Listening to Farmers

TECHNOLOGY ASSESSMENT AND REFINEMENT THROUGH INSTITUTION VILLAGE LINKAGE PROGRAMME (TAR-IVLP)

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NATIONAL AGRICULTURAL TECHNOLOGY PROJECT
Regional Agricultural Research Station, Pattambi
KERALA AGRICULTURAL UNIVERSITY

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Technology Assessment and Refinement through Institution Village Linkage Programme (TAR-IVLP)

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FOREWORD

I am happy that a comprehensive document is being brought out with the conceptual, operational and achievement details based on the experience of implementing Technology Assessment and Refinement through Institution Village Linkage Programme (TAR-IVLP) at the Regional Agricultural Research Station, Pattambi

Since independence, India evolved various strategies for increasing agricultural production. A well-formulated network of research establishments suited to meet the complex and diverse agricultural scenario came into being. The research information generated by the system needs to be assessed and refined in order to suit the requirement of farmers with varying bio-physical and socio-economic environment.

The IVLP has this conceptual background and aims at assessment of each technology module under each kind of production system. There are at present 70 centres under this programme and a large number of technology interventions have been assessed and refined.

This document provides a complete treatise of conceptualization, planning and implementation of the programme at the Regional Agricultural Research Station, Pattambi. The results and experience shared through this publication will be a useful for planning participatory development and farmer education programmes with focus on specific needs and aspirations of the farmers in similar environments.

Dr. P. DAS
Deputy Director General (Extension.)
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MESSAGE

Kerala Agricultural University is a major partner in the National Agricultural Technology Project and has taken up research programmes in various aspects of Agricultural sciences. The Technology Assessment and Refinement through Institution Village linkage Programme (TAR-IVLP) is one, which has an unconventional approach to the process of technology transfer. This participatory research and refinement process has novelty in concept and approach and attempts are made to overcome the limitations of technology transfer programmes hitherto adopted.

Technologies generated in the research stations often fail to deliver the goods under farmer's field conditions. This results from a lack of understanding of the field situations on the part of the scientists and leads to further widening of gap between researches and stakeholders. The TAR-IVLP is a bold attempt for farmer friendly technology development process and needs to be integrated to our research system.

Regional Agricultural Research Station, Pattambi is one of the frontline institutions involved in this participatory mode programmes. A good number of production technologies have been assessed in specified micro-farming situations with active involvement of farmers and refined technologies have emerged. I am happy to note that the scientists involved in the TAR-IVLP activities are bringing out a publication with its conceptual and operational details. I am sure this will serve as a useful guide for planning and implementation of participatory research activities.

Vellanikkara

01-10-2002

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MESSAGE

The Technology Assessment and Refinement through Institution Village Linkage Programme (TAR-IVLP) had put into trial a new approach in technology transfer in agriculture by ensuring participation of stakeholders in the technology generation and evaluation. This system helps the scientists to understand the limitations of technologies generated and refine them to suit the requirements of farming community. The approach towards technology transfer is more farmer centered and takes care of complexity of conditions under which he or she operates.

The Regional Agricultural Research Station, Pattambi, Kerala Agricultural University is one of the centers where the TAR-IVLP is being implemented from 1996 onwards with the active support of Indian Council of Agricultural Research.

A good number of technologies have been assessed and a few refined under the programme. I am happy to note that a comprehensive document is being published on the TAR-IVLP activities at *Ezhuvanthala*, *Pattissery* and *Mavundiri* villages in *Ottappalam* taluk of Palghat district. I am sure that the publication will be a valuable document and the experience shared by the scientists involved will help in planning and implementing of participatory technology development and refinement programmes in agriculture more meaningfully.

(R.K.Samanta)

Bangalore
29th October 2002

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PREFACE

Establishing functional linkages with stakeholders is a primary requisite for effective dissemination of new technologies. Though various extension programmes were implemented nation wide, which were effective for the commercially based large scale production units, small farm sectors were virtually outside the benefits of such programmes. The Technology Assessment and Refinement through Institution Village linkage Programme (TAR-IVLP) was conceived to overcome the shortcomings in various programmes implemented so far and has given a new dimension to extension strategies. Client oriented research and technology development to improve productivity, sustainability and equity forms the fundamental approach in TAR-IVLP. The stakeholders are also partners in the technology developement and assessment process. Novelty in the concept and approach makes this programme unique.

A large number of technologies suitable under different micro farming situations have been assessed and some of them refined with the active participation of farmers. Many a time the packages developed under research stations needed further refinements in farmer's field. This refinement process after thorough evaluation of the technologies formed the central theme of the project. It also provided valuable feedback for the research system for streamlining the research programmes. It has been a novel experience to involve the end users as partners in technology development and expermientation process. The vast pool of indigenous knowledge that the farmers posses and the scientific zeal of researchers put together has given rise to a new research culture, which can boast of a unique and powerful blend.

Kerala Agricultural University is participating in the programme since 1995-96. Initially a pilot scale project was implemented under the Cess funds from Indian Council of Agricultural Research (ICAR). The project funding is under the National Agricultual Technology Project from 1999-00. This publication provides information on the approach, planning and implementation and achievements under the TAR-IVLP activities in the selected villages. Information on the farming situations, production constraints, available technologies, analytical tools and farmer's reactions could be used effectively in the planning of research and development programmes.

The authors gratefully acknowledge the support and encouragement given by Dr. P. Das, DDG (Extension), ICAR; Dr R. K. Samanta, Zonal Coordinator; Dr. K. V. Peter, Vice Chancellor, Kerala Agricultural University; Dr. P. V. Balachandran, Associate Director, RARS, Pattambi and all the staff members at RARS Pattambi. Special thanks are due to Sri. M. Harigovindan, who helped in the preparation of manuscript. The financial assistance provided uner the National Agricultural Technology Project is also gratefully acknowledged.

Pattambi
18-12-2002

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Chapter I

INTRODUCTION

Listening to users is better because......
users know much about what works and what does not
users ultimately decide about what to use and what to discard.
Probe into the user's situation
to understand the user's perspective
to prevent users from becoming losers
in the technology generation / adoption game.

-Virginia N. Sandoval

Realizing the relevance of the inter-dependence of agriculture and industry, an egalitarian approach was adopted with each five-year plan, and an awesome burgeoning of production of food grains, meeting national demands and international standards, was the immediate outcome. Research and development programmes helped generate and initiate numerous technologies. Incidences of poverty and famine were effectively identified and obliterated through out the length and breadth of the country and in the first phase of post independence itself India could be a force to be reckoned with in the food production scenario.

India's agrarian policies and programmes were creditable and class apart, yet the dissemination of the latest outcome of experiments and the results emanated from them in the rural areas of the country was far from perfect. The fruits of research and successful adoption of technology were found cloistered and sheltered in a few pockets of production. There was the realization that without achieving the target of extending the technologies to the villages there cannot be a harmonious and all-round development. Various extension strategies and programmes were streamlined over the years through organization like Integrated Rural Development, District Rural Development Agencies, Lab-to-land Programme, National Demonstration, Operational Research Projects, Krishi Vigyan Kendras and Training and Visit Programmes.

Advantageous as they were in various ways to the commercially based large scale production units, the small farm sector of our villages which has a major role in the over all food production, was virtually unused to the successful adoption of the technological innovations that boosted agricultural production. The modern technology based on capital-intensive inputs made it inaccessible to resource poor farming situations.

Development of appropriate technologies that are adaptable and adoptable at different agro-climatic zones was a strategic step towards providing easier access to new technologies in resource poor situations. Scientific use of natural and man made resources in macro and micro zones adopting a system approach formed the strategy for farmer empowerment programmes. Establishing a strong linkage between research workers and farmers to provide opportunities for field level evaluation of developed technologies and their refinement with the active participation of the users marked a quantum shift in the extension strategy for technology dissemination.

Technology is often thought to be a product that is generated by researchers and flows down to farmers in a one-way linear process. Studies have shown that often the research centres tend to think of farmer as targets of technology transfer (Bebbington, 1991; Farrington and Nelson, 1997). Scientists applaud those who accept their ideas and look upon non-adopters as conservative or traditional. The fact that some technologies are not adopted is ascribed either to the failure of farmers to appreciate the benefits or to the limitations of technology transfer process. Das (1995) stated that the research agenda as well as technology transfer have to be need based for improving the production systems. This is possible only when the scientists have direct contact with the farmers. The lab to land programmes envisaged this kind of farmer scientist interaction and it was successful to some extent. Here the emphasis was more on the technology demonstration than assessment under field conditions and refinement to suit varying microenvironments. Thus the technology assessment and refinement is a step forward where a series of activities must happen if the scientific knowledge can be put to use in a complex farm production system.

The technologies developed by the scientific institutions have to be appropriated adequately on the basis of farmer's experiences lest these will remain untapped. The Concept of farmer participatory research including Participatory Varietal Selection (PVS) and Participatory Plant Breeding (PPB) has been successfully tried in many countries leading to Participatory Technology Development (PTD).

Greater emphasis should be given to the process of empowering the farmers for generation of technology. There should be concerted efforts to collect, document, validate and share indigenous knowledge, duly acknowledging the role of rural community involved. Appropriate, reliable and farmer friendly tools for designing, experimenting and analysis of research should be developed on a priority basis. Methodology for rapid dissemination of developed technology within and across local communities have to be developed. For this, there should be a review of the existing R& D policy to re-orient research, extension and development in a participatory mode.

If productivity of research is to be increased, then the selection of the problem and design of experiments must be jointly planned and decided by the scientists and farmers, and not left entirely to the scientists. Farmers are and remain the main party in the process of technology development and outsiders play only a supportive role. There is a need for a participatory approach and action by the three main stages in technology development process, viz., problem identification and prioritization, evolving appropriate technology and popularization of the evolved technology.

In the problem identification and prioritization stage, farmers should be assigned a major role since they are the ultimate users of the technology. Moreover, they have a treasure of knowledge which they have gained directly from their field. Such traditional indigenous knowledge (IK) of the farmer can serve as a strong base for the sustainable agricultural technology development. In fact many have opined that IK of farmers could be regarded as entry point for future research works by the scientists. The proven local farm practices prevalent in each locality can pave way for the evolution of sustainable practices suitable for the locality. If such practices are identified and taken up for refinement or modification on scientific lines, the chances for the acceptance of research results by the farmers will naturally be high.

In the second stage of evolving suitable technologies for the farmers, the research system has a major role. The involvement of the farmers and extensionists in this stage add to the value of evolved technologies. Unlike in the case of conventional research wherein experiments are conducted in the R&D institutions, where only the scientists are involved, in the participatory Technology Assessment and Refinement (TAR) process, farmers are the experimenters who are guided and supported by the scientists, keeping liaison with the extension personnel. Thus, here there is a true partnership between that three systems and each system earns the confidence, support and approval of the other systems.

The major problem areas that threaten the concept of evolving improved technologies in agricultural research system, as identified by the G.V.K.Rao committee are: (1) an inadequate focus on local problems in research programs and (2) an excessive emphasis on uniformity of experiments and a straight jacket approach in research. The National Agricultural Research Project (NARP) initiated in 1978 strengthened research infrastructure in the zonal research stations of State Agricultural Universities substantially. However the research program planning process at many zonal research stations were neither relevant to the farmers' needs nor have the researchers been able to embrace problem solving creative research mode (MANAGE,1993).

The Farming System Research (FSR) methodologies meant to overcome many of the above problems did not make much headway. One important component of FSR is its multi-disciplinary perspective. However, research projects continued to remain mostly uni-disciplinary and crop-specific. Inter-disciplinary team building by involving scientists with conviction, commitment and mutual respect was indeed a difficult task to accomplish in reality. As Simmonds (1991) said, "Inter disciplinary teams are bureaucratically very okay, but inter disciplinary thinking remains scarce".

The existing technologies have to be made area specific and manageable at the level of small producers. Moreover, many of the technologies for sustainable agriculture are knowledge-based and warrant group action (integrated pest management, integrated plant and soil nutrient management, soil and water conservation and management, agro forestry etc.). Farmer Participatory Research provides ample opportunities to make them active participants in technology development and thereby helping local economies.

The coastal agro-ecosystem with its varied socio economic and agricultural features demand interventions in different areas for providing sustainability and ensuring optimum production. The operational holdings, which are hardly more than 0.25ha, and the diversity in farming systems, the resource poor farmers can look forward to technological options through participatory technology development, assessment and refinement. Stability, sustainability and productivity in small farm production systems and higher productivity and profitability in well defined farm production systems can be achieved through this demand driven process. The transformation from National Agricultural Research Project to National Agricultural Technology Project and the Technology Assessment and Refinement through Institution Village Linkage Programme was based on these facts.

Chapter II

TAR-IVLP: CONCEPTS AND OBJECTIVES

Technology adoption in the farming sector depends on many factors. Most important one is the appropriateness of the technology itself. Inadequacy of the extension system for promotion of the available options for specific farming situations and attitudinal constraints would also play a role. The problem in technology development, adaptation and dissemination results from the lack of proper understanding of the farming system, poor feedback and inadequate mechanisms to test the adaptability in farmers field.

Farmer participatory research has been globally acclaimed. Technologies developed by the research system have to be appropriated adequately on the basis of farmers' experience, lest these technologies will remain only in the shelves. It is eventually the farmers' judgment that determines whether a new technology is good or not. Hence there is a need for involving farmers in the evaluation of technological options. Assessing an innovation in terms of agronomic analyses alone is meaningless, as the farmers take a decision to adopt a technology on the basis of its qualitative, economic, intrinsic and extrinsic characteristics. The group farming approach, the Experiments in Farmers' Fields (ECF), the Group Approach for Locally Adaptable and Sustainable Agriculture (GALASA) in Kerala, and the farmer participatory research including Participatory Varietal Selection (PVS) and Participatory Plant Breeding (PPB) in parts of India and Nepal have evoked encouraging response and results. Still, all these attempts were single technology based, rather than comprehensive technological sets. On-farm technology assessment should be taken up on a system perspective, aiming at the step-by-step adding up of technological components as 'parts of the whole'. Here lies the emphasis on a shift from uni-disciplinary to multi disciplinary, and 'specificities' leading to 'holistic' view of farm technologies.

Stakeholders' participation in technology assessment and validation

In the words of Chambers *et al.* (1989) "instead of starting with the knowledge, problems analysis and priorities of scientists, participatory research starts with that of farmers and farm families. Instead of research station as the main focus of action, it is now the farm. Instead of the scientists as the central experimenter, it is now the farmers".

In technology adoption research, the present focus has been on the 'system-blame' hypothesis rather than the 'farmer-blame' hypothesis. The characteristics of the technology, the access conditions of farmers, the specific agro-eco and micro-farming situations largely decide the adaptability of farm technologies. According to Werner (1993) agricultural innovations propagated to increase productivity were not adopted by small resource-poor farmers as was expected. The reason is not farmers' ignorance, but the inappropriateness of many technologies, economic consideration, policy issues related to pricing and marketing. Besides the agronomic evaluation criteria, the innovations must be technically sound, compatible, economically viable and sustainable. He suggested that the development of innovations is an iterative, dynamic and spiral process involving four stages viz., exploration of problems, identification of alternatives, their testing and assessment. There are five broad criteria for selecting alternative techniques: feasibility under given socioeconomic circumstances, correspondence with farmers' goals and preferences, feasibility under given natural conditions, ecological and economic viability.

Demand-driven technology development through farmer participatory approaches is but a sure way to sustain production, productivity, profitability and sustainability of fragile agro-eco systems. Efforts to institutionalize farmer participatory approaches are to be made on a war footing in the context of globalization of agriculture. Martin and Sherington (1997) stressed the potential benefits to farmers from taking participatory research by enabling a better technology fit with the farming system, the production constraints and economic and social conditions of farmers, addressing needs, particularly of resource poor, more rapid testing, mutual relationship between formal research and informal technology. Participatory approach models emphasize that communities are expected to set their own priorities and standards which may be unique to their problem situations. This approach focus on human and economic concerns. Farmer participatory research focuses on the farmer as an innovator and experimenter leading to interest in collaborative and collegiate relationship between farmers and researchers ((Singh,1999; Venkattakumar and Sripal , 1999).

Witcomb (1999) had shown that farmers had not adopted new technologies in Complex Diverse and Risk-prone (CDR) agricultural environments. Farmer participatory research functions as an alternative to this top-down transfer of technology. If participatory approaches are widely applied, they would contribute greatly to the food security of the developing world. Technologies can be regarded appropriate only if they are systematically tested under recommendation domains for effectiveness and consistency. Site-specific assessment and refinement of technologies could be made by farmer participatory research and such technologies would be accepted by the farmers (Dwarakinath and Samantha, 2000; Johnkutty *et al.* 2001).

The technology innovation process follows a research → technology development → testing and adaptation → integration and adoption continuum. Verification of technology for specific situation is essential for assessing its validity. Evolving location specific technologies matching the diverse agro-ecological situations blending the innovative inputs and traditional wisdom has been rightly chosen as the path. The technology assessment and refinement approach has built in mechanisms for operational linkage between researchers and farmers. The Indian Council of Agricultural Research implemented a pilot project on Technology Assessment and Refinement through institution village linkage programme from 1995. This pilot phase programme provided substantial information on the effectivity of the concept and was the stepping-stone for the launching of a full-fledged project under National Agriculture Technology Project (NATP).

Objectives

The objective of the Technology Assessment and Refinement through Institution Village Linkage Programme is to refine the research → Technology development → testing and adoption continuum in order to make the transfer of technology effective and complete. The field-testing and refinement process of each technology module facilitates this. The project structure is formulated with the following objectives

1. To identify client driven technologies and their potentials for the agri-hort, fish and livestock production systems of the coastal agro- eco region
2. To assess and refine technologies aiming at stability and sustainability along with productivity of small farm production system and to sustain higher productivity and profitability in the well defined farm production systems
3. To assess and refine labour saving and drudgery alleviating technologies matching with the prevailing farming situations
4. To identify and assess technologies for facilitating effective participation of farmwomen in the agri-hort, and livestock production systems.

Chapter III

PROJECT PLANNING

Background information

The Costal Agro-eco System

Planning development programmes based on the agro climatic zones is considered as an effective approach for ensuring sustainability and stability. This involves scientific use of natural and man made resources adopting a system approach. The homogeneity in agro-climatic characters viz. rainfall, temperature, soil characters, topographic features, water resources, cropping systems and farming systems make the approach more effective and purposeful. Based on these characters the country has been divided into 15 zones. Kerala state comes under the coastal agro-eco system. The west coast plain is a long narrow strip between the Western Ghats and Arabian Sea comprising an area of 7.3 million hectares. Kerala has a coastline of 590 km and the width of the land strip range from 30 to 130 km. The lush evergreen vegetation, backwaters and rivers crisscrossing the land, and undulating topography are some of the characteristic features.

Physiographically the land is divided into three natural zones viz (1) The Lowland (2) The Midland and (3) The Highland. The lowland is made of river deltas, backwaters and shores of the Arabian Sea. The midland region has a rolling Topography with hills and valleys. Topography of highland region is mountainous with altitudes ranging from 400-2000 m from mean sea level.

The coastal ecosystem of Kerala has a humid climate except the southernmost pockets and eastern parts of Palakkad district where the climate is generally subhumid. The mean annual temperature varies from 25.4 °C to 31.4 °C in the central parts of Kerala. In midland areas the mean temperature is around 27.5 °C while in highland regions it is around 15 °C. Due to overcast skies during South West monsoon, bright sunshine hours are less. In winter it is about 10 hours per day. The mean relative humidity varies from 85 per cent to 95 per cent during June to September and is about 70 per cent during the other months. Rainfall distribution is bi-modal. The onset of southwest monsoon usually is between 25th May and 1st June and the North East monsoon from the middle of October. Mean annual rainfall is 2963 mm with 126 mean annual rainy days. Almost 60per cent of rainfall is received in the months of June, July and August. The northern districts experience a prolonged dry spell if premonsoon showers fail. On the basis of the morphological features and physicochemical properties, the soils have been classified into red loam, laterite, coastal alluvium, riverine alluvium, grayish Onattukara, brown hydro-morphic, hydro-morphic saline, acid saline, black soil and forest loam.

Kerala is blessed with abundant water resources both as surface water and ground water, which depend heavily on quantum of rainfall received. In certain years, due to heavy rains from the two monsoons, floods occur in many parts of the state resulting in substantial damage to life and property.

The total forest area (10,81,509 ha) is distributed over 23 territorial divisions and six wildlife divisions. The diverse topography, climate and demographic conditions have exerted influence on the type and status of forest vegetation. About 39 per cent of the tribal population lives within reserve forests.

Land use and cropping pattern

Out of the total geographic area forests occupy 27.83 per cent. Cultivable wastelands come to 2.23 per cent. A disturbing pattern has been the increase in land put under non-agricultural uses. The net sown area consumes 51per cent with a cropping intensity of 135 per cent.

A wide variety of crops are cultivated in the coastal agro- ecosystem of Kerala. They include plantation crops like coconut, areca nut, cashew, coffee, tea and rubber, annual/seasonal crops like rice, tapioca, pulses, sesame, ground nut, tobacco, fruit crops like banana, pineapple and mango, spices like pepper, ginger, turmeric and cardamom and vegetables like bitter gourd, ash gourd, cucumber, snake gourd, amaranthus, brinjal, bottle gourd, pumpkin and chillies.

