalai Hills

Source : Red Data Book of Indian Plants Vol.III (1990), Botanical Survey of India, Calcutta.

Field Status of Selected Species Listed in Red Data Books

During the year 1993-1994 four different areas of Kerala and Tamil Nadu states were surveyed and about 25 rare plants were collected live. This includes 10 species which are listed as threatened in the Red Data Book of Indian Plants. Our study suggests that the status of many of these plants are not correctly determined in Red Data Books and that many plants which are really threatened in the field are not included in these Books.

The species, *Syzygium travancoricum Gamble* is listed as endangered and according to the Red Data Books only one collection of this species has been made in recent years from some sacred groves of central Kerala since Bourdillon discovered it in 1894. We have located this species in different parts of Kerala ranging from Kulathupuzha, Asramam, Kollam in the south to Payyannur in the north. This species was observed to be a dominant tree in a sacred grove (Paleri Kavu) in Alappadambu village, Payyannur, Kannur district.

Another threatened species, *Phaeanthus malabaricus Bedd.* (Fig.2.4) was considered endemic to Wyanad and Tambracherry, Kerala and is represented by the type specimens and very few were subsequently collected from other localities. Our team has located this species in Myilamoodu section of Kulathupuzha forest range, Kollam district, Pampa valley, Ranni R. F., Pathanamthitta and in Vellanimala forest near Pattikkad, Thrissur district. This study has revealed that this species is widely distributed in Kerala though it is rare in the locality from where it was first described.

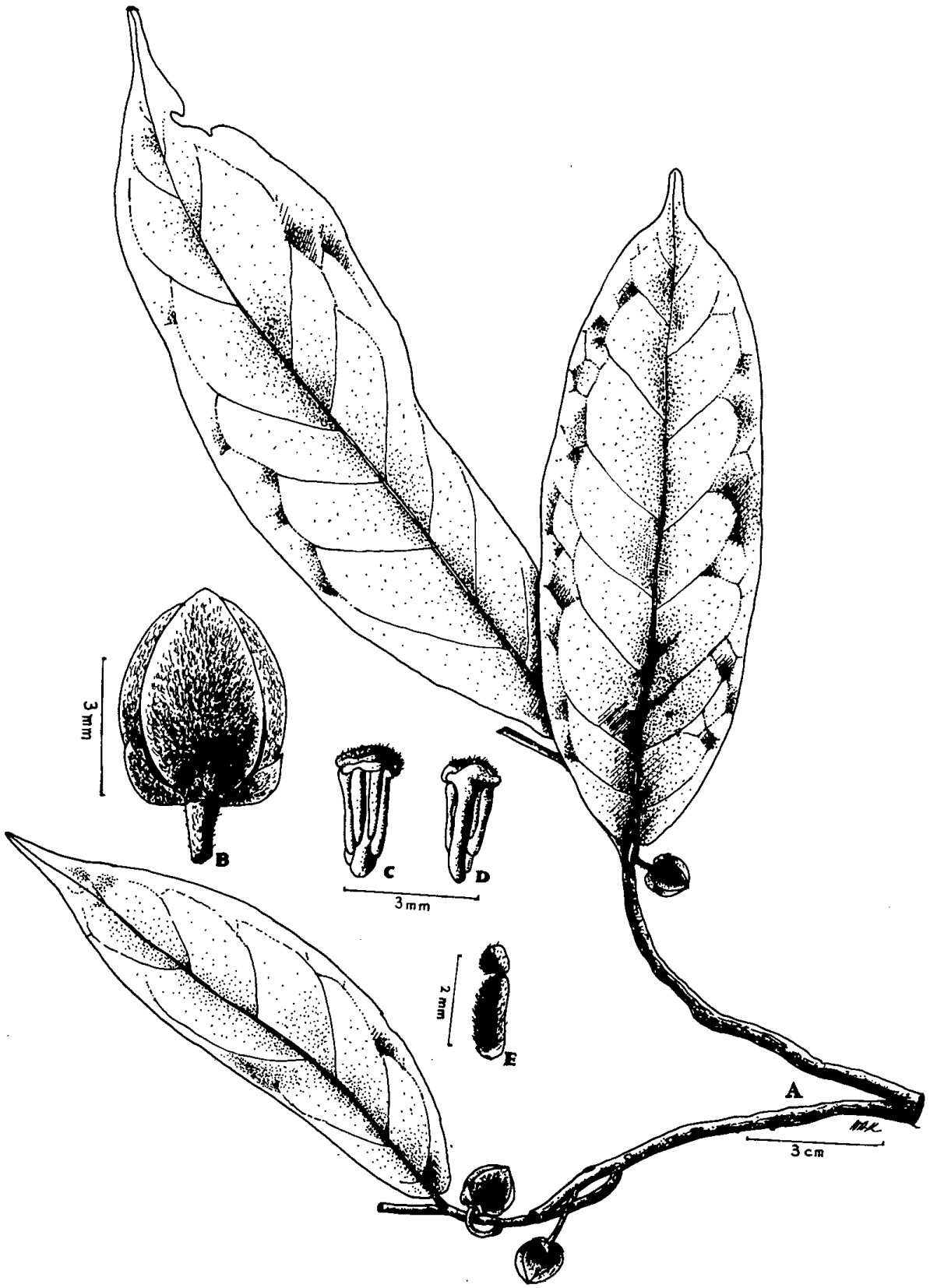


Figure 2.4 *: Phaeanthus malabaricus Bedd.,*
A. Twig; B. Flower; C & D. Stamens (different view); E. Pistil

The species like *Capparis rheedii DC.* and *Cynometra travancorica* Bedd. which are listed in the Red Data Books were the two commonest species of Vellanimala forest area, Pattikkadu, Thrissur. According to the Red Data Books the species *Cynometra travancorica* Bedd. was reported from only two localities, one in the Siruvani, western slopes, Palghat district, the other in the Sollekallu R. F., Chikamaglur district, Karnataka.

Piper barberi Gamble, a very rare species which was known from only two localities so far, was collected in a new locality. The type collection of this species was from Kannikatti (Tirunelveli) in May 1901. The second collection was after a lapse of several years in 1970 from the type locality and it was believed that this species is endemic to Kanyakumari district. But this species is fairly well represented in Myilamoodu section of Kulathupuzha forest range in Kollam district.

Further ,our study has revealed that the Red Data Book species *Hydrocotyle conferta* Wight and *Elaeocarpus munronii* Mast. are in fact common locally. The former species is found in the ecotonal areas of high altitude hills of many parts of southern Western Ghats. *Elaeocarpus munronii* is one of the dominant trees of moist evergreen forests of many parts of Kerala.

Rediscovery of "Extinct" Species

The survey made in Myilamoodu section of Kulathupuzha forest range, Kollam district, Kerala along with KFRI scientists, led to the rediscovery of the following 3 species considered extinct in the Red Data Books:

1. *Sageraea grandiflora* Dunn (Annonaceae)

   There was no report of this species since the type collection from Konni forest area, Pathanamthitta district, Kerala by Bourdillon in 1894.

2. *Madhuca bourdilloni* Gamble (Sapotaceae)

   This species was also believed as extinct. The type collection was made by Bourdillon in the late 19th Century.

3. *Nothopegia aureo-fulva* Bedd. ex Hook.f. (Anacardiaceae)

   After the type collection by Beddome (1876) from Tirunelveli hills, this species has not been reported by any botanist from any where till we rediscovered it.

Rare Species not Listed in Red Data Books

Our study has shown that many plants are being threatened in the field. There are at least 15 species that are rare in the field which we have surveyed. The rarity/vulnerability of each species was determined on the basis of their range of distribution in the past and present, and types of threat to extant populations etc. On this basis, the following species are considered rare.

Aglaia barberi Gamble
Anaphyllum wightii Schott
Crotalaria barbata Grah.
C. clarkei Gamble
Derris canarensis (Dalz.) Baker
D. thothathrii Bennett
Hedyotis membranacea Thw.
Julostylis polyandra Ravi et Anil
Morinda reticulata Gamble
Miquelia dentata Bedd.
Nervilia prainiana (King & Pantl) Seidenfaden
Orophea malabarica Sasidharan
Pleiocraterium verticillare (Wight & Arn.) Brem.
Pothos armatus Fischer
Rauvolfia micrantha Hook. f.

Collection of Land Races

Apart from the collection of endangered plant species we have collected more than 30 traditional rice varieties which are on the verge of extinction. Many traditional rice varieties are becoming extinct for several reasons. For example, the people in Wyanad, Kerala, are now cultivating only a few traditional rice varieties but in the past they had cultivated many. A rare rice variety, 'gandhaka sala' which is a scented one was collected from here. This variety is now cultivated only by a very few people. The people in Jeypore tracts, Orissa are still practising traditional rice cultivation. Our team collected about 30 traditional rice varieties each with its own characteristics from 3 tribal villages of Jeypore tracts, Koraput district, Orissa. (See Table 2.2).

II. Micropropagation Techniques in Saving Endangered Plant Species

Micropropagation techniques find application in

a) rapid multiplication of species for conservation,
b) producing variants that are of importance in the improvement of agronomically important characters and
c) eco-restoration.

Different approaches of tissue culture like axillary bud culture, meristem culture, callus culture and somatic embryogenesis are used to achieve the above objectives. Tissue culture finds application in the conservation of endangered plants for the following reasons:

1. Several of the endangered plants have low sexual reproductive capacity and produce only very few vegetative propagules. The long prebearing period of trees may have contributed to this trend.

2. Many plants have become endangered due to the destruction of their original habitats.

Rapid vegetative propagation can take care of the first group, while the variability generated during tissue culture (somaclonal variation) may be helpful in selecting genotypes adapted to the changed habitat. Desirable sterile hydrids can also be multiplied on a large scale via tissue culture (*Rhizophora lamarckii*).

Several medicinal plants are cross-pollinated and they, therefore, exhibit much variation with respect to the contents of active principles. Developing a system for rapid vegetative propagation of elite medicinal plants is therefore important. Based on these considerations the plant species listed in Table 2.7, belonging to different categories like endangered/rare/medicinal/mangrove, were subjected to *in vitro* culture with varying levels of success.

Table 2.7

Status and level of success in tissue culture

Plant Species	Status	Economic Importance	Tissue Culture
Crotalaria longipes	Endangered and endemic to Kolli & Nilgiri hillls	Legume	Embryo culture *
Syzygium travancoricum	Endangered& endemic	Medicinal	Callus culture
Piper barberi	Endangered & endemic to South Western Ghats	Medicinal	Axillary bud culture
Alstonia venenata	Rare & endemic to Southwest India	Medicinal	Axillary bud culture
Uraria picta	Rare	Medicinal	Axillary bud culture *
Rauvolfia densiflora	Rare and endemic to Western Ghats	Medicinal	Axillary bud proliferation *
R. beddomei	Rare and endemic to Western Ghats	Medicinal	Axillary bud proliferation
Gluta travancorica	Rare & endemic to South Western Ghats	Timber yielding	Callus culture

Table 2.7 (Contd.,)

Plant Species	Status	Economic Importance	Tissue Culture
Crotalaria barbata	Rare & endemic to South Western Ghats	Legume	Embryo culture and polyembryony
Polyalthia suberosa	Rare & endemic to Indian subcontinent	Legume	Axillary bud proliferation
Cordia diffusa	Rare & endemic to Coimbatore district		Axillary bud proliferation
Aristolochia indica		Medicinal	Axillary bud culture *
A. krisagathra	Endemic to Western Ghats	Medicinal	Axillary bud culture *
Crotalaria madurensis	Endemic to South Western Ghats	Legume	Embryo culture
Rauvolfia tetraphylla		Medicinal	Axillary bud culture *
Tylophora indica		Medicinal	Axillary bud culture *
Kaempferia galanga		Medicinal	Meristem culture*
Holostemma ada-kodien	Rare	Medicinal	Axillary bud proliferation
Aerides sp.		Ornamental	Immature pod culture
Tinospora cordifolia		Medicinal	Axillary bud culture and callus culture
Rhizophora sp.	(mangrove)	Medicinal/ Tannin yielding	Callus culture
Xylocarpus sp.	(mangrove)	Timber yielding	Callus culture
Heritiera sp.	(mangrove)	Timber yielding	Callus culture
Excoecaria agallocha	(mangrove)	Medicinal	Callus culture

* *Complete protocol for propagation is standardised*

Some of the interesting results are as follows:

- A total of 24 species including four species of mangroves (*Rhizophora, Heritiera, Xylocarpus, Excoecaria*) are under different stages of development *in vitro.*
- Complete protocol for the micro propagation have been established for rare medicinal plants i.e. *Rauvolfia beddomei, R. densiflora, Uraria picta* and *Aristolochia krisagathra.*
- Viable micropropagation protocol for other medicinal plants (*Aristolochia indica, Tylophora indica* and *Kaempferia galanga*) have also been standardised (See Fig. 2.5).

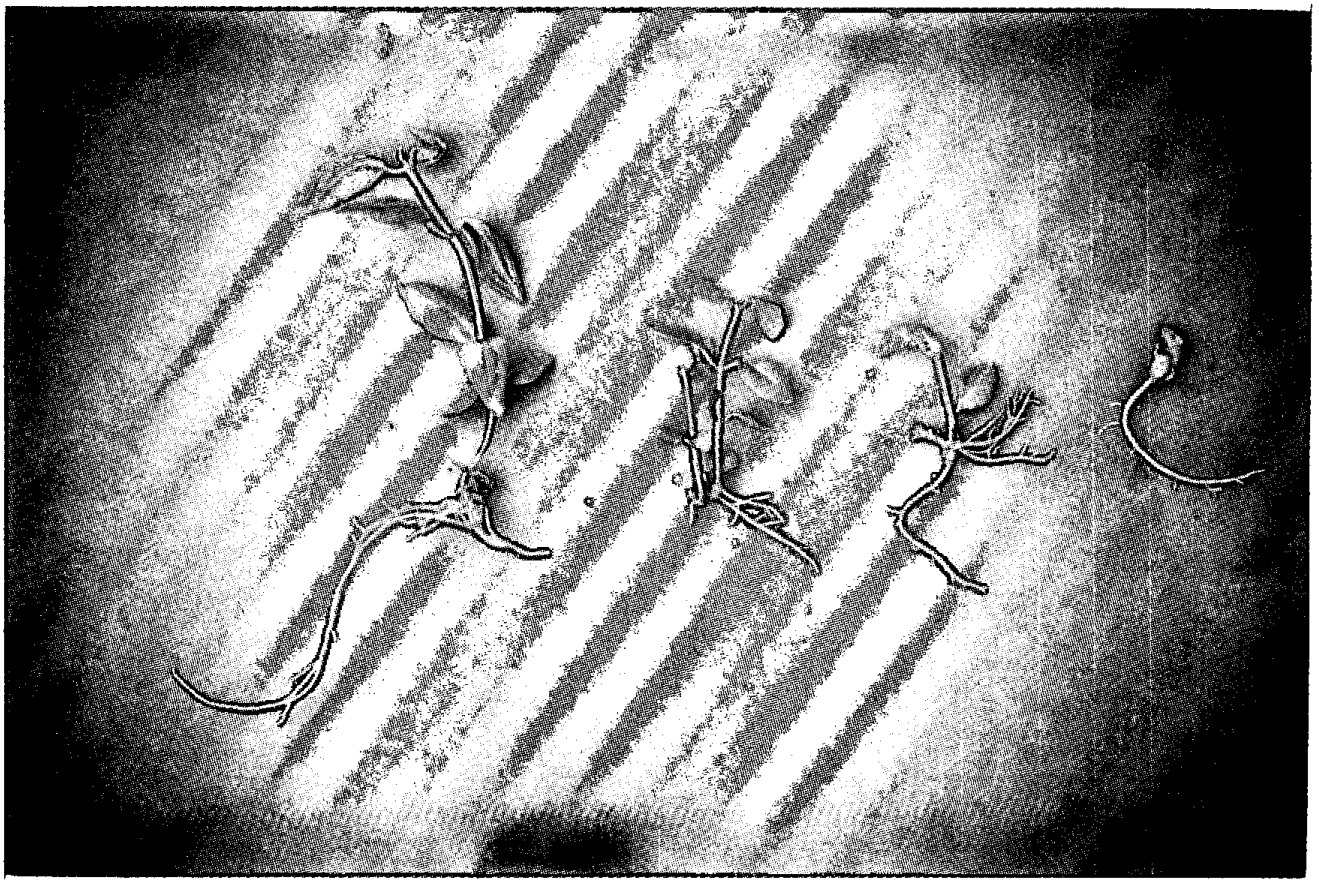


***Figure 2.5** : Plantlets of Tylophora indica, an important medicinal plant regenerated through somatic embryogenesis from leaf callus*

Sub Programme Area 204

Genetic Garden for Sustainable Mixed Farming

In our genetic garden located at the Livestock Research Station, Kattupakkam, situated about 40 km south of Madras, the biological software species which were collected last year are being maintained. In December 1993, some of these were planted to produce seeds and to assess their potential in the newly cleared and fenced area identified for a polycultural fruit orchard. Since this orchard will be used as a demonstration plot in sustainable agricultural techniques, the following biological software species, which play an important role in maintaining soil health and recycling of nutrients, were planted along with fruit plants.

Sesbania rostrata

Glyricidia sepium

Acacia holoservicea

Leuceana latisiliqua

Tectona grandis

Erythrina indica

Acacia nilotica var. cupressifomis

Dalbergia sisoo

Azadiracta indica

The following important tree species were procured from The Hendry Double Day Research Association, U.K. under "Overseas Seed Exchange Programme" :

Cassia siamea

Leuceana leucocephala

Gliricidia sepium

Terminalia catappa

The above seeds have been propagated in our nursery site at Kattupakkam, to incorporate them in the sustainable mixed garden.

The biological software species will be evaluated for their usefulness and selected species will be multiplied to be supplied to farmers.

Sub Programme Area 205

Studies in Genetic Diversity

I. Genetic Diversity Studies in Mangroves and Endangered Plant Species

Advances in the field of molecular biology have paved the way for generating molecular markers either by the direct analysis of the genetic materials (RAPDs, RFLPs) or of the gene products (proteins, isoenzymes). The major thrust of the molecular biology group has, therefore, been towards the use of molecular markers in

a. genomic characterisation,

b. elucidation of the nature and extent of polymorphism at inter- and intra-population and inter- and intra- specific levels, and

c. assessing the genomic homology between closely related plant species/groups;

with prime emphasis on endemic mangrove species, and rare, endangered and medicinal plant species of Tamil Nadu listed in the Red Data Book (Botanical Survey of India).

Species Under Study

Leaf samples and/or propagules (planting materials) have been collected from a number of mangrove species eg. *Rhizophora apiculata, R. mucronata, R. x lamarckii, Avicennia marina, A. officinalis, Excoecaria agallocha, Xylocarpus granatum, Heretiera fomes, Brugiera gymnorrhiza,* and *Nypa fruticans* from different locations. Extensive collections were made for two mangrove species (*A. marina* and *E. agallocha*) from varied ecogeographical regions—Pichavaram, Ennore, Adyar and Bhitarkanika from the eastern coast and Goa, Ganapathiphule, Ratnagiri and Thane from the western coast. From each location 5-10 morphologically distinct individuals were selected and leaf samples were collected from them.

Leaf samples were also collected from a number of rare and endangered plant species and their related species (*Rauvolfia serpentina, R. densiflora, R. micrantha, R. tetraphylla, Piper barberi, P. longum, Aristolochia krisagathra, A. indica,* and *six Crotalaria spp*) either from their natural habitats or from the plants maintaitned at the Foundation.

Extraction and Purification of Nuclear DNA

Isolation of pure DNA is the basic requisite for genomic analysis using molecular markers and other related studies. Nuclear DNA was extracted from the leaf samples

collected from the above mentioned species following extraction procedures with CTAB buffer with high salt concentrations and precipitation in either no salt CTAB buffer or in isopropanol. Modifications were made in the protocol so as to isolate the pure DNA from the leaf tissue in the mangrove species which are high in phenolics and other secondary metabolites and rich in mucilages. Species specific isolation procedures have been standardized for a few mangrove and endangered plant species. The modified protocols invariably yielded about 25-40 mg of DNA from about 2.5 gm of leaf tissue. The purity of the extracted DNA samples were tested both spectrophotometrically and also electrophoretically. In certain cases the high molecular weight DNA fragments were recovered from the gels either by electroelution or by simply cutting the desired DNA fragments from the low melting agarose, heating upto 60°C and recovering them by Phenol: Chloroform treatment and subsequent precipitation in 90 percent ethanol.

Random Amplified Polymorphic DNA (RAPD) Analysis

RAPD analysis based on the polymerase chain reaction is one of the most ingenious developments in the field of molecular biology in recent years. By this procedure, genomic DNA sequences, defined by oligonucleotide primers flanking the complementary sequences can be amplified to millions of copies. The variation thus generated between the genomic DNAs of different samples provides a direct measure for their genetic divergence.

The purified DNA sample of about 30 individual plants collected from 8 distinct populations of *A. marina* and *E. agallocha* are being analysed for RAPD polymorphism using random primers. The optimum conditions for amplification have been standardised. The reaction mix of 25µl with 2.5µl assay buffer, 2.5µl $MgCl_2$, 2.0µl 10mM dNTP mix, 15 ng primer, 0.5 units of Taq DNA polymerase and 150 ng of the genomic DNA was used for the PCR amplification. The samples were overlaid with 25µl of mineral oil and amplified for 45 cycles (1st cycle: 3.30 min at 92 C, 1 min at 37 C and 2 min at 72 C; 44 cycles: 1 min at 92 C, 1 min at 37 C and 2 min at 72 C follwed by 15 min at 72 C for primer extension). The amplified samples were run on 1.8 per cent agarose gel in 0.5 x TBE buffer. The genetic diversity measurements are to be carried out using Nei's index for assessing the intra divergence and inter-population in both the investigated species.

RAPD analysis for assessing the species interrelationships has also been initiated in 5 species of *Rauvolfia* and a few endangered and endemic *Crotalaria* species. A few modifications in both the amplification conditions and also the concentrations of the genomic DNA were made to achieve optimum amplifications. RAPD analyses are also being undertaken in a few other endangered species.

Restriction Fragment Length Polymorphism (RFLP)

RFLP is detected as the variation in the length of the DNA fragments homologous to a labeled probe after digestion with several restriction endonucleases and the markers thus generated can provide the genomic fingerprints of the individuals/ species/lines. The RFLP mapping in both mangroves and endangered plant species are being undertaken using non-radioactive labelling kits.

The extracted and purified DNA samples of a few mangrove and endangered plant species were initially tested for their suitability of digestion with different restriction enzymes. 10μg of genomic DNA following overnight digestion with 1 unit of restriction enzyme (Hind III, Bam H1, Eco RI, Eco RV) gave complete digestion. The digested DNA samples run on the agarose gels were transferred to Nytran N+ membranes. At present, heterologous genomic DNA probes from rice genome maps are being used for RFLP analysis. Table 2.8 gives details of the particulars of the probes that are being used to detect RFLP. These probes are regularly being transformed into DH5 - *alpha* strains of *E. coli* derived competent cells. The inserts from the transformed plasmids have been isolated. Also, PCR based amplification of the probe DNA is underway.

Table 2.8

Details of the rice genomic clones being used for the RFLP studies

Clone	M.W.	Vector	Copy	Site	Chromosome
RG 393	1.9 kb	pUC8	Rep.	Pst1	4
RG 134	0.6 kb	pUC8	Rep.	Pst1	10
RG 213	1.3 kb	pUC8	MC	Pst1	3
RG 244	1.6 kb	pUC8	MC	Pst1	4

Rep.- Repetitive sequence; MC- Multiple Copy

Construction of Partial Genomic and cDNA Libraries

Construction of cDNA and partial genomic DNA libraries using pUC 18 as cloning vector is being carried out in a few mangrove species. Genomic DNA has been isolated and digested with several restriction enzymes. Using methylation sensitive restriction enzymes (Pst 1, Bam H1), it is possible to isolate single copy genes. These single copy genes shall be used as probes for RFLP studies. Hot phenol extraction method is being followed for mRNA isolation. Using the mRNA isolated from the mangrove species, cDNA libraries shall be constructed using commercially available kits. These clones, from cDNA libraries, will be used for RFLP studies and isolation of the genes involved in salt tolerance.

Isoenzyme Analysis

Isoenzyme analysis is one of the useful tools to measure genetic variability, both at intra- and inter-specific levels. The commonly used extraction procedures for isoenzymes do not suit the mangrove species due to the presence of phenolics, quinones, tannins and other secondary metabolites and the mucilages that get attached to the disrupted cell contents upon homogenisation, rendering most of the proteins inactive. Several extraction buffers were tested. Homogenising the material with approximately three times (v/w) extraction buffer (0.1 M phosphate buffer, pH 6.8), gave the most satisfactory results. Protocols for a number of isoenzymes (ADH, MDH, Esterases, Poly phenol oxidases and Amylases) have been standardized for a few mangrove species. In depth studies on the inter- and intra-population divergence in two mangrove species (*A. marina, E. agallocha*) are underway at present. Samples are being compared from different ecogeographical regions, taking into account the patterns obtained for the different enzymes to assess the genetic diversity at inter- and intra-population level.

II. Collection, Conservation and Utilization of Salt Tolerant Rice and Its Wild Relatives

Breeding rice (*Oryza sativa L.*) for salt tolerance is gaining importance both due to growing salinization of soils and an increasing demand for rice production along the coastal areas. There are limited levels of inherited tolerance in cultivated rice to salt stress except in a few traditional cultivars that are being grown in the coastal saline areas. The wild relative *Porteresia coarctata* Tateoka has salinity tolerance but attempts to transfer this character into cultivated rice have not been successful so far.

Several traditional rice cultivars growing along the marshy swamp areas from the east and west coasts of India and some from Nigeria (through IITA, Ibadan) were collected to assess their levels of tolerance. Some improved salt tolerant cultivars from IRRI were also screened as controls (details in MSSRF Annual Report 1992-93). Physiological, biochemical and molecular studies on mechanisms conferring salt tolerance were carried out. This kind of screening for overall performance of the plants under salt stress (both NaCl and Artificial Sea Water, ASW) revealed the presence of better sources of genes for salt tolerance in three traditional cultivars namely, 'Oor Mundukan', 'Sonali', and 'Meghna'. *In vitro* propagation studies of these cultivars gave interesting results with several cultivars growing better and producing more tillers under salt stress (especially under 10% ASW treatment). Several cultivars were also screened for their tissue tolerance, vigour, growth and ion regulation patterns. The genetic relationships among these varieties were also studied. Morphological assessment of the cultivars using scanning electron microscopy revealed the presence of salt hairs in 'Oor Mundukan' and 'Sonali'.

Studies aimed at understanding the biochemical parameters like the stress induced enzymes and proteins, 2-D electrophoretic patterns and characterisation of proteins are also being undertaken. Molecular analysis using RAPD (Random Amplification of Polymorphic DNA) markers and RFLPs (Restriction Fragment Length Polymorphism) are in progress to assess the amount of relatedness among several of these cultivars.

Molecular Studies on Porteresia coarctata

P. coarctata is the only known relative of rice that is clearly salt tolerant. This species grows along the mangrove areas, both on the east and west coasts of India and in Bangladesh. This species thus forms a useful source of genes for salt tolerance that can possibly be transferred to rice. Attempts in such a direction have so far failed. It would be useful to test a wide range of these species from the point of their ability to hybridise with *O. sativa.*

Studies were initiated to look intensively into this aspect of identifying variants in *P. coarctata*, based on their morphology , physiology, biochemistry and genetics. Extensive collection trips to both the eastern and western coasts of India were made and several populations were collected. Initial studies on the morphometrics have shown that there is rich variability within the collections, primarily based on the habitats. Further, studies on the identification of biochemical and molecular variations revealed that there are high levels of variability within this species. Enzyme based variations and DNA level variations (Isozymes and RAPD analysis) are valuable in the characterisation of the populations.

It has been reported that possibly *P. coarctata* may be genetically closer to *O. meyeriana.* Identification of genetic proximity of *Porteresia* with other tetraploid and diploid rice is being carried out using molecular markers, RFLPs and RAPDs. Suitable micropropagation systems are currently being developed to grow these plants *in vitro*, under a collaborative research programme with the Scottish Agricultural College, Scotland, UK (Dr. Robert P Finch of Department of Plant Sciences) as this species is known for its unorthodox seeds that are highly recalcitrant.

Genotype based variants collected already have shown that these can be promising for attempting hybridisation with other diploid rice cultivars as well (Jena, personal communication). It is now proved that success with *P. coarctata* system can only be achieved if there is enough genetic variation. A careful characterisation of intraspecific variability with *P. coarctata* has been initiated.

Small Oligonucleotide based DNA Amplification (SODA)

SODA is a PCR based marker system and is essentially a modification of the RAPD marker. Several previous studies have projected that shorter oligonucleotides, shorter than 10 bases, can be the possible sources of better amplification and can circumvent some of the common problems faced when using RAPDs. This

technique uses oligonucleotide sequences of 5-7 bases in achieving the amplification. The advantages of SODA over RAPDs are that they are independent of magnesium chloride concentration and dNTPs in the reaction mix. They can also detect better polymorphisms, detecting even single base changes in the target DNA. This new methodology was successfully tried on *Porteresia*, *Brassica*, and rice. Further standardisation is under way.

The above studies on salt tolerant traditional and wild rice are aimed at achieving some common base to breed salt tolerant strains. The success in identifying the variability in *Porteresia* system, has led to further collection and characterisation of the germplasm. Suitable systems for the transfer of salt tolerance character into cultivated rice will also be attempted. Traditional cultivars, especially 'Oor Mundukan' and 'Sonali' are being studied further for their agronomic characters and the studies would be extended to several other traditional cultivars growing along the coastal areas.

Sub Programme Area 206

Development of Mangrove Ecosystems Information Service (MEIS)

The Mangrove Ecosystems Information Service (MEIS), a collection of databases on mangrove experts, bibliography (1975-1993), core sites and varietal information, was formally dedicated to the mangrove world on 17 December, 1993 by Dr. B C Y Freezailah, Executive Director of the International Tropical Timber Organisation (ITTO). The design and development of MEIS were carried out under a project funded by ITTO. The MEIS is micro-computer based and component databases can be distributed on floppy diskettes, without the user having to acquire expensive software or hardware.

Mangrove Experts Directory (MANEXP)

MANEXP is a compilation of biographic and research details of researchers and scientists whose primary or secondary interest is in the area of mangrove ecosystem. MSSRF had developed a questionnaire to gather data. Information gathered up to 31 October, 1993 has been used as the basis for the design of the database. The data are being updated every six months.

This database is developed on micro CDS/ISIS version 3.07 for ease of storage, retrieval and distribution. This database is also available in FOXPRO for DOS/ WINDOWS version. Since it is possible to create multiple index and handle multiple tables, the search and retrieval are made easier. The user may search and retrieve information using a combination of entries or keywords for specific information.

The search terms, for example, could be individual names, country locations, affiliating institutions or subject matter terms, specialisation, separately or in combination. The appropriate record can be printed out in any desired format. In the present stage, a total of 594 entries from 61 countries are available.

Mangrove Bibliographic Database (MANBIB)

This database is designed to complement the UNESCO Bibliography of mangroves research covering the period 1600 - 1975. MANBIB covers the period upto 1993, and includes reports which are occasional, and not covered by indexing journals. The total number of entries is about 5000. MANBIB contains six different print formats. They are full record without abstract, full record with labels, full record with key words, bibliographic citation, citation with abstracts, and citation with keywords. MANBIB enables quick retrieval of bibliographic information through CDS/ISIS package or in FOXPRO and will be disseminated either through networks or other means including postal services. The services provided by MANBIB include provision of abstracts, or copies in consonance with international copyright laws and conventions.

This database is indexed using a list of descriptors which is defined by MSSRF specific to studies on mangroves. Abstracts of references are included in the database wherever available. Over 70% of the entries have abstracts.

Mangrove Resources and Inventory Database (MANRES)

MANRES is a directory of 22 core sites in some of the mangrove rich countries of the world, and includes comprehensive information on sites, region or country levels besides data on geographic and biological aspects. MANRES also includes colour images and maps of the sites. MANRES is developed in FOXPRO 2.5.

This information is refined from data originally collected locally at each site from 9 countries for 22 sites and updated by expert teams visting the sites. This information will be augmented by inventorying studies that are in progress in different parts of the world. It may be noted that the sites described in MANRES have been nominated for the identification of potential sites, rich in diversity for preservation as gene banks. (Sample screen in Figure 2.6).

Information on any protected forest with mangroves present is available in a directory covering 42 countries and about 1092 sites. This information was obtained from the World Conservation Monitoring Centre (WCMC) at Cambridge. Besides, country level information is available for Australia, Brazil, Fiji, India, Indonesia, Malaysia, Pakistan, Panama, Papua New Guinea, Philippines, Senegal, Singapore, Sri Lanka, Thailand and Vietnam.

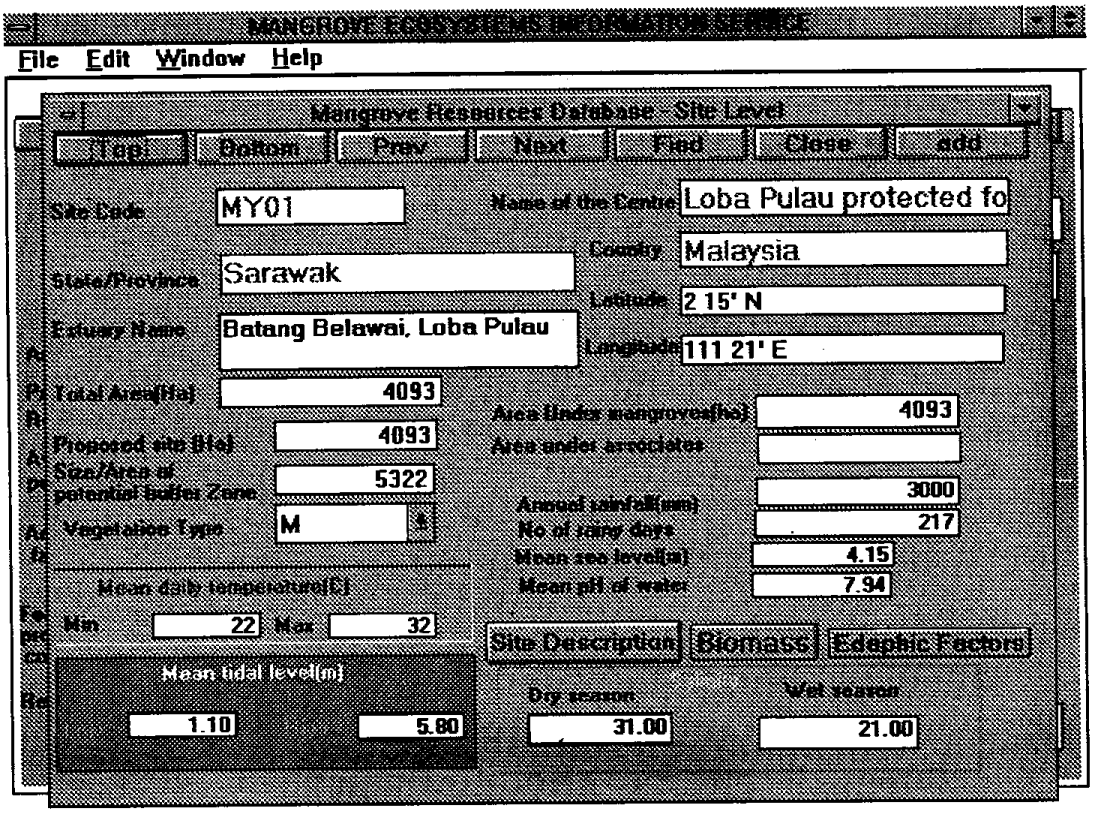


***Figure 2.6** : Mangrove resources database — site level*

Mangrove Species and Genetic Variability Database (MANVAR)

Varietal information on mangroves at present is limited to morphology. The morphological variations in a given species, and variations between species are compiled and indexed using FOXPRO 2.5. Further, molecular level data where available is also compiled. The purpose is to make data available for the assessment of biological (particularly, genetic) diversity of a given mangrove ecosystem. Data on morphological variations, and results of molecular level studies are available on this database. (Sample screen in Figure 2.7).

Future Work

The databases so far developed will be linked to other national and International databases. They can be accessed through telephone and satellite networks. The reprints of all the references stored in bibliography database will be gathered and will be available in MSSRF.

Scientist to scientist information systems are well developed. Efforts to develop location specific information systems for small and marginal farmers are scanty. An interdisciplinary Dialogue on Information Technology held in 1992 led to the concept of Information Villages. To compliment this concept, a multimedia package

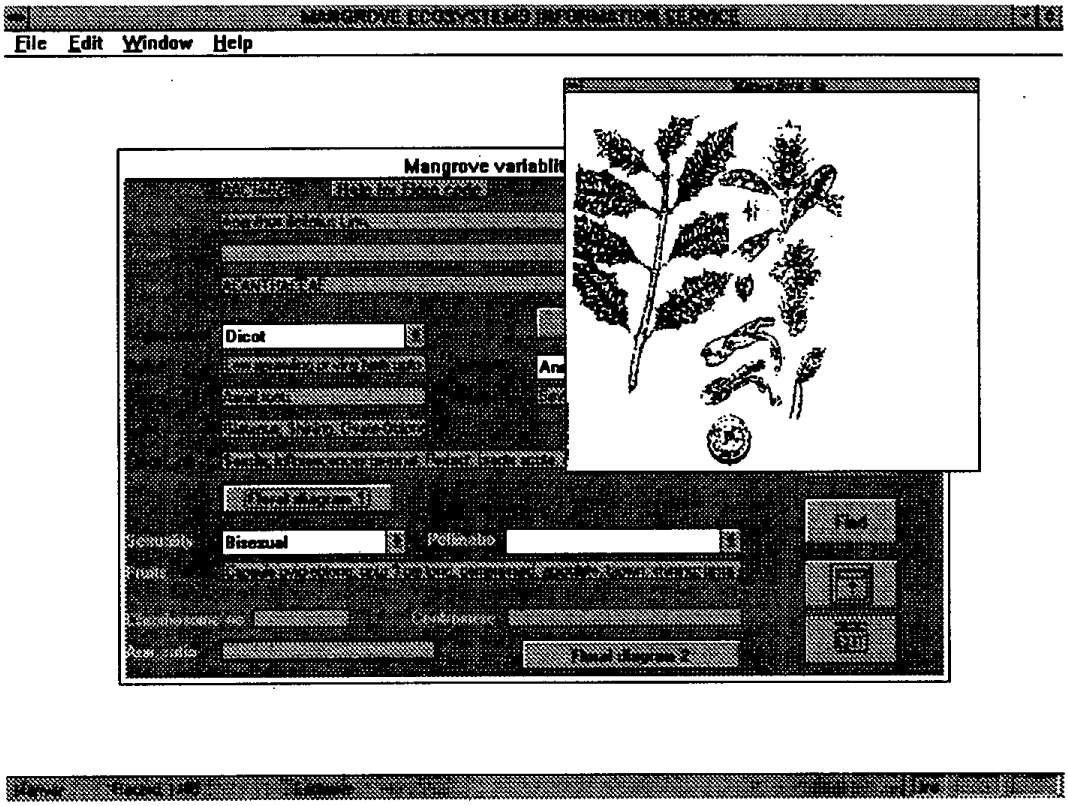


Figure 2.7 : *Mangrove variability database*

for meteorological, pest management and marketing information system, in which the outputs will be in different media like computer-simulated demonstrations and presentations with audio is being designed and developed. All this will be available in local languages. Feasibility study for this system is now in progress.

Sub Programme Area 207

Saving Endangered National Parks and Sanctuaries

Under the Wild Life Protection Act (1972) and several state laws and statutes, many Wildlife Areas have been declared by State Governments as National Parks and Sanctuaries. About 3.7% of the Reserved Forest area is thus under the protected area system now. Of late there is a distressing and disturbing trend in the management of the protected areas due to factors such as conflicts with local communities, commercial activities, poaching and inadequate understanding of the importance of protected areas for the ecological security of the country.

Some recent examples of threats to protected areas are: (1) Narayan Sarovar Sanctuary, (Gujarat) (2) Gulf of Kutch Marine National Park (Gujarat) (3) Bhitarkanika Sanctuary (Orissa) (4) Konark - Balukhand Sanctuary (Orissa) (5) Manas (World Heritage Site, Assam) (6) Nagarhole (Karnataka). In the face of such threats, wildlife conservationists cannot remain complacent and rest content that these areas have already been notified as protected areas. There is need for arousing national awareness and concern towards this problem. Strategies for ensuring the safety of "protected" areas will have to be developed. Foresters and wildlife managers who are entrusted with the task of managing these areas, community leaders and NGO groups who have actively championed the cause of wild life conservation and mass media representatives who act as watch dogs and have promptly drawn attention to issues in wild life protection, have to get together to prepare a common agenda for saving our priceless genetic estate. For developing a NGO-Forester-Media coalition to prevent further damage to our protected areas a two day workshop was convened at MSSRF, on 18 and 19 December, 1993.

The Global Biodiversity Convention which came into force on 29 December 1993, recognises for the first time, in a legally binding article, the sovereign rights of nations over their biological resources. The Biodiversity Convention also recognises *in situ* conservation, represented by Biosphere Reserves, National Parks, Wildlife Sanctuaries and other forms of protection, as the predominant conservation strategy. It is in this context that attention to the growing threats to the limited protected areas in the country, which are reservoirs of our genetic wealth, becomes urgent.

Realising the vital role of this rich reservoir of biodiversity for the future of India and her large population, be it water or soil conservation, agricultural productivity or the essential balance that makes life possible, the participants at the Madras Dialogue unanimously decided to form a *National Biodiversity Alliance* and to launch *Conservation Action - 94*, an action programme designed to preserve India's selected area system for present and future generations.

The members of the National Biodiversity Alliance decided to look at some of the crisis points of India's protected areas on a site-specific basis. The aim of the Alliance is to force and reinforce government action on the basis of an understanding of the maladies affecting each protected area and propose potential remedial measures.

The following six areas were chosen on the basis of the seriousness and diversity of threats on the one hand, and richness of biological wealth on the other, for inclusion in Conservation Action-1994. The scientists and activists who were entrusted with the task of preparing the study reports are also mentioned.

a.	Manas World Heritage Site (Assam)	- Shri. Deb Roy
b.	Bhitarkanika area (Orissa)	- Dr. Hemal S. Kanvinde and Shri. C.R. Das
c.	Dudhwa Tiger Sanctuary and National Park (Uttar Pradesh)	- Shri. Valmik Thaper and W.W.F. - India
d.	Kutch Marine National park (Gujarat)	- Prof. G.M. Oza Shri. Lovkumar Khachher Smt. Prithi Nambiar
e.	Gulf of Mannar Marine National park (Tamil Nadu)	- Dr. Sanjay V. Deshmukh Shri. G. Venkataramani
f.	Nilgiris Biosphere - (Tamil Nadu, Kerala, Karnataka)	- Dr. V.S. Vijayan Shri. B.J. Krishnan Dr. Ranjit Daniels

The above areas represent or typify serious problems arising from commercial and industrial exploitation of natural resources, poaching of plant and animal species, high intensity of grazing and pressure of human population, including ethnic conflicts.

The Convenors will form site-specific alliances and were authorised to co-opt appropriate individuals/institutions in the preparation of integrated Status-cum-Action Reports by 31 July 1994.

The Rajiv Gandhi Foundation has kindly extended financial support for the preparation of the project reports which will contain the following information:

- Description of the sanctuary with maps and pictures, with particular reference to its unique features:
- Current status - anthropogenic and commercial pressures
- A plan of action for restoring and maintaining the sanctuary in a pristine condition

The twin programmes of saving endangered plant species and threatened national parks and sanctuaries will help to arrest genetic erosion and conserve biological diversity.

Sub Programme Area 208

Monitoring Ecosystem Health Using Bioindicators

Biological indicators are those organisms or communities which respond to specific stresses to which they are exposed. As they are cost effective and reliable, attempts have been made to identify a few bioindicator species for biotic and abiotic stresses especially with reference to the mangrove ecosystem of Pichavaram.

The study has been initiated using soil microbial diversity and microbial function as an index for soil health, lichen and phylloplane diversity for air quality and bottom dwelling fauna for aquatic biomonitoring. The combined results of these studies are expected to provide a practical basis for biomonitoring.

I. Microbial Indicators of Environmental (Ecosystem) Quality

Microorganisms respond directly to environmental changes. Growth conditions will influence the expression of cellular functions including those of enzymes, affecting the levels and extent of activities. The structure of microbial communities will alter rapidly as microbial populations respond to external changes to maximise the chance of survival and to optimise their growth rate. In the natural environment, even when microorganisms grow slowly, their generation times will still be within hours or days, which is rapid, compared with plants or animals. Thus, the microorganisms with their morphological, physiological and genetic characteristics, can serve as a very good "early warning system" for pollution since they will signal changes when such changes may still be reversible.

With this in view studies were initiated to monitor i) microbial diversity as the index of pollution in the mangrove ecosystem; ii) soil enzymes (microbial function) as an indicator of soil health and iii) phylloplane diversity (mycological) to measure air quality. Studies were also initiated to isolate specific microflora which can deal with certain pollutants.

Microbial Diversity at Pichavaram

The mangrove microbial flora (the primary producer of the ecosystem) are in a state of flux, being subject to recurring changes due to tidal movement of waters, inflow and outflow of organisms and nutrient substrates. The process involved in the production, cycling and transport of nutrients in the mangrove ecosystem is naturally complex. All systems are sustained by primary production from autotrophs and recycling of nutrients by abiotic and biotic processes, the latter being largely a function of heterotrophs. A detailed survey of the microflora involved in the various nutrient cycles (ammonifiers, nitrifiers, phosphate solubilisers, sulphur oxidisers

and iron oxidisers) was carried out in water and soil samples collected from five different sites. Identification of the flora is to be carried out. The predominant fungal and bacterial strains isolated will be taken up for eliciting responses to pollutants viz., heavy metals (lead, chromium and mercury), organochlorides and organophosphate pesticides.

Soil Enzymes as Indicators of Soil Health

Soil enzymes (microbial function) are derived predominantly from the microflora. The root system of plants and plant residues also contribute to them. They play a major role in the nutrient cycles in soils. Any action altering the life functions of soil organisms could indirectly affect the soil enzyme activities. These could be used as indicators soil. To correlate the distribution of microorganisms, total biomass and enzyme actvities, studies have also been initiated on the enzyme assay in soils from Pichavaram. The protocol for cellulase assay has been standardised.

Phylloplane Mycoflora

A survey of phylloplane mycoflora of *Rhizophora apiculata* was carried out from three zones namely Chinnavaikkal, Keerikuda and Periaguda to see the pattern of distribution. A comparison was done between young and old leaves and between matured leaves from the top and bottom of the species. The distribution pattern of the mycoflora species did not vary from these different areas. The number of colony forming units (cfu's) however were more on the bottom leaves and on the old leaves facing the water body. The isolates will be taken up for further studies in eliciting responses to pollutants.

Short-term Effect of Endosulfan on the Microbial Flora in Soils

The effect of endosulfan, an extremely hazardous pesticide on the microbial flora was studied under laboratory conditions. The experiments were carried out under upland and flooded condition (60%WHC). Soil collected from paddy fields from Chidambaram, soil rich in organic matter and red soil were used as different soil types. The application of endosulfan was done at 5mg a.i./gm of soil twice, at intervals of 15 days. The cfu's were recorded initially and also after addition of the pesticide each time. In the soil rich in organic matter and red soil the cfu's came down drastically while in paddy soil it was comparatively higher and was of a single type. The fungal population seemed to be more sensitive than bacterial population. A persistent bacterium capable of growing in the presence of the same concentration in nutrient agar was isolated from the paddy soil. Further studies related to the breakdown of endosulfan by this microbe will be evaluated.

II. Lichens as Bioindicators in Mangroves of Pichavaram

The importance of mangrove ecosystems, especially that of Pichavaram, Tamil Nadu has been stressed in the previous reports. As a part of the effort to monitor the damages to the ecosystem, suitable bioindicators involving lichen species are being developed.

The total number of lichen species and their occurrence on mangroves have been studied earlier. There are as many as 7 species of crustose lichens, 2 species of foliose lichens and one species of fruticose lichen occurring on *Rhizophora apiculata, R. mucronata, R. lamarckii* and *Excoecaria agallocha.* All these 10 lichen species are distributed among 6 lichen genera basically. Earlier observations revealed that fruticose and foliose lichen species are dominant in the areas facing sea breeze. Currently numerical data regarding their occurrence and distribution in the different parts of this mangrove ecosystem have been collected. These areas namely Neduodum (landward border) Sanikuttai vaikkal (seaward border) Periaguda and Keeriguda (core regions) have been selected after careful preliminary surveys.

A method for collecting data systematically has been developed. The six lichen genera have been observed on all the three species of *Rhizophora.* Hence *R. apiculata,* one of the most common species, has been chosen as a representative. Similarly *E. agallocha* has been selected, as this is also common, bearing a number of lichen colonies. Lichens are totally absent on *Avicennia* species and are insignificant on other mangrove species. Further, for convenient handling of the data, these two trees are referred as Tree species 1 (*E. agallocha*) and Tree species 2 (*R. apiculata*) respectively (together noted as a "tree") and divided into five tree zones as detailed below:

- Tree zone 1: *E. agallocha* trunk
- Tree zone 2: *E. agallocha* canopy
- Tree zone 3. *R. apiculata* stilt root
- Tree zone 4. *R. apiculata* trunk
- Tree zone 5: *R. apiculata* canopy

Moreover as the mangroves are distributed in islets, the data was collected from both waterward and landward aspects of sampled trees. In order to get a uniform sample size, a 30 cm scale was used as a standard measure. This scale was placed on the sampling area of the tree and the lichen colonies along the length were counted and recorded.

Consequently a total number of 450 samples for each designated area were collected as mentioned below:

Total no. of trees	=	15
No. of tree zones	=	5
No. of aspects	=	2
No. of samples/zone	=	3
Total no. of samples/area	=	(15 x 5 x 2 x 3) = 450

Finally a total no. of 1800 samples were collected for all the four areas (450 x 4). The data was coded and tabulated. The data in Table 2.9 and 2.10 indicate that more lichen colonies occur on *R.apiculata* species than on *E. agallocha.*

Among the lichen species fruticose lichen *Roccella* is the most abundant (except on *E. agallocha*) followed by *Pyrenula, Dirinaria, Lecanora, Graphis,* and *Buellia species* as indicated in Table 2.9.

More lichen colonies occur on the water facing side of each zone except in the case of *Buellia* which prefers the land-facing side. *Pyrenula and Lecanora* do not show any marked preference as indicated in Table 2.10.

Table 2.11 reveals that fruticose followed by foliose lichen colonies are more abundant in the border mangrove areas like Neduodum and Sanikuttai vaikkal than the core regions like Periaguda and Keeriguda. *Roccella* and *Dirinaria* dominate in these border areas whereas *Pyrenula* is more abundant in the core regions. Table 2.12 suggests that the lichen species *Roccella* and *Dirinaria* prefer border areas of the mangroves, especially those sides having direct access to sea breege with copies moisture. This is partly supported by the data in Table 2.11 which shows that more number of *Roccella* and *Dirinaria* occur on the water facing side. Although similar waterfacing *Rhizophora* patches occur in the core regions these two are not so abundant as in border areas, as indicated in Table 2.11. The crustose species *Pyrenula* is less specific to sea breeze moisture (Table 2.11) and dominates in the core regions (Table 2.11).

Based on the data collected so far, it is observed that the mangrove species *Rhizophora* can be chosen as the most ideal species for biomonitoring lichen colonies (Table2.9) *Roccella* and *Dirinaria* can be useful as biomonitors of disturbance in the border mangrove patches facing sea breeze and *Pyrenula* species as the biomonitor for the core regions since they are the dominant species in their respective areas (Table 2.12). Although their sensitivity levels to pollutants are unknown, any gross deviation in their abundance and distribution is expected to indicate a change in the environment.

Table 2.9

Lichen genera distribution on "tree" species

Tree species	Number of colonies of individual lichen genera					
	Roccella	*Dirinaria*	*Graphis*	*Buellia*	*Pyrenula*	*Lecanora*
1	17	476	339	221	729	315
2	3997	2513	579	437	2528	1185
Total colonies	4014	2989	918	658	3257	1500

Tree species 1 E. agallocha 2 R. apiculata

Table 2.10

Lichen genera distribution on different tree zones

Tree zones	Number of colonies of individual lichen genera					
	Roccella	*Dirinaria*	*Graphis*	*Buellia*	*Pyrenula*	*Lecanora*
1	6	208	176	134	482	160
2	11	268	163	87	247	155
3	1513	789	271	224	998	633
4	1384	1026	147	163	1024	349
5	1100	698	161	50	506	203

Table 2.11

Lichen genera distribution on waterward and landward sides of trees

Aspect	Number of colonies of individual lichen genera					
	Roccella	*Dirinaria*	*Graphis*	*Buellia*	*Pyrenula*	*Lecanora*
Water facing side	2326	1781	525	207	1643	708
Land facing side	1688	1208	393	451	1641	792

Table 2.12

Relative abundance of lichen species among the four mangrove areas

Mangrove areas	Number of colonies of individual lichen genera						Total colonies
	Roccella	*Dirinaria*	*Graphis*	*Buellia*	*Pyrenula*	*Lecanora*	
Neduodum	1934	1668	333	101	601	67	4704
Periaguda	58	500	325	286	1381	671	3221
Keeriguda	239	274	42	42	346	262	1205
S.vaikkal	1783	547	218	229	929	500	4206

III. Faunal Bioindicators of Estuarine Pollution

There has been considerable interest worldwide on invertebrates as early warning systems, under the assumption that being lower down in the food chain, any environmental disorder they indicate can be detected much before organisms higher

up in the food web are affected. Estuarine pollutants such as heavy metals and other toxicants affect the benthic life more than the other life forms. With these criteria in view, studies were carried out on benthic invertebrates including the bivalve *Perna viridis* and the associated epibionts. However due to sampling and identification problems, it was decided that one species of epibiont namely *Balanus amphitrite* alone be studied. The characteristics of these two invertebrates are -

- both are sedentary ;
- *Perna viridis* is a mollusc and *Balanus amphitrite* is a shell forming crustacean;
- both are presumably sensitive to the levels of calcium and acidity in the estuarine water.