Table 1. Area under major crops in Kerala (1998-99)

Crop	Area (x100 ha)	Production (tonnes)
Rice	3526	716743
Tapioca	1128	2630155
Coconut	8823	5132 (million nuts)
Areca nut	736	68479 (million nuts)
Cashew	913	51336
Pepper	1824	68510
Ginger	111	39362
Banana & plantains	815	784574
Pineapple	90	73707
Vegetables	1928	—
Rubber	1699	559099
Mango	873	253281
Jack	859	325000
Tea	347	58726
Coffee	837	49886

Agriculture in Kerala has certain unique features in the production system and practices. This is due to the particular physiographical features of the land and variations in the local environments. The agricultural features are:

1. The homestead system of cultivation with mixed cropping of perennial and annual crops; mixed farming of crops- live stock, crop-livestock- fish.
2. Rice cultivation in areas of diverse conditions viz. Kuttanad and Pokkali lands where land is below sea level and subjected to inundation by sea water and extreme salinity, the kole lands with water stagnation, the deep clayey 'poonthal padams' of eastern Palakkad and high range paddies of Wyanad and Idukki.
3. Plantations of coconut, rubber, areca nut, pepper, cardamom, coffee and tea

Crop sequences

With its diverse soil and ecological conditions there exists high degree of variability in cropping patterns and multiple cropping is the rule in most of the areas. The important crop combinations and crop sequences in the lowland, midland, highland and high ranges are given below:

1. Lowlands

Perennial	-	Coconut, Areca nut
Annual	-	Tapioca and banana
Seasonal	-	Pulses, vegetable, groundnut, sesame, rice in wetlands.

In wetlands the crop sequences followed are Rice –Rice-Pulses, Rice- Rice- Vegetables, Rice-Sweet potato/vegetables and Rice –Rice –Fallow.

2. Midlands

Perennial	-	Rubber, Cashew, coconut, areca nut, nutmeg , clove, pepper, and cocoa.
Annual	-	Tapioca, ginger, banana, yam, turmeric.
Seasonal	-	Pulses, groundnut , vegetables.

In wetlands, the crop sequences followed are Rice-Rice-Pulses, Rice-Rice-Sesame, Rice-Rice-Vegetables, Rice-Banana, Rice-Sugarcane, Rice–Sweet potato and Rice- tapioca.

3. Highlands.

Perennial	-	Pepper, cardamom, coffee, tea, coconut, rubber.
Annual	-	Tuber crops, banana, ginger, turmeric.
Seasonal	-	Pulses, vegetables, Rice in wet lands.

4. High ranges.

Perenial	-	Coffee, tea, rubber, cardamom.
Seasonal	-	Pulses, vegetables, Rice

Cropping patterns

Cropping patterns with mixed stand of various crops is seen throughout the state. The special and temporal arrangements can be generalized as four major systems can be identified.

1. Rice based farming system.
2. Coconut based farming system.
3. Tapioca based farming system and
4. Homestead farming system.

In certain isolated parts of the state, farming systems based on banana, areca nut and pepper as the main crop also exist. As mentioned earlier, homestead farming is a characteristic feature of the state and crop plus livestock is almost the general rule in homestead farming.

Crop production and productivity of the coastal ecosystem of Kerala are influenced by various biophysical and socio-economic constraints including vagaries of monsoon, poor fertility status of soil, problem soils, floods and drought spells during critical periods of crop growth, low availability and use of organic manures, imbalanced and non-judicious use of fertilizers and plant protection chemicals, soil erosion, pests and diseases, non availability of farm labour, high cost of production, less remunerative price for the produce, price fluctuation, drudgery of farm operations in wet lands, lack of infrastructure facilities like assured irrigation and farm mechanization.

The livestock comprises cows, buffaloes, work bullocks, goats, and pigs. The poultry population includes homestead backyard fowls, ducks and commercial units of broiler chicken. There is huge demand for beef, mutton, eggs, chicken, milk and milk based products. These sectors can provide employment opportunities. The livestock poultry system is essential to provide organic manure for crop agriculture.

Table 2. Livestock population in the state (1996 estimate)

Category	Total no.
Cattle	3396335
Buffaloes	165125
Goats	1860501
Sheep	6058
Pigs	142784
Others	6114
Poultry (total)	26946091

Coastal Kerala ranks first in India in fish production as well as fish consumption. The exploited fishery wealth accounts for 3.5 percent of total income of the state, contributing to 20 percent of the total export of Kerala. The fisheries sector of coastal Kerala can be divided into marine and inland. While the state is leading in marine fish production, the inland production potential is yet to be tapped. Wherever there are waterlogged areas, inland fish culture is practiced. Fish catching in backwaters, prawn filtration in paddy fields and rice cum fish culture in traditional paddy fields, prawn culture in pokkali fields, coconut-fish culture in the intervening channels, rice fish sequence and growing of fresh water fishes in the small homestead ponds are the main fish production systems and Agri-fish production systems of the coastal agro-ecosystem.

Agro-climatic zones:

Kerala is divided into five agro climatic zones based on physiography, climate, soil characteristics, sea water intrusion, land use pattern, vegetation etc. and as per the recommendation of the "Committee on Agro-climatic Regions and Cropping Pattern" constituted by Government of Kerala in 1973. The zones are (i) Southern (ii) Central (iii) Northern (iv) High altitude (High range) and (v) Special zone for problem areas. The project area on Technology Assessment and Refinement through Institution Village Linkage Programme is in the central zone

The Central Zone

The central zone comprises of Ernakulam, Thrissur and Palakkad districts excluding the Pokkali lands of Ernakulam kole lands of Thrissur and Attappadi area of Palakkad district due to their distinct agro-ecological features.

Table 3. Important statistical information on the central zone

Particulars	Central zone	State
Total geographic area	0.97million ha	3.88 million ha
Population	7.9 million	29.1 million
Density of population	532 to 1170/ km^2	749 / km^2
Literacy	88.2%	90%
Administrative divisions Taluks	15	63
Development blocks	44	152
Panchayaths	221	991
Per capita land	0.09	0.13 ha
Per capita cultivated land	0.06	0.07 ha

The zone can be basically classified into three natural physiographic divisions viz. the high land, midland and the low land. The topography of the high land region is mountainous with altitude ranging from 400 to 2000 meters above MSL. The mid-land region has a rolling topography with hills and valleys. The low land covering mainly coastal land consist of river deltas, backwaters and sea shores of the Arabian sea. There are six rivers flowing through the central zone to the Arabian Sea.

Central zone receives heavy rainy fall but the distribution pattern is quite erratic. More than 75 per cent of the annual precipitation is received during the three months of June, July and August. The average maximum temperature varies from 24.8°C to 36.4 °C. and minimum from 21.1 °C to 23.1 °C. The humidity is as high as 92 percent during June – August. But in parts of Palakkad district, the humidity is around 40 per cent during December – March period due to the entry of dry winds through the Palghat gap of the western ghats.

The soil types are laterites, coastal alluvium, riverine alluvium, brown hydromorphic, black soils and forest loams.

The total net area under irrigation in this zone is 0.17 million hectare, which works out to 51.59 percent of the total area irrigated in the State. (Kerala State – Resource based perspective plan 2020 AD, 1997)

About 80 percent of the population in the zone is directly dependent on agriculture. The land reforms and other land legislative measures initiated in the state are reflected in the fragmentation of agricultural holdings in the zone also. More than 92.8 per cent of the holdings are less than one hectare in size. Holdings of size more than four hectares accounts for only 0.46 per cent. The cattle population is high and a good number of farmers rear cattle for milk, manure and also as work animals for field operations. Fishing is the major occupation of the people in the coastal areas of Ernakulam and Thrissur.

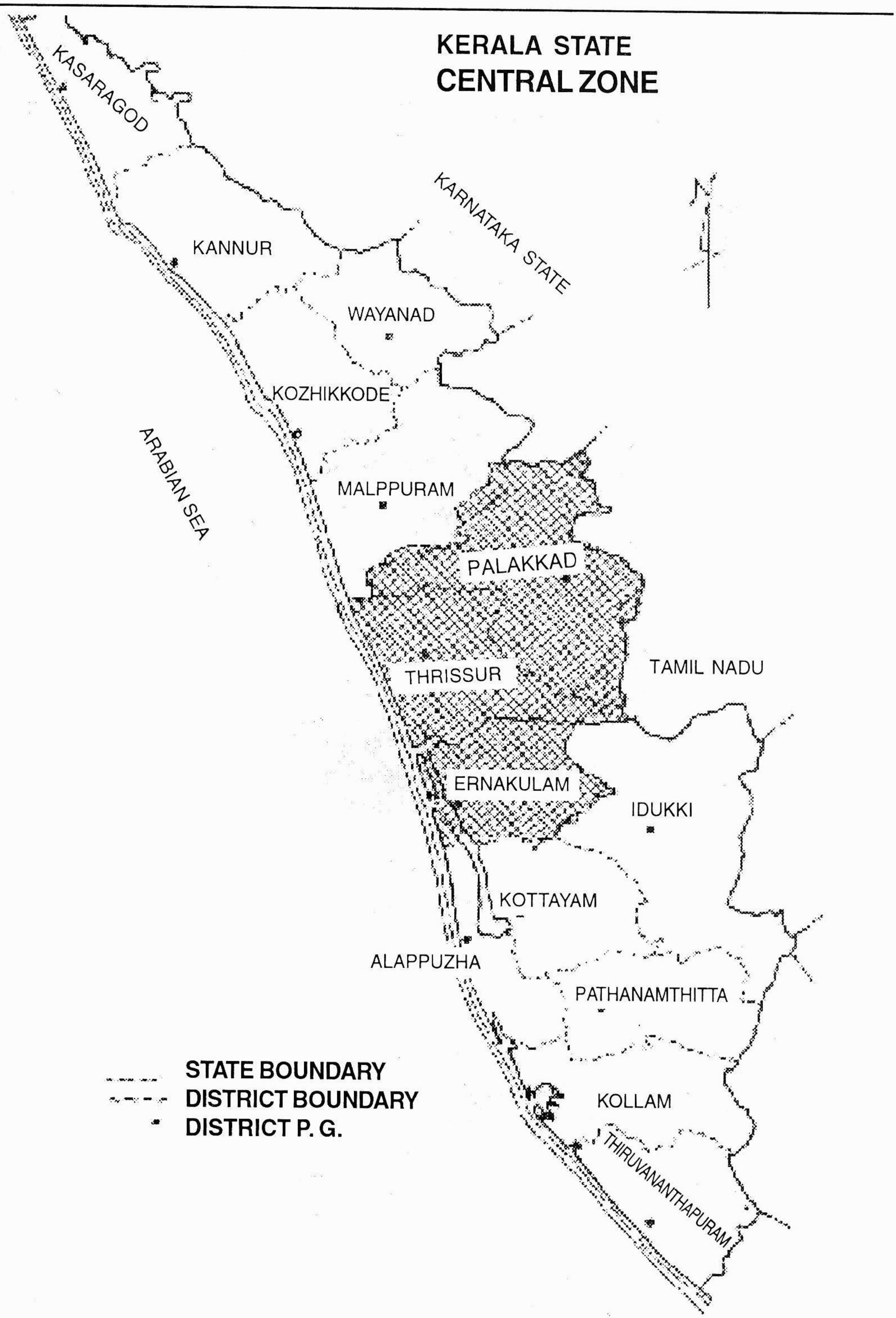


Fig. 1 Kerala State- administrative divisions and zonal boundary

Rice is the major crop covering nearly half of the total cropped area of the zone. Paddy, a labour intensive and comparatively less remunerative crop, is giving way to commercial crops like coconut, areca nut and rubber. Single cropped rice fields are being widely converted for planting coconut. Many paddy fields, especially in Thrissur district are used for brick making. Palakkad district is known as the 'Rice bowl of Kerala'. It accounts for 69.3 percent of the production of rice in the zone and 31.6 percent of the state's production of rice (Kerala State – Resource based perspective plan 2020 AD, 1997). Chittoor taluk ranks first in average yield of rice. Vegetables and banana are grown on a large scale. Cotton, sugarcane, groundnut, minor millets and coarse cereals are also grown in parts of Palakkad district.

The zone also assumes horticultural importance by the coverage of large areas under pineapple and mango (Thrissur & Palakkad districts). Fruit trees form an integral component of the homesteads of the zone. During peak fruiting seasons, large quantities of pineapple, mango, jack and banana are marketed to states of Maharashtra, Karnataka and Tamil Nadu from the zone. Dry ginger produced in Muvattupuzha and Kothamangalam Taluks of Ernakulam districts has an important role in the spice export market. Arecanut is grown on large scale in Thrissur district and Kunnamkulam is an important market center for areca nut. Palakkad district has the major area under cashew in the zone.

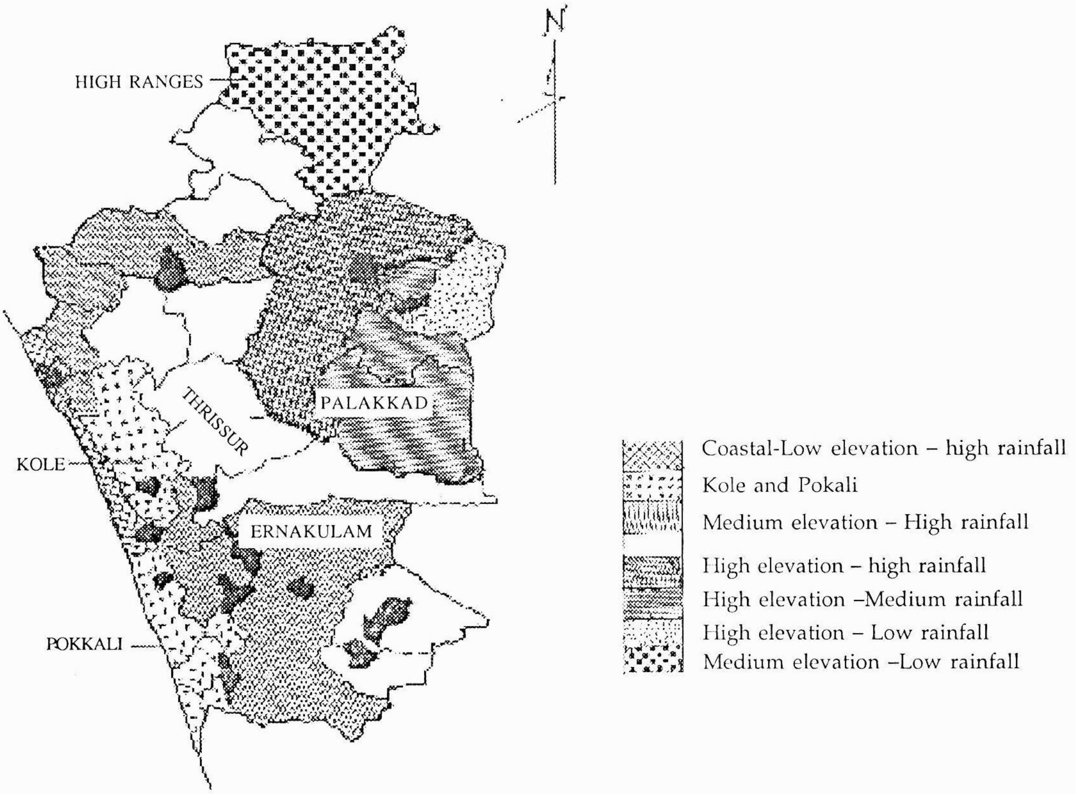


Fig. 2 Central zone: Agro-ecological situations

Table 4. Area and production of major crops in the central zone

Sl. No	Crop	Palakkad		Thrissur		Eranakulam	
		Area (ha)	Production (t)	Area (ha)	Production (t)	Area (ha)	Production (t)
1	Rice	120809	262494	40977	82991	46152	74234
2	Other cereals/millets	7611	5214	0	0	0	0
3	Pulses	4660	3510	625	447	2390	1711
4	Ground nut	10031	8371	0	0	0	0
5	Sugarcane	2488	18137	0	0	0	0
6	Pepper	4231	518	4389	1118	6249	938
7	Areca nut	3623	2854	5377	6472	3593	3100
8	Cashew	5750	2069	4368	3117	1299	427
9	Coconut	48929	237 *	76656	491	64816	357
10	Rubber	28112	28122	13105	18361	56025	69997
11	Tapioca	7272	148981	2113	50870	61133	163469
12	Banana	8653	77195	7314	63680	7439	78344
13	Pineapple	124	797	346	2728	5132	26723

* Million nuts

The productivity of major crops in the region is low except for crops like rubber and tapioca and is lower than the state average in many crops.

Table 5: Productivity of important crops*

Crop	Productivity in the zone (kg/ha)			State average
	Palakkad	Thrissur	Ernakulam	
Rice	2173	2025	1608	2061
Coconut**	4269	6578	5589	6188
Areca nut	788	1204	863	1147
Ginger	3541	1913	2791	3546
Pepper	175	210	169	375
Banana	11725	14170	13653	12666
Cashew	435	413	376	562
Tapioca	22981	21298	28035	23316
Rubber	1056	1412	1273	1189

*Source: Directorate of Economics and Statistics, Thiruvananthapuram and Farm Guide 2002, FIB, Thiruvananthapuram

** Number of nuts

Agro-ecological situations in the zone:

1. **Low land coastal zone (MSL to 7.5 m)**

   a. Coastal area – low elevation – high rainfall
   b. Kole and Pokkali (included under special zone of problem areas).

2. **Midland zone (medium elevation 7.5 m to 75 m)**

   c. Medium elevation – high rainfall
   d. Medium elevation - black soil – low rainfall

3. **Highland zone (high elevation 75 m to 750 m)**

   a. High elevation – high rainfall
   b. High elevation – medium rainfall
   c. High elevation – low rainfall
   d. High ranges (included under special zone of high ranges)

The low elevation high rainfall coastal area have rice, coconut and vegetables as major crops. The sandy soils are poor in nutrient status. In the medium elevation –high rainfall midland zone soils are lateritic/ sandy loams and major crops grown include rice, coconut, vegetables, tapioca, banana, sweet potato etc. Rice – banana- rice rotation, banana- tapioca/ yam rotation, rice- rice-green manure rotation etc. are common in the low lands of this tract. Uplands have coconut, areca nut, banana, tapioca, pepper, mango, cashew, jack fruit, pineapple, vegetables, sesamum, pulses, sweet potato and rubber. The high elevation high rainfall regions have undulating topography and lateritic/ loamy soils. Rice based cropping systems and polyculture in homesteads are similar to that of medium elevation tracts. In the low rainfall tracts rice, millets, groundnut, vegetables, cotton, banana, Tapioca, turmeric, coconut are the important crops grown. Sugarcane also is grown in the black soil tracts.

Operational area of the project

Locale of the study

Palakkad district

Palakkad district lies between 10°9'57" to 11°14'17" north latitudes and 76°1'36" to 76°54'30" east longitudes and is located in the east central portion of Kerala state. It covers an area of 4,38,947 ha as per the survey of India toposheet. The district is bounded by the high hills of Nilgiris in the north and northeast. The subdued hills and spurs of the Western Ghats in the east and southeast separate the district from the Coimbatore district of Tamil Nadu. The south and southwest portion is partly bounded by high hills and partly by 'Karappara' river, separating it from the Thrissur district. The west and north west is bounded by low ridges separating it from the Malappuram district.

For administrative convenience, the district is divided into five taluks viz., Palakkad, Alathur, Chittur, Ottappalam and Mannarkkad. It has 13 Developmental Blocks (DBs) and 12 Assistant Director of Agriculture Blocks (ADBs), comprising of 93 *Krishibhavans* (Panchayat-level Agricultural Extension Units KBs). The names of ADBs are as follows: i) Alathur, ii) Koyalmannam, iii) Nenmara, iv) Kollengode, v) Chittur, vi) Palakkad, vii) Mannarkkad, viii) Sreekrishnapuram, ix) Agali, x) Shoranur, xi) Pattambi and xii) Thrithala.

Fig. 3 Palakkad district –administrative divisions

Physiology and relief

Palakkad district as a whole can be considered as a mid-land dissected plain, being at a higher elevation than the adjoining costal plains. The district has an undulating topography with a major portion of it falling with in the slope range of less than five per cent. The elevation of the district ranges from 20 m above Mean Sea Level (MSL) in the west central portion to more than 2300 m on the Nilgiri ranges. Several rivers such as 'Tutapuzha', Gayathripuzha', 'Kuntipuzha', 'Kannadi' river, 'Bhavani' river and their tributaries drain through the district.

Climate and rainfall

The district in general enjoys a dry tropical climate. This is more severe towards the eastern side adjacent to Tamil Nadu. The normal annual rainfall of the district is around 2397 mm. But the east slopping Attappady valley and the eastern region of Kozhinjampara receive only around 915 mm and 1164 mm rainfall respectively. Major portion of the rainfall is received during the southwest monsoon from May to September. Maximum rainy days and rainfall are during June and July months. Palakkad has an oppressive hot season with fairly good seasonal rain. The hot season is from February to March, with the latter as the hottest month.

Irrigation projects

There are seven completed irrigation projects in the district viz., i) Malampuzha, ii) Pothundy, iii) Mangalam, iv) Walayar, v) Gayathri, vi) Chitturpuzha and vii) Kanhirampuzha.

Based on the participatory appraisal of agricultural situations involving farmers, Agricultural Officers, local grama panchayath representatives, district level officers of development departments; Nellaya Panchayath located about 14 km away from the Regional Agricultural Research Station, Pattambi was chosen for the project implementation. Within this Panchayath, 3 villages namely Pattissery, Ezhuvanthala and Mavundiri were selected. The selected area does not come under command of any irrigation project.

Chapter IV

CHARACTERISATION OF PROJECT AREA

AGRO- ECO SYSTEM ANALYSIS

A complete picture of the agro-ecosystem of the project area was evolved to provide sufficient background information on the land and the people. Critical analysis of available resources, infrastructure facilities, employment and income generation activities, problems and possible remedies for these problems was made.