The results of the study are summarised in Table 2.13. The four localities selected for the study are representative of organic pollution (Pondicherry 1 and 2) industrial pollution (Ennore) and relatively unpolluted conditions (Kovalam and Kumta). The results give no evidence suggesting that the various kinds of pollution have had any noticable influence on these organisms, contrary to our expectations. For example the largest average size of *Perna* is that from Pondicherry and the highest density of *B. amphitrites* is from Ennore. Both these sites are polluted by industrial effluents and sewage. On the contrary the least polluted estuary, namely Kovalam, has unusually small size *Perna viridis* and a very low density of *B. amphitrite*. Further the samples taken from Kumta, which is unpolluted, do not have any *B. amphitrite* at all. From the above results it is inferred that these benthic invertebrates do not show any definite trend in size or numbers as indicators of the influence of pollution or disturbance.

In order to identify rough and ready tools for monitoring environmental degradation in estuarine ecosystems benthic fish fauna have been chosen. The benthic fishes in general are:

- known to be sensitive to toxicants and can demonstrate the ill effects by way of external disorders;
- they are easily studied under field conditions;
- most species have local names which enable identification and dissemination of information to the local people.

The results of studies in the estuaries of Pichavaram, Adayar and Ennore on the benthic fish fauna are summarised in Table 2.14. Though this data is very limited, it is apparent that the species shared by the three estuaries are mostly catfishes. This has found support in studies elsewhere which suggest that catfishes tend to survive under polluted conditions longer than other bottom dwelling fishes.

Table 2.13

Variation in size of Perna viridis and density of the epibiont Balanus amphitrite in selected localities

Attributes	Ennore	Pondicherry 1	Pondicherry 2	Kovalam	Kumta
Depth (mts.)	< 1.0	< 1.0	1-3.0	< 1.0	Not Known
Sample size of *Perna viridis*	12	13	12	13	7
Surface area of *Perna viridis* (sq. cm)					
Avg.	47.08	31.58	76.54	12.50	39.07
S.D.	8.33	8.33	20.45	3.18	4.08
C.V.(%)	17.70	28.00	27.00	25.40	11.21
min.	32.00	21.50	22.00	7.00	33.00
max.	60.00	48.00	98.00	18.00	45.00
Balanus amphitrite, Number of individuals per *P. viridis*					
Average	368.83	153.00	114.08	61.67	-
S.D.	142.40	84.17	52.21	56.43	-
C.V.(%)	38.70	55.01	45.77	91.50	-
min.	65.00	18.00	56.00	5.00	-
max.	560.00	258.00	247.00	211.00	-
Density (sq. cm)	7.80	4.90	1.60	4.50	-

Table 2.14

List of bottom dwelling fishes collected from Pichavaram, Adyar and Ennore during the period February '94 - April '94

Type	Vernacular name/ Common name	Scientific name	Site A	Site B	Site C
Eel					
	1. Senaipambu	*Pseudechidna bummeri*	+		
	2. Mannulli	*Muraenicthys gymnopterus*	+		
	3. ?	*Muraenesox cinereus*	+		
	*4. Nelakodanjan	*Bascanichthys deraniyagalai*			+

Table 2.14 (Contd.,)

Type	Vernacular name/ Common name	Scientific name	Site A	B	C
Catfish					
	1. Thoppakeluthi/ Kattai Keluthi.	*Mystus gulio*	+	+	+
	2. Venkeluthi/ Vellai keluthi	*Arius subrostatum*	+	+	
	3. ?	*Arius caelatus*	+		
	4. Irunkeluthi	*Plotosus canius*	+	+	
Flat Head					
	1. Udupathy	*Platycephalus indicus*	+		
Snake Head					
	1. Koravai	*Channa punctatus*	+		
Gobioids					
	1. Uluvai	*Glossogogius giurus*	+		
	2. ?	*Acentrogobius cyanamos*	+		
	3. ?	*Trypauchen vagina*	+		
	4. ?	*Awaous grammepomus*	+		
	5. Mudskipper/ Karuppuvaetti.	*Boleophthalmus boddarti*	+		
Flatfish					
	1. Nakkumeen	*Cynoglossus punticeps*		+	

* *may be two different species of Bascanichthys - to be verified.*

site : A - Pichavaram, B - Adyar, C - Ennore.

PROGRAMME AREA 300

Biovillages and Sustainable Agriculture

The Biovillage Programme initiated in 1991 in the villages of Kizhur, Sivaranthakam and Pillayarkuppam of the Union Territory of Pondicherry seeks to promote sustainable human development through an integrated approach to farm and non-farm employment and to quality of life improvement.

Sub Programme Area 301

Formulation of Biovillage Demonstration Project

The participatory eco-agro-socio-economic baseline survey covering the biophysical and human resources, and the farming systems, undertaken during the last reporting period (1992-93) helped to assess the current status and use of resources, institutions and infrastructure, as well as the potentials and constraints to sustainable development in the three villages. In order to demonstrate that the biovillage approach is a feasible paradigm to sustainable agriculture and rural development, a 'Biovillage Pilot Demonstration Project', covering thirteen villages in the Union Territory of Pondicherry, was formulated and presented to the United Nations Development Programme (UNDP) for support. The project content essentially consists of

- testing and adapting technologies, especially bio-technologies, including organic farming and integrated resource management systems,
- facilitating the initiation of a set of production activities suited to the resource poor, based on the technologies tested and adapted to utilise local resources and
- fostering the growth of institutional structures which lead to the long term sustainability of the programme.

The primary participants and stakeholders of the project are the resource poor in the project villages such as the landless labour, marginal and small farmers, and rural women.

Sub Programme Area 302

Technological Empowerment

Several research and demonstration, income and employment generating activities were undertaken to translate the technology into production activities so as to provide technological empowerment to the resource poor (Table 3.1). Several technologies were identified an introduced last year (see AR 1992 - 93, pp.95 - 96)

Table 3.1

Technologies identified for skilled technological empowerment

I. On-Farm research and demonstrations	II. Income and employment generation
Evaluation of rice cultures	Mushroom production
Rice seed production	Group sericulture
Hybrid rice seed production	Community fodder plantation
Hybrid vegetable trials	Fodder banks
Biofertilisers	Community aquaculture
School nutrition garden	Integrated aqua-horticulture
Environmental sanitation	Recycling of biowaste
	Broiler chicken production
	Flower production
	Homestead nutrition garden
	Government programmes (Coir rope making)

I. On-Farm Research and Demonstrations

Early Evaluation Trials of Rice Cultures

Evaluation trials with seven International Rice Research Institute (IRRI) rice cultures received from the Annamalai University, Chidambaram, Tamil Nadu, were conducted during the '*kuruvai*' (May-August 1993) and '*samba*' (September-December 1993) seasons. During '*samba*' data on only three cultures could be recorded as they matured early while the rest were lost in a cyclone. The yield performance of culture IR 4563-52-1-36 EL308395 was the highest in all the three seasons (6580, 6150 and 5900 kg/hectare), followed by IR 4595-4-1-13EL308393 (5400, 5500 and 5250 kg/hectare). The culture IR 37260-1-1-6 EL308401 matured earlier (110 days) than others by 5-10 days.

Pure Seed Production

Initial trials with five varieties (ADT37, ASD18, CO43, CO45 and *Ponni*) were carried out in 0.4 hectare of land during '*samba*' season for producing pure seeds. Co43 & Co45 produced a grain yield of 4000 & 4200 kg / ha respectively, while *Ponni*, ASD18 & ADT37 produced a grain yield of 3000, 2875 & 3600 kg/ha respectively.

Hybrid Rice Seed Production

Work on the production of hybrid rice seed, initiated last year, continued. Multiplication of the Cytoplasmic Male Sterile (CMS/'A') lines was carried out last year. Six hybrid rice lines obtained from the Directorate of Rice Research (DRR), Hyderabad and four locally adapted varieties were included in the testing of 'R' lines. 'CMS' line multiplication was also done. Two maintainer lines (IR 58025B and IR 62829B) and ten restorer lines are being raised for multiplication. Three hybrids (AHRT K-04, AHRT K-06 and ORI-161) received from the DRR are being tested for their adaptability.

Hybrid Vegetable Trials

Adaptive research trials on varieties of okra (Parbhani Kranti and No.7 of MAHYCO) and brinjal (Palur-1 and Round-14) were conducted in the Pillayarkuppam village. Parbhani Kranti is susceptible to the incidence of white fly and yellow vein mosaic. Palur-1 was found to be susceptible to borer infestation. Round-14 had higher consumer preference. Okra No.7 MAHYCO recorded an yield of about 11.5 tonnes and brinjal Round-14, 39 tonnes per hectare.

Evaluating the Suitability of Biofertilisers

Azolla *:* Different strains of inoculum were pre-tested for adaptability. *Azolla microphylla* was identified as the most suitable species for propagation in the area. A total of 15 farmers were identified and trained in *Azolla* technology at the Tamil Nadu Agricultural University. Community nurseries were established in all the three villages to supply material for propagation. Adaptive trials, five in each of the three villages, were conducted and the results were evaluated. The plot size for the trials was 0.2 ha and the duration of the crop was 130 to 145 days. The results showed that application of *Azolla* increased yield by 10% and reduced the cost of chemical fertilisers by 15-20%. (Table-3.2).

One trial with various treatments for the control of snails and grazers showed that 'furadon', a chemical pesticide, can be replaced effectively by biopesticides. The problem of supplying inoculum during summer months could be mitigated by having common nurseries. Pest (snails and other grazers) incidence in the *Azolla* nursery is a problem which restraints some participants from continuing with *Azolla* technology. Grazer control has to receive high priority.

Sesbania *:* Six species of *Sesbania* received from the International Rice Research Institute were evaluated. *S. aculeata* gave 500 kg of seed per hectare in 150 days while *S. rostrata* 600 kg in 140 days. Others gave much lower quantities of seeds ranging from 1000 to 3000 kg per hectare. *Sesbania rostrata* seeds (2 kg) obtained from the Tamil Nadu Agricultural University were raised for seed multiplication on 2000 m^2 of land at the Gloria Farm located in the Pillayarkuppam village.

Table - 3.2

Economics of Azolla application

Variety	Control Plot Cost * (Rs.)	Treatment Plot Cost * (Rs.)	Yield		Net Profit		Net Profit	
			Con-trol (Kg)	Treat-ment	Con-trol (Rs.)	Treat-ment	Con-trol (Rs.)	Treat-ment
Pillayarkuppam								
PY4	1821	1805	1030	1076	1613	1784	8065	8920
Ponni	1780	1770	825	891	2069	2388	10345	11940
Sivaranthakam								
CO43	2193	2163	1002	1060	1176	1370	5740	6510
CO45	2160	2130	916	970	892	1101	4460	5505
Kizhur								
CO40	2320	2305	820	869	413	592	2065	2960
CO45	2110	2070	742	779	363	527	1815	2635

* *Cost - Cost of cultivation*

Bioearth : Trials on the residual effect of bioearth, initiated last year, were continued. Results showed that at an application level of 5 tonnes/hectare the grain yield increase over control was 20% during '*navarai*' (winter) and 23% during '*kuruvai*' (summer) paddy crop. Straw yield increase was only during '*kuruvai*' season (25%). The application of bioearth was done during the *samba* (autumn) season. All the plots had received only 60 kg of nitrogen fertilisers in four split doses.

Vermicompost : In collaboration with the Unit for Research in Soil Biology and Biotechnology of the New College, Madras, the effect of vermicompost on paddy and sugarcane is being evaluated. Vermicompost pits of different sizes were laid out, using the used up straw from mushroom production. Vermicompost fertiliser will be made in the homestead nutrition gardens.

School Nutrition Garden

The nutrition garden established two years ago at the village school in Pillayarkuppam was maintained during the current year also by the children and the staff of the school. The garden continued to supply vegetables to the mid-day meal programme. The garden was enriched with the planting of pomegranate and acid lime fruit trees and protected by erecting a bamboo fence.

Environmental Sanitation

An awareness campaign on the importance of environmental sanitation was carried out in the Pillayarkuppam village. The 'pour flush' model with twin leach pits was found to be appropriate for the conditions in the biovillages. Five Single House Model toilets were constructed at Pillayarkuppam with the assistance of Sulabh International, a consultancy firm engaged in the construction and management of environmental sanitation structures. These toilets were built in the houses of the resource poor households located at different parts of the village so as to serve as demonstrations. Their use and performance are being monitored for evaluation. The introduction of single house toilets has already made a significant impact. Many households want this facility. Steps were taken for building 15 toilets with the support of the government. The campaign had its effect with authorities in the local school who want the school toilets restored to proper use. After a series of meetings and discussions during the awareness campaign it was realised that it is premature to go in for community toilets, given the prevailing state of consciousness on environmental hygiene and community cohesiveness. It was therefore decided to postpone the introduction of community toilets. Stagnation of waste water around the drinking water taps has been identified and recognised as another major environmental sanitation problem in the village. The poor management of the drinking water supply system with frequent breakdowns and insufficient supply are responsible for the lack of enthusiasm for taking measures to prevent water stagnation around community water taps. Social inhibitions prompt the Project to delay the introduction of biogas production from human waste.

II. Income and Employment Generation

Enabling the resource poor to translate the knowledge gained and skills attained into income and employment generating production activities is the second step in the technological empowerment process. The base line survey had identified several interventions and production activities with potential for improving the livelihood security of the resource poor in the three biovillages.

During this year, effort was focussed on adapting the interventions to the specific circumstances of the potential resource poor participants.

Mushroom Production by Rural Women

The first group of 12 landless women selected were given an overview of the mushroom technology by taking them to the Tamil Nadu Agricultural University for a 3-day visit. Production of one batch of mushroom by the participants was completed. Mushroom is grown in huts of the size of 2.5 m length, 1.5 m breadth and 2.0 m height, built with locally available coconut fronds, palmyrah leaves and dried sugarcane leaves over a three-tier rack made of casuarina poles. The participants obtained an yield of 350-400 grams of fresh mushrooms per day bringing a monthly income of Rs. 120-150. (Table-3.3).

The second batch of mushroom production is in progress. By growing a total of three batches of mushroom, the participants should be able to fully internalise the technology and will gain confidence in producing mushroom economically and of marketable quality. A spawn production facility with capacity to produce 35-40 bottles per day has been established. Simultaneously work on mother spawn preparation was also started. Trials are being undertaken to substitute glass bottles with polybags to facilitate easy transport of spawns to villages.

Table 3.3

Adaptive research trial done in the participant's household in Sivaranthakam village

Variety : CO-1 *Pleurotus citrinopileatus*

S.No	Straw dry wt (kg)	Straw wt (kg)	Fuel dry wt (kg)	Temp (C) *	Humidity (%)	Total yield (g)	Spawning to harvest (days)	Used straw (g)
1.	1.0	0.75	28	28.5	75	700	40	400
2.	1.5	1.0	29	29.0	75	700	42	475
3.	1.0	0.75	27	26.5	78	590	45	500
4.	0.5	0.5	28	28.5	75	740	42	600
5	0.5	0.5	29	29.5	74	410	41	300
6.	1.5	0.5	30	29.5	72	380	43	320
7.	1.0	0.75	29	30.0	75	490	37	500
8.	1.5	1.5	28	29.0	74	690	41	450
9.	0.5	0.5	29	30.0	72	605	39	300
10.	1.0	0.75	30	30.0	70	650	42	300

* *temperature and humidity readings taken inside the mushroom hut.*

Two landless, educated, unemployed youth belonging to the biovillages were trained in spawn production. They, in addition, are engaged in the distribution of spawn bottles to, as well as collecting fresh mushrooms from, the participants. An informal mushroom growers association has been formed as a mechanism for group action. Distribution of spawn and marketing of fresh mushroom, were facilitated with the formation of the group. The mushroom producers have also organised themselves into a saving group. A market survey on the demand for fresh mushroom was undertaken. Arrangement for marketing the product has been made with the Pondicherry Agro-Services and Industries Corporation (PASIC). New marketing outlets

such as fast food centres, private grocery shops and hotels are being established. Uncertainty in the supply of straw is the major problem encountered by the landless women. The issue is not that of physical availability of straw in the village, but accessibility for the landless households. The problem is being attended to with the help of the land-owning families. Rat infestation is another problem that is being dealt with.

Group Sericulture for the Landless

Sericulture was identified as one of the employment and income generating activities for the landless households. Apart from training and facilitating the rearing of cocoons, the project envisages the establishment of a mulberry bank to make available mulberry leaves for feeding the silk worms. A mulberry gene bank with nine varieties of mulberry was established at the Krishi Vigyan Kendra in Pondicherry. A mulberry bank of 0.4 hectare was established with the planting of 5,000 saplings of M5 variety. The feasibility of rearing silk worms in the environmental conditions of the biovillages was tested in the Pillayarkuppam village. Two farmers harvested 14.5 kg and 27.0 kg of cocoons for 75 crossbred (L x NBD2) brushed DFLs each. The drastic fall in cocoon price is the biggest constraint in pushing this activity through. The national policy of permitting the import of silk including yarn has resulted in the plummeting of cocoon prices in the country. In late 1992 when the project was formulated the price ranged between Rs. 160-200 per kg of cocoon. Since then the price has declined to one third to one half and has been Rs. 50 to Rs. 60 per kg during the past several months.

Community Fodder Plantations for Stall Feeding of Goats

Goat rearing through stall feeding is one of the supplementary income generating activities for the resource poor. Lack of fodder is a limiting factor. A fodder plantation is therefore being established on the common land. Ten landless households are participating in the goat rearing programme. The Government of Pondicherry has agreed to lease 0.73 hectares of common land in Pillayarkuppam village for establishing the fodder bank. Palatability tests were conducted with several locally available fodders. The following five plant species (*Gliricidia sepium, Sesbania grandiflora, Inga delci, Leuceanae leucocephala* and *Linnea coromandalinecea*) were identified as suitable for promotion, and planting in the proposed fodder plantation.

Fodder Banks for Landless Dairy Farmers

Three farmers in Pillayarkuppam village are engaged in raising fodder. Under a Memorandum of Agreement signed with them the farmers will grow fodder and sell at a fixed price (Rs.0.25/kg) to the participating landless dairy farmers. These three farmers received training at the Tamil Nadu Agricultural University on various

aspects of forage cultivation. Fodder banks covering 0.6 hectares have been established. Hybrid napier, lucerne, hedge lucerne, stylo, cow pea, and *Sesbania grandiflora* are grown. Three farmers who raised fodder obtained yield/hectare/year of 248 tonnes for hybrid napier, 7 tonnes for perennial legumes and 16 tonnes for cow pea. For the programme, 10 landless families were brought into contact with the officials of the Service Area Bank for obtaining credit for the purchase of cows. The bank has agreed to extend medium term credit (5 years) amounting to Rs. 4,750 per cow. A lactating cow yielding about 7 litres of milk per day however costs about Rs.7000. The landless households find it difficult to raise the balance. A revolving fund has been created with the help of the Hunger Project, Japan to make up the deficit. The long time taken in securing credit from the commercial banks and the quantum of credit which is short of requirements are important constraints. Only a Revolving Fund mechanism operated by the stake holders can help to take dairy enterprise to the unreached.

Aquaculture in Community Ponds

Utilising the production potential of community resources like the common village ponds and enabling the resource poor to benefit from such income generating resource is being demonstrated by undertaking pisciculture in one of the ponds in Kizhur village. A community tank with a pond area of 0.5 hectares was taken on lease. With support from the Department of Rural Development, the pond was cleaned and desilted. The pond was prepared by clearing predators and fertilising it with cow dung (250 kg as basal dose and 125 kg every subsequent month) to encourage plankton growth. Supplementary feed (rice bran and groundnut cake at 2:1 ratio) was given @ 2% of the body weight of fish. Fodder grass (CO-2 Bajra - Napier cross) was planted along the banks both to check bank erosion and to serve as feed for the grass carp. The pond was stocked with 2000 fingerlings of appropriate mix (Catla 600, Rohu 325, Mrigal 200, Silver Carp 75, Grass Carp 300 and Common Carp 500). An aquaculture estate with 9 landless women was formed to undertake pisciculture and management of the pond. When a remunerative venture of this kind is undertaken by the landless poor, particularly women, social tensions develop. These have to be carefully monitored and are to be resolved by the villagers, assisted by the local administration. A total of 430 kg of fish were harvested during the month of May 1993. A total sum of Rs.9100/- was got through the sale of fish which will be distributed to the nine participants and the village panchayat. The Fisheries Federation provided the logistic support in marketing.

Integrated Aqua-Horticulture System

The integrated fish-flower-fodder system continued for the second year. The pond was stocked with a mix of 1000 fingerlings of Catla (400), Rohu (200), Mrigal (150) Grass carp (50) and Common Carp (200). Production of Crosandra flower was 113 kg which was sold @ Rs. 60/kg. The fodder grasses were mainly used for cattle.

Integrated Farming Systems with the Recycling of Biowastes

The feasibility of value addition and income and employment generation through integrated use and recycling of biowastes is being taken up. Two dairy cows are to be fed primarily on the fodder produced. The dung and urine from the cows would be used for generating biogas for fuel and slurry will be used to fertilise the fodder. Three families will be taking part in this activity. Subsidy at the rate of Rs. 2000 per plant has been sanctioned by the government to the participants for establishing the biogas plants.

Broiler Chicken Production for Small Farmers

The performance of two varieties viz. Starbro and Ross of broiler chicken was tested by a small farm household at Pillayarkuppam village. Both varieties were found to get acclimatised well. In a 45 day trial, Starbro registered feed efficiency of 1:2.21 against 1:2.12 of Ross. This trial has caught the attention of the farmers in the neighbourhood. Remunerative marketing opportunities and high cost of feed are two major constraints.

Flower Production by Women of Marginal Households

Two marginal farmers were assisted in undertaking the production of Crossandra, a tubular flower used as hair decoration by women, by rendering technical advice and arranging the supply of quality seedlings. One farmer earned a net profit of Rs. 240 per month by growing crossandra flowers in 320 square meters of land after investing Rs. 1200 on this venture. Four women of marginal farmers' households and four landless women were trained in the cultivation of jasmine (variety CO1), the flowers of which are in great demand. The Project is rendering support to these participants by way of technical advice and arranging the supply of seedlings.

Homestead Nutrition Gardens

In order to improve the household nutrition status the Project took the initiative in establishing nutrition gardens in the backyards of 12 households in Sivaranthakam, 5 in Pillayarkuppam and 5 in Kizhur. Vegetables grown included okra, brinjal, chili, tomato, amaranthus and radish. Trees for fruit such as lime and pomegranate and leaves such as curry leaves were also planted. Training in household nutrition gardening was given to the participants at the Krishi Vigyan Kendra of Pondicherry.

Marketing Support to Vegetable Growers

Introduction of hybrid vegetables and training in vegetable production have started making an impact. Vegetable production in Pillayarkuppam increased from a few kilograms to about three tonnes per month. Increased production has also created problems of marketing. With timely intervention, a producer- friendly marketing system was put in place. First, a Vegetable Growers' Association was formed. A tie-up among the Vegetable Growers' Association, the Pondicherry Agro-Food

Products and Civil Supplies Corporation (PAPSCO) for the production and marketing of vegetables was arranged. Under this arrangement the growers produce the kind and types of vegetables which can be marketed. PAPSCO in turn opened a collection centre in the village, and arranged for sale through its outlets. In addition, the PAPSCO would share a part of the profits. The Project undertook the monitoring. Seeds and other inputs needed for production were made available through the Pondicherry Agro Services and Industrial Corporation (PASIC). The producers benefited from an assured market, stable prices and reasonable profit.

Government Programmes

Under the initiative of the Foundation, acting as a conduit, techno-infrastructure development, and income / employment generating activities have also been commenced with the support of the government agencies. The Foundation facilitated the organisation of a six-month coir rope making training course for 10 women in Pillayarkuppam village by the District Industries Centre. Two participants were helped in securing credit from the local bank to start production units.

A community threshing floor with an area of 689 square meters built by the District Rural Development Agency (DRDA) of the Pondicherry Administration in Pillayarkuppam village was dedicated to the community on the 31 January, 1994 by Mr. James Gustave Speth, Administrator, United Nations Development Programme. The Biovillage Project staff coordinated the work including selection of site, moving out encroachers, clearing of debris etc. A 13-member maintenance committee has been formed. With the help of the Villianur Commune Panchayat of the Pondicherry Government the project took the initiative of bringing drinking water and stree lighting to MGR colony where the poor of the Pillayarkuppam village live.

Biovillage Consortium

The Biovillage Consortium constituted in support of the implementation of the biovillage programme met in June 1993. At this meeting, the work plan for 1993-94 was reviewed and areas requiring intervention and action by the respective agencies were identified and follow-up action agreed upon.

Conclusion

To sum up, the work done during the year has demonstrated that through a market-driven approach to the identification of enterprises and through concurrent attention to technology, training, techno-infrastructure and trade, it will be possible to raise the per capita monthly income of landless labour women from the present level of about Rs.300 to over Rs.1000. Such a sustainable job-led economic growth strategy in villages would help to strengthen livelihood and nutrition security at the household level and thereby create conditions where other social interventions like education and child care can yield the desired results.

Sub Programme Area 303

Integrated Pest Management in Groundnut, Soyabean and Cotton

An effective plant protection cover holds the key to higher and more stable yields in groundnut, soyabean and cotton. Prof. S. Jayaraj, eminent entomologist, joined the Foundation in April, 1994 as an ICAR National Professor in Agriculture to initiate applied and participatory research in the area of packaging and delivery of integrated pest management (IPM) techniques. IPM is an important component of sustainable agricultural practices and depends for its success on the cooperation of farming families in a village or watershed or an irrigation command, area Genetic resistance, cultural practices, botanical pesticides, biological control, pheromone and light traps, crop rotations, mechanical control methods and need-based application of chemical pesticides are all integrated in the form of an effective crop protection system. Work was initiated during July 94 in the Chengai-MGR district in the control of pests of rainfed groundnut. The guidance and help of the Tamil Nadu Agricultural University, the Tamil Nadu State Department of Agriculture, SPIC Science Foundation, ICAR Institutes, Southern India Mills Association and Sakthi Soya and other concerned agencies is being taken in the implementation of this programme.

Sub Programme Area 304

Sustainable Livelihoods and Food Security Systems in Asia and the Pacific Region

At the instance of the Director of the Regional Bureau for Asia and the Pacific of the UNDP, New York, the Centre for Research on Sustainable Agriculture and Rural Development (CRSARD) of the M.S. Swaminathan Research Foundation has undertaken an in-depth study for developing strategies for sustainable rural livelihood and household nutrition security systems in the Asia-Pacific Region. The study, designed to lead to UNDP's global objective of promoting a new development paradigm which takes into account environmental parameters, gender equity and people's participation in the process of nation building, encompasses three components:

1. Compilation and analysis of data relevant to the construction of agricultural balance sheets (resources and outputs) in the Asia-Pacific region for 2000 and beyond (2020);
2. Review of strategies adopted for building national and regional food security systems, employment generation, human resource development and implementation of strategies for the elimination of endemic hunger by the year 2000 with particular reference to technology, services and public policies including agrarian reforms in the Asia-Pacific region; and

3. Propose a paradigm of sustainable rural development with a set of action strategies for developing a social and scientific agenda, and action programmes to strengthen rural livelihoods and nutrition security at the household level. The proposals will focus on:

   - building national and regional food security systems;
   - generating opportunities for economically viable self-employment in rural areas;
   - imparting a pro-poor, pro-women and pro-nature orientation in technology development and dissemination;
   - promoting sustainable human development and
   - protecting the ecological foundations essential for sustainable advances in biological productivity.