Transect walk and rapport building exercises were performed to get a first hand information about the Agro ecosystems, farming practices, cropping patterns, geographical layout and infrastructure facilities. The observations, comments and view points raised during the transect walk was recorded.

A thorough analysis of the people's perception preferences, needs and problems was done using the Participatory Rural Appraisal (PRA) technique. A cross section of people including elders, practicing farmers, rural youth and women took part in the PRA events. After dividing the respondents into appropriate groups, each group was handled by core team members and selected optional team members.

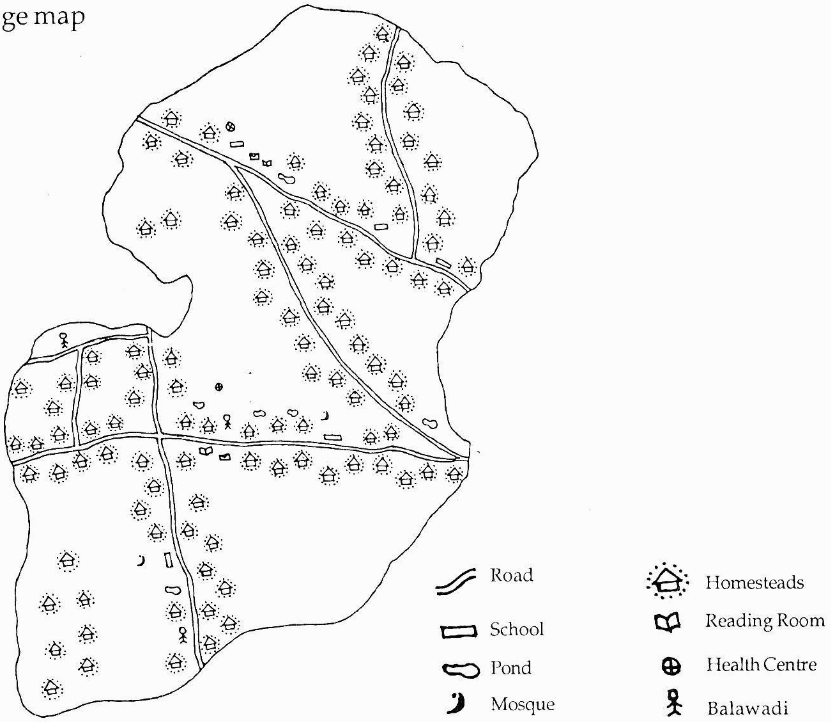
In this document, Participatory Rural appraisal (PRA) / Participatory Learning and Action (PLA) have been used synonymously by operationalizing as , "an approach (and family of methodologies) for shared learning between local people and outsiders to enable development practitioners, government officials, local bodies, local people and researchers to plan together appropriate interventions."

- ★ The PRA arrangements and lessons learned from the PRA exercises done:
- ★ Project identification
- ★ Local resource assessment (Natural, technological, human, infrastructure, money)
- ★ Felt needs (production, employment, income, social welfare, technology)
- ★ Discussion (with people, experts, local bodies)
- ★ Directions from TAR IVLP National project (NATP)
- ★ Traditional knowledge and skills
- ★ Limited resources, unlimited needs
- ★ Prioritization
- ★ Implementation, monitoring, evaluation (participatory)
- ★ Appraisal (also used in identification, prioritization, implementation, monitoring, evaluation. Hence also called P L A)

  The PLA exercises enabled the local folk to assemble together; analyze their past; examine their present envisage their future by assessing

- ★ geographic situation, resources,agro-eco system, socio-economic situation
- ★ problems and causes; needs and priorities;
- ★ exploring locally available resources
- ★ hammering out feasible solutions
- ★ fixing intervention points
- ★ formulating action plan
- ★ monitoring and evaluation

Fig. 4 Village map



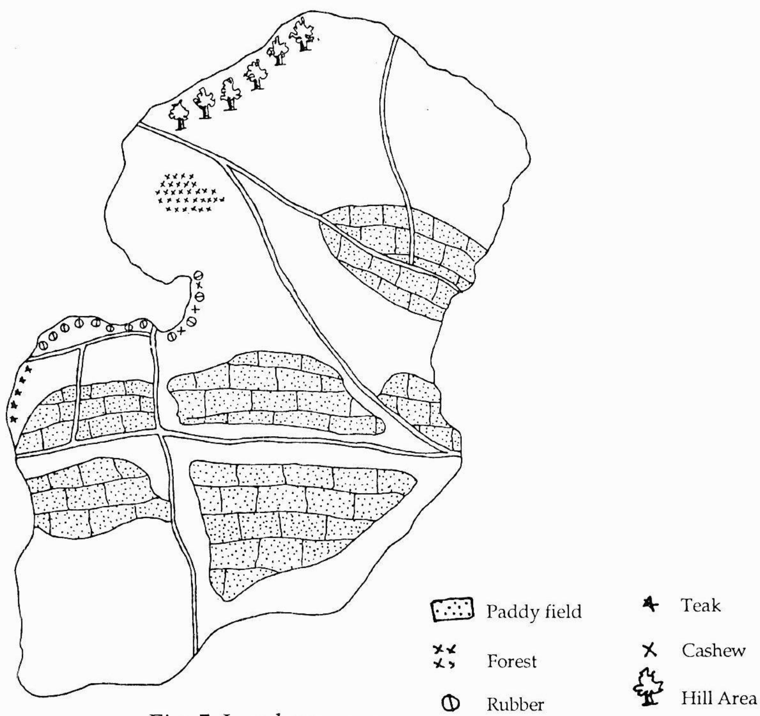


Fig. 5 Land use map

Key PLA principles followed for the project:

Participation	:	local people served as partners in data collection and analysis.
Flexibility	:	was not seen and used as a standardized methodology, but depended on purpose, resources, skills and time.
Team work	:	involved outsiders and insiders; men and women; mix of disciplines
Optimal ignorance	:	Felt as cost and time efficient; ample opportunity for analysis and planning.
Appropriate imprecision	:	still found realistic.
Systematic	:	for validity and reliability, partly stratified sampling, cross-checking

Key techniques followed for the PLA exercises

Interviews/discussions	:	individuals, households, focus groups, community meetings; preceded by rapport building
Mapping and diagramming	:	Transects, timelines, social maps, resource maps, seasonality diagrams, venn diagrams , mobility maps, lively hood analysis diagrams preference matrices, problem – cause digrams.
Ranking	:	Crops, enterprises, crop varieties, preferences, and problems
Trend analysis	:	Historical diagram/time line and seasonal calendars.
Triangulation	:	Cross-checking, follow up, reiteration
Prioritization	:	Problems and causes
Intervention points	:	Fixed after discussion
Project fixing	:	After identifying participants and plots
Implementation	:	By focused groups (collaborative)
Monitoring and evaluation	:	Participatory
Feedback	:	From focused groups
Refinement	:	By research system

Sequential steps followed for PLA

Site selection

Preliminary visit

Rapport building

Team formation

Exploration of secondary data

Data collection

Triangulation

Prioritization

Data Analysis

Action planning for interventions

Implementation of action plans

Monitoring and Evaluation

Feedback of success/failure of interventions

Planning for extrapolation/refinement

Composition of PLA team and structuring of work

A group of representative people (10 to 15/ exercise)

One mediator to facilitate the process (lead facilitator) for each group

Process recorder/Content Recorder

Two or three observers who minutely observed the proceedings have acted as environment controllers/Gate keepers so as to isolate tactfully the 'blockers', 'aggressors', 'clown actors' and 'dominators' in the participating group.

A small facilitating team of interdisciplinary nature (of course with interdisciplinary thinking!).

The Team had a preliminary sitting.

Had preliminary visits to local Agricultural Development units, Local bodies; collected secondary source of data, maps etc.

Was frank and open to the people. Built up personal rapport.

The team was polite and patient, showed empathy and respect; were great listeners and keen observers/recorders.

'Dominators', 'blockers', 'aggressors', 'clown actors' were managed tactfully intervened politely ; encouraged all to participate.

Took care of 'what', 'when', 'where', 'which', 'who', 'why' and identified appropriate participants for different PLA tasks.

Kept checklists to remind team members of important issues which needed further inquiry.

Made plan for everyday of the field work based on an analysis of the collected information.

Reviewed field work daily with the team, going over all notes and evaluating the field work and the methods. Understood the team's mistakes and corrected.

PLA tools were never stereotypic or rigid. Introduced refinements, improvisations and combinations according to situations.

Had repeated meetings and interactions with same focused group, cross-checked, and dug deeper and probed.

Triangulated (Cross-checked) the findings and analysed.

Met as a team to prepare diagrams, charts, maps and matrices to summarize the main findings.

Thus the findings of the PLA became very near real truth and hence believable.

Table 6. Tools used in agro ecosystem analysis

Events	Tools/methods used	Remarks/ Improvisation
Identification of village	Participatory discussion with Panchayath Officers, Village Officers and Agricultural Officers	4 Panchayaths shortlisted– ultimately Nellaya and Kulukkalloor panchayath were selected
Perusal and analysis of secondary sources of data		
Understanding geographic lay outs, micro-farming situations, farming practice etc and preparation of transect map	Transect walk	Mapping with sketch pen on paper; modelling on the floor and triangulation – farmers
Historical background of the village, changes and trends with elderly people	Time line	Participatory group discussion
Time line of crops grown elderly people	Time line	Participatory group discussion of
Preparation of village map	Mapping and modelling	Mapping with sketch pen on paper; modelling on the floor (by farmers) and triangulation
Preparation of land use map	Mapping and modelling	Mapping with sketch pen on paper; modelling on the floor (by farmers) and triangulation.
Mobility of the village	Mapping	Mapping with sketch pen on paper; modelling on the floor (by farmers) and triangulation
Preferences of crops/varieties/practices	Matrix scoring and ranking	On chalk board by assigning scores
Rainfall pattern	Mapping	Mapping with sketch pen on paper; modelling on the floor (by farmers) and triangulation
Seasonal crop calendar	Mapping	Mapping with sketch pen on paper; modelling on the floor (by farmers) and triangulation

Events	Tools/methods used	Remarks/ Improvisation
Cropping pattern	Mapping	Mapping with sketch pen on paper; modelling on the floor (by farmers) and triangulation
Labour demand and availability	Mapping	Mapping with sketch pen on paper; modelling on the floor (by farmers) and triangulation
Institutional linkage of the village	Venn diagram	Using chalk and paper cut out circles
Sector wise income expenditure break up	Livelihood analysis	Pie diagram using chalk, colour powder, twigs, seeds etc. drawn on ground
Analysis of resource flow of inputs and out puts	Resource flow mapping	Mapping with sketch pen on paper; modelling on the floor (by farmers) and triangulation
Documentation of ITK	Group discussion/ Brain storming	
Identification of problems	Focused group interview, matrix ranking	Ranking by farmers
Problem cause relationship	Problem cause relationship diagram (problem tree)	Diagram by farmers
Identification of intervention points, nature and details of interventions and family	Participatory group discussion and focused group interview	Farmers decided the nature of intervention and treatments' the the core team facilitated involvement in each intervention

Historical background of the project village

The method of time line was employed to trace out the calendar of historical events from yester years, which elderly people of the group could remember to the present. The group comprised of 14 participants, their ages ranging from 60 to 80 years. There were five in the age group of 75 to 80. This time line could form the basis of tracing trends through history and study the nature of their impact on the social and agro-ecological status.

Despite repeated queries about the origin of the name of the village, none of the participants could give an answer. Though the villages do not have commendable history on infrastructural development/progress a railway line was laid way back in 1925. This was constructed for transporting teak wood from the world famous Nilambur forests by the British. Several land races of rice were popular during that period. Kazhama, Thekkencheera, Orkazhama, Kumbalavan, Thavalakannan and Aryan are few such varieties. The Koppan – Pengattiri road traversing the villages was laid in1930. The first bus running on coal appeared in the adjacent main road (Pattambi - Nellaya – Cherpulassery) in 1945. The farmers have practiced well planned organic farming technology for rice since the Fifties.' Green leaves tree locally called 'Oduku' was used as green leaf manure in order to improve soil health. Use of cowdung and wood ash was a compulsory practice in paddy lands. Engaging bullock pairs for land preparations was on exchange system among farmers till 1970.

In 1971, the zamindari system disappeared due to Land Reforms Act. Land was transferred to tenants resulting in fragmentation of holdings. The system of giving lease to the zamindar and wages in kind to the labourers were stopped. Consequently cost of production of rice per unit area increased tremendously. The rain fall pattern showed declining trends during this period. Application of chemical fertilizers for rice, mainly urea began in the early seventees. HYV paddy appeared in the area only in 1980.

Time line of the selected pilot village

1925	Rail line laid, Post Office established (*Nellaya*)
1927	Popular land races of rice – *Kazhama, Thekkencheera, Orkazhama, Kumbalavan, Thavalakannan & Aryan* widely cultivated
1930	Road between *Koppan* and *Pengattiri* laid
1945	Bus service (First Coal vehicle service) started, L.P. School established.
1950	Organic farming technology for rice and other crops followed
1955	*Ezhuvanthala* Post Office (E.D.) established
1956	Daily wages for agrl. labourers – three *'Narayam'* measures of paddy *(Approximately 2.75 kg)*
1964	Use of radio started
1970	Bee keeping started in isolated pockets
1971	Land Reforms Act, Introduction of *Koottumundakan* cultivation in rice *(Special type of rice cultivation)*
1972	Application of fertilizer urea began, severe deforestation due to Nationalisation of forests
1980	Introduction of HYV paddy
1981	Electrical connection established
1984	Introduction of tractor for farm operations
1985	Tube well at *Pottenchira* for drinking water supply.
1986	Application of cow dung and green manure for paddy cultivation started decreasing. Practice of raising third crop of paddy started declining.
1987	Nobility of farming as a profession showed signs of degradation
1989	Television introduced
1990	Home scale processing of paddy declined
1993	Telephone connection (with ISD) established
1995	Area under coconut showed sharp increase

The first use of tractor was in 1984. The first tube well dug in 1985 with very high discharge resulted, according to the farmers, in lowering of the ground water table, draining the ponds and wells in summer thereby forcing them to discontinue the "Puncha crop" (summer paddy). From the early nineties, there has been considerable increase in the area under coconut.

Demographic details

Table 7. Details of Nellaya Panchayath

Particulars	Nellaya	Palakkad panchayath	Central zone district	State
Area (km²)	27.41	4480.0	9736.9	38863
Population (lakhs)	27714	2044399	7937355	290.99 lakhs
Male	13034	994196	3877440	142.9 lakhs
Female	14680	1050203	4059915	148.1 lakhs
Scheduled Castes (lakhs)	3260	376424	NA	2549409
Male	1610	NA	NA	NA
Female	1650	NA	NA	NA
Literacy (%)	73.68	81.3	89	90.9
Male	74.65	87.2	92	94
Female	72.50	75.7	87	86
Total Households (nos)	4519	484996	1453640	6230426
Operational holdings		188565	434638	1626916
Cultivated land per holding (ha)		0.39	0.299	0.26
No. of paddy production 'samithis'	17	NA	NA	NA
No. of coconut group farming samithis	10	NA	NA	NA

Climate & soil

Climatologically, the project area comes under tropical semi arid climate. The area receives good showers during SW monsoon period (June to August) and scanty NE monsoon showers during October – November. The average annual precipitation of the area is 2115 mm. More than 75 per cent of the rainfall is received during the months of June, July, August and the maximum in July followed by June and August in that order. No showers occur at all during the months of January-March period.

The typical rainfall pattern and the shortage of irrigation facilities allow only rain fed agriculture. Hence hectic agricultural operations take place only in the Kharif and Rabi seasons.

The period from February to May is summer during which the daily maximum temperature may shoot upto 40°C. During the months of December – January the temperature may come down to 18°C.

The mean humidity is 82 per cent. During the period from June to August the RH may be more than 90 per cent.

Soil

The soils of the area are derived from laterite and alluvium. The soils mainly come under Oxisol, Entisol and Inceptisol which are poor to medium in fertility status with slightly acidic pH.

Crop husbandry

Agriculture is the main occupation of the people of the area. Above 90 per cent of the area is under rain fed agriculture. The bimodal rainfall pattern confines majority of seasonal and annual crops to the Kharif and Rabi seasons. Major food crops of the area are rice, tapioca, vegetables and cowpea. Commercial crops like coconut, areca nut, pepper, cashew, ginger, turmeric and rubber are grown as components of homestead with the exception of rubber which is grown on plantation basis.

Rice, the staple food of the population is mainly grown under a special system of cultivation called *'Koottu Mundakan"*. This is a system of rice cultivation in which a mixture of seeds of a non-photo sensitive (First crop) variety and a photosensitive variety (Second Crop) of rice in the proportion 70:30 (W/W) is sown during first crop season. The first crop variety will be ready for harvest in August – September and the second crop variety in January - February. After the harvest of first crop both organic and inorganic manures are applied and incorporated and the sprouts of the photosensitive variety from the stubbles are allowed to grow. The photosensitive variety is harvested as the second crop. The total output is less when compared to two independent crops but the system has advantage in that the cost of cultivation is less and it is ideal for soils which are not amenable for tillage operations during second crop planting season..

Coconut, the second major crop of the area is grown mainly as a rainfed crop. Though the area under coconut has increased threefold in recent years, the yield is very poor. Lack of scientific practices like irrigation facilities, water conservation practices and soil management are the main reasons for the poor yield. Inter cropping in coconut based homesteads is not practised scientifically.

The root crops like colocasia, amorphophallus, yams and coleus are grown mainly in the homesteads. Vegetables like ash gourd, cucumber, pumpkin, bitter gourd, bhindi, brinjal and amaranthus are grown in rice fallows where irrigation is available during summer.

The productivity of almost all the crops of the villages is far below their potential levels due to a spectrum of biotic and abiotic stress situations, socio-economic and cultural reasons inherent with the area. The technological interventions under the project has taken care of these stress situations.

Animal husbandry

The livestock and poultry population of the village is very low. Cows, work bullocks, goats and backyard poultry birds comprise the livestock of the village. Few homesteads rear crossbred animals or improved strains of poultry.

Allied activities

Agro based enterprises, commercial units and household production units and other income generating activities are practically non existent in the villages. About 40 per cent of the population is engaged as agricultural/other labour. About 10 per cent of the population had sought employment in the gulf countries; 3 per cent are Government employees; 3 per cent are engaged in business and another 4 per cent in miscellaneous activities. The rest 40 per cent of the population are practicing farmers. Since 40 per cent of the population are agricultural labourers, the labour supply even during the most peak period is in surplus. The village can absorb only 80 per cent of the labourers during period of peak farm operation.

Crop preference by farmers (matrix ranking)

One of the tools employed under PRA techniques, matrix ranking, revealed the villagers preferences and attitudes towards a particular of interest. The reason for likes/dislikes and the subtle 'differences' in choice and priority among the villagers of different areas could be understood which helped to prioritize and determine the strategy. Their criteria for selection provided the researchers, extension workers and policy makers a new perspective in the programme planning.

After the initial round of discussions, rapport building and orientation to the methodology and purpose, the participants were requested to spell out all the major crops of the locality and their constraints in growing them. The team tactfully handled the 'gate keepers', 'dominators' and 'special interest pleaders.' The farmers were asked to develop a matrix having the crops in a line on the top (columns) and the constraints on the left hand side (rows.) There were nine crops and seven constraints and hence nine vertical columns and seven horizontal rows which altogether made 63 'boxes' in the matrix. The farmers were asked to assign ranks ranging from one to nine to the crops of their choice considering each of the seven constraints. In-depth discussions, mental evaluations, instantaneous corrections and finally arriving at group consensus to assign the ranks were the most creative outcome of this participatory opinion building process.

The constraint-wise ranking of the crops (Table 8) indicated that Cassava with four first ranks is perceived superior to all the other crops in the farmers' preference concept. The second and third ranks were for arecanut and coconut respectively. Rice was ranked last due to the constraints. Serious socio-economic and technological interventions are required to reverse the trend in the case of rice.

Varietal preference for rice by matrix ranking

Rice being the major crop of the area, farmers' preference with reference to rice strains both for first crop and second crop separately analysed through matrix ranking. The participants were asked to list out all the rice varieties of their locality, their traits – both good and 'bad' and their advantages as well as disadvantages. A matrix was developed by the participants with the varieties on the top (columns) and the traits (criteria) in the rows. (Table 9 & 10)

First crop:

Eleven varieties and seven traits were treated in the matrix. The participants were asked to assign ranks ranging from 1 to 11 to the varieties of their choice considering each of the seven traits. The results indicated that the traditional tall indica varieties (*'Chenkazhama'* and "*Vellakazhama'* are perceived superior to the HYVs in the farmers' preference concept. *'Poojyam Path'* which is a non-descript variety was ranked third.

Second crop:

The results furnished in table 6 showed that the non-descript variety 'Co' followed by the traditional tall indica variety *'chettadi* and *'vellari'* secured the first three ranks in that order.

The farmers' perception derived from this PRA exercise has brought about the following two conspicuous trends.