The project work commenced in July 1993, under the guidance of Dr. M.S. Swaminathan and Dr. K.N.N.S. Nair, Distinguished Fellow. Based on a desk study and supplemented by consultations and interactions with experts at the Headquarters of the Food and Agriculture Organisation of the United Nations, the World Food Programme, the International Fund for Agricultural Development, Rome and the International Food Policy Research Institute, Washington D.C., USA, the preliminary findings, covering the dimensions of the food security issues against a global setting, and outlining possible approaches and strategies to ensure food security towards the end of the decade and beyond, were documented. These findings were presented for consideration at the Plenary Session of the International Commission on Peace and Food held at the Carter Centre, Atlanta, USA during 2-5 October, 1993. To study the strategies and measures (technological as well as institutional) adopted and pursued in ensuring food security in the countries of the region, Dr. Nair undertook a field trip to the Regional office of the FAO at Bangkok, International Rice Research Institute, Manila and Indonesia and China.

Food security under this study is defined as *household nutrition security* which is specified as not only availability of, but also access to, balanced diets, safe drinking water and elementary sanitation at the level of individual households. Imparting not only physical availability but also the dimension of economic access to food security involves looking at the prospects for employment and purchasing power improvement for the resource poor families.

During the past two decades, food production has kept pace with population growth in most countries of the Asia-Pacific region, and in some countries has outstripped the latter. Much of the increase in production and productivity has been achieved through the use of scarce resources like water, and chemical inputs such as mineral fertilizers and pesticides which are leading to biotic and abiotic stresses on the resource base. Despite significant progress in food production

during this period, chronic hunger caused by inadequate purchasing power remained widespread among the resource poor, wage-dependent households such as marginal farmers, the landless and rural artisans. Between a quarter to one third of the population in the Asia-Pacific region remains below accepted levels of livelihood security and the proportion is growing.

Most of the rural families in the Asia-Pacific region depend on agriculture (any form of biomass output based on land and water) and processing of agroproducts, for their livelihood. A high proportion of total income in poor families goes towards purchase of food. Agriculture, as provider of both food and jobs, is thus vital to overcoming poverty in the countries of this region and can be sustained in the future only by producing more food, fuel wood, fodder and fiber from less land, less water and less energy per unit of output.

In the context of continued increase in population, of diminishing land and fresh water resources, of expanding biotic and abiotic stresses, and a slow growth in the diversification of opportunities for gainful employment, the food security challenges of today and of tomorrow in the Asia-Pacific region, are not only to maintain self-sufficiency in food production which is fundamental for the continued economic development, but to expand the economic access to food thereby ensuring food, security at the household level. Development strategies need to be reoriented in a manner that the quality of human life is improved while living within the carrying capacity of supporting ecosystems. This calls for the promotion of a new paradigm of agricultural and rural development based on the integrated application of the principles of ecological sustainability, economic viability and social equity.

The study reveals that food grains needed for the anticipated population in the year 2020 can be produced by the countries of the region, since many of them possess large untapped yield reservoirs even at currently available levels of technology. For instance, Japan's average yield of rice at present is 6 tons per hectare. Japan had reached the current rice yield of 1.3 tons per hactare of Laos and Cambodia as early as early 900 AD, 1.7 tons of India and Philippines by 1200 AD, 2.6 tons of Indonesia by 1900, 3.5 tons of China by late 1920s and 5.5 tons of People's Republic of Korea by 1960s. Since the additional output has to come from higher yields, it is important that the future green revolution technologies are environmentally sound, socially equitable both in gender and economic terms, and employment intensive. The biovillage model developed at MSSRF, which is based on the integration of the best in traditional wisdom and technologies with the most appropriate technologies of modern biotechnology as well as of information, space and management technologies, provides a basis for ensuring sustainable nutrition security at the household level.

The draft report relating to this study will be subjected to a peer review at a workshop to be held at MSSRF on 10-11 August, 1994. The final report will be presented to UNDP at the end of August, 1994.

Sub Programme Area 305

Chronicling of Integrated Intensive Farming Systems (IIFS)

With a rapid decline in per capita land and water availability and with large additions to the rural work force, intensive farming, on an ecologically sustainable basis, has become essential for safeguarding national food security as well as the livelihood security of the poor. Integrated intensive farming involves mixed cropping and mixed farming practices blending appropriate combinations of crops, tree species, farm animals and fishes. At the request of the FAO (Food and Agriculture Organisation), the Foundation is currently compiling successful examples of integrated intensive farming in India.

The aim is to prepare case studies for a Regional Workshop tentatively scheduled to be held in December at the MSSRF. The output of the case studies and the seminar would be oriented towards policy makers.

Twelve case studies including crop-crop system, crop-livestock system in dryland and irrigated conditions, crop-aquaculture and agro-forestry system are being identified for detailed study.

Evaluation of management interventions, development and application of a comprehensive performance assessment system and development of methodologies for selecting indicators for sustainability and unsustainability are part of the programme.

A review of the research base available in the country is being done with help from the Project Directorate for Cropping Systems Research, Modipuram, Meerut, Uttar Pradesh, and Central Research Institute for Dryland Agriculture of the Indian Council for Agricultural Research (ICAR), Hyderabad, and the International Crops Research Institute for Semi-Arid Tropics (ICRISAT), Hyderabad.

An analysis of the major components of sustainability such as soil health and water table, and production constraints arising from the triple alliance of pest-pathogen-weeds, post-harvest analysis of grain qualities (grain filling, shrivelling and mottling), history and pedigree of the farming system, and the energy efficiency of the systems will form part of the study.

The sustainability and replicability of each system will be studied. The physical and chemical properties of the soils of the various systems and the microbial population of the soils will be examined. The productivity per cubic metre of soil, water and air in the different systems will be evaluated. The root system of different crops in a multi-tier system and companion plantings will be studied in detail. The human carrying capacity of the land and water available will also be examined to arrive at the number of people that each of these systems would be able to support in an ecological by sustainable manner.

The provisional list of farms chosen for this study is given below :

1. Gloria Land form of Sri Aurobindo Ashram near Pondicherry
2. Mr.Bhasker Save, "Kalpa Vriksha Farm", P.O.Deheri, Umbergaon, Valsad District, Gujarat - 396 170
3. Sardar Ajith Singh's farm at Virur near Balharshah, Chandrapur district, Maharashtra for intensive horticulture in an ecologically sustainable way
4. Mr.A.J.Joseph's farm, Aviyil, Chungathara, Malappuram district, Kerala
5. Mr.P. Gomathinayagam's farm, 18 Uchi Makali Amman Koil Street, P.N.Pudukudi, Puliangudi - 627 855, Nellai-Kattambomman district, Tamil Nadu, for rainfed ecological farming
6. Mr.Velusamy Mudaliar, Puliangudi - 627 855, Nellai-Kattabomman district, Tamil Nadu
7. Mr.P. Thangasami's farm, Senthangudy, Nagaram Post - 614 624, Pudukkottai district, Tamil Nadu, for agro-forestry system
8. Mr.L. Narayana Reddy's farm, Sorahunase Post, Via Varathur, Bangalore - 560 087, Karnataka, for intensive integrated dry-farming system
9. Mr.K.T. Thomas Kuruvinakunnel, Idamattom P.O., Palai, Kerala 686 588 for integrated ecological farming system
10. Permaculture Resources, Pastapur, Zahirabad near Hyderabad, Andhra Pradesh
11. LEISA - Mr.G.Nammalwar, "Kudumbam", Odugampatti (P.O), Via Keeranur, Pudukottai district for intensive integrated dryland farming system.

Some more cases of IIFS are being gathered from the Central Institute for Brackishwater Aquaculture, Madras, Tamil Nadu, and the Central Institute of Inland Fisheries Research, Cuttack, Orissa. One or two cases of coastal agro-forestry will be included.

This short term FAO supported project will be continued on a long term basis through the establishment of a comprehensive national database on farms and farmers practising integrated intensive farming systems on an ecologically sustainable and economically viable basis. The IIFS database will be maintained at the Honda Informatics Centre of MSSRF. This will be the first comprehensive database in India on successful examples of integrated intensive farming. The IIFS database will help to understand the pre-requisites essential for getting more food, income and jobs from our natural resource endowments, using methods which are environment-friendly.

Sub Programme Area 306

Evolution of a Plan for Integrated Conservation and Development Programme in Tamil Nadu

Tamil Nadu has always stressed the need for conserving its forest wealth, nearly 17% of the geographic area having been declared forests. Tamil Nadu has also been a pioneer in the field of social forestry, launched in the seventies to meet the genuine needs of the people for fodder, fuelwood and other products. The Tamil Nadu Social Forestry Programme (TNSFP) launched in 1981 with help from the Swedish International Development Authority (SIDA) has proceeded in two phases, the second phase ending in 1995. The Government of Tamil Nadu and the Ministry of Environment and Forests of the Government of India requested the Foundation to assist in the formulation of a plan that would consolidate the gains of TNSFP and extend the programme, and would incorporate the principles of conservation and development central to the Agenda 21 of UNCED 92. The Foundation constituted a study team for this purpose. This team, after extensive consultations with many experts and officials and field visits prepared a detailed document of data, case studies and analyses to evolve an Integrated Conservation and Development Plan (ICDP) for Tamil Nadu.

The ICDP is premised on the importance of involving the community in the implementation process as primary actor. It emphasises the need for finding solutions for forestry problems in non-forestry sector. Further, the ICDP is promoted as a long-term programme rather than a short-term project, in view of the general decline in quality of land in Tamil Nadu. The ICDP as an integral component of natural resources management programme, recommends strengthening practices in tree husbandry, soil conservation and water management, while stressing the need to develop wasteland enterprises.

The core of ICDP, however, is its commitment to a participatory approach through development of micro-level plans. The villagers will define their needs through participatory plan formulation, and will implement the plan. The implementing agency will help define the technological limits, regulate fund flow and support to the programme. Every village will be viewed as a separate project, thus there will be no generalised targets, components or fund requirements.

The Social Forestry Wing of the State Forest Department will be the co-ordinating agency in view of its experience and expertise, while a parallel NGO structure will provide social support at the village, and at the divisional levels.

The programme will be implemented in 500 villages, based on the strength of the present core staff of the Social Forestry Wing. Since replicability would be built in, it is envisaged that the self propelling momentum will help to extend the programme to all the villages of the state. On a broad, normative basis, the outlay for five years will be Rs. 265 crores excluding inflation. The cost benefit analysis, including inflation, reveals a favourable ratio of 1.75 with an internal rate of return of 5%, thus establishing the financial viability of the plan.

PROGRAMME AREA 400

Reaching the Unreached

Sub Programme Area 401

Tamil Nadu Council for Sustainable Livelihoods

The aim of the Council, formerly known as the Tamil Nadu Council for achieving the threshold for a productive and healthy life for all, is to bring together governmental and voluntary sectors for eliminating endemic hunger. The Planning Commission of India estimates the number of women, children and men living below the poverty line by their inability to purchase food which on an average can provide 2200 calories per person per day. Thus undernutrition and poverty are organically linked.

After three years of exploratory work, the Tamil Nadu Council chose the total eradication of poverty and thereby hunger as its primary goal from 1993. For this purpose, the Council launched a Hunger -free District Programme on 17 October, 1993. (17 October had been designated by the United Nations as the International Day for the Eradication of Poverty). A workshop was held on that day to define the quantitative and qualitative dimensions of the hunger problem in Tamil Nadu and to develop a strategy for creating a suitable environment for the sustainable eradication of hunger. A Household Livelihood Assessment Card was prepared to identify the critical requirements for enabling families to meet their basic needs. This card is now being pre-tested.

The Council supported projects in two broad areas, namely, creating an enabling environment for ending chronic hunger and promoting empowerment mechanisms, which can help the socially and economically handicapped families, particularly women, to acquire the necessary economic and technological empowerment. The enactment of the new Panchayati Raj Bill will lead to about 10,000 women serving as members of the Panchayats in Tamil Nadu. For the country as a whole, this number will be about a million.

Under the programme for generating an enabling environment, the Council has concentrated its attention on child care facilities and education of women and to the creation of additional economic opportunities for women through the acquisition of new skills together with focus on health care and family planning based on informed choice.

The projects in these areas include:

- Multisectoral approach for better maternal and child health survival implemented by the Gandhigram Rural University.
- Health awareness education programme of the Satyamurti Centre for Democratic Studiess.

- Promotion of a sustainable job - led economic growth strategy through biovillages in Pondicherry by MSSRF.
- Generation of opportunities for skilled work through the eco-horticulture project by MSSRF.
- Development of alternative child care strategies by Project ACCESS.
- Project on mother and child welfare at Usilampatti sponsored by the Indian Council for Child Welfare.

Among empowerment mechanisms, the use of theatre for voicing the views of those who mostly remain unheard is proving to be a powerful tool. Recently, the Council, in collaboration with the State Institute of Rural Development, Tamil Nadu, and UNICEF, has initiated work on the preparation of training modules for Panchayat leaders, with a special focus on women and child development. The Council also proposes to assist in the effective implementation of the Chief Minister's 15-point programme for children in Tamil Nadu.

Project Hunger Free District

Chronic hunger, a major problem of a large section of our population, is characterised by lack of physical and economic access to balanced diets and safe drinking water.

Tackling hunger in a specific geographical area was taken up as the overall objective of the project Hunger Free District launched in the year 1993. The districts chosen were Dharmapuri and Coimbatore.

Activities

The workshop on Hunger Free Districts held at MSSRF on 17 October, 1993 helped in understanding the problem and its manifestations. Experts from various fields shared their views and experiences which helped in evolving strategies at the district level to tackle the causes of hunger.

Steps taken

A. Information on all available governmental anti-poverty schemes was collected. It has been observed that;

   The benefits of many of the anti-poverty programmes very often did not reach the target group.

   Inadequate follow up action, especially in employment generation schemes like the IRDP, results in poor recovery of loans on one hand and inability on the part of the beneficiaries to cross the poverty line on the other.

B. Developing a tool for data collection at the household level :

A tool for gathering qualitative and quantitative data has been developed. This is basically an interview schedule designed to gather information from families on various development indicators ranging from family size, dietary habits and educational levels to credit accessibility and income levels.

This tool, called "Livelihood Assessment Index Card", is presently being field-tested at Dharmapuri.It is expected to help in generation of information necessary for promoting a sustainable livelihood for the poor.

C. Gathering quantitative data at the block level :

Quantitative data like population, percentage of SCs and STs, literacy levels, sex ratio, number of agricultural labourers, ratio of workers to non workers etc are also being collected for Dharmapuri district through secondary sources to identify the most backward blocks and the most backward villages within these blocks where the project activities can be initiated.

A well developed village in a relatively well developed block would serve as a control for evaluation.

Sub Programme Area 402

Project ACCESS

Taking child care as the focal point of the needs of women, girls and young children, ACCESS continued to work at several levels for improving their lives.

Micro Level

The action-research programme continued on both the sites taken up during the two previous years and in a new cluster identified on the basis of the interest shown by local women's groups in the improvement of balwadis.

Models A and B: Self-financed Child Care Centres - Campaigning for a State Child Care Centre

The self-financed child care centre set up in NKK (Ninnakarai-Karaikazhani) by the local *Mahalir Mandram* in 1991 - 92 was taken over as a government centre under ICDS in the course of 1992 - 93. After a painful transition period, the centre has now settled down to fairly smooth functioning, with the continued involvement of the *Mahalir Mandram* and parents' committee in monitoring, offering support to the teacher and participating in the centre's activities.

The child care centre in the fishing community of VMK (Vemburusham - Kokkilamedu), also launched by the local women's group during 1991-92, had to be closed down during 1993-94 due to lack of support and economic difficulties. The building collapsed during the last monsoon and the community is unable to raise funds to repair it. The plan to start a Government balwadi has not materialised yet partly as a result of friction between the two *kuppams*.

Model C: Parental Involvement in Balwadi Improvement

Active parent groups had been set up in the five villages of Anjur cluster during 1992-93 to work for the improvement of the quality of child care services. These groups continued to play a role, though they have kept a low profile. ACCESS has continued to monitor these groups throughout this year, but has not initiated any new activities in the cluster.

The approach in all the above models was to organise women's groups, essentially parents of young children, around the single issue of child care. This approach was found to have severe limitations — the groups themselves were powerless and transient, with no permanent interest holding them together and the issue of child care by itself was not enough to form the basis of a powerful, permanent and active group. A detailed assessment of the two years' work and the lessons learnt from the experience was presented at the Regional Conference of SEARB (South East Asian Regional Bureau for Health Education) in January 1994.

As a result, a modified approach was adopted this year. The strategy is to work through existing local women's groups (*Mahalir Mandram*), helping them to monitor, evaluate and work for the improved management of the local child care centre. This work was undertaken in a group of 12 villages in partnership with a local NGO, MERG (Medical Educational Rural and General Development Trust).

Three workshops were conducted during the year, in April and July 1993 and March 1994, the participants being members of the women's groups, including parents, and the child care workers in the centres concerned. The details of the workshops are found in Table 4.1. In between the workshops, regular visits were paid to each of the centres and women's groups by the staff of ACCESS and MERG, and at least one parents' meeting was conducted in each area. The outcome and conclusions are summarised in Table 4.2. Four of the original twelve groups dropped out in the first three months, three due to organisational problems and lack of interest in the *Mahalir Mandram* and one due to long distance. The variable results can be related to the presence or absence of class and other differences between the parents and the *Mahalir Mandram* members, the cohesiveness and effectiveness of the *Mahalir Mandram* itself and the level of interest in the child care issue. Sustained interest from these groups would require a high level of intervention. The conclusion is that parent groups and women's groups by themselves may not be able to achieve much, since they lack power and authority, and would hence need strong support from the local government. With the revival of Panchayati Raj, the next logical step would be to involve Panchayats more closely in the issues related to child care and women's development, and this is planned for the coming year.

Model D: Employer—financed industrial creche

The creche launched in the Industrial Estate at Ambattur continued to be successfully run by the Indian Council for Child Welfare. No new efforts in this direction were made.

Table 4.1

Workshops on balwadi improvement

Date	Participants	Workshop Content	Decisions / follow-up
21.4.93	Members of 12 *Mahalir Mandrams* and mothers of balwadi children - 26	- Introduction and objectives of the workshop	- Date of the next meeting
		- Group discussion on aims and objectives of the balwadi followed by composition of songs on objectives	- Need for similar meeting for other *Mahalir Mandram* members and mothers
		- Group discussion on daily activities in the balwadi to fulfil objectives and the materials needed	- Need for teachers' participation in the workshops
		- Future plans	
17.7.93	Members of 8 *Mahalir Mandrams*, mothers of balwadi children and teachers - 37	- Games, followed by group discussion on different activities in the balwadi and how these promote aspects of child development	- Need for teachers to consult concerned *Mahalir Mandram* members / mothers in tackling issues
		- Group problem-solving on local issues, mostly centred around land and building (in village-wise groups)	- Ways in which parents can monitor balwadi activities
26.3.94	*Mahalir Mandram* members, mothers, teachers and ayas from 7 villages - 19	- Evaluation of the year's work in improving the balwadi and of *Mahalir Mandram* activity	- MERG took the responsibility of helping these groups in future with ACCESS as a resource when needed
		- Discussion on job responsibilities of teachers and ayas and monitoring by parents	

Table 4.2

Outcome of the balwadi improvement intervention

Name of the village	No. of visits by ACCESS	No. of meetings conducted	Activities/ Outcome	Comment
Melrosapuram *(Melrosa Mahalir Mandram)*	8	2	- Petition drafted to shift the balwadi to new building - Parents helped to maintain the centre - Centre functioning well and teacher very efficient	*Mahalir Mandram* and parents are co-operative and both monitor the centre
Kattur (Kasturibai *Mahalir Mandram)*	28	2	- *Mahalir Mandram* took steps to construct a new building - ACCESS worker participated in daily activities of the balwadi	Parents are supportive and members of the *Mahalir Mandrams* are active and monitor the centre
Sonallur (Beemabai *Madar Sangam)*	10	2	- Self-financed centre started by *Mahalir Mandram* with orientation / training by ACCESS - After two months centre had to be closed - Still trying for a government centre	Women's group very aware and interested. Keenly pursuing objective with support of whole community
Kattankulathur (Sakthi *Mahalir Mandram)*	9	2	- *Mahalir Mandram* helped the teacher in kitchen gardening - Took steps for the repair and maintenance of building - ACCESS worker participated in daily activities of the balwadi	Parents here are not responsive or active. Most of them are agricultural workers with no time to spare. *Mahalir Mandram* is active and monitors the centre
Saṭhanadapuram (Avvai *Mahalir Sangam)*	6	2	- Due to local dispute the teacher did not attend the balwadi - *Mahalir Mandram* involved in settling the dispute and the teacher has resumed duty - Petition drafted to shift the centre to the new building	*Mahalir Mandram* is active but does not represent parents and is not in close contact with them
Thellimedu (Thellimedu *Madar Sangam)*	7	1	- ACCESS worker participated in the daily activities of the balwadi - Teacher is efficient and the centre is functioning well	*Mahalir Mandram* not functioning well. Parents are also not supportive and there is little contact between the two groups
Karunilam (Karunilam *Pengal Grama Munnetra Sangam)*	4	1	- ACCESS worker participated in the daily activities of the balwadi - Teacher is efficient and the centre is functioning well	Parents are supportive of the teacher but *Mahalir Mandram* is not functioning properly and there is little contact between the two groups
Keelakaranai	1	1	- Due to liquor problem efforts did not lead to any concrete outcome	*Mahalir Mandram* and parents not in close contact and parents not co-operative

Intermediate Level

Action Research

In collaboration with two non-governmental organisations, *Pennurimai Iyakkam* and *Tamil Nadu Science Forum*, action-research programmes in two areas were taken up with the primary objective of assessing the child care needs of women in the unorganised sector and developing appropriate strategies to address the problem.

The specific objectives of the studies were:

- To study the mothers' working hours and other conditions of work affecting child care;
- To study the existing arrangements for the care of children (0-4 years) while mothers are at work / doing household chores and the level of satisfaction with these arrangements;
- To study the reasons for non-use of institutional services (where applicable);
- To study the time spent by the mother and other household members in various household tasks;
- To study the educational level, school attendance, economic activities and nature of household tasks including child care performed by male and female children (5-14 years).

The Madras study, with *Pennurimai Iyakkam*, was carried out in four slums of Madras where women are engaged in the occupations of domestic service, rag picking and construction. None of the slums had institutional child care services. The study also gave an in-depth profile of a city slum with regard to child care and related problems.

The study in collaboration with Tamil Nadu Science Forum focussed on the child care needs of women quarry workers in Pudukkottai district. Three villages where an active DWRCA quarry group was functioning were chosen as the study area. Among the three villages, one has an ICDS centre, the other a CSWB sponsored creche whereas the third has no formal child care system.

The methodology adopted for both the research studies was similar, with some modifications where necessary.

Phase I - community profile and census through door-to-door survey, official records and discussions in the community.

Phase II - an intensive study of the sample (mothers of young children) selected from Phase 1, through structured interviews with a schedule, as well as more complex methods of unstructured narrative interviews, participant observation and case-studies.

Phase III - feedback to the community on the research findings and a series of group meetings to finalise strategies for a plan of action.

The findings of these research studies highlighted the need for a strong support system of child care. The first study not only gave a complete profile of women in the three occupations but provided insight into the different meanings that terms like "family" and "child care" have for different groups, pointing to the need for redefinition. The absence of even custodial and nurturant care to children below five years of age, the high rate of criminal activities leading to unsafe environment for the children, high number of non-school-going children due to child care responsibility, high levels of alcoholism among both sexes, and the substantial number of female-dependent households were the major findings of this study. No significant difference was found between the mothers of children in the age groups 0-2 and 2-5 years, as seen from Table 4.3.

Table 4.3

Mothers of young children - Madras

Child-age	Working	Non-working	Total
0-2 years	17	4	21
2-5 years	17	2	19
Total	34	6	40

Although there are no institutional arrangements in the community for child care, a high percentage of women are working; and the older siblings, all non-school-going, are handling the child care responsibility.

The second study presented different findings. These include:- a high level of literacy among all age-groups and sexes, a low level of school drop-out among children aged 6-14 years, (probably reflecting the success of the Total Literacy Campaign in the area), long working hours of mothers, and poor utilisation of the existing services since even the limited facilities available are open only to children above 2 years. In this study, the difference between the child care needs of mothers of children below 2 years of age (who are breastfed) and 2-5 years of age was studied in greater detail. Cross tabulation of this data with the occupational status of the women presented significant findings (Table 4.4).

Table 4.4

Mothers of young children - Pudukkottai

Child-age	Working	Non-working	Total
0-2 years	10	9	19
2-5 years	29	6	35
Total	39	15	54

It was found that among non-working women, a high percentage (60%) who had children below 2 years, were unable to work due to the lack of child care support and need to breastfeed. On the other hand, among the working women, most (75%) had children aged 2-5 years, and of the remaining, 60% had child care support through the joint family.

The next phase was the joint search for viable strategies to rectify the situation (Fig. 4.1). In Madras, after a series of discussions and brainstorming sessions (eight and two spread over 4 months) with the community in two slums a local women's group was formed. After four attempts this group convinced the CDPO to approve an ICDS centre at this location. Since no premises was available for rent, and representations to the Housing Board were unproductive, the group identified a place within the slum for the centre and also agreed to collect funds to erect a thatched building. The local leader is also being pressurised to make his contribution. Construction is yet to start. Activities in the other two slums originally taken up for the study had to be dropped due to various reasons.

In Pudukkottai, the problems of the three areas were addressed separately. The area where there was no formal child care arrangement for children between 2-5 years was taken up first. A local women's group was formed and after 4 meetings spread over 4 months, with the support of the local AIDWA cell, representations were made to the Programme Office (ICDS) and the District Collector to sanction a centre. The findings of the research study were used to substantiate the claim. The centre is to be sanctioned by the first week of May.

The problems in the other two areas, where the institutional arrangements for children between 2-5 years were poorly utilised, were brought up during the workshop organised by TNSF and ACCESS. Local voluntary agencies and Government functionaries were invited as resource persons to the workshop, where the women presented the problems identified during four earlier meetings spread over four months. The two agencies, TNSF and Centre for Action in Rural Development (CARD) have agreed to work closely with the community in one area each to help find solutions and to monitor progress.

While in Madras the respondents were more concerned about the safety and welfare of girls and gave little importance to the needs of the preschool child, in Pudukkottai the situation was different. With a high percentage of school attendance among both boys and girls and the pressing need for women's employment, the problem of child care is perceived, but only in relation to children between 0-2 years, whose mothers are unable to work unless they have support. In both groups, children between 2-5 years are the obvious victims of neglect, though not perceived as such by the community.

Attempts to find innovative solutions, not necessarily institutional, to support mothers of children between 0-2 years are yet to begin.

Training

The emphasis was on sharing experiences through training to help other agencies plan and set up child care centres, and to improve the quality of services. Training experiences were offered to three agencies.

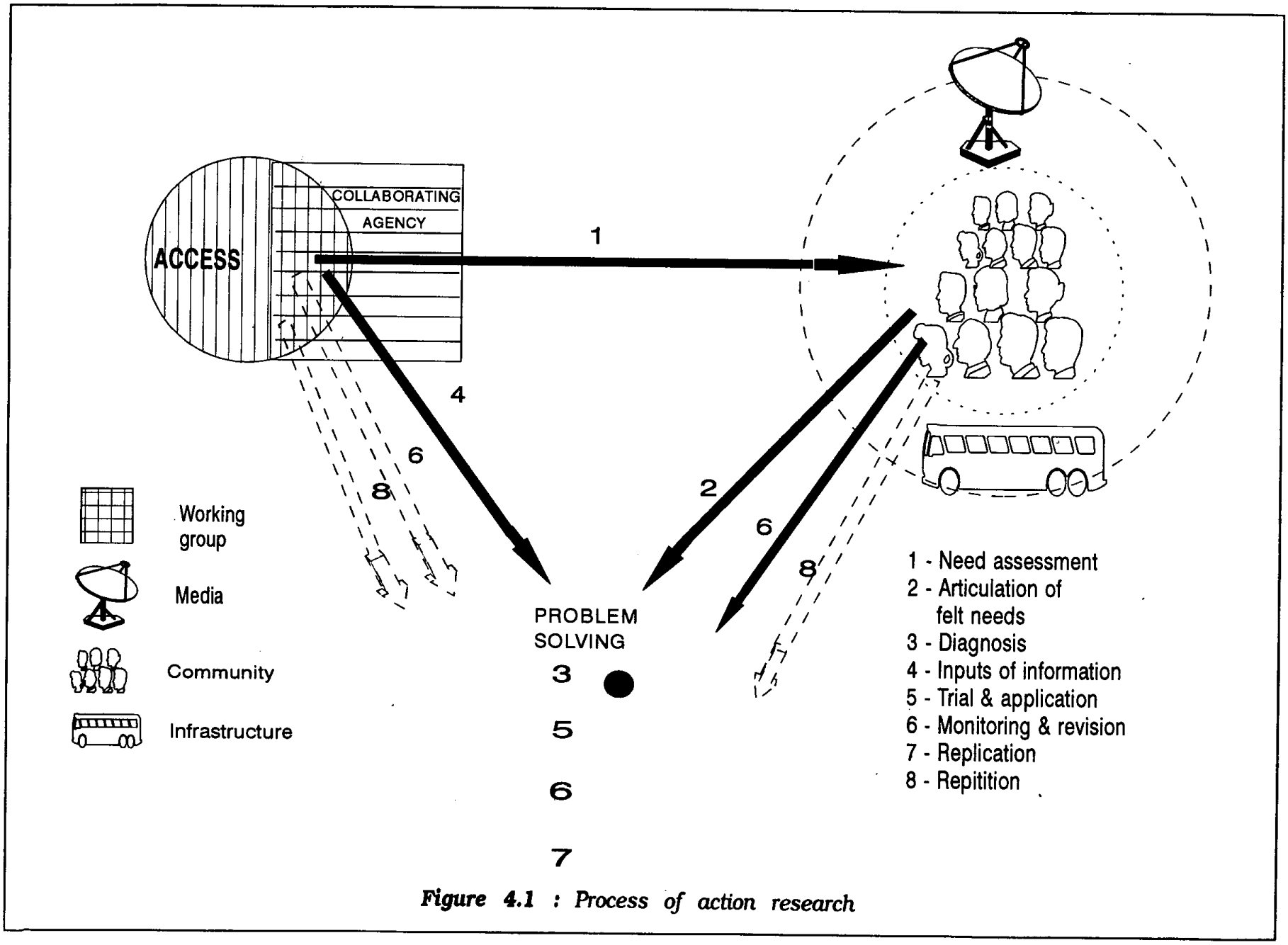


***Figure 4.1** : Process of action research*

1. Irula Tribal Women's Welfare Society, Thandarai is engaged in a variety of women's development programmes for Irula tribal women in Chengai-MGR District, including income-generation through afforestation and forest management, herbal medicine, functional literacy and non-formal education. A one-day orientation on child development and care of the young child (0-6 years) was offered for tribal women animators and programme staff of the agency in January 1994. A day care centre for the children is planned.

2. Centre for Labour Education is concerned with the education, development and welfare of women construction workers. A survey conducted in Annai Sathya Nagar (opp. Reserve Bank of India) where there is a large temporary settlement of construction workers, revealed that there were more than 70 young children in need of services in each of the three sections, A, B and C of the settlement. Most of the mothers here are working and four children lost their lives in a fire last year. CLE has been working to set up a day care centre for young children, as well as provide non-formal education for the older children at this site for more than two years. The centre was launched on 8 March 1994.

Preparatory work was done with the help of the local community and its leaders, who took the responsibility of putting up the low-cost shelters in each case. Six local women were selected to work as teachers and ayas in each of the three areas. ACCESS organised a three-day orientation for these women on the basics of running a child care centre, with the help of resource persons from Indian Council for Child Welfare (ICCW) and Children's Garden School Society (CGSS). Prior to the workshop, the selected volunteers were given an opportunity to observe the daily programme of creches run by other voluntary agencies. Centres have been set up in two areas with an average attendance of more than fifty children aged 8 months to 5 years in each of them, and a third centre is expected to open shortly. ACCESS is monitoring the progress through fortnightly visits. One-day workshops with the teachers are to continue once a month for the next few months.

3. Women's India Association has been running creches for the children of working mothers for nearly two decades, with 54 centres in and around Madras. Most of the creche teachers have been exposed earlier to a 5-week training course sponsored by the Social Welfare Board and have a work experience of ten to fifteen years. The organisers felt the need for a refresher course to improve the quality of work in the creches and make it more developmentally oriented.

After visiting several creches for spot observation and holding two meetings with the organisers of WIA, it was decided to organise a three-day refresher course for all the teachers, and a curriculum was planned jointly with the other two participating training agencies, ICCW and CGSS. It was felt that this three-day module would also be useful as a model for other agencies who may wish to conduct such refresher courses for their workers.

The three-day refresher course, based on the expectations and needs of the workers and using participatory methods, was held in April 1994. It was felt by both participants and trainers that the time was too short to address the various practical problems and difficulties in the field, not all of which could even be fully articulated.

It has been decided to maintain regular contact with the teachers through monthly meetings, and the training will be continued with the help of the same resource agencies, taking up different aspects each month. The experiment will be evaluated at the end of the year.

Macro Level

In January 1992, ACCESS took the initiative to launch TN-FORCES (Tamil Nadu Forum for Creche and Child Care Services) along the lines of the national FORCES, as an informal network of organisations forming a broad-based non-political platform to press for better child care services in the State. The network includes women's groups, trade unions and voluntary agencies concerned with the welfare of women and children, as well as educational, academic and resource agencies.

This experience of dealing with issues relating to women and young children through the network of TN-FORCES was partly instrumental in drawing up the project entitled "Children on the Agenda". The project is guided by a Technical Advisory Committee.

The major aims of the project are:

- To support, strengthen and coordinate the TN-FORCES network to act as a pressure group for Early Childhood Care and Education (ECCE) in Tamil Nadu in general,
- To cultivate a supportive climate for ECCE, specifically focussing on policy makers, the general public and media,
- To improve the qualitative aspects of trainers' training and
- To conduct research and documentation to support the process.

The project has four broad areas of action, namely :

- Network Development
- Advocacy and Communication
- Training and Instructional Materials
- Research and Documentation

Network Development

Network development forms the base as the network itself must promote the cause of the young child. Enabling the network to perform the function of watchdog in relation to issues of child care through dissemination of information to the participating members, and strengthening it to work towards common goals and develop as a platform for raising issues on child care are the major objectives. The outcome would be a more sensitised, alert and responsive network able to address a range of issues related to child care.

Activities

A TN-FORCES meeting was held in November '93 in which 19 organisations participated. The members decided to observe the year 1994 as Campaign for Maternity and Child Care Support Services. Five sub-groups were formed to achieve the goals of the network.

The subgroup on media met twice and deliberated on intervention strategies. The identification of the appropriate media for intervention and the choice of sponsorship was decided. The child health subgroup in its meeting focussed on the theme "Promotion of Breast Feeding for Better Child Survival" and formulated a plan of action for the same. The training subgroup is working on a training module with the support of ACCESS to conduct 2 levels of training for creche workers and organisers/supervisors respectively. The other two subgroups would be focussing on creches and dialogue with employers.

Besides this, exposure on the role and activities of TN-FORCES was provided to organisations participating in the UNICEF - sponsored conference on "NGOs role in the State Plan of Action for Child Development". The workshop conducted by the Tamil Nadu Voluntary Health Association (TN-VHAI), on "Women, Health and Development" also provided an opportunity for explaining the role and functions of TN-FORCES. This has resulted in an increase in the number of members of the network to over 45. A quarterly Newsletter was launched and issues were released in January and April, 1994, reaching out to 250 organizations.

Advocacy and Communication

The specific objectives in this area are

- Influencing and sensitising the media in giving wider coverage and publicity to child care issues and
- Creating public awareness about child care issues through the visual and print media.

Audio Visual Media

A 23-minute video film in Tamil entitled *Ivargalin Kuzhanthaigalum Kuzhanthaigalthane* dealing with the problems of women in the unorganised sector and the need for child care centres was made and screened on 16 March 1994 on the occasion of the International Women's Day, and followed up with a panel discussion. An English version has also been prepared. Two 32-second audio spots were also produced on the need for child care centres, one of which is being regularly broadcast on FM radio. About ten messages have now been identified on all aspects related to the issue of child care, for dissemination through the electronic media. Selected radio and television programmes from All India Radio and Doordarshan were recorded in the month of December. The programmes have been analysed and the report completed. The findings are to be disseminated and used as a basis for action.

Print Media

Several articles on topics such as Maternity Benefit Act, child care, women and work have been published in popular Tamil dailies and weeklies. A photo-feature on the subject of women, work and child care was also published in a youth magazine. Articles and messages related to women and child care were published in two issues of *Magalir Sindanai*, the monthly magazine of All India Democratic Women's Association (AIDWA) one of the member organisations. 10 magazines were selected for analysis. In the first stage, based on guidelines, the extent of representation of women and children issues was identified. The second stage of print media deals with content analysis in selected areas.

Training and Instructional Materials

The quality of child care service is heavily dependent on the skills of the functionaries and their level of motivation. Hence there is a need to provide an adequate training input in skills, attitudes and values to trainers of the State child care services and NGOs concerned with training in the voluntary sector.

The objectives under this area of the project are :

- Development and implementation of a module for trainers' training along with the necessary support materials, both print and audio visual and
- Development of prototypes for low-cost toys and play materials as support materials for training.

Activities

A 6-day trainers' training programme for State Government trainers/instructors/ supervisors was conducted at Coimbatore in February on providing improved services for children of the 0-3 years age group. This is the first attempt by a State Government to focus on all-round development of infants. A workshop was organised for 3 days in March to develop a module on play curriculum for the 3-6 years age group. The first training course to try out the module is to be held in the month of June. A trainers' profile is being developed, and pre-course monitoring of ongoing training is being conducted. Collection, study and preparation of an inventory of printed and electronic resource materials for use in training programmes are being carried out.

The periodical *Chittu Kuruvi* published by TINP reaches 30,000 field workers in child care. It was planned to include a 4-page supplement on ECCE in 6 issues in the year 1994, with the involvement of specialised agencies of TN-FORCES. The first issue has already been published in January - February 1994 while work is going on for the next few issues. Developing and designing low-cost soft toys for children in balwadis is another major area of work. A meeting was organised in December to develop a few prototype sets of toys for the 3-6 years group of balwadi children and a designer is working on the prototype.

Research and Documentation

A classified database is an effective tool in the policy-making process and in evaluating programmes and action.

The specific objectives are

- undertaking studies on the need and extent of child care services in Tamil Nadu
- compiling and updating status reports and developing a database
- identifying and following up issues emerging from the studies
- initiating a dialogue with policymakers based on the above data and influencing the policy-making process to activate interventions in favour of the child.

Activities

Preparation of draft questionnaires for updating the status report on child care services was completed. This was followed by identification of knowledge gaps from earlier reports after which a framework was prepared to update the status report on child care services in Tamil Nadu.

A meeting of research scholars interested in child care was held and an informal research network formed. Two meetings have been held and issues and topics of common interest identified. A methodology workshop to formulate common tools is planned. Documentation that is being carried out includes background materials for media persons and others interested in writing on the issues, research for the video script, media watch in the form of a clippings file and translation of some important documents into Tamil. The development of indicators for monitoring and evaluation is also in progress.

Inputs for Policy-making

A national consultation on "Maternity and Child Care Services" was held in September 1993, in which forty leading professionals and organisations participated. As a result of the consultation, and pressure from TN-FORCES and other NGOs, the National Commission for Women, which had appointed three legal panels to review laws related to women, set up a fourth one on "Labour Legislation and Social Security for Women".

Further the National Commission for Women along with UNICEF jointly conducted a workshop in March 1994 on "Infant Feeding Practices and the Law" which made very positive recommendations, particularly with reference to extension of maternity leave. Another achievement has been the setting up of the National Child Care Fund for which the national FORCES has been campaigning since 1989. TN-FORCES is also campaigning for extension of maternity leave and cash benefits to women in the unorganised sector.

Documentation

The project entitled "Multiple Approaches in Early Childhood Care and Education in India" which was initiated in April 1993, with the support of the Aga Khan Foundation,

aims to document about 10 innovative child care programmes as a series of in-depth case studies, through a network of agencies involved in them.

An Advisory Committee including specialists from several disciplines guides the project in its technical and operational aspects. The Committee has developed the following criteria for inclusion of programmes for documentation. Each selected programme must

- address the intersecting needs of women, young children and girls (i.e. focus on day-care for children between 0-6 years, with special emphasis on the age group 0-3 years),
- be need-based, client-oriented and responsive in both content and process,
- have systems of optimal size and not single units,
- cater to lower socio-economic groups,
- be non-profit-making in nature and
- have had a minimum period of tenure as an indicator of continuity and success.

In addition, the selected programmes as a group should

- represent diversity in auspices and structure (i.e. semi-government, private, voluntary, employer-funded, union-sponsored, denominational, cooperative, NGO-government partnership, school-based, community-based, indigenous etc.),
- have a geographical spread over the country.

The process is participatory and involves networking and sharing of experiences among the agencies so that the documentation may be used as a tool for advocacy by the network.

The following programmes have been selected so far and documentation is in progress. It is expected that at least four case-studies will be published by the end of 1994 and the rest will be completed in 1995.

	Programme	Agency
1.	Family Day Care in Urban Bombay	TISS,Bombay
2.	NGO - Govt. Partnership in ICDS	URMUL, Rajasthan
3.	Creches for Children of Women Tobacco Workers	SEWA, Ahmedabad
4.	Day Care Services for Children of the Urban Poor	Mobile Creches, New Delhi
5.	Community Pre-schools: An Alternative Model for the Rural Poor	PWDS, Tamil Nadu
6.	Early Childhood Education: an Integral Part of Community Development	SIDH, Mussorie

Sub-Programme Area 403

This section is reported under SPA 503

Sub-Programme Area 404

Eco-horticulture and Household Nutritional Security

This project was initiated in 1992 to improve the nutritional security status of households and to increase the income of farmers through horticultural enterprises. In order to assess the current level of food security and major nutritional maladies a detailed socio-economic and nutritional survey was conducted in the project area with the help of a consultant pediatrician. The details of our survey are presented below :

Out of the 49 villages under the horticultural programme 37 villages were selected for conducting the nutritional and socio economic survey. The field supervisors were asked to identify ten families meeting the following criteria :

- Famlies with children aged 0-5 years
- Families below the poverty line
- Access to land around the house to establish a kitchen garden.

Nutritional and Socio-economic Survey

The socio- economic survey was carried out among the identified families with the help of field supervisors and the data obtained was analysed to determine

- the current state of food security for each household under study
- the food security risks faced by the household
- the insurance mechanisms available to the household
- the type of household
- the possible future state of household food security.

The current food security status in both the blocks viz. Kattangulathur and Kancheepuram as per our survey showed only a very small percentage of population experiencing a secure food status with a majority of the population experiencing a high food insecurity level. When co-related to the household's income, employment and food consumption pattern, it was seen that unemployment was the major reason for the prevailing food insufficiency. Therefore steps to increase household income through diversified opportunities for work are essential for ensuring economic access to balanced diets.

Future State of Households

The assessment of future states of food security was also done based on the current state of the household, food security risks faced and the insurance mechanisms available. The transition functions from the current state to the future state for each household was determined using the formula

$$FS = [CS + f (I.R)]$$

where FS is the likely future state of the household food security in next time period,

CS is the current state of the household food security in current time period,

f(I.R) is the function describing the transition from current state to the future state,

I is the level of food security insurance available to the household,

R is the level of food security risks faced by the household.

The three states of food security are low food security state, moderate food security state and high food security state, representing the various degrees of inadequacy of the diet. All the households were classified by their movements between current and future state:

those households where the movements were positive $FS > CS$

those households where the movements were negative $FS < CS$

those households that remained in the same state of food security $FS = CS$.

From our survey it was evident that due to the prevailing unemployment in Kattangulathur block nearly 52 % of the total population under survey would see a worsening in their current food security status, while only 23% of them will continue to experience the same level of food security. Only 25% of them would see some improvement in their food security state in future. Similarly in Kancheepuram block nearly 78% would see a worsening in their current food security status while only 13.5% would be expected to remain in the same status. It is expected that only 4.5% would see some improvement in their food security state in future.

Nutritional Assessment

The nutritional assessment of the children from the identified families was done with the help of a consultant pediatrician using anthropometric measurements and a rapid clinical survey. For the classification of the children into various grades of malnutrition, the widely accepted classification of The Indian Academy of Pediatricians was used. Out of the 476 children under nutritional assessment survey in both the blocks, 257 were found to be in the normal range; 133 in Grade I malnutrition, 69 in Grade II malnutrition, 17 in Grade III malnutrition and 5 in Grade IV malnutrition (see Figures 4.2 and 4.3).

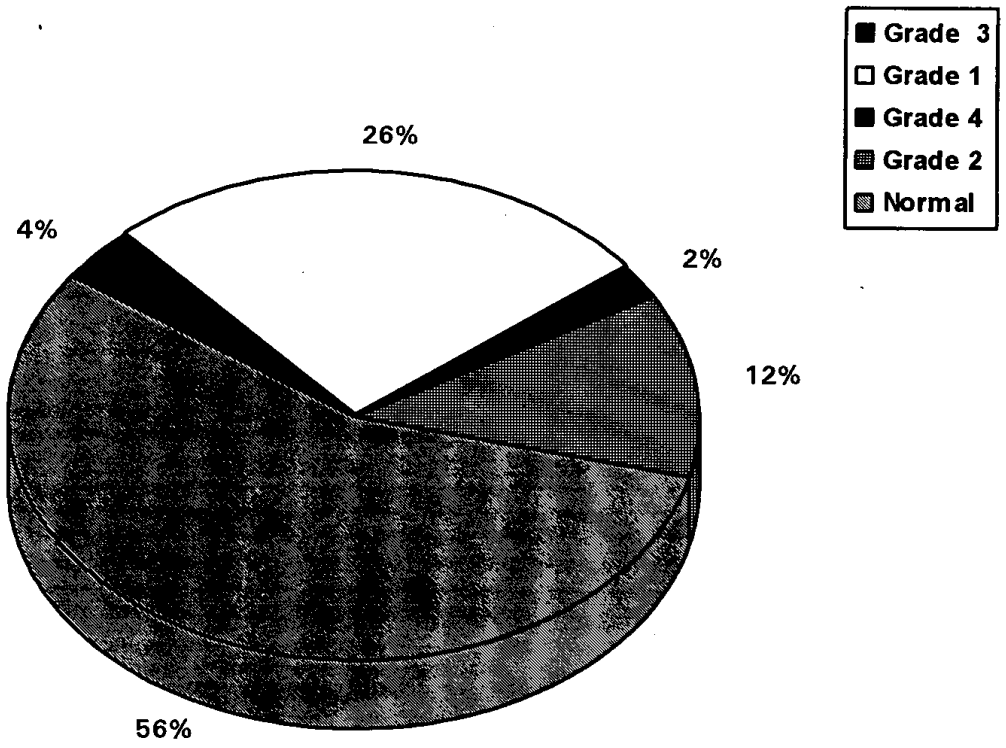


Figure 4.2 *: Nutritional status of children in Kattangulathur block*

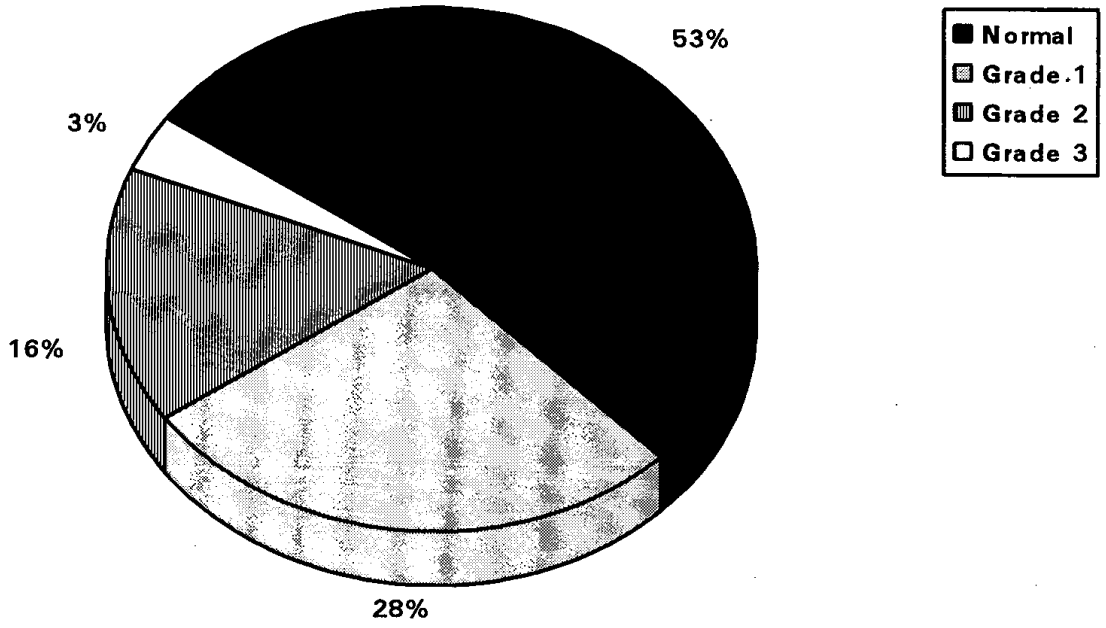


Figure 4.3 *: Nutritional status of children in Kancheepuram block*

The analysis shows a large percentage of children falling under the malnourished and under-nourished group. The overall survey reveals the prevalence of malnutrition and under-nutrition in both the blocks due to the following reasons:

- lack of awareness about low cost nutritive and horticultural products among the women of the households;
- lack of knowledge on primary health and hygiene;
- low income of the household.

Work is currently underway to address these issues. Training will be given in the raising of nutrition gardens and to increase the skills identified in household women for setting up their own horticultural enterprise which will increase their income level.

Nursery Establishment

A group of local youth were trained to provide grass root extension services in their villages and equip farmers with new skills and knowledge. The details of the training programme are given in Sub Programme Area 501. In order to supply the necessary elite planting materials, fruit plants procured from various institutions have been planted at the newly cleared and fenced area at LRS (Livestock Research Station) Kattupakkam, as seen from Table 4.5.

Table 4.5

Planting materials for distribution

Crop	Variety	No. of plants planted during 1993-94	Estimated No. of plants for distribution in 1995-96	1996-97
Pomegranate	Ganesh	402	2010	4020
Acidlime	Seedless	395	2000	3950
Mango	Ratna	10	60	100
Mango	Kesar	9	50	90
Mango	Sendura	4	20	40
Mango	Alphonsa	6	30	60
Mango	Banglora	25	125	250
Mango	Neelam	25	125	250
Guava	Lucknow 49	100	500	1000
Sapota	PKM1	50	250	500
Indian Gooseberry		39	200	390
Anona		20	100	200

Sub Programme Area 405

Sustainable Livelihood Security Index : Information and Data Needs

The previous annual reports furnish details about the concept and methodology for arriving at the index. SLSI was constructed to test the relative status of the livelihood security of the population at a macro-level in the different agro-climatic zones of India. This was done with the already existing data. Later SLSI was constructed for the household level wherein the basic unit of analysis is the household. The computation methods have also been described in detail in the earlier reports.

Another attempt is the Pichavaram Case Study which is described under Sub Programme Area 102 of the previous and current reports. This study differs slightly because efforts were first made to develop a questionnaire and refine it periodically so as to furnish all the necessary information for computing SLSI. This was done based on the responses of the locally residing communities during preliminary surveys. The index has been developed only for some essential components such as income, educational status and asset ownership status. Further studies are being carried out by Dr.Maria Saleth, who has joined the Institute of Economic Growth, University of Delhi, Delhi.

Planning of any integrated rural development and sustainable resource management programme requires a considerable amount of information such as

- demographic features
- socio-cultural characteristics of the communities
- occupational structure, income level and other indicators of well-being, the size and quality of resource base
- productivity
- cost structure
- profitability of alternative technologies
- efficiency of marketing systems
- social and institutional constraints
- potential for alternative or supplementary economic activities
- sustainability of resource use.

Work on gathering such data has been initiated in the Pichavaram area.

Sub Programme Area 406

Agribusiness for Small Farmers

The UNDP-Union Planning Commission sponsored project on "Planning for Full Employment : Strategies for the Small Farmers Agri-business Consortium" made further progress during the year.

In December 1993, the Government of India set up a Society, under the Societies Registration Act of 1860, titled "The Small Farmers Agribusiness Consortium (SFAC)" for the purpose of catalyzing agro-industrial growth in the country. The registered office of the Society is the Ministry of Agriculture, Krishi Bhawan, New Delhi.

Project Design Teams

Reputed NGO's working in different parts of the country were invited to be members of the project design team. These NGO's were entrusted with the task of preparing the project design for the selected district, in consultation with the nodal officer nominated by the State Government and a representative each from the National Bank for Agricultural and Rural Development (NABARD) and Industrial Development Bank of India (IDBI) (Table 4. 6). The project design teams are supported by broad based steering committees and interdisciplinary spearhead teams.

Meetings and Workshops

A project design workshop on extending the economic benefits of modern agribusiness to resource poor farmers was held in Madras on 19 and 20 July, 1993. The aim of this workshop was to ensure that all the district project design leaders followed of the following criteria while formulating the project design:

- Market-driven identification of enterprises
- Integrated attention to technology, techno-infrastructure, training and producer-centred trade
- Management by primary stakeholders
- Backup by a consortium of technical and financial institutions and private and public sector enterprises to provide farm families with small holdings the economy of scale in management and marketing
- Public policy support through national, state and district level committees chaired by appropriate government leaders

- Ownership by participating rural families
- International collaboration where appropriate and advantageous.

The progress made in the design of the projects was reviewed at a meeting organized on 17 October 1993 on the occasion of the World Day for the Eradication of Poverty.

The general consensus in the meetings and the workshops was that the process involved in the implementation of this project should be cast in a participatory mode. Particular attention should be given to the poorest 20% who constitute the unreached in developmental projects. Government involvement should be as a friend, philosopher and helper. There should be involvement without interference. Local initiatives should be nurtured and promoted. Convergence and synergy among governmental and non-governmental organizations, public and private-sector enterprises, technologists and farmers, financial and insurance agencies and all others concerned will have to be promoted. The farm and landless labour families involved in this programme are treated as "participants and producers" and not as "beneficiaries". The mind-set of the people involved in project formulation and implementation should be free from the patronage approach. It should relate to the promotion of new social contracts, new skills, and to adding economic value to the time spent in work by rural women and men.

The objectives were narrowed down to the following:

- to identify areas with untapped production and marketing potential and work out details of economically viable enterprises;
- to define needs and opportunities in terms of technology, techno-infrastructure, training and trade;
- to arrive at an organisational structure at the village and district level;
- to develop a step by step procedure for the management of such organizations.