1. The traditional tall indica varieties are preferred by farmers indicating some specific advantages for such varieties.
2. Some traditional varieties are preferred to improved high yielding genotypes

Table 8. Matrix ranking of crops by farmers

Production constraints	Crops								
	Pepper	Cassava	Rice	Coconut	Rubber	Vegetables	Banana	Areca nut	Ginger
Moisture Stress tolerance	4	3	9	8	1	6	7	5	2
Low cost of production	2	1	9	6	5	4	7	3	8
Less fertilizer requirement	2	1	9	5	4	7	8	3	6
Less pesticide requirement	5	1	9	2	6	8	4	3	7
Less time to get the produce	6	9	2	4	3	1	8	5	7
Less risk	5	1	9	2	4	8	7	3	6
High profit	7	9	1	3	8	2	4	5	6

Traits	Crops										
	Vellakkazhama	*Chenkazhama*	*Jyothi*	*Jaya*	*Poojam Pathu*	*Kanchana*	*Soori*	*Kunjukunju*	*Thavalakannan*	*Mattatriveni*	*Aathira*
Grain yield	10	9	1	2	3	7	6	4	11	5	8
Grain colour	2	1	4	9	10	5	11	6	3	7	8
Grain weight	2	1	6	5	9	4	11	8	3	7	10
Pest/disease tolerance	2	1	9	8	4	7	6	11	3	5	10
Quantity and quality of straw	1	2	7	6	9	5	4	11	3	8	10
Cooking quality	1	2	4	8	5	7	9	6	3	7	8
Market price of paddy	2	1	4	9	8	10	11	7	3	6	5

Table 10. Matrix ranking of second crop rice varieties by farmers

Traits	Varieties					
	Chettadi	*Co*	*Ponni*	*Mashuri*	*Unda Mazhuri*	*Vellari*
Grain yield	2	1	3	6	5	4
Grain colour	3	1	4	6	5	2
Grain weight	2	1	5	6	4	3
Pest/disease tolerance	1	2	4	5	6	3
Quantity and quality of straw	2	1	4	5	6	3
Cooking quality	3	2	4	5	6	1
Market price of paddy	3	2	4	5	6	1

Linkage with development agencies

The Venn/Chapathi diagram was made through participatory interaction with the farmers to identify the frequency of contact and importance attached by them to various service organizations/ institutions. The maximum importance and hence the frequency of visit was to the service co-operative bank, Nellaya situated 2 km away. Post Office (1/2 km) and Village Office (2 km) came second and third respectively. Krishi Bhavan (2 km) and the Village Extension Office (1 km) stood fourth in the ranking. It is disturbing to note that despite having about 75 per cent literacy, the frequency of visit and importance to the rural library is meager. It was clear that when compared to the neighbouring areas, extension and development programmes/projects have so far evaded them. The village is devoid of a hospital, veterinary hospital and high school. The nearest market is 7 km away which placed the farmers in a disadvantageous position.

Livelihood analysis of the villages:

The pie diagrams indicate the sources of income and expenditure of the people of the village. Though more than 80 per cent of the population is involved in agriculture, this sector contributed only 40 per cent of the income derived. The farmers rightfully pointed out the reasons as (1) low coverage of commercial crops, (2) low productivity of existing commercial crops (3) low cropping intensity of seasonal/annual crops (4) low coverage of HYVs. Farmers attribute all these limitations solely due to lack of irrigation facilities. An equal proportion (40 per cent) of the income is generated from agricultural labour. Nearly 10 percent of the income of the village comes from the NRIs in Gulf countries. On the expenditure side, food consumed 40 per cent of the income.

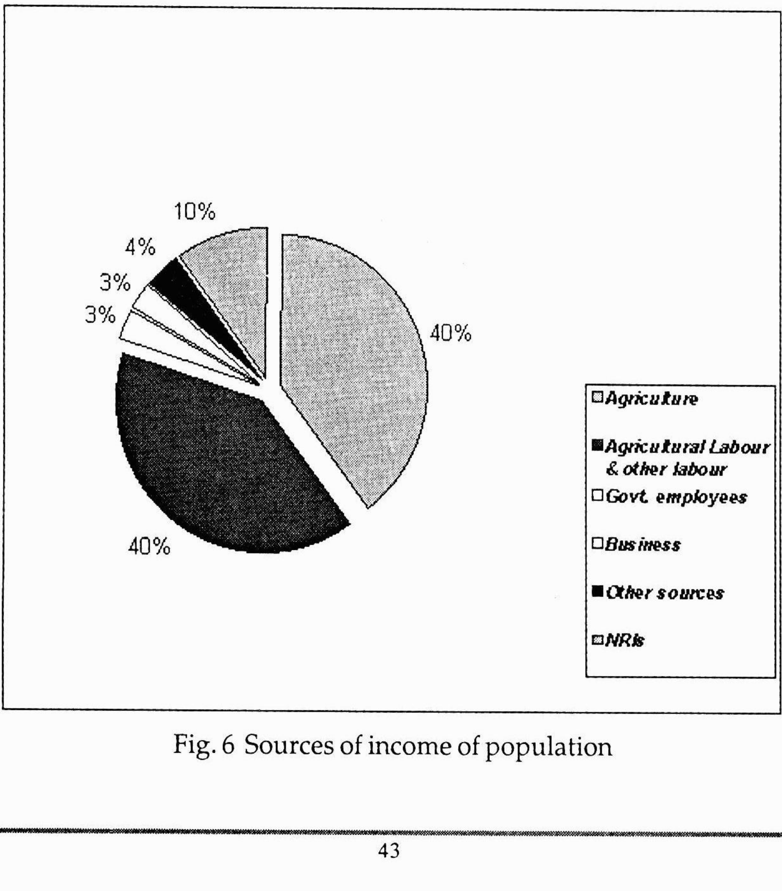
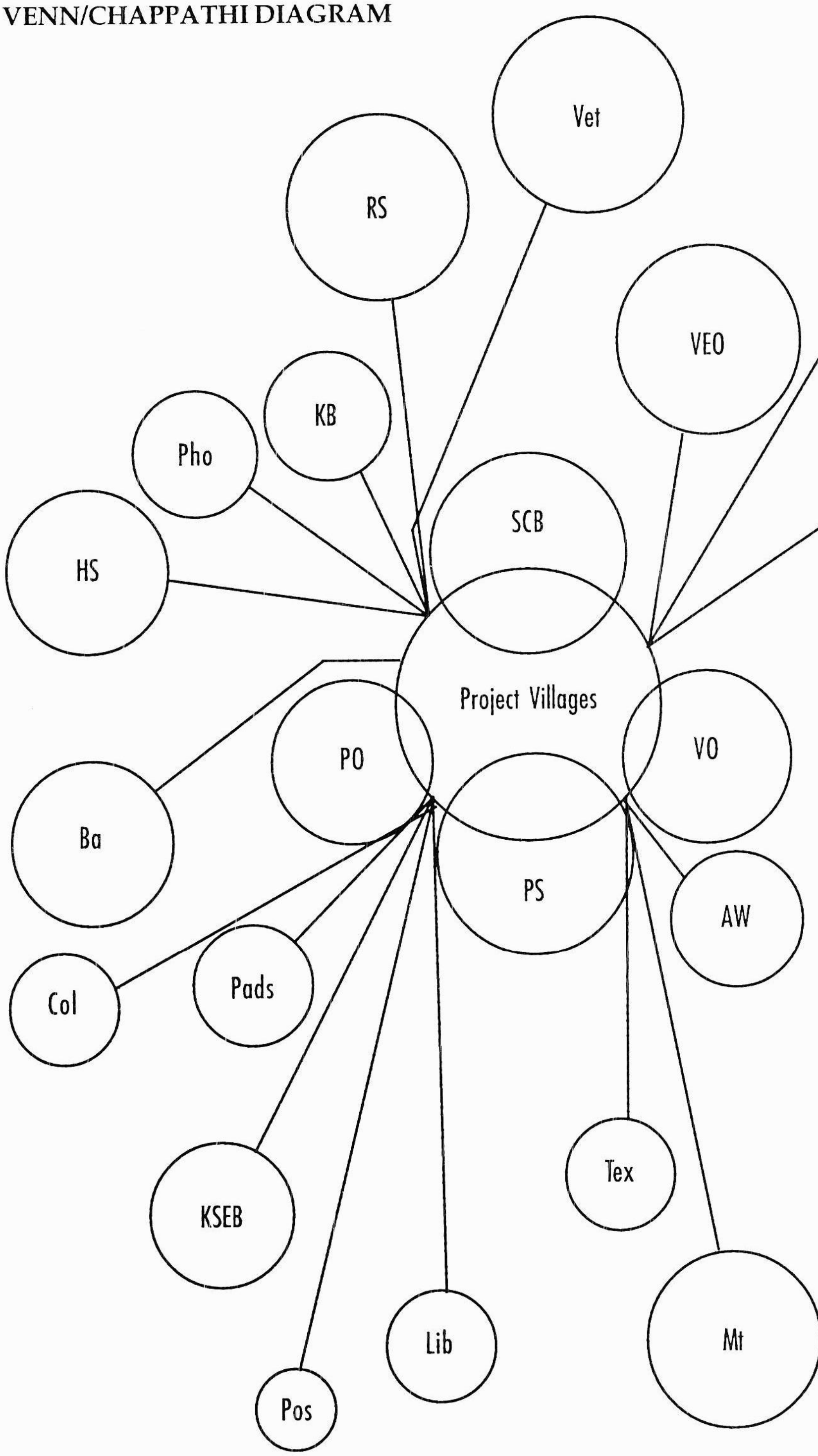


Fig. 6 Sources of income of population

VENN/CHAPPATHI DIAGRAM



1. SCB - Service Cooperative Bank
2. VEO - Village Extension Office
3. VO - Village Office
4. PS - Primary School
5. PO - Post Office
6. Pho - Panchayat Office
7. KB - Krishi Bhavan
8. RS - Ration Shop
9. Vet - VeterinaryDispensary
10. BO - Block development Office
11. HC - Health Centre
12. AW - Anganwadi
13. Mt - Market
14. Tex - Telephone Exchange
15. Lib - Library
16. Pos - Police Station
17. KSEB - Electricity Board
18. Pads - Padasekara Samithi
19. Col - College
20. Ba - Banks
21. HS - High School

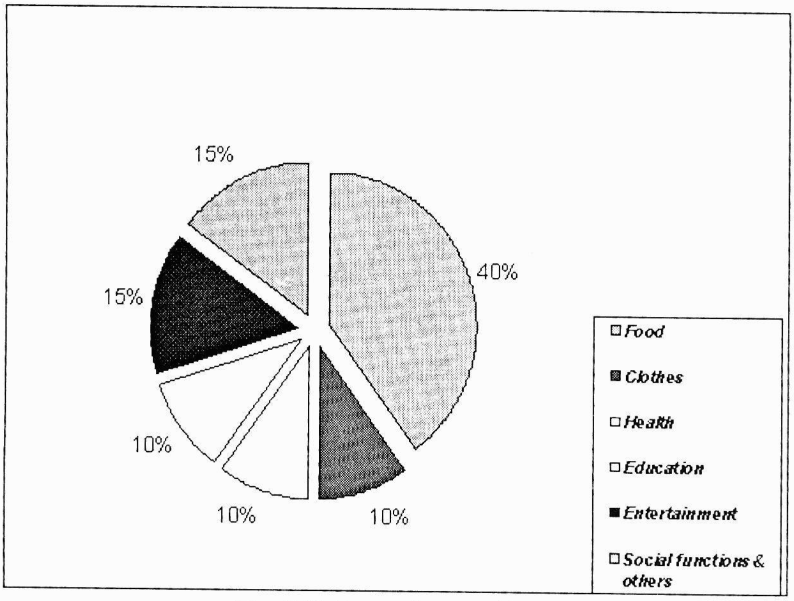


Fig. 7 Pattern of expenditure

Resource flow

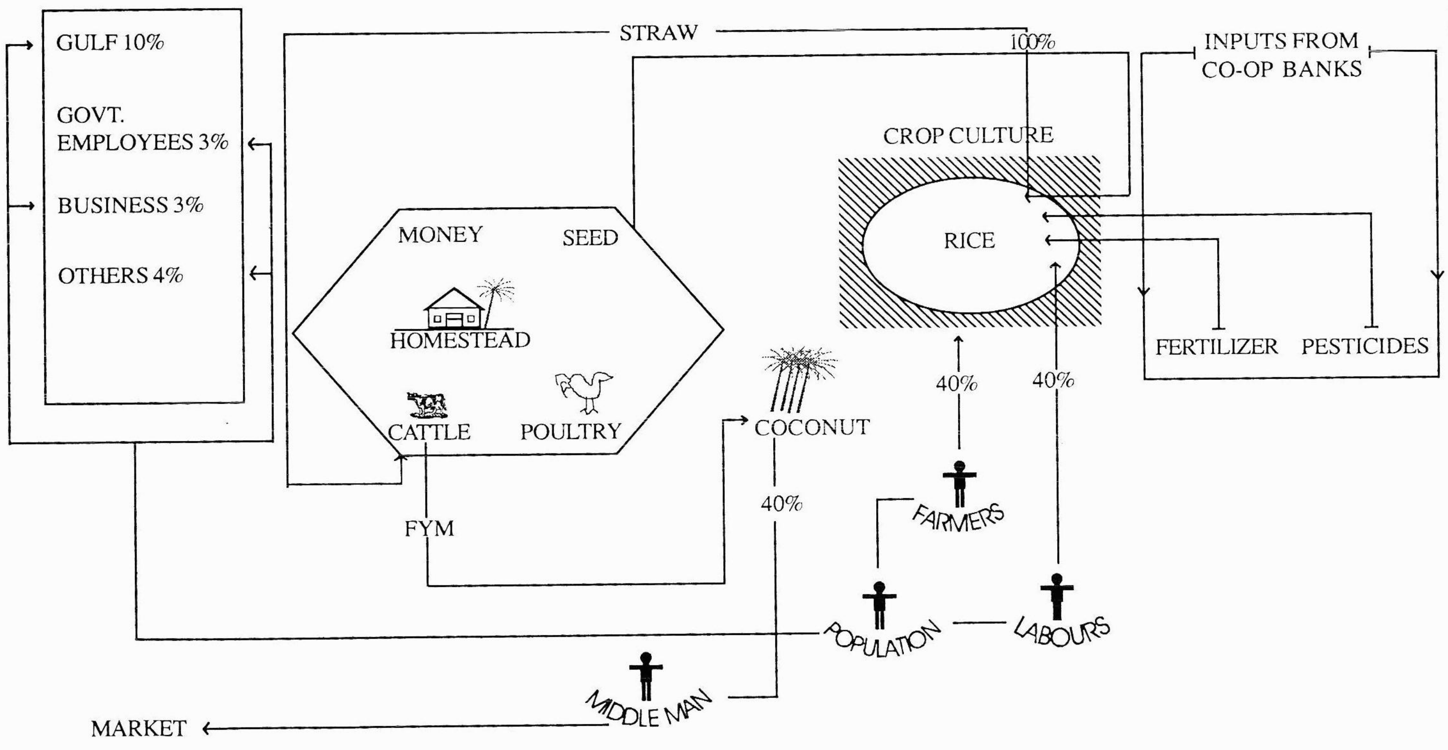
The inputs such as fertilizer and pesticides are brought from the Vallapuzha Co-operative Bank, Nellaya. Since the farmers are very poor and due of the non-judicious use of inputs, the resource utilization is often ineffective. A typical example is the case of fertilizer. Since urea is the cheapest fertilizer and as the farmers are not aware of the role of nutrients in crop production majority of them apply urea alone to the rice crop. The ultimate result is reduction in yield due to various pest/ diseases.

Indigenous technical knowledge (ITK) of farmers

Farmers, over generations, have developed and practiced their own technical know-how. For many practices they have established rationale, which are explicable in the light of modern science. They also have developed techniques, the scientific bases which are unknown to them. The core team could identify the following ITK from the farmers:

1. Brushing/sweeping rice plants using branched bamboo thorns, leafy twigs of the plant 'Parakom' and use of coir dipped in kerosene to knock down larvae of leaf roller.
2. Using garlic and flour of Bengal gram as repellant against rats.
3. Using a mixture of garlic and asafoetida as insect pest repellant.
4. Using special hooks locally called 'chelli kolu' to hook out rhinoceros beetle from coconut crown.
5. Depositing salt and sand mixture in the coconut fronds to kill rhinoceros beetle.
6. Applying leaves of 'parakom' in the root zone of banana to control rhizome weevil
7. Mango preserved in brine solution is applied on the mouth of goats to cure infections
8. Giving coconut oil/coconut milk/arrack to goats to cure stomach upset
9. Against fowl pox of the poultry, the farmers apply powder blue/salted mango/sediment of toddy
10. Using neem oil on the wounds of livestock to repel flies
11. Using a mixture of neem leaf and turmeric for controlling worms in calves

RESOURCE FLOW



Chapter V

PROJECT IMPLEMENTATION METHODOLOGY

The crucial stages of the entire programme were initiated and run in the most participatory way. Each family enrolled in the project manages a series of interventions. What the core team and the farmer participants experienced is that each homestead is functioning as a mini multidisciplinary research unit in the background of rural realities. For implementation of the project activities a balanced multi-disciplinary team (core and optional) was formed.

Using the four patterns viz. space analysis, time analysis, flow analysis and decision analysis the Agro-eco System analysis was conducted. The tools/methods and certain improvisations introduced for Agro Eco System analysis were as follows

'Problems' were identified and prioritized based on importance to crops/enterprises, severity of problem, loss in productivity, frequency of occurrence and those affecting more farmers. If any one or more of the system properties viz. productivity, stability, sustainability and equitability were negatively affected it was taken as a 'problem'. Thus problems due to biotic and abiotic limiting factors, inefficient and insufficient use of inputs, stress, perturbation, and the like, which ultimately could negatively affect the production system properties were identified and prioritized by the stake holders, ably facilitated by the core team scientists.

Both the villagers and core team were convinced of the potentiality of the tools/methods as a plethora of data and information could be collected within a short time there by saving human labour, money and energy. As all the families were literate and numerate improvisations in the PRA tools were possible. Instead of using rangoli powder, pebbles, twigs etc. most of the mapping were done by using chalkboard, colour chalks, sketch pens and paper. Crop/varietal matrices and ranking were done by assigning scores and ranks.

The farmers contributed to decide the type of observations, measuring devices, procedures for taking and recording observations and reporting results. During participatory group sessions, the farmers wanted the use of less sophisticated and easily adoptable techniques for taking biometric and qualitative observations using measuring/weighing devices available in their domestic set up.

Hence as a prelude to the interventions, a series of brain storming sessions were created. They were facilitated to spell out

a. What observations are to be taken by them
b. How and when these observations are to be taken and recorded by them,
c. What type of measuring/weighing devices are to be used by them, and
d. Mode of registering and reporting the observations and results of interventions

A number of interesting suggestions and options emerged from the brain storming sessions. After the process of 'pooling', 'screening' (to avoid superfluousness, incompleteness and lack of clarity), 'selection' and 'group consensus', the approaches, methods and devices were finalized as

1. Calender of operations to be recorded by the farmers
2. Biometric observations to be recorded by the farmers

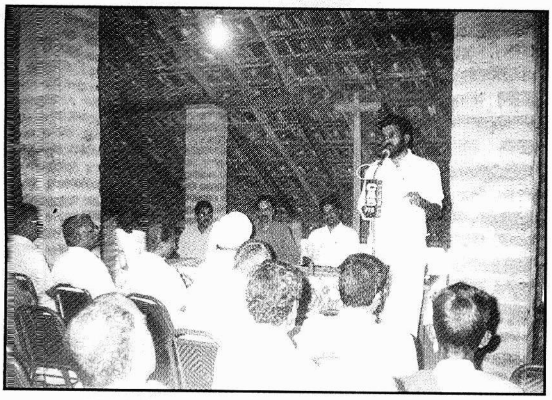
3. Sample crop cuts by the farmers
4. Easy to use and locally available measuring devices to be used. The core team would standardize or calibrate such devices in front of the participants to ensure uniformity
5. Per plot (per treatment) yield to be recorded by farmers
6. Qualitative attributes to be inspected and recorded by the farmers
7. Periodic observations and final sample crop cut surveys to be done by the core team
8. Final triangulation of observations/results by creating Focused group sessions for each intervention.

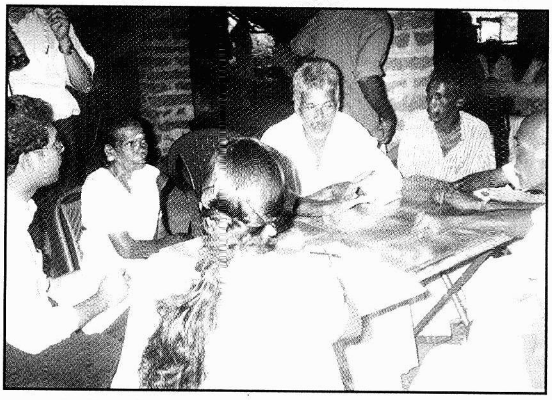
The literate farmers filled up the notebooks and proforma on their own. Those who were not able to do so (hardly 5-8 per cent) sought the help of their educated children.