The work done so far in the design of district level projects is summarized below. The Dharmapuri, Pondicherry and Pithoragarh projects were designed at the Foundation, while the others are being developed by the agencies indicated in Table 4.6.

Table 4.6

SFAC Pilot Projects

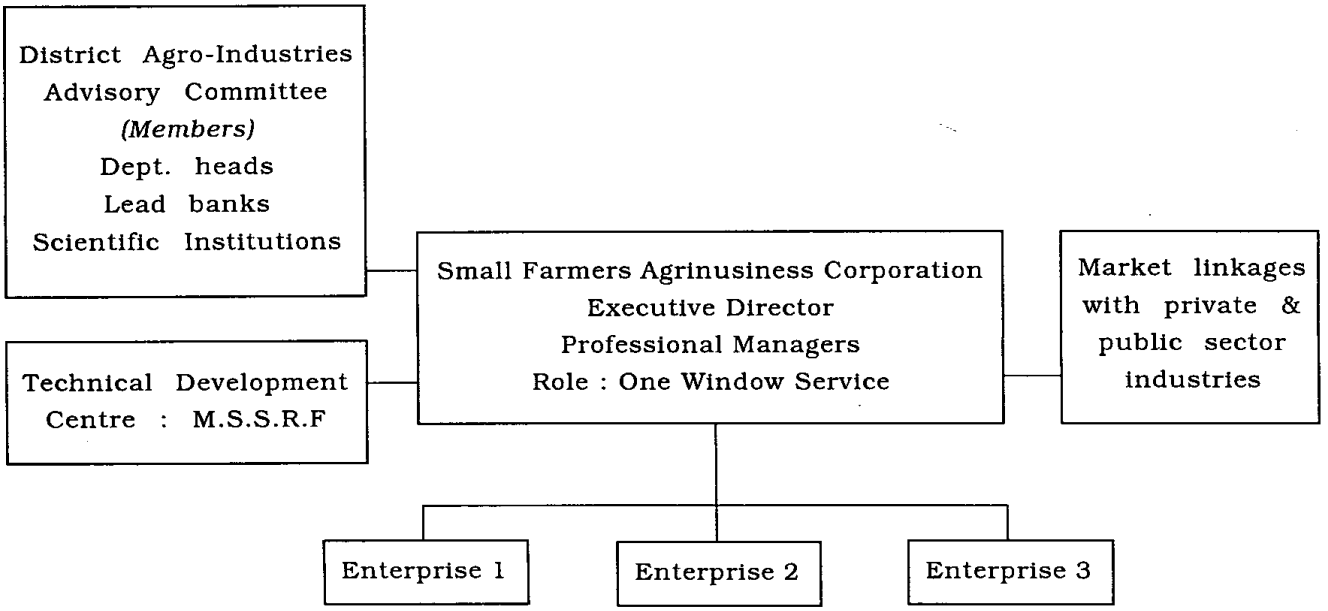
State	District	Nodal Officer	Project Design Agency	IDBI Nominee	NABARD Nominee
Tamil Nadu	Dharmapuri	Ujjagar Singh Horticulture	CRSARD Madras	S.Andi Madras	K. Ramana Madras
Pondicherry	Pondicherry	P. Zacharia Dir Agriculture	CRSARD Madras	S.Andi Madras	K.Ramana Madras
Uttar Pradesh	Pithoragarh	R.S. Tolia Secy Uttranchal	CRSARD Madras	B.K. Batra Kanpur	S.C.Kapoor Lucknow
Kerala	Ernakulam	K.V Nambiar State Plan Board	CMD Trivandrum	B.G. Mathew Kochi	R.N.Hegde Trivandrum
Gujarat	Valsad	K.S Verma Guj Agro Ind.	IRMA Anand	Jayaraman Iyer R Ahmedabad	Sanjay Desai Ahmedabad
Rajasthan	Bikaner	G.N Haldea Area Devpt Com	IDS Jaipur	A.K. De Jaipur	
W.Bengal	Midnapore	M.N. Roy DRDA	CWDS Delhi	D.Dutta Calcutta	G.V. Chelam Calcutta
Assam	Barappetta	Secy Agriculture	NEIBM Guwahati	P.Mohan Ram Guwahati	
Orissa	Ganjam	Commissioner Agri and Rural Development	Berhampur University	J.K Chatterjee Bhuvneswar	A.R. Pandey Bhuvneswar
Karnataka	Dharwad	Commissioner Agriculture	ISEC Bangalore	V.M. Manogaran Bangalore	E.V.Naidu Bangalore
Andhra Pradesh	Mahboob Nagar	V.S Sampath, Dir Agriculture	SIRD Hyderabad	Md. Basheeruddin Hyd	John Kurian Hyderabad
Madhya Pradesh	Jabalpur	M.K. Roy M.P Agro Industries Corp, Bhopal	M.P. Agro Industries Corporation Bhopal	G.S. Krishnan Bhopal	S.S.Rao Bhopal

Organisational Structure

After carefully reviewing the organisational choices such as co-operatives, society, private Ltd. company and joint stock company, it seems appropriate that the Dharmapuri and Pondicherry district Small Farmers Agribusiness Consortium (SFAC) be a corporation registered under the Companies Act. This company will have diversified avenues of income from the various enterprises.

At the level of individual enterprises in the villages, the participant families could form an agri-business club or informal self help group in the initial stage. Such groups are recognized for receiving credit by Lead Banks. As these groups grow in experience and confidence they can be registered as societies. The advantage of agri-business clubs is that the members will be in a position to exchange information, and motivate each other to take pride in their work and maintain good quality.

***Figure 4.4** : The District Small Farmers Agribusiness Corporation*



Replication

The strategy will be self replicable on two counts: a) It is market driven rather than subsidy driven. b) Informal groups at the village level can help in making group action an effective instrument of increasing household income.

Investment

It is envisaged that the initial investment needed will be approximately rupees ten crores per district. Some of this investment can be met through ongoing government schemes. There will be a technical assistance component for purposes like training and provision of essential techno-infrastructure. The rest will be loans and credit schemes of the lead banks.

I. SFAC: Dharmapuri, Tamil Nadu

This project design was completed in February 1994. It has been submitted to the Planning Commission, UNDP, National SFAC, Government of Tamil Nadu and NABARD.

The enterprises suited to the agro-ecological and market situations of Dharmapuri district and meeting the stipulations of the SFAC paradigm of ecological sustainability, social equity and economic viability are given below. The focus is on decentralized production and centralized services for agro-processing and marketing.

Horticulture : The following programmes have been identified

Production and sale of grafts of superior mango varieties: There is already a tradition in Dharmapuri for producing good quality mango grafts. The demand for such planting material far exceeds supply. Therefore it is proposed to organize a production programme for about half a million mango grafts each year. A market tie up will be arranged and the products will be marketed all over the country under a special brand name.

Papaya production and processing: Excellent varieties of papaya are found in the state that not only yield heavily but provide opportunities for the production of papain. Papaya cultivation will be taken up in about 500 ha in the district.

Organic vegetable production: The production of organic vegetables and the production of seeds will be taken up in one compact block of villages.

Processing of fruits and vegetables: There are several food processing units that are working at less than full capacity. Their full capacity will be utilized through this project.

Floriculture: Ornamental plants and budded rose plants have a good scope and their production will be taken up in a cluster of villages.

Sericulture : There are several on-going sericulture projects in Dharmapuri district. Rural families do not derive full benefit from sericulture since processing takes place elsewhere. Therefore production of raw silk and its processing into finished products will be integrated.

Industrial silk complex: There is a demand for good quality silk in the world market. Indian silk remains ungraded. To bridge this gap bivoltine cocoon production will be taken up in a selected cluster of villages covering 1500 ha of mulberry area. This will be linked with the industrial silk complex to produce graded silk fabric.

Village sericulture estates: Silk reeling will be integrated with the available cocoon production in a selected cluster of villages. Cottage basins will be introduced into the villages where women trained in silk reeling will take up this work. The farmers will be trained to switch over from multi-voltine to bi-voltine silk worms.

Wasteland development enterprises : The wasteland development programme will aim at both the improvement of degraded soils and the creation of more skilled jobs in the farm and non-farm sectors. Dharmapuri district has 20,000 ha classified as wasteland. Programmes for improving the biological potential of the soil in such wastelands will

be undertaken in about 1000 ha. The choices of tree species for upgrading degraded soil are based on the following enterprises:

Fodder and dairying: To meet the shortfall of fodder and link it with dairy farming.

Biopesticides and nitrification inhibitors: For this purpose neem, pungam, anona and other trees capable of yielding bio-pesticides, non-edible oils and cakes which serve as nitrification inhibitors can be planted using seeds of superior "plus trees".

Raw material for furniture: Tree species, suitable for the manufacture of furniture, toys and allied enterprises will be chosen. Linkages will be established with the John Makepeace School of Furniture in the U.K for designing suitable furniture for export.

The precise blocks suitable for the above enterprises have been identified and maps have been prepared.

II. SFAC: Pondicherry, U.T.of Pondicherry

The design of this project was completed in February 1994. It has been presented to the Planning Commission., UNDP, National SFAC, Government of Pondicherry and NABARD for review.

Participatory rural appraisals were conducted in fifteen villages to discuss the project with farmers and agricultural labourers. The basic thrust has been to identify and develop competitive advantages for the farmer groups through organizational structures.

The following enterprises have been identified for initial attention under the SFAC programme:

Pondicherry Region

Horticulture: With special reference to local vegetables, the major thrust will be on improving the marketing procedures for these products by ensuring that the producers receive a fair share of the product price.

Oil seeds: Organized marketing will be promoted for groundnuts.

Poultry Farming: Poultry estates will be established in a cluster of villages.

Karaikal Region

All women aquaculture estates: 745 ha of brackish water area has been identified by MPEDA as potential area for aquaculture. This potential is yet to be tapped. Lack of expertise and the high investment cost of starting a semi-intensive brackish water aquaculture unit have been major deterrents in developing this enterprise.

A demonstration cum training project has been sanctioned by the Department of Biotechnology. The Government of Pondicherry, through its Department of Fisheries has approved 12 ha for starting the demonstration site at South Keezhvanjoor village and 3 ha at village Akkravatam for starting the hatchery. A further 30 ha land at Oduthurai

village will be given to the Women's Development Corporation, Pondicherry, to start are All Women Aquaculture Estate. The help of Marine Products Development Agency and Central Institute of Brackish-water Aquaculture was taken in project preparation. This project will be based on considerations of both ecology and equity. Equity issues are being addressed both in gender and economic terms. Ecological issues, particularly intrusion of saline water in adjoining areas and into the ground water, will be addressed. A workshop to consider these issues was organized in collaboration with FICCI on 19 April, 1994.

III. SFAC : Pithoragarh, Uttar Pradesh

The state and district level steering committees have discussed the modalities of the project. The focus is on identifying enterprises high in market value and low in volume and weight. These are essential criteria since much of the transportation is still dependent on mules and human beings in this Himalayan district. The following enterprises have been selected for agri-business:

Herbal based industries : The cultivation and processing of herbs for medicines, foods and cosmetics are to be carried out at the high altitude areas of Pithoragarh District, mainly in the areas of Johar, Darma and Vyas in Munsiari and Dharchula Thesil.

High value nut-fruit based industries : Cultivation and processing of almonds, walnut, sweet cashewnut (meetha Pangar), apricot, hazelnut, chilkoza and pecanut are to be undertaken in combination with leguminous vegetables. This district has a suitable climate for growing nut fruits in altitudes ranging from 1000 - 3000 meters. Nut fruits have several advantages since they are non-perishable in nature, high in value, rich in protein and can preserve the soil.

Leguminous vegetables : The focus will be on cultivating leguminous vegetables such as peas, french beans, dolichos bean, *rajma*, urad and Soyabean in the mid-Himalayan blocks.

Vegetable seeds : Hybrid seedlings of cole crops will be raised in poly houses.

Pulses & vegetable based industries : Surplus lentils and seasonal vegetables will be used for making *baree* (traditional processed food) in Champawat and Lohaghat blocks.

Integrated fisheries and vegetable production : Using a micro-hydro water mill a pilot scale plant will be set up in the Jauljibi Mudkot belt of Munsiari Tehsil.

Wool based industries : The traditional skill base for spinning and weaving woollen carpets, shawls, blankets etc. already exists in the district. Thrust will be given on quality improvement, using natural vegetable and rock dyes. Linkages have to be formed with designers and markets.

Ringal, rambas and bamboo based industries : Ringal based articles form an essential part of life of the hill peasantry. Thrust will be on plantation, design and quality improvement and direct access to the market by craftsmen. Initial concentration will be in Berinag block.

Ecotourism : The district, especially the high valleys or Johar, Darma and Vyas, have an enormous potential for eco-tourism, trekking and camping. However it is very important

to avoid the ecological problems created in noted trekking areas, by charging a trekking fee and by restricting the number of trekkers during the trekking season.

The economic and social viability of the above enterprises are being integrated.

IV. SFAC: Ernakulam, Kerala

This project is being designed by the Consultants for Management Development, (CMD) Trivandrum. The final report was completed in April 1994. The following enterprises have been identified:

Integrated coconut development: This will have five main components: coconut farm development in hitherto neglected plantations; a coconut oil extraction unit, desiccated coconut unit, a coir mat unit and a coconut charcoal unit.

Aquaculture and rice farming: Aquaculture will be carried out in paddy fields during off-season. Rice-prawn culture in *pokkali* lands and establishment of a 2000 ha aquaculture estate will receive priority.

Floriculture: 50 women's clubs will grow orchids and anthuriums.

Each project has been assessed from a strictly bankable point of view. Detailed analyses were done following formats of NABARD and IDBI. These projects are regarded as the first generation seeds of agri-business development in the district and are expected to spin off later on a larger scale.

V. SFAC: Valsad, Gujarat

The project is being designed at the Institute of Rural Management at Anand, Gujarat (IRMA). The following enterprises have been selected as suitable for the agro-ecological and market situations of Valsad district:

Horticulture: The main thrust will be on developing mango and chikoo cultivation with the help of proper organization of small farmers. A direct link will be developed between farmer and food processing unit.

Aquaculture: With a 200 km stretch of coast, 90 sq km of brackish water area and 150 sq km area under fresh water, Valsad district possesses enormous potential for marine and inland fisheries. There is scope for improving capture and culture fisheries and for introducing brackish water aquaculture. The help of MPEDA, Gujarat Agro-industries Corporation, and Gujarat Fisheries Central Co-operative Association Ltd. is being sought for preparing the action plan.

VI. SFAC: Bikaner, Rajasthan

This project is being designed at the Institute of Development Studies (IDS) in Jaipur. The aim will be to arrest some of the ecological problems arising from arid zone irrigation

such as water logging and salinization and to introduce sylvi-horticultural and sylvi-pastoral systems of land and water use. The production of high quality seeds and other high value products will receive emphasis. The following enterprises have been selected:

Non edible oil seed : Seeds of Thumba, Ratanjoth and Neem will be collected for processing.

***Arid horticulture*:** This includes cultivation of pomegranate, ber, grapes, and the production of hybrid seeds.

Seed village : Different varieties of ground nut seeds will be produced.

VII. SFAC : Midnapore, W.Bengal

This project is being designed by the Centre for Women's Development Studies (CWDS), at New Delhi. Several steering committee meetings have been held and the following enterprises are being considered:

Floriculture; Betel vine; Fisheries : There is potential for processing of these products since all three are surplus products and are marketed outside the district.

Wasteland development enterprises : Sericulture, fruit cultivation, plantation of medicinal herbs and other products to utilize the 46,000 ha of cultivable waste land in the western part of the District.

VIII. SFAC : Barapetta, Assam

This project is being designed by the North Eastern Institute of Bank Management (NEIBM) based at Guwahati, Assam. The Project Design Steering Groups met at Guwahati on 8 February, 1994. It was recognized that this region faces many social problems. The following enterprises have been identified for detailed action:

Sericulture : Barapetta, Assam is in the unique position of being able to produce three varieties of silk (Eri, Moga and Mulberry Silk). Thrust will be given to designing new blends of silk.

Horticulture : Vegetables, bananas and mangoes will receive greater attention.

Aquaculture and rice farming : The central region of Barapetta is prone to floods. This area can be brought to productive use by alternating piciculture with rice production. Aquaculture can also be taken up in the numerous *beels* (ponds) found in this region.

Dairy enterprise : This enterprise will be taken up subject to the revival of the Indo-Australian cattle breeding farm.

Eco-tourism : The Manas Sanctuary is a world heritage site and local people will be involved in conducting eco-tourism. A conservation corpsof young Bodo women and men will be developed

Handicrafts : Local crafts will be developed with emphasis on bell metal.

IX. SFAC: Ganjam, Gajapati Districts, Orissa

The University of Berhampur has undertaken the task of designing the project. The following enterprises have been identified and investigations as to the viability of each enterprise are being carried out.

Horticulture: The following programmes have been identified:

Orange production and processing: Oranges are grown in the temperate climate of the hilly terrain of Gajapati district. The indigenous tribal population will be involved in orange production, processing and marketing. The area including Koinpur, Jeerango, Serango and R.Udaygiri is most suitable for carrying out this activity.

Medicinal plants: The Ramgiri and Mahendragiri areas of the Gajapati district are suitable for cultivating medicinal plants on a commercial basis.

Organic vegetables and seed villages: Purushottampur, Hinjilicat and Aska areas of Ganjam are known as the vegetable basket of southern Orissa. Irrigation facility is available and there is a potential for taking up organic farming and vegetable seed multiplication..

Aquaculture: There is a good potential for carrying out aquaculture activities. Two coastal blocks, Chikiti and Ganjam, are suitable for the promotion of brackish water aquaculture. The current demand for shrimp seed is 200 million in Ganjam district. The OSSRARC hatchery has a capacity of 80 million. 24 decentralised backyard shrimp hatcheries with a capacity of 5 million each can meet the shortfall. The help of MPEDA, Gopalpur Fisheries department and College of Fisheries has been sought to prepare this project.

Salt farming is practised at Ganjam and Humma. As part of the Goitre Control Programme, the Government of India proposes to set up iodised plants here. 5 reservoirs of different concentrations of brine are maintained for salt manufacture. The possibility of utilizing the first two reservoirs for aquaculture is being studied.

Wasteland enterprises : The following programmes have been identified

Teak nursery: There is a great demand for teak saplings inside and outside the district. In Bhanjanagar area the possibility of starting one such nursery is being considered.

Processed timber and toy making: Vast stretches of wasteland have been brought under afforestation in the social forestry programme. The trees in most of the patches are ready for harvesting. SFAC can provide market support to the village forest committees and study the possibilities of setting up processing facilities.

X. SFAC: Dharwar, Karnataka

This project is being designed by the Institute of Social and Economic Change (ISEC), Bangalore. A steering committee and several sub committees have been formed. The following enterprises have been identified and investigations are being carried out to find out the viability of each enterprise.

Horticulture: with an emphasis on Byadgi chillies and fruits.

Cotton: This area is known for its cotton cultivation and the emphasis is on value addition through ginning. The economic viablity of growing hybrid/coloured cotton, is being worked out.

XI. SFAC: Mahboobnagar, Andhra Pradesh

This project is being designed by the State Institute of Rural Development (SIRD) based at Hyderabad. The steering committee and several sub committees have been formed to work out the details.

XII. SFAC: Jabalpur, Madhya Pradesh

This project will be designed by The Madhya Pradesh Agro Industries Corporation based at Bhopal. The details are being worked out.

Education, Communication, Training and Information Services

A number of training programmes, seminars and conferences, which are an important component of the activities of the Foundation, were organised. A new dimension has been added to education and dissemination of information with the development of an electronic library. Staff development through participation in important conferences and scientific meetings/training programmes was encouraged. In addition to the annual inter-disciplinary dialogue, the Foundation hosted the Second Asia-Pacific Biotechnology Conference jointly with the National Academy of Agricultural Sciences of India.

Sub Programme Area 501

Training Programmes

As in the preceding years, training programmes organised this year are reported as Expert - Farmer, and Expert - Expert interactions.

Expert - Farmer Interactions

As part of the activities reported under SPA 301 (Biovillages), farmers and women from landless families were provided training in different technical practices, the details of which are given in Table 5.1.

Table 5.1

Training programmes for farmers and landless women

Technique	Training agency	Participants
Coir rope making	District Industries Centre, Pondicherry	Women
Biofertilisers	TNAU, Coimbatore	Farmers
Hybrid seed production	Maharashtra Hybrid Seeds Co., Jalna	Farmers
Homestead nutrition gardens	Krishi Vigyan Kendra, Pondicherry	Women
Jasmine production	Private Agencies	Women
Mushroom production	TNAU, Coimbatore	Women
Composite fish culture	Private Agencies	Women

Each of these training programmes included demonstrations and hands-on training.

Training Programmes in Eco-horticulture

The Foundation places considerable emphasis on the establishment of eco-horticultural estates as a means of relatively quick employment and income generation. Since early 1992, an eco-horticulture training programme is being conducted in the villages of Chengai-MGR district with help and support from the International Agricultural Training Programme (IATP), U.K., Krishi Vigyan Kendra (KVK) located at Kattupakkam and CAPART, New Delhi. The scope and dynamics of this group of programmes have been described in SPA 404 in this report.

At the core of the training programmes is the induction training for trainers, which was reported in the Third Annual Report. In the current year, the second induction training programme was organised with the same curriculum as before. Minor changes, based on the experience of the previous programme, were incorporated. An important stimulus for the second programme is our observation that trainees of the first programme have been able to train other farmers by conducting one-day interactions in their villages. In all 4253 farmers have benefited from such interaction.

The impact of such a movement is reflected in the visible changes in the cropping pattern. In many contact farms, the cropping pattern has shifted from paddy-paddy-paddy (before training) to paddy-paddy-vegetables (after training). The vegetables in cultivation are brinjal, chillies, tomato, bhendi and gourd. In one village (Ponniamparai) all the contact farmers have shifted to vegetable cultivation in place of groundnut during the January - April season, or in place of paddy during March - June season. One farmer, through effecting a shift from paddy to bhendi in the November - April season was able to increase his income by Rs.19500 per hectare. Such a large increase in income, and the reduced water consumption, have prompted him to go for vegetables in the third season as well. The changes in one village in areas under vegetables due to training are presented in Table 5.2.

Table 5.2

Changes in area of vegetables

Crops	Before training (ha)	After training (ha)
Tomato	1.58	11.20
Brinjal	9.59	16.65
Chillies	7.73	15.37
Bhendi	11.76	19.00
Clusterbeans	—	0.52
Amaranthus	0.02	0.82

Location-specific Eco-friendly Techniques

Eco-horticulture, a variant of the sustainable agriculture system, lays major stress on treating the soil as a living entity. As a result of our field supervisors upgradation training, farmers have now switched over from external resources-based practices to low internal recycling practices. Farmers who had neglected the valuable and rich farm yard manure for years have now started realizing the importance of organic manure in maintaining soil health and in turn plant health. The other organic sources include biofertilisers, vermicomposting, green manures and green leaf manures.

Soil sampling : Realizing the importance of eco-friendly techniques for community health and sustained production, 84 farmers tested their soil to calculate the quantity of nutrients required. The field supervisors of respective villages not only trained the farmers in soil testing procedures but also helped in getting the samples analysed. These types of services, not available hitherto, are greatly appreciated.

Biofertilisers : Azospirillum treatment with seeds of bhendi and seedlings of tomato, brinjal and chillies has also gained popularity among the contact farmers. Having understood the advantage of cost-benefit ratio and learnt the skill of treatment with bio-fertilizers, farmers are now willing to adopt this technique for all the crops.

Vermi-composting : Our field supervisors demonstrated this technique to their contact farmers. Soils fertilized by excreta of earthworms contain 5 times more nitrogen, 7 times more phosphate, 11 times more potash, 3 times more magnesium, 3 times organic carbon and 40 times more humus than control plots. This technique of vermicomposting is not readily accepted by the farmers. However a few farmers have already started vermicomposting and are using it in the fields of bhendi and banana.

Green manuring : After the upgradation training on "green manure and green leaf manure" many farmers have started applying leaves of *pungam, notchi,* calotropis and *kathumanga* in their field. Seeds of green manure crops like daincha and sunhemp were distributed to the interested farmers.

Crop protection : In the conventional system most farmers resort to chemical control, which not only pollutes the air and water but also kills both harmful and beneficial insects. With the growing concern for environmental safety, there is an urgent need to educate farmers about the eco-friendly and economically viable plant protection measures. In this context, chemical control is regarded as the last resort.

The field supervisors imparted training on the integrated pest management technique specific to individual crops. Among the various components of integrated pest management viz. crop rotation, light trapping, resistant varieties, barrier cropping, biological control, trap cropping, pheromone trapping and botanical pesticides, only two techniques - light trapping and botanical pesticides - have attracted farmers.

Bio-pesticides : The introduction of various leaf decoctions to control pests have gained wide popularity due to cost effectiveness and practicability. In Kayarambedu village, tobacco

leaf extract at the rate of 10% was found to be very effective against cowpea aphids. In the same village another farmer sprayed a mixture of garlic, chillies and onion and controlled cowpea aphids effectively without resorting to any chemicals.

One field supervisor advised his contact farmer to apply leaf tea made out of *pungam* leaves, neem leaves and *notchi* leaves mixed with cow urine and asafoetida to control fruit borers of *Coccinia indica.* The farmer admitted that it was very effective in controlling the pest and also increased the fruit size and appearance. The above mentioned leaf tea was also found to be very effective against the same pest in Vadiyur of Kancheepuram District.

Similarly neem based pesticides were tried by the farmers only after the upgradation training conducted by the field supervisors. At Thaipakkam two farmers tried neem oil @ 3% to control fruit borers and succeeded. In the same village two other farmers sprayed neem cake extracted at the rate of 5% for bhendi and chilli fruit borers and realized its effectiveness. The same neem cake extract was also found to be very effective on aphids and fruit borer of cow pea and ribbed gourd respectively in Musaravakkam village.

Expert - Expert Interactions

Training Programme on Information Retrieval Using CD-ROM Technology - 9-15 December 1993 (co-sponsored by CAB International, UK)

The Foundation has established an electronic library as a core facility (SPA 504). The collection in this library is available for use by researchers in the region. To enhance user awareness and capability, the Foundation organised a training programme on the use of CD-ROM databases with the support of CAB International (CABI). Mr. Tim Ison and Dr. Arun Kashyap of CABI served as training experts. Besides staff of the Foundation, participants included library services personnel from the University of Madras, Tamil Nadu Agricultural University, Tamil Nadu Veterinary and Animal Sciences University, and SPIC Science Foundation. The curriculum, adopted by CABI worldwide, was designed to start with the fundamentals and familiarise the users with features of SPIRS software and advanced search techniques. The participants spent over 60% of the time in working on the CDs. The participants, on satisfactory completion, were given certificates by Mr. James Gilmore, Acting Director-General of CABI.

Sub Programme Area 502

Workshops / Conferences

As part of the activities reported under programme areas 100 to 400, the Foundation hosted a number of conferences, meetings and seminars. Many of the meetings had the purpose of designing or evolving frameworks for future research or action by affording scope for proactive, interdisciplinary analyses of various issues relating to sustainable rural development and conservation of biological diversity. The halls and laboratories in the new building were dedicated to various individuals whose work and support have inspired many of the programmes of the Foundation. Most of these ceremonial occasions were integrated with seminars / meetings on themes that were advanced by the work of the concerned person. Besides, weekly seminars are held where the staff of the Foundation or visiting scientists are invited to present and discuss their recent research.