Detailed plan of work

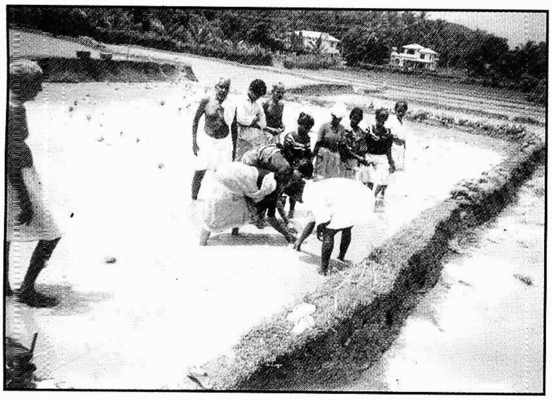
Table 11. Activity chart

Activity	Process Indicator
Constitution of interdisciplinary team of Scientists	University constituted core team and optional team to take up the work of TAR
Training of core group interdisciplinary team of scientist	The inter disciplinary core group attended IVLP training organized by Zonal Co-ordinating unit, Bangalore and CPCRI, Kasaragode
Selection of villages and farmers	Core team and optional team of scientists after a series of participatory discussion with Panchayath Officers, Village Officers, local Agricultural Officers and district officials selected two villages based on agricultural backwardness/poor access to technology
Agro-eco-system analysis for resource characterization and problem identification for different farming conditions of selected areas	Core team of scientists did the Agro-eco system analysis using four pattern viz., space analysis, time analysis, flow analysis and decision analysis. Various PLA tools and their improvisations were employed for resource characterizations. Problems were identified and prioritized.
Identification listing and classification of technologies/research information	Stock taking of the generated technologies/research information from the SAU and other research institutes relevant to the agro-eco-region and specific production system and micro farming situations, always keeping the farmers' perspective.
Preparation of detailed action plan by the concerned centres	The action plan and technical programme were discussed by the core team and optional team and approved



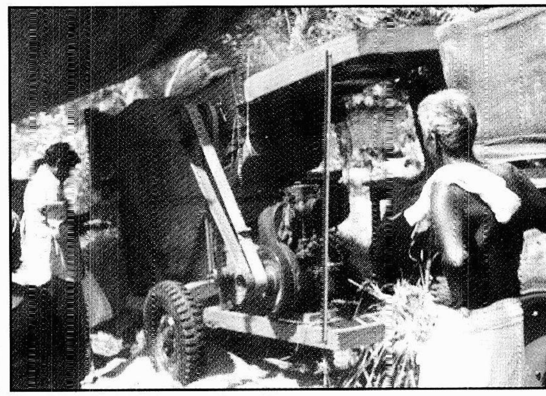


PRA sessions for active involvement of users - MLA Inaugurating the session and group discussion in progress

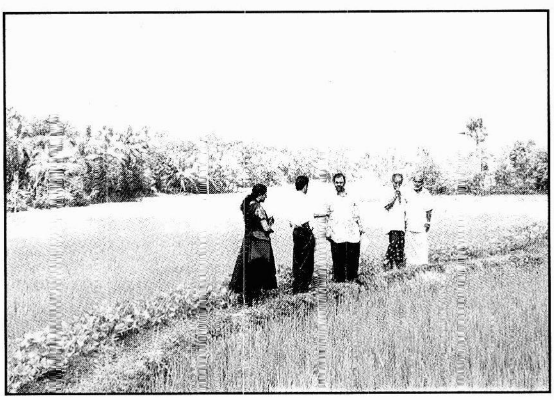


Optimum spacing of plants and right choice of varieties ensured higher yields

Mat nursery and mechanisation of transplanting saved costs

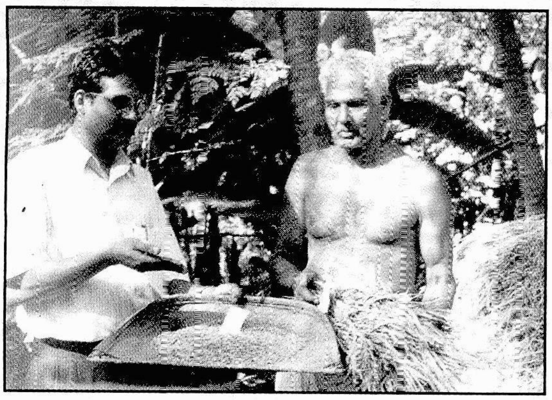
Use of vertical conveyor reaper & Rasp Bar Type thresher - cost saving measures




Fringe cropping and fallow utilization to augment income

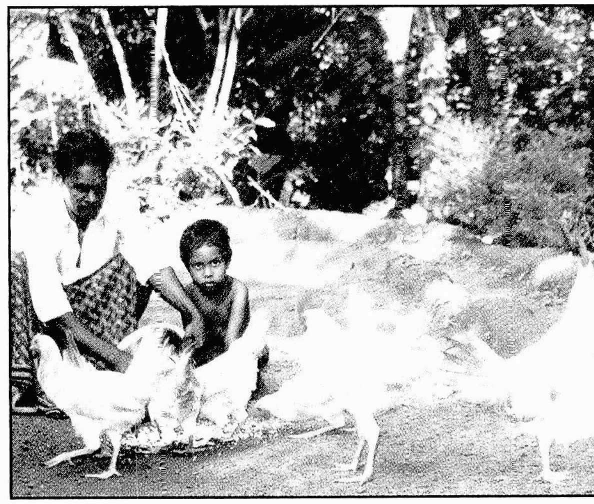

Vermi compost from farm wastes - Ideal technology for recycling organic wastes


Raising green manure crop in rice fields to improve soil health



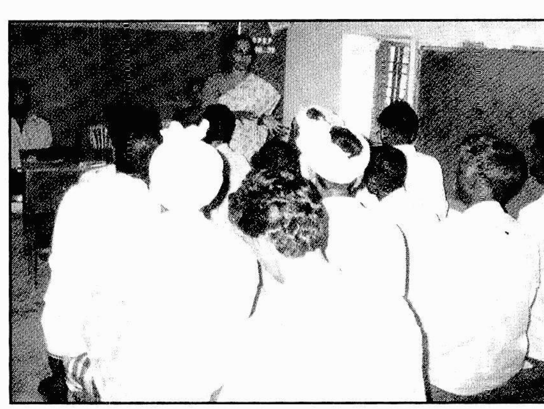

Recording observations on experiments - active involvement by farmers


Field training for vegetable growers

Rearing Malabari goats & Backyard poultry - income generating activities


Home scale processing of fruits & vegetables - hand on training

House to house visits & mass contacts - keeping in touch

Monitoring indicators

Process indicators – steps involved to achieve the milestones proposed for the first year.

1. Increase in productivity of seasonal/annual crops and enterprises
2. Increase in cropping intensity
3. Balanced use of internal and external inputs
4. Reduction in drudgery due to rice farm mechanization
5. Decrease in cost of production of rice due to mechanization
6. Increase in women participation in income generating activities
7. Increase in production of coconut based homesteads
8. Increase in productivity of milch animals

Micro farming situations identified in the project area

1. *Rain fed lowlands- transplanted first crop paddy*

In this micro farming situation rice is grown as a transplanted crop using a dry seeded nursery. Cropping is dependent on southwest monsoon, which normally commence from June first week. Short or medium duration varieties are preferred for this crop.

2. *Rain fed lowlands – broadcast first crop paddy*

The first crop is raised as a dry seeded crop well in advance of the monsoon in this system. The summer showers obtained during April-May period facilitate preparation of land and sowing. Medium duration varieties are used for this type of crop.

3. *Rain fed lowlands – transplanted second crop paddy*

In the double cropped wetlands a second crop of rice is raised as a transplanted crop. Seedlings are raised in wet nurseries where sprouted seeds are sown. Short/ medium/ long duration varieties are chosen according to availability of water.

4. *Rain fed lowlands – wet sown second crop paddy*

Short/ medium/long duration varieties of rice are raised by wet seeding.

5. *Rain fed uplands– transplanted/broadcast single crop paddy*

These are uplands where a single crop of paddy is raised which may be followed by vegetables/pulse crops/sesamum. Short / medium or long duration varieties of rice may be used in this system depending on water availability.

6. *Rain fed lowlands – '**koottumundakan**' system of paddy*

This system is followed in rain fed low lands where water is available for two crops. A photo-sensitive rice variety is mixed with a photo insensitive variety and is sown together. Both direct sowing or transplanting is practiced. The photo insensitive variety is harvested by September-October period and the stubbles are retained in the field. The photosensitive variety comes to harvest by February. This system saves cost of planting/ seeding and other cultural operations.

7. Summer rice fallows

The rice fields after the harvest of second crop remains fallow in most of the cases due to water scarcity. Vegetable crops like ash gourd, pumpkin, cucumber, bottle gourd, cowpea and pulse crops such as black gram, green gram, cow pea, horse gram and oilseed crop like sesamum can be raised during this period.

8. Rain fed multiple crop homesteads

This is a complex system of raising a number of perennial and seasonal crops together for optimum utilization of resources and for realizing maximum output. Most predominant one is the cropping system where coconut, areca nut, pepper, banana, tuber crops, yams, vegetables, fodder crops other spice crops, fodder/ timber yielding trees, fruit crops like mango, jack, sapota, guava, tamarind etc find a place.

Problems identified and their prioritisation

1. Low productivity of *viruppu* and *mundakan* rice

Rice is the most important crop of the Ezhuvanthala, Pattissery and Mavundiri villages, cultivated in 91 hectares. Low productivity of *viruppu* and *mundakan* (first and second crop) rice was the problem indicated by farmers of both the well-endowed and small production systems. The average yield of paddy is hardly 2 t/ha against the district average of 2.5 t/ha. Use of local varieties which have low productivity, adoption of *'Koottumundakan* system (Mixed variety ratoon) of cultivation which has low productivity per unit area and time, poor fertility status of the soil, imbalanced fertilizer use, inefficient and unscientific pest and disease management practices, water stress situations in low land and uplands during critical periods, weed menace etc are some of the factors identified. Among the socio-economic causes, lack of interest in rice cultivation especially by the young generation is a serious issue.

The poor economic condition and small holding size are the major problems in small production systems. This prevents the farmers from the capital-intensive technologies for achieving higher production like quality seeds of HYV's, chemical fertilizers and plant protection measures. Analysis of problems in the case of well-endowed farmers indicated issues like imbalanced use of fertilizers, use of low yielding varieties and inefficient pest and disease management.

2. Low productivity of coconut based homesteads

Coconut being the second major crop of the area is grown mainly as a rain fed crop in the homesteads. The homesteads represent a miniature Kerala with almost all crops which has some use in keralite's day to day life. The intercropping in coconut-based homesteads is not practiced in a scientific manner. The productivity homesteads are low. The farmers cited the poor productivity of homestead system as the second most important problem. Lack of scientific approach in formulating a suitable crop cafeteria utilizing the available natural resources to the extent possible, poor soil fertility, soil moisture stress, lack of moisture conservation measures, inadequate nutrient use, non availability of suitable crop varieties for intercropping, poor use of paying crops are the major problems. Poor economic base of the small production system farmers does not allow them going for high-density intercropping, fertilizer use and conservation measures. Well-endowed farmers who have irrigation facilities lacked knowledge on a scientific high density and high intensity intercropping system for optimising productivity.

3. Low cropping intensity in rice based cropping system

Rice covers about 60 per cent of the total cultivated area in first and second crop season, leaving as much area as fallow in summer months. This considerably lowers the net output per unit area.

Lack of irrigation facilities during summer months is the limitation under small production systems. Though technology and crops are available for utilizing the residual moisture of the rice fallows they are not adopted due to poor awareness, lack of technical know how and poor economic status of the small production system farmers.

4. Low income status of farm women folk

In the villages though population wise the females dominate the males, their share in the income generated is meagre. This is mainly because they are confined to the domestic works of the family, which do not give them any monetary benefits. The men folk are the decision makers of the family. The women are unaware of the various enterprises and avenues, which can fetch them reasonable income. Awareness creation and introduction of homestead-attached enterprises have immense scope for effective utilization of free time for improving the economic status of farmwomen of the project area.

5. Low productivity in crossbred milch cows in homesteads

More than 50 percent of the families rear cross- bred cows but the productivity is very low. The average production of milk per day per animal is only 2–3 litres. This problem is prevalent in both well endowed and small farm production system. Major causes for the problem are poor health status of the cows and calves due to poor management practices like imbalanced feeding, lack of de-worming practices and ignoring the ecto-parasites.

6. Inferior production and sustainability of composite vegetables production system

The primary cause for the low productivity of vegetables is non-availability of quality seeds and an equally important factor is the inadequate production management. Few farmers keep own seeds for the succeeding crop but a majority depends on the market or other sources. Availability of quality seeds at the right time is always remaining a constraint. Crop losses due to various diseases and pests also were cited as major problems.

7. Inferior productivity and sustainability of nendran banana.

Cultivation of *nendran* banana is an important activity in the project area. Inadequate production management practices, especially insufficient application of organic manures, imbalance in use of chemical fertilizers and loss due to pests and diseases is the problem–cause–picture of the micro-farming situation.

The problems faced by farmers in each of the micro-farming situation were deliberated during the interaction sessions. Each of these problems were defined and the problem cause analysis performed.

Assessment of technologies as to their appropriation in the micro farming situation require a series of monitoring indicators for judging appropriateness of technologies included. A set of indicators was selected to monitor the impact of technologies assessed and refined. This included

1. Increase in productivity of seasonal/annual crop enterprises under different micro faming situations
2. Increase is cropping intensity of rice based cropping systems and homestead systems
3. Balance in use of internal and external inputs
4. Reduction in drudgery due to mechanisation of farm operations
5. Decrease in cost of production as a result of resource use efficiency
6. Increase in women participation and their income generating activities
7. Increase in productivity of coconut based homesteads
8. Increase in productivity of milch animals

Depending on the types of interventions made, the indicative tools were specified to each intervention.

Specific indicators

1. New variety/Management practice for crops

   a. Economic indicators

      Cost of intervention per unit area
      Incremental cost
      Additional returns
      Returns per rupee spent

   b. Farmers reactions

      Flexibility and compatibility of the technology (with the existing system)
      Risk elements involved
      Skill requirements
      Alternative suggestions and feed back

2. Mechanisation intervention

   a) Organic parameters

      Operational conveniences
      Noise/vibration levels/dust
      Skill requirement
      Work displacement (gender bias)
      Work hazards

   b) Economic indicators

      Cost of machine
      Recurring costs
      Cost of preparatory works and interventions
      Incremental cost / savings if any
      Returns (additional if any)

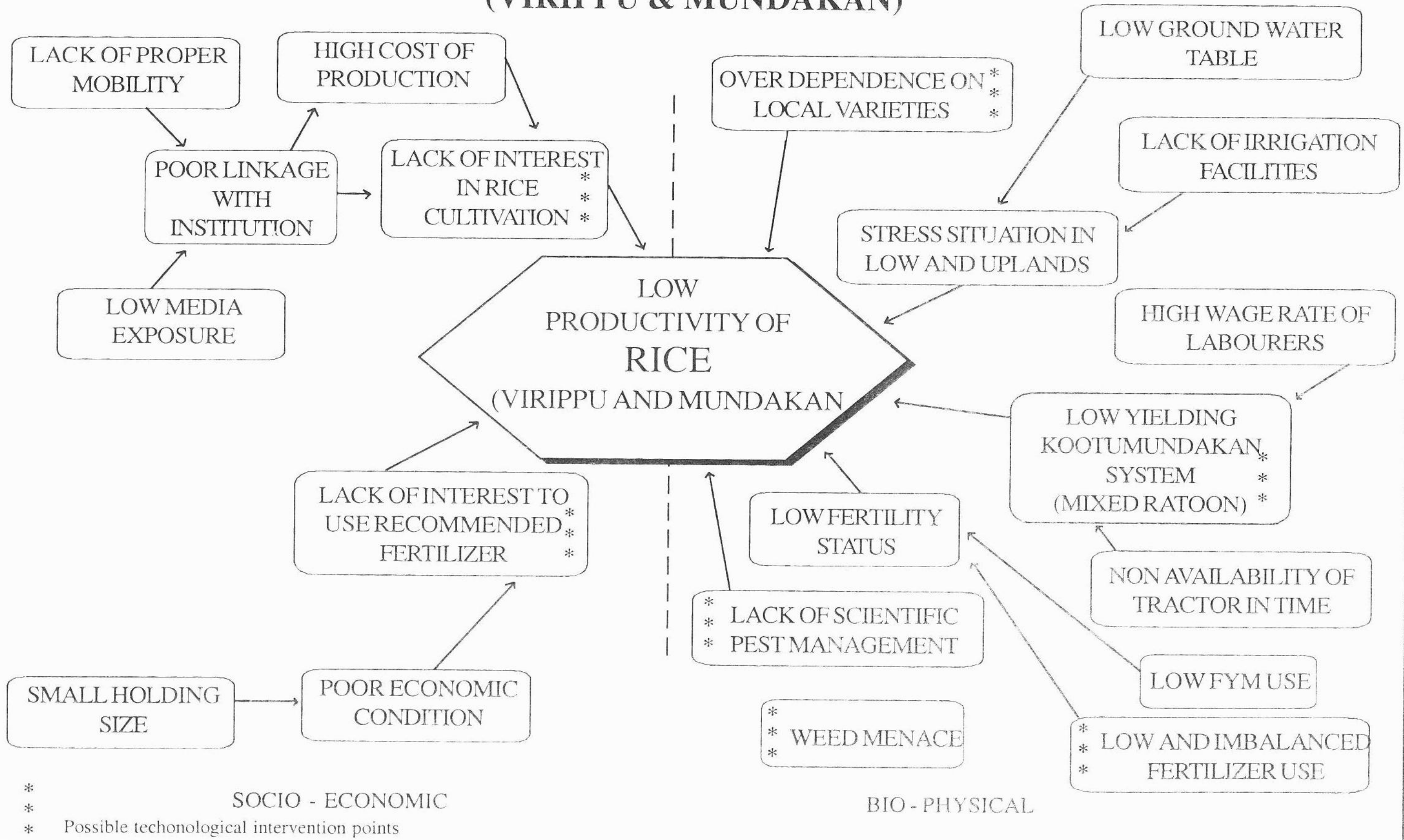
   c) Farmers reactions

      Access to technology source
      Confidence level
      Simplicity/complexity of operation
      Work quality
      Time saving if any
      Extent of drudgery alleviation
      Alternative suggestions

Improvisation of methodologies

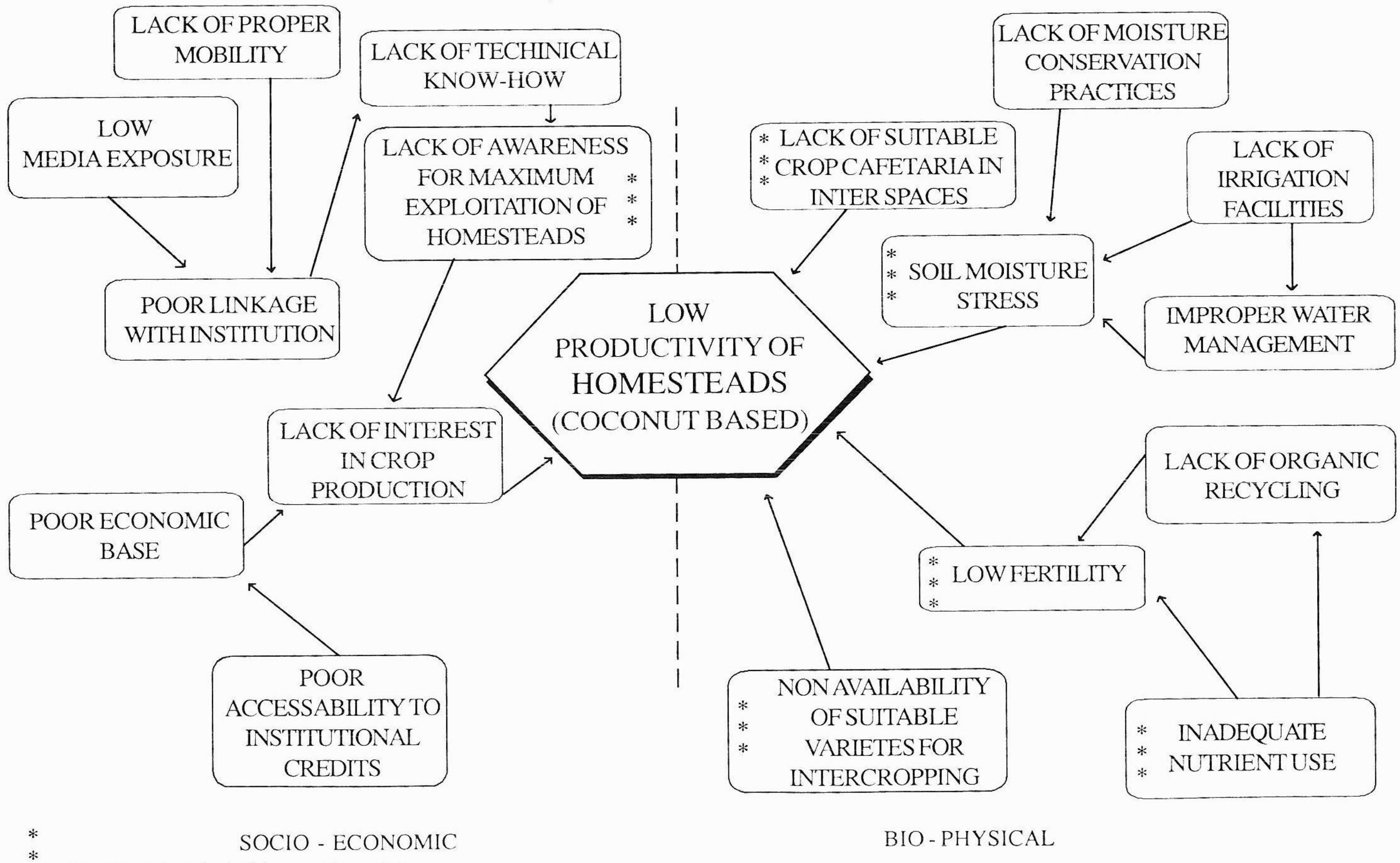
Farmers had their own ways of judging each technology for its positive and negative aspects. Tools used to convince them about the usefulness of the technologies should be such that they can use the same themselves. Use of less sophisticated measuring and weighing devices and easily adoptable techniques for observations and qualitative evaluation of each technology was ensured.

PROBLEM CAUSE RELATIONSHIP FOR LOW PRODUCTIVITY OF RICE
(VIRIPPU & MUNDAKAN)



PROBLEM CAUSE RELATIONSHIP FOR LOW PRODUCTIVITY OF HOMESTEADS

(COCONUT BASED)



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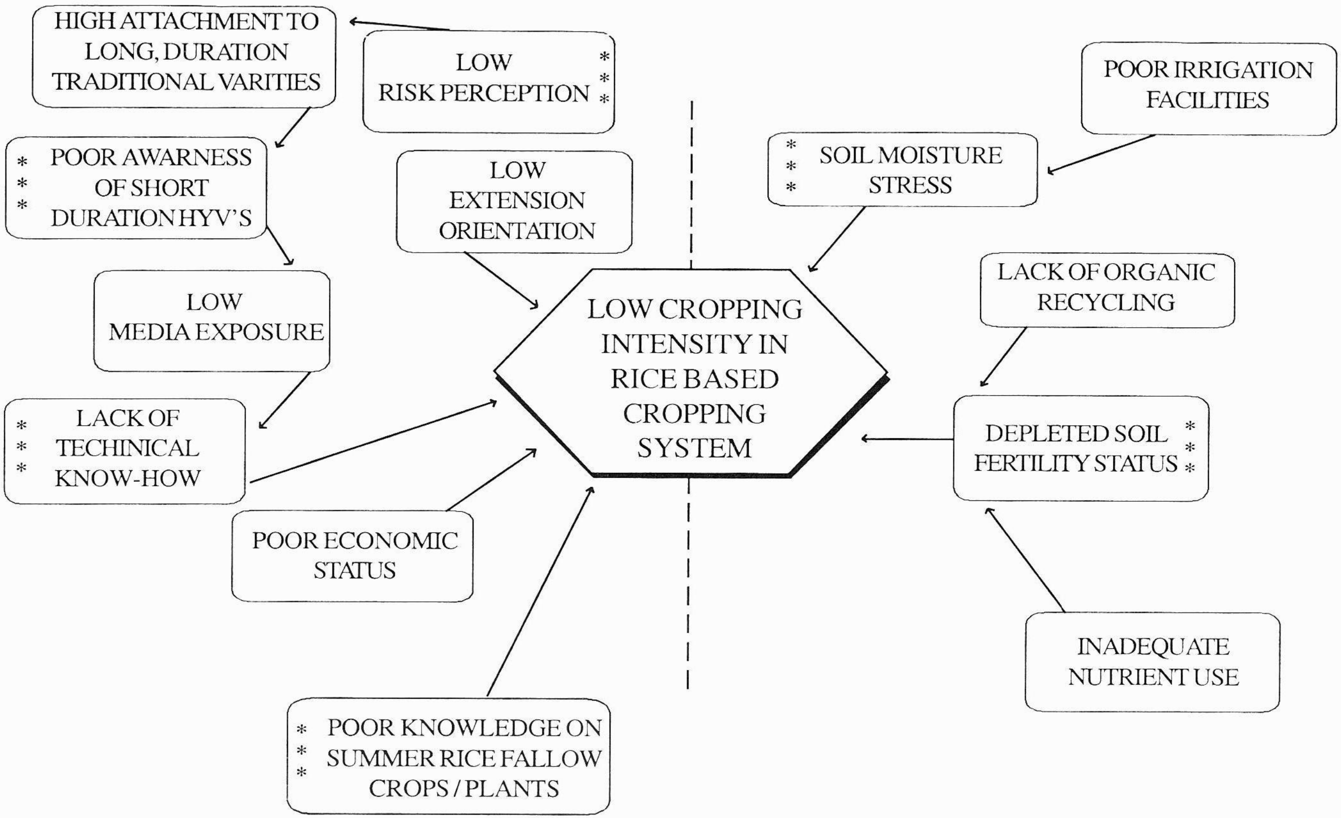
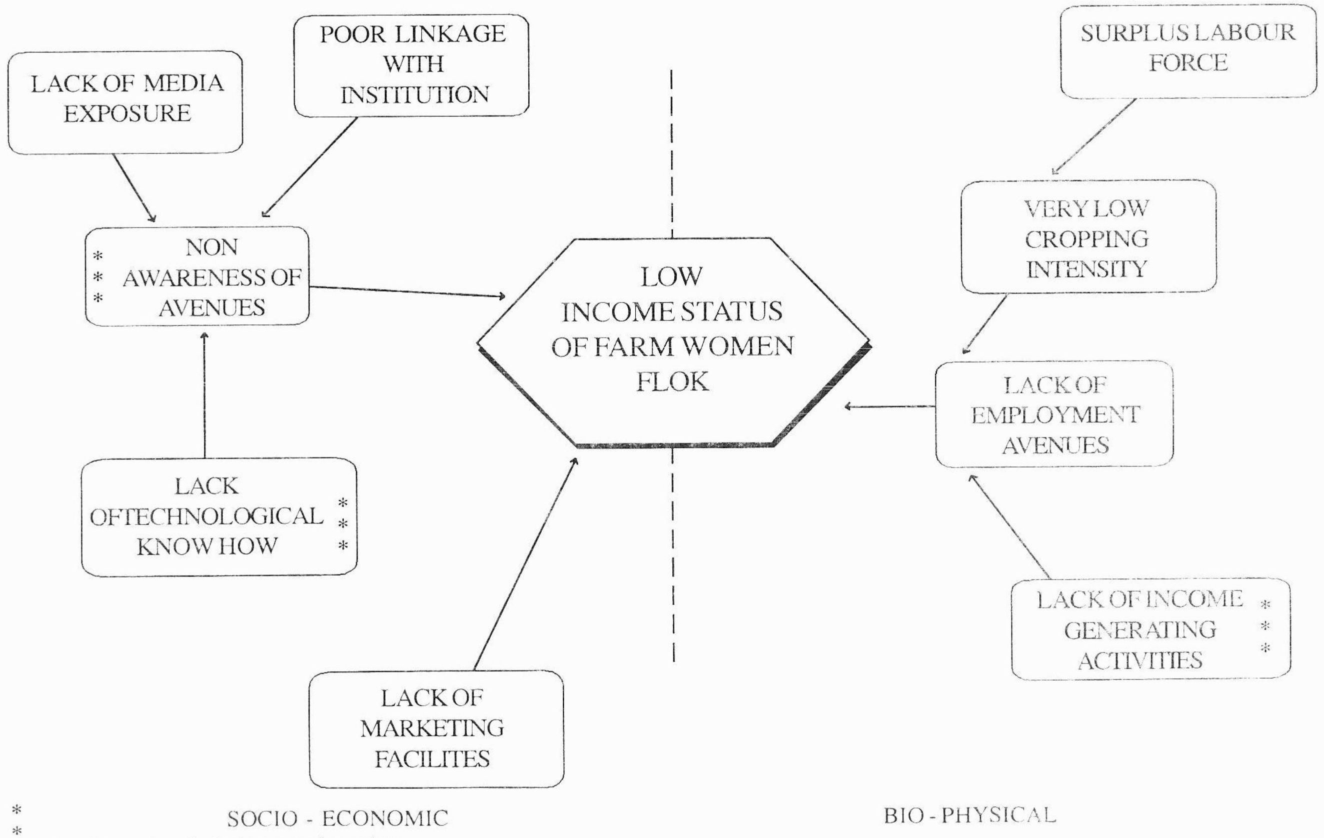
Possible techonological intervention points

LOW CROPPING INTENSITY IN RICE BASED CROPPING SYSTEM PROBLEM CAUSE RELATIONSHIP



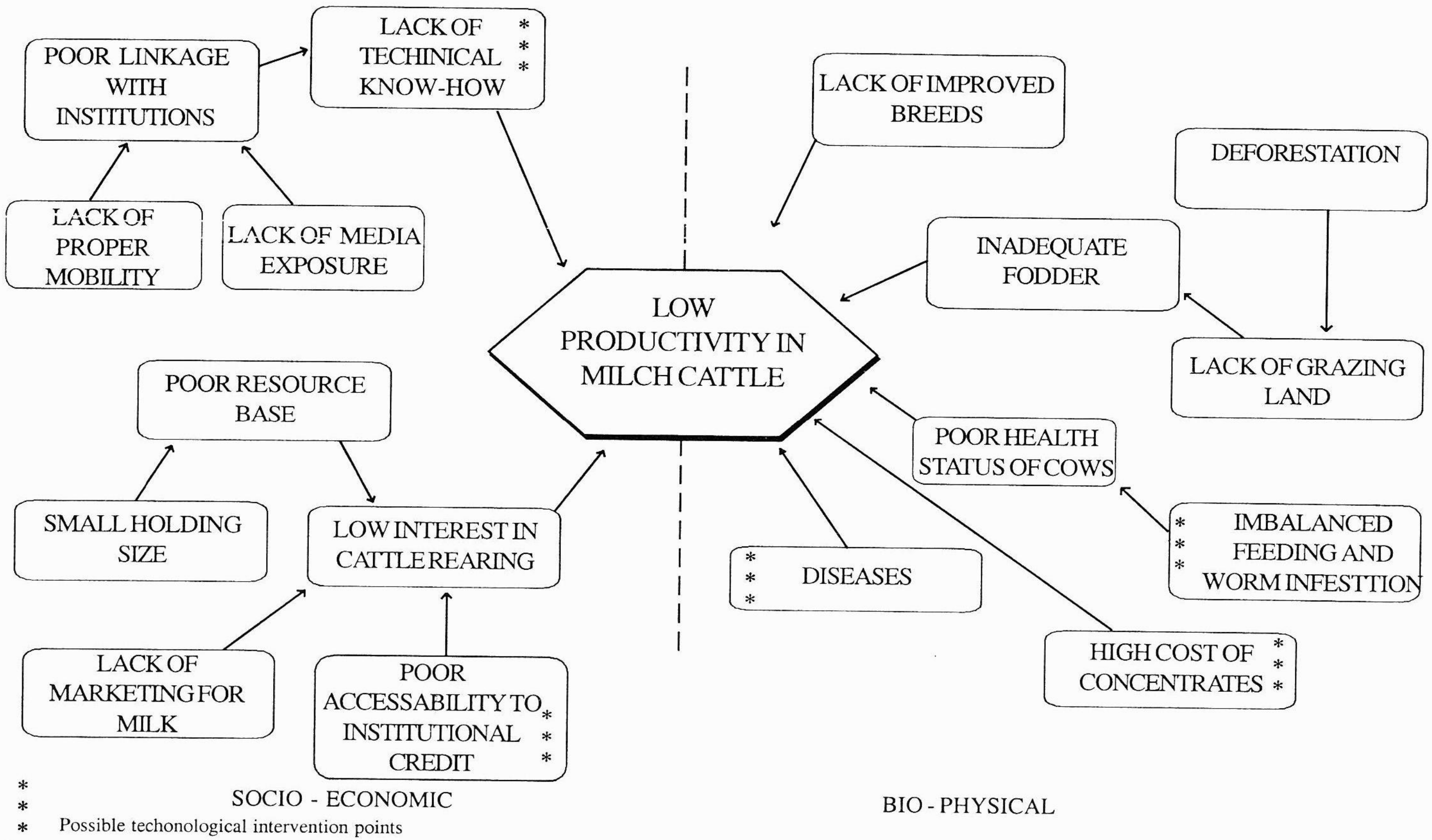
* * * Possible techonological intervention points

PROBLEM CAUSE RELATIONSHIP FOR LOW INCOME STATUS FOR FARM WOMEN FOLK

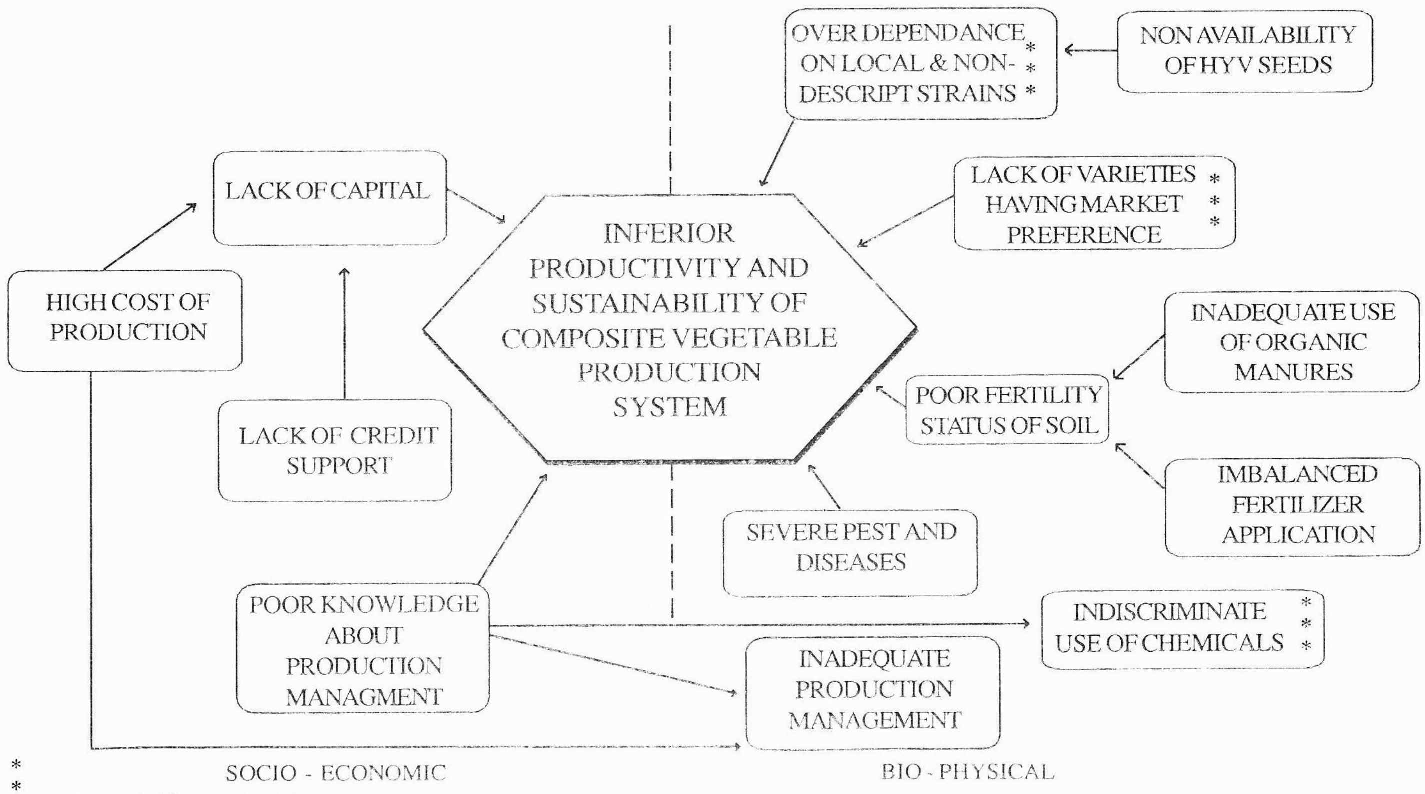


* * * Possible techonological intervention points

PROBLEM CAUSE RELATIONSHIP FOR LOW PRODUCTIVITY IN MILCH COWS



PROBLEM CAUSE RELATIONSHIP OF INFERIOR PRODUCTIVITY AND SUSTAINABILITY OF COMPOSITE VEGETABLE PRODUCTION SYSTEM



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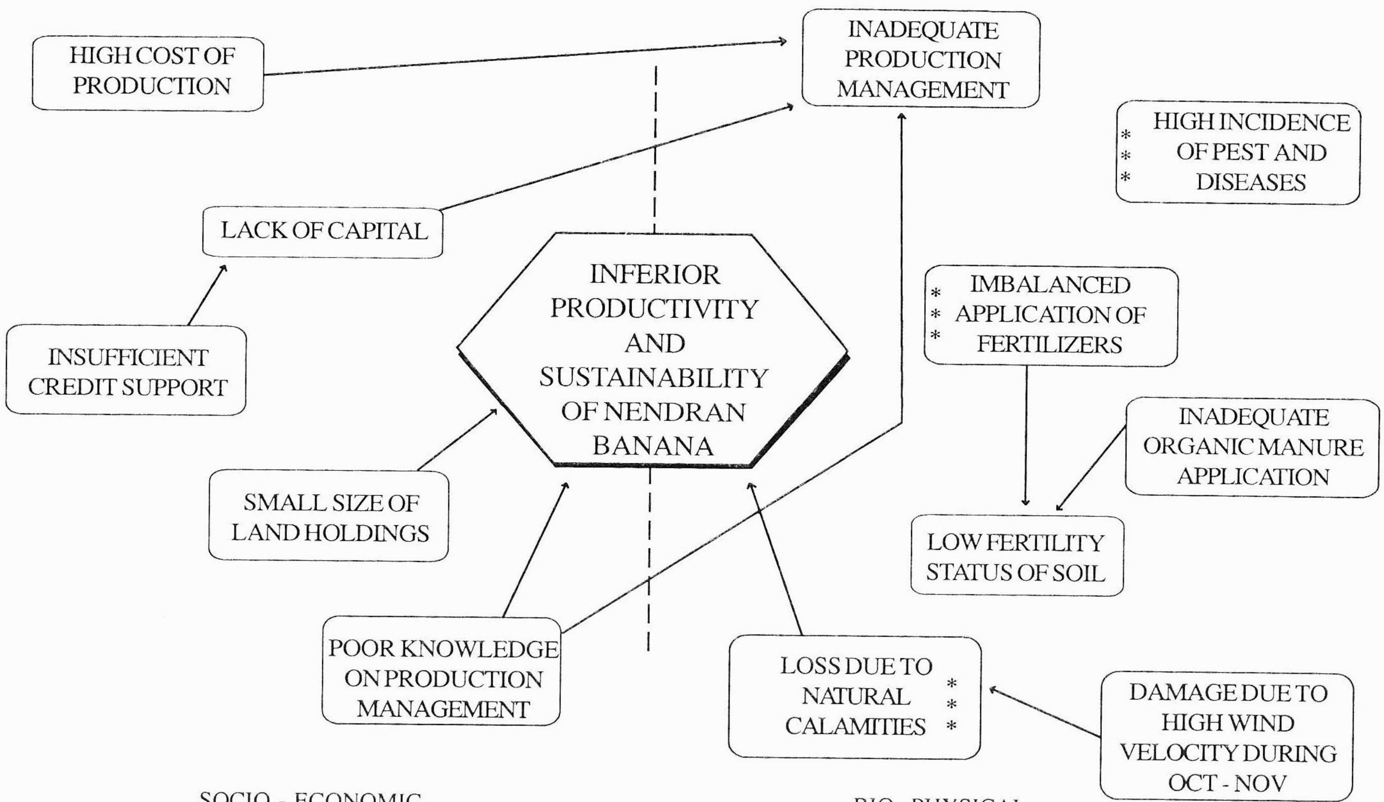
* Technological Intervention points

PROBLEM CAUSE RELATIONSHIP OF INFERIOR PRODUCTIVITY AND SUSTAINABILITY OF NENDRAN BANANA



SOCIO - ECONOMIC BIO - PHYSICAL

*
*
* Possible techonological intervention points

Table 12. Technology matrix

Problem	Important causes	Theme(s)	Generated technologies available	Existing (farmers) practice	Technology taken for assessment
1. Low productivity of first crop (*Virippu)* and second crop (*Mundakan)* in rainfed uplands and wet lands	1. Inherently low yielding traditional *Koottumundakan* (mixed ratoon of I and II crop) system under transplanted condition	Natural Resource Management (NRM)	*In situ* growing of daincha in summer fallows, its incorporation during land preparation	Fallowing the lands during summer meager quantities of cow dung and green leaf manuring during land preparation.	*In situ* broadcasting of daincha (*S.aculeata*) in summer KH fallows followed by two dosages of NPK fertilizers for both I and II crop 40:20:20 kg/ha
	2. Low use of organic manures and fertilisers	Integrated Plant Nutrient Management (IPNM)	NPK fertilizers in two splits for I crop & single dose in II crop	Application of urea alone during II crop after I crop cut	NPK @ 40:20:20 and 20:10:10 kg/ha NPK respectively for I and II crop.
	3. Inherently low yielding traditional *Koottumundakan* under broadcast condition	NRM	Pre-emergent weedicide application + NPK fertilizers	Application of cow dung + manual weeding	Use of pre/post emergent weedicides
	4. Low use of organic manures and fertilizers	NRM/SE		Application of cow dung manual weeding	
	5. Weed menace	IPNM/ Socio-Economic (SE)	Pre-emergent weedicide		Pre emergent weedicide
	6. Over dependence on low yielding conventional local varietal combinations	NRM/SE	Nil	Farmers' practice (*Chenkazhama* + *Chettadi*)	Evaluation of 3 new combinations of HYVs/or HYV+ traditional variety