Dedication Theme Seminars

- A one-day meeting on "Community participation in mosquito control" was held on 11 August, 1993 to mark the dedication of Sambasivan Auditorium. Dr. M. K. Sambasivan (1900-1936), during his tenure as Chairman of the Municipality of Kumbakonam in Tamil Nadu, was responsible for sizeable reduction in incidence of filaria and other vector-borne diseases. His achievement was brought about through concerted community work and public health measures. The principal speaker at the seminar was Dr. V. P. Sharma, Director of Malaria Research Centre, New Delhi, who highlighted the current resurgence of malaria in various parts of the country, and the simple, effective measures that have been evolved to control its incidence. Members of the Students' Action Group for Mosquito Control in Madras, and the sponsors, Rotary International District 3230, participated and presented their views.

- A day-long workshop was organised on the 17 October, 1993 to coincide with the dedication of a hall in honour of Mr.Ramkrishna Bajaj, leader of the Hunger Project in India and an eminent industrialist committed to Gandhian values and goals. The theme of the workshop was the formulation of an action programme for hunger-free districts. The distinguished participants in this workshop included Mr. C. Subramaniam, former Governor of Maharashtra, Mr. M. Arunachalam, Union Minister of State for Small Industries, and Mr. Erling Dessau, (then) Resident Representative of UNDP in India. The participants discussed various strategies and approaches to creating hunger-free districts as part of the problem of bringing about sustainable development. A programme has been drawn up for Pondicherry district, and is being implemented (details in SPA 401 in this report). This workshop was held also to mark the first international day for the eradication of poverty.

- The library in the Foundation was dedicated in honour of late Mr. S. Bhoothalingam, distinguished economist and civil servant, on the 6 January, 1994. Mr. L. C. Jain,

former Member of the Union Planning Commission, delivered the First Bhoothalingam Memorial Lecture on "Sowing the Seeds in Time : India's Future", where he highlighted Mr. Bhoothalingam's services in the building of India's steel industry.

- The Community Gene Bank was dedicated in honour of Prof. G. T. Scarascia - Mugnozza, well known plant geneticist and President of Italian National Science Academy, on 27 January, 1994, on the occasion of the launching of the IBPGR - supported Community Biodiversity programme.

- A hall was dedicated on 28 January, 1994 in honour of Mr. B. R. Barwale, builder of India's seed industry and pioneer in hybrid seed production, during the international dialogue on farmers, and plant breeders' rights, by Dr. Balram Jakhar, Union Minister for Agriculture.

- A hall was dedicated in honour of Mr.M.K.Narayanaswami, planter and community leader on 13 April, 1994 during which a *Deepasthambham* donated by Mr. M. A. Parthasarathy, Chairman of IUCN Commission on Education and Communication, was erected and inaugurated.

Symposium on Inventorying and Monitoring of Biodiversity with Special Reference to Mangrove Ecosystems (17 Dec. 1993)

The Biodiversity Convention, adopted at UNCED '92 at Rio de Janeiro, came into effect on 29 December 1993. Dissemination and availability of appropriate information is an essential component in integrating the convention in the national frameworks of law and procedures relating to environment as well as trade. This symposium was organised with these aspects in view, and was meant to assess the strengths, gaps and potential of the current developments in information technology to catalogue and monitor biodiversity, and its sustainable utilisation. The emphasis on mangroves is due to the design and development of a Mangrove Ecosystems Information Service (MEIS) by the Foundation, which is a unique collection of databases (details in SPA 206).

The symposium was inaugurated by Dr. M. Channa Reddy, Governor of Tamil Nadu, who also dedicated the CD-ROM library of the Foundation to the nation. Dr. B.C.Y. Freezailah, Executive Director of the International Tropical Timber Organisation (ITTO), Japan, dwelt on the implications of biodiversity conservation in timber trade. He also dedicated the MEIS to mangrove researchers of the world. Dr. Robin Pellew, then Director of the World Conservation Monitoring Centre (WCMC), Cambridge, UK, gave a detailed presentation on gaps in information on mangroves. Dr. N. Seshagiri, Director-General, National Informatics Centre, New Delhi, described the current status of electronic networks in India which would provide help in accessing biodiversity related information. Mr. James Gilmore, Acting Director General, CAB International (which publishes TREE CD which is the most comprehensive guide to world forestry literature) analysed the scope of existing databases and their usefulness in biodiversity conservation.

National Biodiversity Alliance

Representatives of committed organisations and mass media, lawyers, scientists and forestry experts committed to conservation action were invited for a dialogue at the M.S.Swaminathan Research Foundation on 18-19 December, 1993. 42 eminent persons drawn from various fields met under the chairmanship of Dr. M.S. Swamianthan and debated the serious crisis afflicting the protected area system of the country, encompassing over three percent of India's land mass, which serves as reservoirs of our genetic wealth. It was decided to form a National Biodiversity Alliance and to launch "Conservation Action - 1994", an action programme designed to preserve. India's protected area system for present and future generations.

The participants decided to take up qualitative issues and look at some of the crisis points of India's protected areas on a site-specific basis.

The following six areas were chosen for study and action under *"Conservation Action 1994".*

- Manas World Heritage Site, Assam
- Bhitarkanika Area, Orissa
- Dudhwa Tiger Sanctuary, Uttar Pradesh
- Kutch Marine National Park, Gujarat
- Gulf of Mannar Marine National Park, Tamil Nadu
- Nilgiris Biosphere Area

Studies at these sites have been initiated with financial support from the Rajiv Gandhi Foundation.

Status cum action reports are being prepared for these six threatened sites. The main focus is on the following aspects :

- Current status of these Protected Areas - anthropogenic and commercial pressures
- Strengthening legal foundation for community based developments
- Development of threat alert mechanisms
- A time frame for action
- Structure of alliance
- Finance

Policy Maker's Workshop on the Conservation and Sustainable Management of Biological Diversity in the North-eastern Region

A regional consultation was organised at Guwahati from 7 to 9 February, 1994 by the Ministry of Environment and Forests of the Government of India and the M.S.Swaminathan

Research Foundation to formulate a strategy for conserving the biodiversity of the North-eastern region of India, which is rich in genetic resources of crops and many medicinal plants and for converting this biological diversity into economic wealth on an ecologically sustainable basis. The consultation was attended by Chief Secretaries, Secretaries to Government, Principal Chief Conservators of Forests, Directors of National Institutions, leading scientists, representatives of Universities and non-governmental organisations and senior officers of the Government of India. Dr. M.S.Swaminathan, Shri S.C.Dey (Addl. Inspector of Forests), Shri.Samar Singh (Secretary General, World Wide Fund for Nature - India), Dr.P.K.Hajra (Director, Botanical Survey of India), Dr. Ashish K.Ghosh (Director, Zoological Survey of India) and Dr. R.S.Rana (Director, National Bureau of Plant Genetic Resources) participatd. The inaugural session was attended by two Ministers of State of the Government of Assam.

Deliberations on the various aspects and issues of biodiversity conservation were conducted for three consecutive days. Some of the actions decided to be undertaken are :

- Restructuring of land use pattern based on principles of ecological sustainability, economic viability and social equity;
- An Integrated Biodiversity Conservation Strategy involving both *in-situ* and *ex-situ* methods and a Biodiversity Inventory for the N.E.region;
- A local management council for protection of wetlands;
- Strengthening NGOs and forming Citizens' Council for biodiversity conservation involving all principal stakeholders;
- A Regional Biodiversity Alliance comprising representatives of political and community leaders, government and non governmental organisations, media and scientists.

Inter-Disciplinary Dialogue on Methodologies for Recognising and Rewarding Informal Innovation in the Conservation and Utilisation of Plant Genetic Resources

The fifth annual inter-disciplinary dialogue in the series ***New Technologies : Reaching the Unreached*** held at M.S. Swaminathan Research Foundation (MSSRF) from 28 to 31 January, 1994, related to methods of recognising and rewarding the contributions of rural and tribal women and men in the conservation of plant genetic resources (PGR). For over 10 years, both in the forum of FAO and the Keystone International Dialogue Series in Plant Genetic Resources, the need to acknowledge their contributions have been recognised under the generic term *Farmers' Rights.* Although the concept of Farmers' Rights is now widely known and accepted, there is as yet no national Plant Variety Protection Act which incorporates a transparent and administratively implementable method of conferring such rights on tribal and rural women and men. The Global Convention on Biological Diversity which came into force

on 29 December, 1993, recognises that the biodiversity occurring in a country is the sovereign property of the people of that country. The Uruguay Round of GATT Negotiations which concluded in Geneva on 15 December, 1993, calls upon all member nations to either adopt a patent or a *sui generis* system of protection of new plant varieties. The present Dialogue attended by 54 experts from 12 countries discussed a draft legislation prepared by Dr. M.S. Swaminathan for adoption by developing countries. This draft legislation proposed a method of conferring rights on the following three groups of stakeholders in a new crop variety :

(a) Breeders and their scientific collaborators/breeding institutions

(b) Farmer-innovators who have contributed to the conservation of parent genetic stocks which have gone into the making of the variety submitted for protection, and

(c) Farmer-cultivators, who cultivate the new variety.

The Dialogue was addressed by Dr. Balram Jakhar, Minister for Agriculture, Government of India and Mr. James Gustave Speth, Administrator of UNDP.

After detailed discussions, the Dialogue participants helped to prepare a draft of the Plant Variety Recognition and Rights Act, containing the following features :

(a) Protection of breeders' rights;

(b) Protection of the rights of farmer-cultivators to raise crops of new varieties from their own seeds; farmer-cultivators may also undertake limited exchange of new seeds with their neighbours and

(c) Recognition and reward for the contributions of tribal and rural women and men in the conservation and selection of plant genetic resources which have gone into the pedigree of the protected varieties.

Farmer-innovators will be provided support for strengthening their work in *in-situ* and *ex-situ* conservation of plant genetic resources from a Community Gene Fund operated on transparent and simple procedures. The Community Gene Fund will derive its income from a levy of 5% of the gross sale value of all varieties approved for protection.

Another important provision relates to the right of the Minister for Agriculture to convert the exclusive Plant Variety Right granted under this Act to non-exclusive plant variety rights (automatic license of right) provided that such right shall be exercised only in respect of crops related to food, fibre, fuel, medicines, pesticides and fertilisers and provided further that such conversion to no-exclusivity shall take place only three years after the grant of the right.

The draft Act prepared at this Dialogue is the first of its kind which converts the universally agreed concepts of breeders' and farmers' rights into an administratively implementable legal document. It has hence evoked widespread interest among international organisations connected with this issue like FAO and the Union for the Protection of New Varieties of Crop Plants (UPOV).

The Madras draft legislation addresses an important issue referred to in the resolution on *"Interrelationship between the Convention on Biodiversity and the Promotion of Sustainable Agriculture"* adopted at the intergovernmental meeting held at Nairobi on 22 May, 1992. The draft legislation was printed and circulated widely. In addition, the proceedings of this Dialogue will be printed by Macmillan, India during the fall of 1994.

The Madras draft provides the basis for national legislation in countries rich in plant genetic wealth on plant variety protection on the basis of the UPOV Convention of 1978. The draft act, if adopted, will concurrently stimulate investment and initiatives in plant breeding, enable farmers to benefit from advances in plant breeding and biotechnology and help rural women and men to intensify their efforts in the conservation of genetic diversity in plants, particularly at the intra-specific and ecosystem levels.

The fifth dialogue in the series "Reaching the Unreached" thus takes to its logical conclusion the ideas developed at the first dialogue held at Madras in January, 1990 under the Keystone International Dialogue Series on PGR.

Second Asia-Pacific Conference on Agricultural Biotechnology (6 - 10 March 1994; organised in collaboration with the National Academy of Agricultural Sciences, the Rockefeller Foundation and the Food and Agriculture Organisation)

The First Asia-Pacific Conference was organised by the Chinese Academy of Sciences in Beijing in 1992, and brought together researchers, academics, policy makers and organisations connected with advances in agricultural biotechnology. The Second Asia-Pacific Conference was organised at Madras by the Foundation with a view to affording Indian researchers and organisations an important opportunity to acquire first-hand understanding of the role of agricultural biotechnology in the Asia-Pacific region, which is the fastest growing region of the world. The Conference had a variety of pro grammes such as plenary lectures, symposia, poster sessions and panel discussions. A total of 432 participants from over 15 countries participated in this conference.

The Conference was inaugurated by Dr. M.S.Swaminathan, Conference Chairman, who placed the conference in the context of GATT negotiations and the emerging issues of intellectual property rights in relation to utilisation of biological resources. The conference was addressed among others, by Dr. Obaidullah Khan (FAO Representative for Asia and the Pacific), Dr. V.L.Chopra (Director-General, ICAR), Dr. C.R.Bhatia (Secretary, DBT), Dr. Reuben Olembo (UNEP), Dr.Jim Peacock (CSIRO, Australia) and Prof. Li Zhengsheng (former Vice-President, Chinese Academy of Sciences). The Conference hosted plenary sessions every day, nine symposia, and two days of poster presentations. A highlight was the organisation of two panel discussions, one on intellectual property rights and another on hybrid rice production, sponsored by the SPIC Science Foundation, and the Maharashtra Hybrid Seeds Company, respectively. The Conference concluded with a panel discussion on the future course of action. The third Asia-Pacific Conference will be held in Bangkok in 1996 and the fourth in Canberra in 1998. Selected papers and presentations will be published by Oxford & IBH in late 1994.

Sub Programme Area 503

Communication for Development

I. Folk Theatre for Development Communication

The Foundation continued to work with folk performing artists belonging to the *Kattaikkoothu* (or *Therukkoothu*) tradition, through the *Kattaikkoothu Kalai Valarchi Munnetra Sangam* of Kancheepuram in promoting the use of traditional theatre forms for development communication. This year the activities, supported by the Sasakawa Peace Foundation of Japan, focussed on three distinct objectives: dissemination of messages on ecology and environment through the medium of *Kattaikkoothu*, contextualisation of these messages and interaction between scientists and development professionals on the one hand and folk artists on the other to create mutual understanding and suggest new themes/ concepts to be tackled by the folk media.

Dissemination : The play *Pancha Bhootam* on the theme of sustainable development, centres around the role of forests in conservation and the need for Man to live in harmony with Nature. It was developed by the *Sangam* last year and performed in sixteen villages. The feedback received showed it to have been greatly appreciated by the rural public familiar with *koothu*. So this year it was decided to work with two versions to suit different audiences and conditions.

A condensed one-and-a-half-hour version was performed by the students of the training school, with the help of a few adult artists, at ten middle and high schools in and around Kancheepuram during the months of December and January. This not only exposed the school children to concepts of conservation and sustainable development but provided the opportunity for the young performers to give of their best before real audiences.

The regular full-night version of the play was also presented in ten villages in the area. Since members belonging to several troupes came together to stage the play this year, more than forty players are now in a position to perform the play as part of their regular repertoire. Two invited performances have already been held, and more requests are coming in.

Contextualisation : To make the school performances meaningful to students, it was necessary to place them in context and link them with the regular educational programme. With this end, a seminar was held for teachers from the participating schools just before the performances were scheduled. The seminar was intended

1. expose them in advance to the play *Pancha Bhootam* and discuss its message and possible follow-up;
2. suggest practical activities which the children and teachers could take to protect the environment;

3. suggest ways in which environmental messages could be incorporated into the school curriculum through both classroom and out-of-class activities;

4. link the teachers with Government officials, NGO and environmental activists who could provide them with concrete assistance and guidance.

More than sixty persons, including teachers, Government officials, specialists in environmental education and representatives of NGOs attended the one-day seminar and useful links have been established.

Interaction : The interaction, probably the first ever of its kind, brought together about thirty *koothu* artists from different performing troupes, and a small group of scientists and development professionals. The objectives were twofold: to help scientists/professionals to understand the strengths as well as limitations of the traditional form as a communication media, and to suggest to the artists some important ecology-related messages to be conveyed to rural audiences.

During the morning session, the artists gave a series of demonstrations revealing the complexities and capabilities of the medium itself; in the afternoon, suggestions about messages were made by the scientists. These related to the importance of biodiversity and the need for conservation of varieties in danger of extinction; the risks consequent on indiscriminate use of pesticides and fertilisers; and the nutritional value of horticultural products, especially vegetables.

During the ensuing free and lively discussion, many issues were tackled, such as the legitimacy of using a traditional form for conveying messages, the risk of losing credibility through "sponsored" performances about which rural audiences are well aware, the possibility of degradation of the art form itself, and the appropriateness of the selected messages for the art form.

Though ideas for possible new plays were not immediately discernible, both groups felt that they had benefited from the frank discussion and had much to explore in the future. More such interactions were suggested as part of the process of building credible development communication messages while maintaining the integrity of the traditional art form.

II. Voicing Silence

Launched in early 1993 with support from The Hunger Project, the women's theatre project aims to act as a catalyst in women's development. The objective is to use theatre in two ways — both to enable women as participants to voice and critique their own experiences and crystallize their perceptions, and to enhance the understanding of the spectators through this live communication medium.

The year began with several performances, for students and women's organisations, of *Subbutai,* the production developed in last year's workshop. The performing group, however, could not be sustained, for various reasons. So this year the emphasis has been on

the development of materials expressing different perspectives and perceptions about women, rather than on performances. This deliberate change of emphasis grew out of the difficulties of setting up a stable and experienced performing group in a new place within the short time available.

The Process

With this focus, the new plays have been developed through the following process:

Workshops: Five days in October 1993, with Prof. S. Ramanujam, Head, Dept. of Drama, Tamil University, Thanjavur, as resource person and eight days in March 1994 with Prof. S. Ramanujam and Ms. Mina Swaminathan as resource persons.

Rehearsals : From July 1993 to February 1994, the usual schedule was two full-day rehearsals a month, with extra pre-performance rehearsals when needed. The group, still fluid, presently consists of fifteen members, both male and female, mostly students.

The Plays

The two plays *Chuvadugal* (Footprints) and *Mouna-k-kuram* (Silent Prophecies) deal with widely different issues, use different styles and address different audiences. In terms of theatrical presentation, both plays can be described as simultaneously indigenous and experimental productions. Drawing on the rich folk traditions of Tamil Nadu, with song and dance as the chief media of expression, the productions have also made the best use of Western modes of actors' training, body movement, voice training and improvisation.

Chuvadugal (Script and Direction: A Mangai, with support from Mina Swaminathan) is a documentary play, based on a biographical novel by Rajam Krishnan, about a revolutionary woman activist of the first half of this century from the East Thanjavur region of Tamil Nadu. Maniamma began life in a closed, ritual-bound world from which she could never have escaped if she had not raised questions. Her social and personal interrogation continued throughout her life; every move was an answer to a question.

The play treats the protagonist as "evolving" rather than "fixed". She is not made a "heroine", but her heroism is revealed in several ways. The structure of the play itself helps the audience to question and interpret at every point — it unfolds through choric narration, with several performers playing the role of Maniamma at different phases of the action.

The first performance of *Chuvadugal* (20 April, 1994) was for a group of college teachers of M.S. University, Tirunelveli and evoked interest by its appeal to their personal experience. The second performance (28 April, 1994) was for a 4,000-strong audience at the State-level meet of the Communist Party of India in Ambasamudram. For this conscientised audience, the performance became a fitting homage to a leader of the movement. Several requests for performances have since been made, including one from Maniamma's native area.

Mouna-k-kuram (Script, Design and Direction: Prof. S. Ramanujam, with support from A. Mangai and Palani, is based on *kuravanji* literature, one of the literary modes of the 16th - 18th centuries. An exposition of gypsy life and love in classical form, its imagery expressing the affinity of the gypsies with Nature, their traditional skills and knowledge, and their playful, demystified eroticism, it also provides the basis to question the traditional puranic images of the Indian woman. Flashbacks reveal the gypsy woman's "silent prophecies" (foreseen, but left unsaid) to three women - Chandramati, Draupati and Sita. The autonomous gypsy rejects these woman-degrading myths which are still enshrined in contemporary life, while her own passionate reunion with her mate emphasizes a more egalitarian partnership between man and woman.

Performed in balletic style, with simple props, the contemporary relevance of the play is clearly visible under the surface of its classical form and narrative structure.

With three plays in the repertoire, and two more to be developed, next year will focus on performance, using different networks to reach various audiences.

Sub Programme Area 504

Informatics, Information Services and Databases

The Foundation, with a view to taking the benefits of the emerging Information Superhighway to scientists and scholars, has established an informatics centre dedicated to the memory of the late Mr.Shoichiro Honda. The informatics centre houses an electronic library with a collection of CD-ROMs, and the staff are involved in designing and developing databases that are of relevance to the Foundation's objectives.

Infrastructure

The informatics centre has a collection of 7 PCs 486/386 with CD-ROM drives, optical disc drives, color scanner and a variety of printing devices including a slide printer. Multimedia features and software are also available. Besides, a wide variety of copyright software for document processing and database design are available. Power in the informatics centre is provided by the Solar photovoltaic generator of 10 KVA capacity designed and built by Central Electronics Limited.

The Electronic Library

The electronic library in the Foundation is a collection of CD-ROM databases, and of databases from FAO, CIMMYT and similar organisations. On-line access to a variety of databases worldwide is available through DIALOG. Email connection to SIRNET and ERNET are available.

The CD-ROM collection here is considered one of the largest in the country. The entire CABI range of CDs are available, covering every area of research in agriculture and rural development, crop sciences, animal and veterinary sciences, forestry, pollution and related matters. The coverage of CD-ROMs is over 3 million records, most of them with abstracts and key words. Updates are available upto March 1994. This facility is open for use to any bonafide researcher.

FAO's AGROSTAT is another important database produced by FAO. It provides comprehensive data for the years 1961 - 1993 on population, production, trade etc., for a large variety of agricultural produce covering approximately 135 countries.

The Foundation plans to acquire DERWENT Biotechnology Abstracts, Aquatic and Fisheries Sciences Abstracts and Energy & Enviroline. The Foundation's library has also been automated using CLAM / DOS, a software developed by IIT, Madras.

In addition to the databases associated with the Mangrove Ecosystem Information Service (MEIS), work was initiated during the year on the development of the following two databases :

(a) Database on Integrated Intensive Farming Systems in India

Under this FAO sponsored project, detailed case studies have been undertaken on farms and farmers associated with intensive mixed farming systems involving crop-livestock, crop-fish, crop-livestock-fish, agro-forestry and other combinations. Cases of successful intensive farming systems based on environmentally sound technologies are being chronicled. A national database on intensive, integrated farming will be developed and maintained on the basis of these studies.

(b) Database on the Intellectual Property Rights of Tribal families with reference to the conservation of biological diversity

Detailed inter-disciplinary studies are in progress in the tribal areas of South India on the contributions of tribal women and men in the conservation, selection and sustainable management of biological diversity, with particular reference to plant genetic resources (see P.A. 200). These studies are providing insights into the genetic conservation ethics and methods of tribal families. A database is being developed with the information collected, so that it can be of help in decisions relating to recognising and rewarding the contributions of tribal families under the generic term *farmers' rights* in the *sui generis* system of plant variety protection now being developed for the country.

Publications

Books / Monographs

Mina Swaminathan. 1993. *Maternity and Child Care Support Services*, Proceedings No.8, CRSARD, Madras

Mina Swaminathan. 1994. *Mudal Moonru Varudangal* (Tamil Version of The *First Three Years*), Directorate of Social Welfare, Government of Tamil Nadu

Sanjay V. Deshmukh and Balaji V. (Ed.). 1994. *Conservation of Mangrove Genetic Resources*: a training manual, CRSARD, Madras, pp. 427

Sanjay V. Deshmukh and Balaji V. (Ed.). 1994. *Project for the Conservation and Sustainable Utilisation of Mangrove Forest Genetic Resources in the West and Central African Region*, CRSARD, Madras, pp. 56

Swaminathan, M.S. (Ed.). 1993. *Wheat Revolution : a Dialogue*, Macmillan India, Madras, pp.164

Swaminathan, M.S. (Ed.). 1994. *Ecotechnology and Rural Employment*, Macmillan India, Madras, pp.396

Swaminathan, M.S. and Vineeta Hoon. (Ed.). 1994. *Methodologies for Recognising the Role of Informal Innovation in the Conservation and Utilization of Plant Genetic Resources*, Proceedings No.9, CRSARD, Madras

Articles in Journals / Books

Balakrishna, P. 1993. Biodiversity of insects. Hexapoda 5 (2) : 9 - 15

Balakrishna, P. and Rob. P. Finch. 1994. Breeding salt tolerant rice. *Proceedings of the Second Asia-Pacific Conference on Agricultural Biotechnology* (Accepted for publication)

Balakrishna, P. and Swaminathan, M.S. 1994. *Biodiversity and biotechnology. Biotech Journal* (Accepted for publication)

Balakrishna, P. and Swaminathan, M.S. 1994. Screening of rice for their overall performance. *Proceedings of the National Academy of Sciences* (Accepted for publication)

Daniels R.J.R. 1994. Conservation of birds in the Indian agricultural context. *Birds in Indian Agriculture.* Rana B.D. and Jain A.P. (Eds)., CAZRI, Jodhpur

Daniels R.J.R. 1994. Endangered plants : an approach to *in situ* conservation in South India. *Zoos Print.*

Daniels R.J.R. 1994. Status of amphibian diversity in India. *Status of Biodiversity Conservation in India.* Kothari A. (Ed.). New Delhi

Jayanthi, M. and Vishwanath Patil (1994). In vitro studies of some medicinal and endemic plants of Western Ghats. *Proceedings of the Second Asia-Pacific Conference on Agricultural Biotechnology* (Accepted for publication)

Sanjay V. Deshmukh. 1994. Mangrove ecosystems of India. *Status of Biodiversity conservation in India.* Kothari A. (Ed.). New Delhi

Swaminathan, M.S. 1993. From nature to crop production. *International Crop Science I* Buxton, D.R. *et al.* (Ed.). Crop Science Society of America, Madison, pp. 385-394

Swaminathan, M.S. 1993. The role of rice in the national food security system. *Hybrid Rice : Food Security in India.* Barwale, B. R. (Ed.) Macmillan India. pp. 148 - 170

Swaminathan, M.S. 1994. *Draft legislation for protection of farmers' and breeders' rights.* Working Paper, CRSARD, Madras

Swaminathan, M.S. 1994. A plan variety protection system for India. GATT Accord : India's strategic response. Ramachandraiah, V. (Ed.) Commonwealth Publishers, New Delhi. pp.175 - 243

Ravishankar, T., Vedavalli, L., Selvam, V. and Nambi A.A. 1994. Role of tribal communities in the conservation of plant genetic resources. M.S.Swaminathan Research Foundation, Madras

Articles in Popular Journals / Media / Special Lectures

Balakrishna, P. 1994. "DNA analysis : imaging and processing". Proceedings of Workshop on Methods in Stereology. IGCAR, Kalpakkam. India 22 - 24 February

Balakrishna, P. 1994. "Conservation of mangrove forests by indirect methods". ITTO Tropical Forest Update. 4 : 7

John Joseph, S. 1993. "Community biodiversity movement". Regional Cooperation Research Programme on Ecosystems Rehabilitation. UNESCO

Josekutty, P.C. 1993. "How to set up a tissue culture project". Seminar on new project opportunities for investment/diversification in Tamil Nadu organised by Industrial Guidance and Export Promotion Bureau, Tamil Nadu and R.V.Centre for Entrepreneurial Development, Madras, 10 November

Josekutty, P.C. 1994. "Setting up floriculture and tissue culture projects". Seminar on opportunities for setting up export oriented agrobased and biotechnology projects in Tamil Nadu. 18 January