Table 12. Technology matrix

Problem	Important causes	Theme(s)	Generated technologies available	Existing (farmers) practice	Technology taken for assessment
II. High cost of production and drudgery in first and second crop rice cultivation	1. High labour cost 2. Labour the costliest single input 3. Acute labour scarcity during peak periods of operation of nursery pulling out, spraying harvesting and threshing. 4. Drudgerous and labour consuming operation in rice cultivation (nursery pulling out and transplanting, spraying, harvesting and threshing)	SE SE SE / NRM NRM	1. Manually operated 6 row transplanter, self propelled Chinese type 8 – row transplanter and mat nursery 2. Need based spraying with power sprayer 3. Harvesting with self propelled Vertical Conveyor reaper – windrower 4. Portable motorized mini thresher portable power operated rasp-bar thresher-cum-winnower	Conventional nursery, manual pulling out and hand transplanting by women Need based spraying with knapsack sprayer Harvesting with country sickle Conventional method of beating and treading by feet	Skill training, method demonstration & perception assessment on self propelled Chinese type 8 – row transplanter and Mat nursery Need based spraying with Power Sprayer Harvesting with self propelled Vertical Conveyor reaper – Windrower 1. Portable motorized mini thresher 2. Portable power operated rasp-bar thresher-cum-winnower
III. Low productivity of first crop (*virippu*) in the rain fed uplands under initial drought situation	Low productivity of landraces Non use of HYVs matching with the prevailing stress situation	NRM / SE	Medium duration HYVs for upland and wet land situations	*Thavalakannan, Kazhama, Kunjukunju*	Medium duration HYVs in rain fed uplands under initial drought situation (*Aiswarya, Kanchanan, Jyothi*)

IV. Low productivity of first crop (*Virippu*) in the rain fed low-lands under initial drought and terminal flood situations	Low productivity of landraces Non use of HYVs matching with the prevailing stress situation	NRM /SE	Medium duration HYVs for normal situations	Landraces – *Thavalakannan, Kazhama*	Medium duration HYVs in rain fed lowlands under initial droughty and terminal flood situation
V. Low productivity of second crop (*Mundakan*) in the rain fed uplands under terminal drought situation	Low productivity of landraces Non use of HYVs matching with the prevailing stress situation	NRM /SE	Medium duration HYVs for normal situations	Landraces – *Thavalakannan, Kazhama, Chettadi*	Medium duration HYVs in rain fed uplands under terminal drought situation
VI. Low productivity of second crop (*Mundakan*) in the rain fed low lands under terminal drought situation	Low productivity of landraces Non use of HYVs	NRM /SE	Medium duration HYVs for normal situations	Landraces – *Thavalakannan, Kazhama, Kunjukunju*	Medium duration HYVs in rain fed uplands under terminal drought situation
VII. Low productivity of second crop (Late sown single crop in '*Karinkora*' wetland)	Low productivity of landraces Non use of HYVs	NRM /SE	High yielding long duration photosensi-tive varieties	Landrace – *Chettadi*	High yielding long duration photo sensitive variety – *Nila* (Ptb-48), *Karuna* (Ptb-54)
VIII. Low productivity of	Imbalanced feeding of animals	NRM /SE	Improved strains of fodder crops	Feeding paddy straw, kitchen wastes and inadequate quantities of	Hybrid Napier Guinea grass and Congo signal

milch cattle (reared in homesteads under limited resource conditions of the homestead backyards)	Lack of fodder crops suitable for rain fed homesteads		fodder crops	oil cakes	in the vacant spaces of homesteads
IX. Low productivity and profitability of vegetables in second crop and summer rice fallows	Inadequate use of organic manure Imbalanced fertilizer application	NRM /SE NRM /SE	Basal FYM+NPK fertilizers Top dressing NPK fertilisers In several splits (depending upon the type of vegetable crops)	Meagre quantities of organic manure (Chicken manure) and Factomphos in several splits – Potash is neglected	Chicken manure + regionally recommended dosage of NPK for cucumber, ash gourd, bitter gourd Vermicompost + regionally recommended dosage of NPK organic manure alone in high dosage
X. Low income status of women folk	Lack of income generating activities for women Non awareness of avenues Lack of technical know how on nushroom, poor productivity	NRM /SE SE NRM	Growing oyster mushrooms in the homestead backyards Training and media exposure Training in mushroom culture	Cultivation of non-descript strains using spawns from private agencies	*Pleurotus sp* variety Co-1, *Vellayani-1* *Ananthan*
XI. Low income status of women folk	Lack of income generating activities for women Non awareness of avenues	NRM /SE SE	Apiculture in homesteads Training and media exposure	Rearing honey bee in the homesteads	Placing bee hives in rubber plantations Placing bee hives in cashew and mango

	Lack of technical know how Comparative performance of Indian honey bees in different Agri-hort production systems	SE NRM	exposure Training in Apiculture		cashew and mango predominant orchards Placing bee hives in vegetable and coconut gardens
XII. Low productivity of first crop rice in rain fed double cropped terraced uplands	Low fertility status of the soil Low use of organic manures High cost of green leaf manuring High labour cost involved in organic manuring	NRM NRM /SE NRM /SE SE	*In situ* green manuring and NPK fertilizers & Organic manures @ 5 t/ha *In situ* green manuring and incorporation	Ploughing once and leaving fallow after second crop paddy and applying green leaves transported from elsewhere	*In situ* production of *Daincha – Sesbania aculaeta* *In situ* production of sunhemp – *Crotalaria juncea* kozhingil/ wild indigo-*Tephrosea purpurea*
XIII. Low productivity of first crop rice (in rain fed double cropped wetland)	Low fertility status of the soil Low use of organic manures High cost of green leaf manuring High labour cost involved in organic manuring	NRM NRM/SE NRM/SE SE	*In situ* green manuring and NPK fertilizers & organic manures @ 5 t/ha *In situ* green manuring and incorporation *In situ* green manuring and incorporation	Ploughing once and leaving fallow after second crop paddy and applying green leaves transported from elsewhere	*In situ* production of Daincha – *Sesbania aculeata* *In situ* production of subhemp – *Crotalaria juncea* In situ production of *Kozhingil*/wild indigo *Tephrozea purpurea*

Action plan

Detailed action plan for each year was drawn up based on the intervention points. The interventions were broadly grouped as on farm trials (OFTs). Verification trials (VTs) skill development programmes and campaigns. Detailed action plans prepared was discussed in the Site Committee and finalized. This action plan included the plan of work, observations, performance indicators and feed back analysis. Critical inputs in each intervention were provided under the project. Farmers themselves were involved in observations and evaluation of results. In all these the primary role for the farmer himself was ensured right from identification of problem and formulation of research plan. Adaptive research activity with farmers own management and perception and participation was ensured. In each intervention its advantages/limitations of the technology tested was analysed and documented.

Forward linkage with other organizations/institutions

The programme implementation was done establishing a constant linkage with officials of development departments and institutions.

The Department of agriculture, Government of Kerala provided support for the programme during selection of village, problem identification and finalisation of action plan.

The Krishi Vigyan Kendra, Pattambi is involved in the conduct of training programmes evaluation of impact of technologies in the selected areas.

The Central Plantation Crops Research Institute (CPCRI), Kasargode and Central Tuber Crops Research Institute (CTCRI), Trivandrum also provided support to the programme

All the research stations under KAU provided technology inputs.

Chapter VI

RESULTS

This chapter is on the results obtained from various interventions and refinement of technologies based on field evaluation.

Rice and rice based cropping systems

Micro farming system : Upland rain fed (broadcast/transplanted) first crop paddy

In this MFS, four important factors that influence productivity were identified.

1. Uncertainty of rains/summer showers/monsoon showers for start of the crop
2. Use of varieties with low production potential
3. Heavy weed population in broadcast crop
4. Poor management practices (Nutrient management and pest/disease management

The interventions under the project were planned to address these issues. A number of high yielding varieties developed at RARS Pattambi as well as other centers under Kerala Agricultural University were introduced to the farmers and the characteristics of each variety and its yield potential was described to them. Based on their suggestions varieties were selected for assessment under the micro farming situation. Suitable practices for broadcast paddy (weed management and management of pests and disease) were also selected from the available and proven technologies.

On farm trials using high yielding varieties

Broadcast paddy

The objectives of these interventions were to assess the performance of high yielding varieties under broadcast system and to work out the cost benefit analysis. Several varieties were assessed for their adaptability to this MFS and acceptability to the farmers. The performance indicators of the varieties during different seasons are shown in table.

Table 13. Performance of High Yielding Varieties

Variety	Grain and straw yield (t/ha)	
	99-00	00-01
Farmers variety (*Kunjukunju*)	2.20 (2.25)	2.09 (2.00)
Kanchana	4.24 *(4.15)*	*4.40* *(4.28)*
Aiswarya	4.05 (4.25)	*4.95* (5.53)

Straw yield in brackets

On Farm Trial of HYVs for transplanted paddy

This intervention was planned in order to recommend a suitable variety for the micro farming situation as transplanted crop. Performance of medium duration HYVs were assessed under the trial. Three improved varieties were compared with farmers own variety named *Kunjukunju*. Soil nutrient status of each plot was analysed to assess the nutrient requirements. Timely management practices for pests like stem borer, leaf roller and rice bug was adopted in the crop. These practices also helped the farmers to identify the type of pest/disease symptoms, awareness about causal organisms and also some possible measures for control. The trial also provided an opportunity to analyse the cost benefit balance of the production enterprise. The results of experiment was analysed in focused group interview to derive conclusions.

Table 14. Performances of medium duration HYVs (2000-01)

Variety	Grain yield, t ha^{-1}		Straw yield, t/ha		C:B ratio	
	Broadcast	TP	Broadcast	TP	Broadcast	TP
Farmers variety *(Thavalakkannan)*	1833	2133	2245	2583	1:1.07	1:1.62
Kairali	1916	2583	2083	2800	1:1.06	1:1.4
Kanchana	2249	2717	2333	2917	1:1.23	1:1.51
Aiswarya	2500	3166	2750	3250	1:1.37	1:1.54

Performance of short duration variety of paddy – *Matta Triveni*

Matta Thriveni is another paddy variety which has become popular in many parts of the state. This variety has shown good production potential under congenial conditions. The verification trial conducted in the IVLP villages comparing *Matta Triveni* with the local variety Thavalakkannan had shown that *Matta Triveni* could give 64 per cent more yield.

Table 15. Comparison of performance of short duration paddy varieties (2001-02)

Variety	Grain yield t ha^{-1}	Straw yield t ha^{-1}	C.B ratio t ha^{-1}
Matta Triveni	4.03	4.42	1:2.24
Thavalakkannan (Farmers variety)	2.62	3.11	1:1.51
Revathy	4.1	4.2	1:2.12
Remanika	4.3	4.0	1;2.06
Ahalya	3.80	4.0	1:1.75

Varieties were rated with respect to various traits by group consensus through focused group interview.

Table 16. Qualitative assessment of varieties

Traits	Red Thriveni	Thavalakkannan	Revathy	Remanika	Ahalya
Fast growing Medium	Medium	Medium	Medium	Medium	Medium
Withstand water stress in nursery	Low	High	Medium	Medium	Medium
No. of tillers	High	Low	Medium	Medium	Medium
Pests/ diseases in nursery	Medium	Low	Low	High	Medium
Pests / diseases in main field	Low	Low	Low	High	Medium
Care required for cultivation	Low	Low	Medium	Medium	Medium
Flowering habit	Uniform	Uniform	Uniform	Uniform	Uniform
Lodging habit	Low	High	Low	Low	Low
Length of year head	Medium	Medium	Medium	Medium	Medium
Chaff content	Low	Low	Low	Low	Low
Grain size	Medium	Large	Large	Large	Large
Grain weight	Medium	Medium	Medium	Medium	Medium
Grain shedding	Low	Low	Low	Low	Low
Vivipary	Low	Low	Low	Low	Low
Ease to thresh	Easy	Low	Low	Low	Low
Yield potential	Medium	Low	Medium	Medium	Medium
Straw yield and quality	Medium	High	Medium	Medium	Medium
Taste	Good	Good	Good	Good	Good
Volume expansion	Medium	Good	Good	Good	Good
Time taken for cooking	Medium	Medium	Medium	Medium	Medium

There is a preference for rice kernel varieties of paddy among farmers in the area. Assessment of medium duration red kernel varieties were done comparing the performance with prevalent local variety *Kunjukunju*. The results indicated that varieties *Red Mashoori* and *Jyothi* could give 10 to 30 per cent higher yield compared to *Kunjukunju*.

Different varieties tested under the MFS I & II was ranked in terms of preferential traits adopting focused group interview. All the varieties tested under the micro farming situation performed well compared to farmer's varieties. Qualitative traits assessed based on focused group interview indicated that the newly introduced varieties were having comparable quality as that of local types.

On Farm Trial with agronomic/management practices for improving productivity of rice.

Important areas in which interventions were made in relation to rice production under different micro farming situations included nutrient management, weed management and pest/disease management.

Recommendations based on soil analysis had been developed on a zonal basis for each group of rice (short/medium/long duration) varieties. Verification trials were conducted under single cropped upland conditions to demonstrate the effectiveness of balanced fertilizer use. Yield increase to the tune of 34 per cent and increase in net return to the tune of 50 per cent could be realized by adopting these practices.

Table 17. Response of balanced fertilizer use on yield of paddy grown on single cropped uplands (var. *Jyothi*)

Nutrient management practice	Productive tillers/hill	Grain yield t/ha	Per cent increase in yield	Per cent increase net returns
Farmers practice (cow dung 2.5 t/ha NPK 30:20:0 kg/ha)	5.8	2.72	-	-
Recommended practice (Cow dung/FYM=5t/ha NPK 90:45:45 kg/ha)	8.60	3.65	34.2	50.2

Focused group interviews were conducted to evaluate performance of crops with or without fertilizer use.

Table 18. Performance parameters for assessment of fertilizer use

Sl. no	Attributes	Reaction
1	Quick growth	YES
2	More number of tillers	YES
3	More incidence of pests and diseases	YES
4	Uniform flowering	YES
5	More lodging of plants	YES
6	Long and strong ear heads	YES
7	Less chaff content	Neutral
8	More size for grain	Neutral
9	More weight for grain	YES
10	More yield	YES
11	More straw yield	YES
12	High weed menace	YES

Use of weedicides in dry sown / transplanted crop

Weed menace is a major limiting factor in rice production in the single cropped uplands. Efficacy of two pre emergent weedicides namely Butachlor @ 1.25 kg ai per hectare or Pretilachlor @ 1.0 kg ai per hectare and a post emergent weedicide 2,4-D sodium salt @ 1kg ai per hectare were assessed. Under ideal soil moisture conditions application of pre emergent weedicides were very effective in controlling weed growth in the fields. The labour engaged for weeding operation was reduced to 20 per cent or less with the weedicide application. The saving in cost of weeding was Rs. 800 to Rs. 1000 per hectare. The farmers had expressed a number of mis-conceptions on the use of weedicides such as

1. It will adversely affect germination of rice
2. It will affect quality of straw and grain. Straw cannot be fed to cattle
3. All types of weeds will not be controlled
4. Spraying is difficult

In the case of post-emergent weedicide also the farmers expressed similar feelings prior to use of the chemical, but such impressions could be removed with the intervention.

The pre emergent weedicides could be used only when there is sufficient moisture. Rainfall immediately after application of chemical also affected the efficacy.

Increasing cropping intensity with a second crop of vegetables after harvest of I crop paddy

Single cropped uplands are well suited for growing vegetables. Crops like Amaranthus, Bittergourd, Ashgourd, Cucumber, Bhindi, Cowpea, Brinjal and Snakegourd were evaluated.

Table 19. Yield of vegetable crops from single cropped uplands

Crop	Variety	Yield under the micro farming system (t/ha)
Amaranthus	*Kannara local*	5.4
Bitter gourd	*Priya*	8.0
Ash gourd	*KAU local*	18.0
Cucumber	*Mudikode*	11.5
Bhindi	*Arka Anamika*	6.8
Brinjal	*Soorya*	10.0
Cow pea	*Bhagyalakshmi*	6.5
Bottle gourd	*PSPL*	9.0

Pulse/ oil seed crops was another alternative after the harvest of paddy. Performance of black gram green gram and cow pea were assessed.

Table 20: Yield of pulse crops from rice fallows

Crop	Variety	Yield obtained kg/ha
Black gram	*T9*	400
Green gram	*CO.2*	256
Horse gram	*Maru kulthi*	150

Low land rainfed/irrigated first and second crop paddy (broadcast/transplsnted)

The double-cropped paddy lands represent a unique system in the ecological balance in the coastal agro eco system. Rice productivity in the double cropped lands in the district show wide variation from 2.5/ha to 8t/ha. In this micro farming system within the selected villages the productivity an average is 2t/ha. In this MFS also the reasons for low productivity identified include poor fertility of land, low yield potential of varieties used poor plant stand and poor management. Field interventions were planned to address these issues.

Use of improved varieties

Improved short, medium and long duration varieties of paddy were testedfor the first and second crops in this MFS. The performance of all the varieties were better compared to farmers' varieties. Variety *Panchami* did not perform well in the tract.

Table 21. Comparison of HYVs in double cropped wet lands

Variety	Crop season	Yield, t/ha	Increase in yield over farmers variety t/ha	Per cent increase in yield	C:B ratio
Aiswarya *Chenkayama*	I	2.81 2.30	0.51	22.1	1:1.6 1:1.4
Kanchana *Thavalakkannan*	I	2.11 1.78	0.33	18.5	1:1.23 1:1.09
Karuna *Chettadi*	II	4.0 3.10	0.9	29.0	1:1,5 1:1.2
Makaram *Chettadi*	II	4.05 3.50	0.55	13.5	1:1.79
Kumbham *Chettadi*	II	4.23 3.50	0.73	20.8	1:1.86 1:1.57
Pranavam *Chettadi*	II	4.67 3.50	1.17	33.4	1:2.16 1:1.57

In spite of the good yield recorded by variety *Pravana*, farmers gave less preference due to its white coloured grain.

Table 22. Comparison of multiple resistant Medium duration variety under transplanting

Variety	Crop season	Yield, t/ha	Increase in yield over farmers variety t/ha	Per cent increase in yield	C:B ratio
Panchami	I	2.0	1.50	4,2	1:0.96
Pavithra	I	4.8	0.8	22.8	1:2.20
Uma	I	4.0	0.5	14.3	1:1.84
Kunjukunju	I	3.5	-	-	1:1.67

Farmers rated the rice varieties based on a number of characters apart from grain yield and straw yield. Few such characters are indicated here

Table 23. Qualitative assessment of Short/medium duration rice varieties

Characters	*Aiswarya*	*Kanchana*	*Matta Thriveni*	*Kunjukunju*
Acceptability	Acceptable	Acceptable	Acceptable	Acceptable
Growth habit	Fast growing	Fast growing	Fast growing	Fast growing
Tillering	Good	Good	Good	Good
Resistance to pests/ diseases	Satisfactory	Satisfactory	Low	good
Flowering habit	Uniform	Uniform	Uniform	Uniform
Yield Potential	Very good	Good	Good	Good
Straw yield	Good	Good	Good	Good
Volume expansion on cooking	Moderate	Moderate	Moderate	Moderate
Grain colour	Acceptable	Acceptable	Acceptable	Acceptable
Cooking quality	Good	Good	Good	Fair

Table 24. Qualitative assessment of long duration rice varieties

Characters	*Chettadi*	*Makaram*	*Kumbham*	*Pranava*	*Karuna*
Acceptability	Acceptable	Acceptable	Acceptable	Grain colour not acceptable	Acceptable
Growth habit	Lanky	Sturdy	Sturdy	Sturdy	Unwieldy
Tillering	Good	Good	Good	Good	Good

Characters	*Chettadi*	*Makaram*	*Kumbham*	*Pranava*	*Karuna*
Resistance to pests/diseases	Satisfactory	Satisfactory	Good	Good	Good
Flowering habit	Uniform	Uniform	Uniform	Uniform	Fairly uniform
Yield potential	good	Good	Good	Very good	Very good
Straw yield	Good	Good	Good	Good	Good
Volume expansion on cooking	Moderate	Moderate	Moderate	Moderate	Good
Grain colour	Acceptable	Acceptable	Acceptable	Not acceptable	acceptable
Cooking quality	Good	Good	Good	Good	Good

Optimum plant density for transplanted crop

The number of plants per unit area, number of productive tillers and number of grains per panicle are important components of rice yield. Optimum plant density is essential in order to achieve the desired results. The traditional practice is to go for wider spacing and placing more number of seedlings per hill. The plant population per square metre is in the range of 28-30. Increasing the population will be a practice that can ensure higher yields. Verification trials were conducted comparing farmers practice with the recommended practice with respect to plant stand. 18.21 per cent higher yield could be recorded with this low cost/no cost intervention.

Table 25. Comparison of crop performance with optimum plant population

Treatment	Variety	Grain yield t/ha	Straw yield t/ha	Addl. grain yield over farmers practice t/ha	C:B ratio
Farmers practice (28-30 hills/m^2) 6-8 plants/hill	*Aiswarya*	2.62	3.04		1:1.9
	Kanchana	2.68	2.89		1:1.3
	Red Triveni	3.40	3.70		1:1.5
	Karuna	4.38	4.70		1:1.9
Recommended practice 50 hills/m^2 4-5 seedlings/hill.	*Aiswarya*	3.07	3.60	0.45	1:2.2
	Kanchana	3.08	3.36	0.45	1:1.4
Recommended practice 50 hills/m^2, 3-4 seedlings/hill	*Aiswarya*	3.17	3.71	0.55	1:1.4
	Kanchana	3.14	3.40	0.46	1:1.4
	Red Triveni	4.2	4.6	2.0	1:1.9
	Karuna	4.9	5.0	0.68	1:2.2

Farmers perceptions on this intervention provided few interesting information. They felt that this is a low or no cost technology. There is an increase in labour requirement but this more than compensated by the higher yield. They also opined that the reduction in the number of seedlings per hill could be gradual since the women labourers engaged in these field operations have to be trained and accustomed to the modified practice. Ther was a feeling that floods during the initial stages could affect the crop stand.