Attendance in Seminars / Symposia / Training Programme

Ajay Parida. 1994. Participated in short term training course on "Safety aspects in the research applications of ionising radiation" at BARC, Bombay. 7 - 14 June

Balaji, V. and E. Lakshmana Narasimhan. 1994. "Design of mangrove ecosystems information service". Presented at the National Meeting on Design of Biodiversity Databases, JNCASR, Indian Institute of Science, 8 - 9 February

Balaji, V. 1994. Participated in the UNESCO/UNU/ TWAS Project Design Workshop on Sustainable Development in Humid Tropics. Chiangmai, Thailand. 26 - 28 May

Balakrishna, P. 1993. "Biotechnology and Biodiversity". Presented at the XVII International Congress of Genetics, Birmingham, UK

Balakrishna, P. 1994. "New sources of genes for salt tolerance". Sixth Annual Rockefeller Foundation Rice Biotechnology Meeting, Bali, Indonesia. 15 - 21 May

Brindha, N. 1993. "Studies on genetic inheritence of quantitative characters in *Sisamum indicum L*". Paper accepted for presentation at the seventh International Congress of SABRAO (The Society for the Advancement of Breeding Researches in Asia and Oceania), Academia Sinicia, Taipei. November

Brindha, N. 1994. Participated in the training programme on "Hybrid vegetable seed production". Indian Institute of Horticultural Research, Bangalore. 3 - 8 January

Daniels, R.J.R. 1994. Participated in UNEP - Global Biodiversity Assessment, London. 25 - 28 April

Hoon, Vineeta. 1994. Resource person for adaptive strategies of the poor in arid and semi-arid lands : In search of sustainable livelihoods. Organised by IISD, Canada, at Nairobi, Kenya. 10 - 14 May

Hoon, Vineeta. 1994. Participated in a seminar on ôHimalayan conservation programme, governments - people participationö. Vigyan Bhawan, New Delhi. 27 - 28 June

Jayanthi, M., Ramaswamy, N.M. and Sree Rangasamy. 1993. "Natural resistance of fingermillet explants to Kanamycin". Poster presented at National Symposium on Developments in Plant Molecular Biology, Coimbatore. 29 - 31 December

Jayanthi, M., Ramaswamy, N.M. and Sree Rangaswamy. 1993. "Protein profiles of embryogenic, nonembryogenic and seed calli on fingermillet". Poster presented at National Symposium on Developments in Plant Molecular Biology, Coimbatore. 29 - 31 December

John Joseph, S. 1993. Participated in ISPGR Dialogue on developing national policy for plant genetic resources. NBPGR, New Delhi

Josekutty, P.C. 1994. ôEffect of mevimolin on growth and steroid contents of solanum xanthocarpumö. Abstracts of DAE symposium on Stress and Adaptive Responses in Biological Systems. M.S. University, Baroda. 23 - 25 March

Mohan, M.S.S. 1993. Project design meeting on Bioindicators for Tropical Ecosystems sponsored by Global Environment Facility (UNDP). International Mycological Institute, Egham, London. 21 - 22 October

Parani, M. 1994. Attended a training programme on Gene Isolation, Cloning and Plant Transformation at Division of Biochemistry, IARI. 10 - 31 May

Rajalakshmi, S. 1994. Attended a training programme in Plant Molecular Biology at TNAU, Coimbatore. 24 January - 4 February

Robert. P. Finch, Balakrishna, P. and Neil McRoberts. 1994. "Field collection and molecular characterization of *Porteresia coarctata Tateoka*". Sixth Annual Rockefeller Foundation Rice Biotechnology Meeting, Bali, Indonesia. 15 - 21 May

Sanjay V. Deshmukh. 1993. oPlant genetic resources of coastal ecosystems : conservation issuesö. ISPGR Dialogue on "Plant genetic resources : developing national policy", NBPGR campus, PUSA Institute, New Delhi. 1 - 2 December

Sanjay V. Deshmukh. 1993. (a) "Mangrove biodiversity : genetic resources for conservation"; (b) "Development of mangrove ecosystem management plan". Lectures delivered as resource person during UNESCO curriculum workshop on Management of Mangrove Ecosystems and Coastal Protection, Andhra University, Visakapatnam. 27 September - 3 October

Sekar, K. 1993. Participated in the training programme on Integrated Pest Management of Horticultural Crops. Indian Institute of Horticultural Research, Bangalore. 1 - 7 December

Sekar, K. 1994. "Enhancing local capacities for sustainable irrigation water use". Paper presented at national semiar on Irrigation Water Management in Future, Irrigation Management Training Institute, Tiruchirappalli. 27 - 28 January

Sekar, K. 1994. Participated in the training course on Commercial Vegetable Production. Malaysian Agricultural Research and Development Institute, Kualalumpur. 13 - 21 June

Selvam, V. 1993. Participated in the UNESCO workshop on Management of Mangrove Ecosystem and Coastal Protection. Visakapatinam. 27 September - 3 October

Selvam, V. 1993. Participated in the UNESCO regional planning council meeting for ecosystem rehabilitation. Bangalore. 9 - 13 November

Selvam, V. 1994. Resouce person IDRC preimplementation workshop on Coastal Ecosystems (South Asia) Project. New Delhi. 7 - 8 June

Sharada, S. 1994. "Individuals and Gender Issues". Paper presented at the special focus workshop on Prioritizing Action for Gender Justice, Madras Waterloo University Linkage Programme, Department of Geography, University of Madras. 16 - 18 March

Sharada, S. 1994. Participated in the design workshop on Panchayat Training Module, Kerala Institute of Local Administration, Trichur. 7 - 8 April

Sivakumar, N. and Durai Swaminathan. 1994. oProblems and Prospects of ground water utilisationö. Paper presented at State level seminar, IMTI, Trichy. 27 - 28 January

Subhashini, H.D. 1994. "Enhanced salt tolerance of the enzyme peroxidase from mangrove species". Paper presented at the International Symposia on Stabilised Enzymes and Biosensors. Madras. 1 - 5 March

Subhashini, H.D. and Natrajan, K. 1994. "Carbon nutrition and production of Carbohydrases as a measure of assessing symbiotic potential of fungi". Paper presented at the Second Symposium on Biology and Biotechnology of Mycorhizae and Third Asian Conference on Mycorhizae. Yogyakarta, Indonesia. 18 - 21 April

Uma, G. et al. 1993. "Development of sustainable livelihood security index (SLSI) based on socio-economic impact assessment of 15 hamlets in and around Pichavaram mangrove forest, Tamil Nadu, India". Asia Pacific symposium on Mangrove Ecosystem : Programme & Abstracts. pp 184

Vishwanath Patil and Kuruvinshetti, M.S. 1993. "High frequency plantlet regeneration from four rabi cultivars of rabi sorghum". Paper presented at the National Symposium on Developments in Plant Molecular Biology, Coimbatore. 29 - 31 December

About the Foundation

M. S. Swaminathan Research Foundation

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 Section 35 (i) (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 the Foreign Contribution (Regulation) Act, 1976.

Board of Trustees

Dr. M.S.Swaminathan, Madras, Chairma

Dr. V.L.Chopra, New Delhi

Dr. V.K.Ramachandran, Bombay

Ms. Mina Swaminathan, Madras

Centre for Research on Sustainable Agricultural and Rural Development (CRSARD)

Registered in 1990 as a Society under the Tamil Nadu Societies Registration Act, 1975.

Governing Committee

President	Dr. M.S.Swaminathan 11, Rathna Nagar Teynampet Madras 600 018
Secretary	Dr. A.Sankaram 10, Krishnaswamy Avenue Mylapore Madras 600 004
Treasurer	Mr. B.S.Raghavan, I.A.S. (Retd.) 4, IInd Street Nehru Nagar Adayar Madras 600 020

Member	Mr. A.M.Mahmud Hussain, IFS (Retd.) 43, Chamiers Road Madras 600 028
Member	Dr. S.Sankaran Vice Chancellor Tamil Nadu Agricultural University Coimbatore - 641 003
Member	Dr. V.Gnanaprakasam Vice Chancellor Tamil Nadu Veterinary & Animal Sciences University Madras 600 007
Member	Mr. S.S.Rajasekhar "River View" Kotturpuram Madras 600 085
Member	Prof. Kunthala Jayaraman Director Centre for Biotechnology Anna University Madras 600 025
Member	Dr. K.Alagarswamy Director Central Institute for Brackish Water Aquaculture Madras
Member	Prof. T.N.Ananthakrishnan Director Entomology Research Institute Loyola College Madras

Auditors

M/s Brahmayya and Company, Madras

Research Council of CRSARD

Dr. M.S.Swaminathan, Chairman

Dr. M.Ananda Krishnan, Vice Chancellor, Anna University, Madras

Dr. K.Alagarswamy, Director, Central Institute for Brackishwater Aquaculture, Madras

Dr. T.N.Ananthakrishnan, Director, Entomology Research Institute, Loyola College, Madras

Mr. A.M.Mahmud Hussain, IFS (Retd.), Forestry Expert, Madras

Dr. S.Jayaraj, ICAR National Professor, M.S.Swaminathan Research Foundation, Madras

Dr. V.Gnanaprakasam, Vice Chancellor, Tamil Nadu Veterinary and Animal Sciences University, Madras

Dr. Parvathi Menon, Social Scientist, Bangalore

Dr. A.Sankaram, Agricultural Consultant, Madras

Project Advisory Committees

1. Establishment of Mangrove Genetic Resources Centre at Pichavaram, Tamil Nadu

Dr. M.S.Swaminathan, Chairman

Dr. M.Harikrishnan, IFS, Principal Chief Conservator of Forests, Tamil Nadu

Dr. Manju Sharma, Adviser, Department of Biotechnology, Government of India

Conservator of Forests (Research), Forest Department, Tamil Nadu

Divisional Forest Officer, Cuddalore, Tamil Nadu

Dr. Sanjay V. Deshmukh, Project Leader, CRSARD, Madras (Member-Secretary)

2. ACCESS : Action for Child Care and Education Strategies and Services

Ms. Lalita Banawali, Managing Director, The Hunger Project - India Office, Bombay

Dr. Srilata Batliwala, former Director, Mahila Samakhya Karnataka, Bangalore

Dr. Indira Chakravarthy, Professor, All India Institute of Public Health and Hygiene, Calcutta

Ms. Andal Damodaran, Hon. General Secretary, Indian Council for Child Welfare, Madras

Dr. A.Desai, Director, Tata Institute of Social Sciences, Bombay

Dr. Vina Mazumdar, Senior Fellow, Centre for Women's Development Studies, New Delhi

Dr. Freny Tarapore, Principal, S.N.D.T.College of Home Science, Pune

Ms. Mina Swaminathan, Project Director, ACCESS, M.S.Swaminathan Research Foundation, Madras

3. *Multiple Approaches in Early Childhood Care and Education*

Dr. Neera Desai, formerly of SNDT Women's University, Bombay

Ms. S.S.Jayalakshmi, Secretary, Vidya Vikasini Society, Coimbatore

Ms. Rajani Khanna, Programme Officer, Aga Khan Foundation, New Delhi

Dr. H.H.Mankad, Professor, Narsee Monjee Institute of Management Studies, Bombay

Dr. Anjali Metha, Professor, B.K.Institute of Management Studies, Ahmedabad

Dr. Rajalakshmi Muralidharan, Head, Dept. of Preschool and Elementary Education, NCERT, New Delhi

Dr. T.S.Saraswathi, Professor, Department of H.D.F.S., M.S.University of Baroda, Baroda

Ms. Mina Swaminathan, Project Director, ACCESS, M.S.Swaminathan Research Foundation, Madras

4. *Children on the Agenda*

Ms. Andal Damodaran, Hon. General Secretary, Indian Council for Child Welfare Madras

Dr. Rajammal P. Devadas, Vice Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore

Mr. K. Dheenadhayalan, Director, Social Welfare, Government of Tamil Nadu, Madras

Dr. L.S.Saraswathi, Freelance Consultant, Madras

Ms. E.V.Shantha, Joint Coordinator, Nutrition, Tamil Nadu Integrated Nutrition Project, Madras

5. *Establishment of an International Network for the Conservation of Mangrove Forest Genetic Resources*

Dr. M.S.Swaminathan, Chairman

Dr. Gary R. Burniske, Conservation Officer, International Tropical Timber Organisation, Japan

Mr. R.Rajamani, Secretary, Ministry of Environment and Forests, Government of India, New Delhi

Mr. Y.Hirayama, Deputy Representative, UNEP Regional Office for Asia and the Pacific, Bangkok

Mr. Mohd. bin Haji Ismail, Directorate General of Forestry, Peninsular Malaysia, Government of Malaysia, Kualalumpur

Dr. H.G.Palis, Ecosystems Research and Development Bureau, Department of Environment and Natural Resources, Government of Philippines, Manila

Dr. K.W.Sorensen, UNESCO Southeast Asia Office, Jakarta

Representative of Directorate General of Forestry Research and Development, Government of Indonesia, Jakarta

Mr. Zheng De Zhang, Chinese Academy of Forestry, Beijing

Representative of the Ministry of Foreign Affairs, Government of Japan

Dr. V.Balaji, M.S.Swaminathan Research Foundation, Madras (Member-Secretary)

6. *Community Network for the Conservation of Biological Diversity*

Dr. M.S.Swaminathan, Chairman

Prof. G.T.Scarascia-Mugnozza, President, Italian National Science Academy, Rome

Prof. C.Monti, University of Naples, Naples, Italy

Dr. V.Ramanatha Rao, International Plant Genetic Resources Institute, Asia-Pacific Office, Singapore

Dr. R.S.Rana, Director, National Bureau of Plant Genetic Resources, New Delhi

Mr. S.John Joseph, M.S.Swaminathan Research Foundation, Madras

Dr. Sanjay V. Deshmukh, M.S.Swaminathan Research Foundation (Member-Secretary)

Programme Areas and Staff

Prof. M.S.Swaminathan	*Chairman / Hon. Director*

I. Administration and Support Services

Col. (Retd.) Ashok Choudry	*Manager (Estate)*
Mr. R.S.Kuppusamy	*Manager (Personnel & Admn.)*
Mr. C.K.Ramachandran	*Manager (Budget & Accounts)*
Mr. N.Parasuraman	*Administrative Assistant*
Ms. V.Sridevi	*Secretary*

II. Programme Area 100 : Coastal Systems Research

A. Establishment of a Model Coastal Ecosystem

Mr. K.Johnson	*Coordinator*
Mr. G.Ravikumar	*Research Assistant*
Mr. K.G.Mani	*Research Assistant*
Mr. S.Velmurugan*	*Technical Assistant*
Mr. R.Murugan*	*Technical Assistant*
Mr. R.Singaravel	*Research Scholar*
Mr. S.Kaja Mohaideen	*Technical Assistant*
Mr. J.Sateesh Kumar*	*Technical Assistant*

B. Integrated Conservation and Development of Mangrove Forest in Tamil Nadu

Prof. R.Natarajan	*Distinguished Fellow*
Dr. V.Selvam	*Scientist & Coordinator*
Ms. G.Uma	*Scientist*
Mr. K.K.Ravichandran	*Research Fellow*
Mr. T.E.Krishnan	*Driver*

As on 1 July, 1994

* left during the year

C. Genetic Resources Centre for Adaptation to Sea Level Rise

Dr. Sanjay V.Deshmukh	*Sr.Scientist & Coordinator*
Mr. S.Neethimanickam	*Farm Manager*
Ms. S.Rajalakshmi	*Research Assistant*
Ms. Jyothi Kurian	*Research Assistant*
Mr. C.Srinivasa Rao	*Research Assistant*
Mr. Arndt Andresen	*Visiting Research Fellow*

III. Programme Area 200 : Biological Diversity

A. N.I.Vavilov Centre for Research & Training in the Conservation of Biological Diversity

Mr. S.John Joseph	*Project Director*
Dr. L.R.A.Narayan	*Distinguished Fellow*
Dr. T.Ravishankar	*Scientist (Ethnobiology)*
Dr. H.D.Subhashini	*Scientist (Molecular Biology)*
Dr. L.Vedavalli	*Scientist (Social Anthropology)*
Dr. N.Anil Kumar	*Scientist (Systematic Botany)*
Dr. P.C.Jose Kutty	*Scientist (Tissue Culture)*
Mr. A.A.Nambi	*Scientist (Sacred Groves)*
Ms. M.Geetharani	*Gene Bank Manager*
Mr. Christopher Vasanth	*Research Fellow*
Mr. N.Mathan	*Research Fellow*
Ms. Rita Abraham	*Research Fellow*
Mr. K.Sachitanandam*	*Database Assistant*
Ms. Vidya Shankar	*Research Fellow*
Mr. S.Senthilkumaran	*Research Fellow*
Mr. Ajit Anand	*Research Fellow*
Mr. M.Paani	*Research Fellow*
Ms. Sylvia Snehalatha	*Documentation Assistant*

* left during the year

Mr. Shamir Kumar Paul	*Electrical Supervisor*
Ms. Usha Kumar	*Secretary*
Mr. S.Madhusudanan	*Technical Assistant*
Ms. D.Rukmani	*Clerk cum Typist*
Ms. R.Vidya	*Accounts Assistant*
Mr. R.Venkataramanan	*Accounts Assistant*
Ms. S.Prathibha	*Accounts Assistant*
Ms. T.Vijayasulochana	*Clerk cum Typist*
Ms. K.Vijayasree	*Stenographer*
Mr. G.Suresh Kumar	*Technical Assistant*
Mr. K.Ondiveeran	*Agricultural Assistant*
Mr. K.Pandi	*Driver*

B. *Application of Biotechnology in the Conservation of Endangered Plant Species for Genetic Enhancement*

Dr. R.J.Ranjit Daniels	*Principal Scientific Officer*
Dr. Suresh Mathew*	*Sr.Scientific Officer*
Dr. Sudha Nair	*Sr.Scientific Officer*
Dr. M.S.S.Mohan	*Sr.Scientific Officer*
Dr. Hemal S. Kanvinde	*Sr.Scientific Officer*
Dr. Ajay Parida	*Sr.Scientific Officer*
Dr. C.S.Anuratha	*Sr.Scientific Officer*
Mr. P.Balakrishna	*Sr.Scientific Officer*
Dr. G.N.Hariharan*	*Scientist (Lichens)*
Ms. M.Jayanthi	*CSIR Research Fellow*
Mr. Vishwanath Patil	*Research Assistant*
Mr. S.Elango	*Research Assistant*
Mr. K.V.Ramesh	*Research Assistant*
Mr. K.M.Kadirvelu	*Technical Assistant*
Mr. S.Purushothaman	*Office Assistant*

* left during the year

Mr. M.Saravanan	*Laboratory Assistant*
Mr. S.Muralidharan	*Laboratory Assistant*

C. Project for the Conservation and Sustainable Management of Mangrove Ecosystems

Dr. V.Balaji	*Project Director*
Mr. R.Ravi Kumar*	*Database Manager*
Mr. E.Lakshmana Narasimhan	*Sr.Research Fellow*
Ms. S.Lakshmi	*Programmer*
Mr. S.Gopalakrishnan	*Driver*

IV. Programme Area 300 : Biovillages and Sustainable Agriculture

A. Biovillages Project

Dr. R.S.Shanthakumar Hopper	*Project Leader*
Dr. K.N.Shyamasundaran Nair	*Distinguished Fellow*
Dr. G.N.Raju*	*Scientist*
Ms. S.Banumathy	*Research Associate*
Mr. P.Anebajagane*	*Sr.Research Fellow*
Ms. Shanthi Subramanian	*Sr.Research Fellow*
Mr. M.Suresh	*Research Associate*
Ms. A.Savithri	*Research Associate*
Mr. S.Soundararadjane	*Research Associate*
Ms. Soumya Alva*	*Research Associate*
Dr. Danassegarane*	*Research Associate*
Mr. D.Gopalakrishnan	*Research Associate*
Mr. A.Govindarasu	*Research Associate*
Mr. D.Alangaravelu	*Research Associate*
Mr. R.Jeeva	*Research Associate*
Mr. C.Raghavane	*Research Associate*

* left during the year

Mr. D.K.Sridhar Babu	*Research Associate*
Ms. K.T.Kalaiselvi	*Research Associate*
Mr. K.Raghupathy	*Research Associate*
Ms. G.Meenakshi	*Field Assistant*

B. Integrated Pest Management in Cotton, Soyabean and Groundnut

Prof. S.Jayaraj	*ICAR National Professor*
Mr. D.Thamburaj	*Spl. Consultant*
Mr. S.Malarvannan	*Senior Research Fellow*
Mr. M.P.Parthiban	*Senior Research Fellow*

C. Intensive Integrated Farming Systems

Mr. G.Venkataramani	*Consultant*
Mr. L.Pandiarajan	*Research Fellow*

V. Programme Area 400 : Reaching the Unreached

A. Tamil Nadu Council for Sustainable Livelihoods

Dr. S.Rajagopalan	*Distinguished Fellow*
Ms. S.Sharada	*Council Secretary*
Ms. Meera Sundararajan	*Research Fellow*
Ms. P.Sheela	*Stenographer*

B. ACCESS - Action for Child Care and Education Strategies and Services

Ms. Mina Swaminathan	*Hon. Project Director*
Ms. S.M.Kalaiselvi	*Project Associate*
Ms. Jaishree Venkatecan	*Project Associate*
Ms. Padma Varadarajan	*Training Assistant*
Ms. Miriam Cherian*	*Documentation Assistant*
Ms. Usha Alagappan	*Librarian*
Ms. E.Rajeswari	*Secretary*
Ms. Geetha Mohan*	*Accounts Assistant*

left during the year

C. Children on the Agenda

Mr. A.Sarvesan	*Joint Project Coordinator*
Ms. A.S.Padmavathi	*Project Associate*
Ms. R.Dakshayani*	*Project Associate*
Ms. V.Shanthi*	*Project Associate*
Ms. Rama Narayanan	*Consultant*
Ms. K.Annammal	*Secretary*
Mr. A.P.Seshadri*	*Accounts Assistant*

D. Multiple Approaches in ECCE in India

Ms. Krishna Iyer	*Project Coordinator*
Mr. G.Arunachala Krishnan	*Accounts Assistant*

E. Household Nutrition Security

Prof. A.Sankaram	*Distinguished Fellow*
Mr. K.Sekar	*Project Leader*
Ms. N.Brindha	*Research Assistant*
Mr. K.Karthikeyan	*Research Assistant*
Mr. C.L.Mohanram	*Research Assistant*
Mr. S.Mohan	*Driver*

F. Small Farmers' Agri-business Consortium

Dr. Vineeta Hoon	*Project Director*
Ms. Lata Nagarajan	*Sr.Project Associate*
Mr. H.S.Rawat	*Sr.Project Associate*
Mr. N.Sivakumar	*Sr.Research Fellow*
Mr. D.Dhanapal	*Sr.Research Fellow*
Mr. K.Venkoba Rao	*Technical Secretary*
Mr. B.Sundararajan*	*Sr.Research Fellow*
Mr. K.Balaji*	*Research Fellow*
Ms. Signelise Dahl	*Visiting Research Fellow*

* left during the year

VI. Programme Area 500 : Education, Training and Communication for Development

A. Traditional Media

Ms. Hanne M. de Bruin	*Visiting Scholar*

B. Voicing Silence

Dr. V.Padma	*Hon. Project Director*

* left during the year

List of Donors

(Listed in the order of date of receipt)

Core Contribution - Individuals

Dr. M.P.Singh	New Delhi
Dr. S.Nagarajan	New Delhi
Dr. K.P.S.Chauhan	New Delhi
Dr. Sanjay Vasanth Deshmukh	Madras
Dr. N.P.Sarma	Hyderabad
Mr. V.S.Aggarwal	Calcutta
Mr. S.N.Mehta	New Delhi
Dr. S.Bala Ravi	Hyderabad
Mr. B.R.Bhansale	Coimbatore

Core Contribution - Institutions

Government of Tamil Nadu	Madras
Rotary Club of Madras East	Madras
Bankers' Institute of Rural Development Sector	Kanpur
Indian Bank	Madras
The Lakshmi Mills Company Ltd.	Coimbatore
Vijayeswari Textile Ltd.	Coimbatore
Veejaya Lakshmi Engineering Works (Pvt.) Ltd.	Coimbatore
The Hyderabad Deccan Cigarette Factory Pvt. Ltd.	Hyderabad
State Bank of India	Bombay
Venkateswara Hatcheries Ltd.	Pune
Srini Biological Lab (P) Ltd.	Pune
Venkateswara Research and Breeding Farm Ltd.	Pune
Western Hatcheries Ltd.	Pune
Venco Research & Breeding Farm Ltd.	Pune
Balaji Foods and Feeds Ltd.	Pune

Venky's India Ltd.	Pune
Sanghi Industries Ltd.	Sanghi Nagar
The Arjan Deviji Kunzi Sarvagan Trust	Bombay
Lakshmi Card Clothing Mf. Co. Ltd.	Coimbatore
Sun Coat Industries	Bombay

Core Contribution - International

CAB - International	UK
Ms. Ruth Hayward	UK
Dr. George Verughese	Mexico
Dr. Venkat	USA
International Irrigation Management Institute	Sri Lanka
Hunger Project	USA

Project Support

Programme Area	National	International
100 Coastal Systems Research	Dorabji Tata Trust, Bombay	International Development Research Centre, Canada
	Council of Scientific and Industrial Research, New Delhi	Canadian International Development Authority
200 Biological Diversity	Department of Biotechnology, Government of India	International Tropical Timber Organisation, Japan
	Ministry of Environment and Forests, Government of India	Swedish International Development Authority
	Rajiv Gandhi Foundation, New Delhi	The Sasakawa Peace Foundation, Japan
		Swiss Development Cooperation
		Third World Academy of Sciences
		The Darwin Initiative, UK
300 Biovillages and Sustainable Agriculture	Indian Council of Agricultural Research	International Fund for Agricultural Development
		The Hunger Project - Japan
		The Hunger Project - Sweden
		Food and Agriculture Organisation - UN
		United Nations Development Programme

Project Support

Programme Area	National	International
400 Reaching the Unreached	The Hunger Project - India Office, Bombay	Aga Khan Foundation
	Council for Advancement of People's Action and Rural Technology, New Delhi	Bernard van Leer Foundation, The Netherlands
		United Nations Development Programme
		International Agricultural Training Programme, UK
500 Education, Training and Communication	Ministry of Environment and Forests, Government of India	International Development Research Centre, Canada
	National Bank for Agriculture & Rural Development, Bombay	United Nations Development Programme
	Council of Scientific and Industrial Research, New Delhi	The Sasakawa Peace Foundation, Japan
	Social Forestry Research and Development Society, Madras	Stichtung Kalai Mandram, The Netherlands
	Government of Tamil Nadu, Madras	Swedish International Development Authority
	XV Genetics Congress Trust, New Delhi	International Agriculture Training Programme, UK
	Ministry of Environment and Forests, Government of India	The Rockefeller Foundation, New York
	National Foundation for India, New Delhi	

Back Cover

Top (Right)
Mushroom cultivation by women in Pillayarkuppam (biovillage project site)

(Left)
Performing a double role:
women workers who must attend to children while at work

Middle (Right)
Arisaema leschenaultii known as *Paambu chedi* – a snake bite antidote conserved by the tribals in Kolli Hills of Tamil Nadu

(Left)
A visual in the Mangrove Ecosystems Information Service database

Bottom
Raising paddy nurseries inside an old casuarina plantation at Vettaikaran Iruppu

Address:
M.S. Swaminathan
Research Foundation
III Cross Road
Institutional Area
Taramani
Madras-600113. India.