In situ production of green manure

Sustenance of productivity of soil is major task to make the farming enterprise remunerative. Adequate supply of green manure and organic manure has to be ensured to sustain productivity. This was identified as one of the serious limitations. In order to ensure supply of sufficient quantities of green manures for paddy fields, *in situ* production of green manure crops has to be taken up. Double cropped lands where land is kept fallow for 3-4 months can also serve as source of green manure for succeeding crops. Two leguminous crops Daincha (*Sesbania aculeata*) and sunhemp (*Crotalaria juncea*) were used for *in situ* production of green manure in paddy fields. 17-18 t biomass could be produced per hectare of land. During the subsequent crop substantial reduction in weed population could also be observed.

Table 26. Addition of biomass from green manure crops

Treatment	Green manure t/ha
Crotalaria juncea	17.7
Sesbania aculeata	18.7

Farmer's reactions

Low cost technology
Reduction in weed growth in the succeeding rice crop
Fertiliser application can be reduced
Soil health improved

Sowing leguminous crop as green manure along with rice in the dry seeding system

Dry sowing or dibbling of seed on receipt of summer showers is a common practice in the project area. This practice saves cost of raising nursery and transplanting operations. Repeated adoption of this practice lead to poor productivity since organic supplements are not generally provided. Problem of weed growth when the rains are delayed also add to the cost of cultivation. Sowing a leguminous crop, cowpea along with rice during early May is a practice recommended to overcome both these problems. Under conditions of normal rainfall, the fields are flooded by second week of June and the cowpea plants are decayed providing organic manure to the field. Weed growth is also suppressed by the standing crop of cowpea. Verification trials conducted in the project area during 1999-2000 indicated drawbacks of the recommended technology when the rains failed. Under such conditions cow pea plants smothered rice and affected the crop. Based on further trials conducted with bush type cowpea varieties this technology was found very useful. Cowpea variety Pusa Komal was found suitable for the purpose. Two tons of organic matter was added per hectare of paddy land by this method

Improving fertilizer use efficiency

Resource management to extract maximum efficiency is another priority area for saving cost at the same time maximizing productivity. The fertilizer use efficiency is poor due to lack of proper water management and increasing fertilizer use efficiency by adopting suitable practices, which can be easily adopted by farmers, was a thrust area. Urea is the major nitrogenous fertilizer used for paddy. Mixing with neem cake can increase efficiency of applied urea. This practice was demonstrated through the verification trials conducted in farmer's fields. Data from trials indicated that yield advantage is more with this practice.

Table 27. Comparison of urea application methods

Treatment no.	No. of hills /m^2	Plant height (cm)	Effective tillers	Panicle length (cm)	No. of grains / Panicle	Grain yield t ha^{-1}
1	14	125	11	22.3	78	3.26 (C:B ratio = 1.23)
2	14	140	20	21.5	94	3.45 (C:B ratio 1.95)

1. Farmers practice (urea alone) 2. Urea with neem cake (5:1 ratio)

Utilisation of field bunds for raising vegetable crops

Paddy Field bunds provide potential areas for raising vegetables. Scope of fringe cropping in field bunds with cowpea was assessed during *khariff* and rabi seasons. During khariff season heavy rains affected the crop establishment and performance was not satisfactory. Crop establishment and performance was good during *rabi* season. Vegetable yield ranged between 250 to 600 kg from bunds of one hectare paddy land giving net saving ranging from Rs. 1250 to 3000. The cost benefit ratio ranged from 1: 1.7 to 1: 4.0

Labour saving technologies for saving costs and drudgery alleviation

Farming in general and rice farming in particular had become less profitable due to increasing expenditure on labour. The young generation is also not interested in toiling under hard conditions in the open fields thus making labour availability poor. Often there is a system of hiring labour from neighbouring states, which had also reduced openings available for employment. Mechanisation of farm operation for increasing efficiency and reducing cost had been a priority area for research.

Mechanisation of farming operations

Self propelled rice transplanter

Labour is the costliest single input in rice cultivation and the scarcity of labour affects timely operations there by reducing output. Transplanting operations in rice require about 20-25 women labourers per hectare of land. Timely planting and optimum plant population can be ensured by use of mechanical transplanting machines. The technologies for raising mat nursery, use of the transplanting machine, field requirements for using the machine etc. are few factors, which necessitated training. Training programmes of developing skill on these aspects were organized while introducing this technology. Comparison was made in the crop performance of machine planted as well as manually planted plots.

Table 28. Comparison of manual and machine planting of rice

Method of planting	No. of tillers/m^2	Plant height	No. of effective tillers	Yield t/ha	Aditional yield t/ha	Yield increase percent	Cost of operation (Rs.)	Savings (Rs.)
Manual	22.2	64.2	13.9	4.4	—	—	2100	
Machine	25.8	64.7	19	5.9	1.5	34	709	1391

Technical observations

The two methods of planting were compared based on the field requirements and other relevant specifications.

Table 29. Technical observations on machine planting

Particulars	Manual planting	Machine planting
Seedlings per hill	8	2-3
Spacing (cm)	Random	23.8X10
Hills per m^2	28.5	41.6
Age of transplanting (days)	28-30	17-20
Depth of water in the field (cm)	4 to 6	2 to 4
Depth of planting	Deep	Optimum

The ergonomic parameters of the machine as perceived by the farmers were recorded.

Foot and hand reach	Medium comfortable
Sitting posture and comfort	Medium
Visibility for operator	Poor
Noise and vibration	Low
Hazards to operator	Low
Loading mat nursery	Medium difficulty

Feedback from farmers

The technology of mechanization of planting is rice was effective on many counts. The crop performance was good, and substantial saving in terms of cost and drudgery alleviation was there. But this technology also had a few limitations. The feed back from farmers after the skill development cum demonstration programme was that there is a need for thorough training on preparation of mat nursery and machine operation. The existing requirements of water regulation, seedling age etc and small size of plots limit large scale adoption. Farmers were apprehensive about the success of the technology when they witnessed the machine in operation. They were not convinced since the seedlings used were so young. Once the crop was established and the luxuriant growth was observed, their apprehensions were removed. They were also convinced with the higher yield obtained from the machine planted plots. The nature of the terrains, size of plots and problems in management of water during the first crop planting season were other limiting factors. The machine could be used satisfactorily in the single cropped upland areas where water control was easy. Refinements on the method of raising mat nursery, age of transplanting, varieties, which are more suited for mechanized planting, are required.

Use of machine for transplanting displaces women labour. Focus is now given to provide training on use of transplanter to women labourers

Weed management in machine planted plots was possible with the use of Japanese hoes. The operation of hoes also provided a raking effect, which helped in better growth.

Tractor drawn seed dibbler

Manual dibbling of paddy seed is a common practice in the tract. First crop rice is raised by dry seeding methods. Tractor drawn seed dibbler was assessed in place of manual dibbling. The system was successful when the soil moisture level was sub-optimal. Under optimum moisture conditions the wet soil clogged the delivery tube and blocked the seed movement. Simple modifications in the dibbler could solve the problem of clogging. Modification is also required on the size of the scoop that transfer seed to the delivery system so that the quantity of seed delivered is increased

Vertical Conveyor Reaper

Harvest of rice is another labour intensive operation. Mechanisation of this operation will save both in terms of cost and drudgery of operation. Different types of harvesters are being used in major rice growing tracts. Utility of machines in the undulating terrains where the plot size is small has to be assessed before it is recommended. Verification trials were conducted in farmer's fields to assess the usefulness and cost effectiveness of the machine in the selected villages under all the micro farming situations.

Technical information

Working capacity	:	3.7 h/ha
Cutting height	:	10 cm
Grain loss	:	25 kg/ha
Cutting width	:	120 cm

Table 30. Performance of vertical conveyor reaper under field conditions

Treatment	Cost (Rs/ ha)	Saving (Rs/ha)
Manual harvest	1400	
VC Reaper	346	1053

Feedback

The reaper cannot harvest lodged crop and as such will not be useful for long duration tall types

Under wet soil conditions machine cannot be used for harvest. The conditions of rice fields during first crop harvest in all the micro farming situations in the project area is thus unsuitable for use of this machine.

Machine is ideal for medium stature non lodging type varieties during second crop harvest.

Skill development training is required for use of the machine

Custom hire facilities should be available for the machine

Power operated Hold on type and Rasp Bar type paddy threshers

Threshing is another operation which require considerable labour. The operation is generally done by women labourers. Use of suitable machines could be helpful to reduce the cumbersomeness of the operation. Two types of threshers were assessed in the project area.

Table 31. Performance parameters of different types of paddy threshers

Treatments	Cost per hectare (Rupees)	Saving (per cent)
Manual threshing	1397	
Motorised hold on type thresher	792	43.3
Power operated Rasp Bar type thresher	505	64

Table 32. Technical observations and ergonomic parameters

Particulars	Manual threshing	Hold on type thresher	Rasp Bar type thresher
Quality of grains	Good	Good	Good
Quality or straw	Good	Good	Medium
Chaff removal	Poor	Medium	Good
Extent of foreign matter removal	Medium	Medium	Good
Work efficiency	Poor	Medium	High
Height of operation (comfort)	Convenient	Convenient	Less convenient
Posture of operation	Least comfortable	Comfortable	Comfortable
Noise and vibration level	Low	Medium	High
Dust conditions	Medium	Medium	High
Hazards from machine parts	Nil	Medium	High

Feedback

The cost involved on the purchase of threshers especially Rasp Bar type threshers is high and farmers will not be able to afford the same. Custom hire facilities have to made available for wider use of the machine. Rasp – bar thresher being costly (Rs. 70,000), can be used on custom hire or as a group.

Long straw gets entangled in the wire loops of hold on thresher. Alternate design is needed to avoid this.

In all the interventions, which involved mechanization of operations, the investment required for acquisition of machine was beyond the capacity of the farmers. Co-operatives, which can make available such machines on customs hire basis, could be of great help. Road access and nature of the terrain are also important when the machines are to be moved.

Other interventions

Management of biotic stress due to pests and disease were cited, as a major problem in rice cultivation. Eco-friendly methods of pest management on the basis of Integrated Pest Management principles were assessed in farmers fields. Identification of based on symptoms, options available for management area were discussed and finalized. Use of pheromones, light traps and various cultural practices for pest population management were assessed.

Low land rain fed system with 'Koottumundakan' paddy cultivation

This system of rice growing has evolved over years with multiple objectives. In areas were land preparation operations during second crop season is difficult due to problems in water management, this system was the only option available. This is a low input organic production system where traditional varieties are used. Two distinct varieties of paddy seeds are mixed and sown in the field. 65-70 per cent of the seed will be that of a photo insensitive variety and rest that of a photosensitive variety. The system ensures two harvests with one sowing and requires very low management. The main drawback of the system is the low productivity of the first crop.

The interventions in this micro farming situation was to improve the productivity of this system through refinements in the varietal mixture, input management and cultural practices. Productivity of the first crop in which varieties like *'Chenkayama'* and *"Thavalakkannan'* are used range between 0.5 t/ha. to 1t/ha. A series of new varietal combinations were evaluated through on farm trials conducted under this micro farming situation. The results of trial concluded during 1998-99 with different combinations are indicated below.

Table 33. Performance of modified varietal combinations in the *Koottukundakan* system of rice cultivation.

Combinations	Cumulative green yield t/ha	Straw yield t/ha	Grain yield increase (per cent)
1998-99			
Farmers combination *(Chenkayama & Chettadi)*	3.61	4.2	–
Aiswarya & Chettadi	3.04	4.0	-15.8
Chenkayama & Nila	2.72	3.50	-24.7
Aiswarya & Nila	2.82	3.40	-21.9

In the first series of varietal combinations tried, it was observed that the combination evolved by farmers was more productive. Inclusion of high yielding varieties in the mixture was not effective. The vegetative/reproductive growth phases mismatched and the performance was negatively affected. This failure observed was fed back to research system. Based on further trials with new combination of varieties, inclusion of *Swarnaprabha, Makaram and Kumbham* in the system was found promising. These combinations were included in the On Farm Trials in the IVLP villages. Results have shown that these combinations are adoptable and productive. This system of cultivation, which in economic terms is more viable, needs further refinement.

Table 34. Assessment of refined technology in *koottumundakan* system

Combination	Grain and straw yield* I crop (t/ha)	Grain and straw yield* II crop	C:B ratio
Farmers' combination (Chenkayama & Chettadi)	1.60 (4.40)	3.9 (4.10)	1: 1.59
Swarnaprabha & Chettadi	2.80 (3.60)	4.05 (4.30)	1: 1.94
Swarnaprabha & Makkaram	2.85 (3.40)	4.16 (4.40)	1: 1.98
Chenkayama & Makaram	1.98 (3.10)	3.88 (4.40)	1: 1.67

*Straw yield in brackets.

The traditional *Koottumundakan* system is an organically managed one. Integrated nutrient management system was also identified as a strategy for improving productivity of the system. Thus interventions on integrated nutrient management system in *Koottumundakan* was also made. Graded dose of chemical fertilizers were used during first and second crop.

Table 35. Assessment of IPNM practices in *Koottumundakan*

Nutrient management	Grain yield				Per cent increase in yield
	1996-97	1998-99	2000-01	Mean	
1. Farmers practice: Cowdung & ash for first crop, urea @ 30 kg/ha for II crop	3.54	3.73	4.0	3.76	-
2. NPK 20:10:10 for I crop NPK 30:15:15 for II crop	4.40	4.62	4.5	4.51	19.9
3. NPK 40:20:20 for I crop NPK 20:10:10 for II crop	4.51	4.75	—	4.63	23.1

Higher yield could be realised by use of recommended dose of fertilises. Regulation of vegetative growth by removal of top portion was necessary to avoid lodging of the crop.

Summer rice fallows

In double cropped lands the second crop harvest is completed by mid February. The period from December to June in water stress period for the double cropped lands. Most of the area are left fallow after harvest of paddy. By putting land into some kind of use for cropping would bring more returns in terms of earnings as well as soil health. Pulse crops, vegetables, oil seed crops and green manure crops etc are ideal options during this period. Interventions were planned in order to increase cropping intensity of paddy lands and to make them more productive. Cultivation of black gram, green gram and horsegram was successful after harvest of paddy in wetlands.

Table 36. Assessment of pulse crops in rice fallows

Crop	Yield, kg/ha	C: B ratio
Black gram	400	1: 1.7
Green gram	256	1: 1.08
Horse gram	150	1: 0.74

Coconut based cropping systems

Rain fed coconut based homesteads.

Coconut is the second major crop in the project area. This crop is grown in the homesteads, which represent a typical cropping system. A typical Kerala homestead has a large number of perennial and seasonal crop components and livestock attached to it. The crop cafeteria is maintained at a subsistence level in most cases, and the overall productivity of the system is extremely poor. Many reasons have been attributed to this. The crop mix in usually done without any sort of planning and fails to utilize the available light and space effectively. Poor soil fertility, inadequate moisture conservation and insufficient supply nutrients also make this system unsustainable. Most of the farmers cannot plan the homestead in such a fashion as to ensure optimum utilization of available natural resources.

The poor productivity of the coconut based homestead system was an important problem identified in the project area. Careful selection of suitable intercrops to utilize the land and other natural resources is the baseline approach towards these. Technological intervention in this system of cropping was to introduce integrated farming system concept in order to maximize productivity and to ensure sustainability of the system.

Integrated farming system models.

Restructuring of the existing homesteads with possible components of integrated farming system to increase productivity and income, to increase land use efficiency and better utilization of available resources was the objective of the interventions. Two models of integrated farming systems based on coconut based cropping are being evaluated in the micro-farming situation. The interventions are planned based on the fact that the productivity of homesteads is poor, so is the resource utilization efficiency.

Ten homesteads were selected to demonstrate the productivity and resource use efficiency of the homestead models. The systems under comparison were

1. Farmers practice - Random planting of annuals/seasonal/perennials
2. Mixed farming practices

Model 1

Dairy unit (2 cows)
Fodder grass/trees
Feed concentrate preparation
Backyard poultry
Biogas
Fruits / jack, mango, banana, pineapple
Tuber crops – Tapioca, yam, cassava, Arrowroot
Vegetables – Mango, curry leaf, cucurbits, solanaceous crops
Spices - Pepper, ginger

Model 2

Goat unit (2 Malabari goats)
Fodder grass/trees
Bee keeping unit
Backyard poultry
Fruits / jack, mango, banana, pineapple
Tuber crops – Tapioca, yam, cassava, arrowroot
Vegetables – Mango, curry leaf, cucurbits, solanaceous crops
Spices - Pepper, ginger
Medicinal plants

The critical inputs were provided and the component wise performance is being evaluated.

Table 37. Intervention in homestead system with intercrops

Inter crops in coconut based homesteads	Varieties	Survival rate under rain fed conditions
Mango	Assorted varieties	55
Guava	*Red fleshed*	35
Pomegranate	*Ganesh*	30
Pepper	*Panniyur 1* *Panniyur 2* *Panniyur 3* *Panniyur 4, Karimunda*	60

Inter crops in coconut based homesteads	Varieties	Survival rate under rain fed conditions
Nutmeg	-	20
Cloves	-	40
Garcinia	-	12
Fodder grass	*Guinea grass*	25
Vegetables	Different crops	Seasonal
Tapioca	*Vellayani selection* *Sree Vijaya*	Seasonal
Greater yam	*Sree Keerthi,Sree Rupa*	Seasonal
Lesser yam	*Sree Kala, Sree latha*	Seasonal
White yam	*Sree Priya, Sree Subhra*	Seasonal

There has been a decline in the coconut yield during the period from 1998-99 due to severe incidence of coconut mites. Damage by Rhinoceros beetle and Red palm weevil on coconut palms were also found heavy in the project area. Pheromone traps were used to trap and destroy adults of these pests.

Table 38. Weekly catch of coconut pests in the pheromone traps

Pest	Weekly Catch (Location I)	Weekly Catch (Location II)
Rhinoceros beetle	15	24
Red palm weevil	26	28

The pheromone traps were effective in attracting and trapping the pests. The perceived risk of pests attracted being not trapped in the system affecting the crop in the vicinity have been taken care of by adopting a community approach and installation of more number of traps in a wider area.

Fruit trees, spices were planted as intercrops (Nutmeg, clove, pepper, Jack, mango, guava, cashew etc.) during 2001-2002. A preliminary assessment of survival rates has shown that 43 per cent of the tree seedling/grafts planted had survived. Among the crop components survival under rain fed conditions was better for cashew, mango, cinnamon and curry leaf. These crops have a long gestation period and an assessment of the economic impact will be possible only after attaining the bearing stage.

Farmers reported incidence of quick wilt of pepper in the homesteads. Methods for management the disease were included in intervention. The bio- control agent *Trichoderma viridae* was applied around the root zone. Lime application and use of Copper oxichloride drenching as prophylactic measure was also carried out under the assessment programme. Incidence of the disease has not been noticed in the experimental plots.

Animal rearing

Fodder grass is grown as intercrop in coconut garden. Guinea grass had given good biomass yield under partially shaded conditions also. This system of raising fodder grass as intercrop had helped the farmers by providing roughage for feeding cattle.

The methods for preparation of feed concentrates were demonstrated and the home made concentrates were used to feed milch cattle. The combination for the concentrate was as follows

Table 39. Ingredients for preparation of feed concentrate

Sl. No	Name of component	Quantity g/ kg of feed
1	Coconut oil cake	95
2	Groundnut cake	200
3	Rice bran	300
4	Maize	100
5	Tapioca	200
6	Gingelly cake	100
7	Mineral mixture	5

Feeding rate was fixed according to the body weight and milk yield.(1 kg/100 kg body weight 0.25 kg for additional 100 kg or part and 0.4 kg per litre of milk)

The study indicated that the cattle relished the home prepared feed and 70 per cent of the farmers reported increased milk yield ranging from 200 ml to 500 ml per day. The cost effectiveness of preparation of the feed at home was also demonstrated. Feed back obtained from to farmers have indicated the difficulty in arranging different raw materials.

The care needed to store the ingredient properly, time and labour required for preparation of the concentrate for feeding also was cited as drawbacks.

Rearing backyard poultry is a general practice in the project area. Three breeds of poultry were tried in the on farm trial during 1997-98. 'Gramalakshmi' breed was found to be the ideal type under the homestead conditions.

Table 40. Performance of various breeds of Poultry under homestead environment

Performance indicators	*Rhode Island Red*	*Gramalakshmi*	*Athulya*
Weight of birds at 2 months' age (g)	700	600	550
Weight at 6 months' age (g)	1300	1200	1100
Age of first lying (weeks)	29	26	23
Mortality per cent	30	10	20
Disease resistance (fowl pox, Raniket, diarrohea)	Low	High	Medium
Ability to escape from predators	Poor	Low	Good
Egg production per year	180	200	220

Gramalakshmi breed was provided to sixteen farmers during 2000. Survival rate is 65 per cent. On an average, 200 eggs/year have been produced.

Feed back from farmers indicated that during 2000-01 period incidence of diseases like fowl pox and diarrhea was more. It was also observed that the breed was sluggish and ability to escape from predators was poor

Another component evaluated in the homestead environment was to cross-bred rabbits. *Soviet Chinchila, Grey Giant* and *New Zealand* were grown. All the breeds had of fast growth rate compared to Desi types. The mortality rate was high in these types (Table 41). Farmers also opined that marketing of rabbit meat was difficult in the village.

Table 41. Performance indicators on evaluation of crossbred rabbits

Performance indicators	*Desi*	*Soviet Chinchilla*	*Grey Giant*	*New Zeland white*
Weight at 5 months (kg)	0.7	1.4	1.5	1.4
Weight at 1 year (kg)	1.3	2.4	2.6	2.3
Age at first parturition (month)	12	8	7	9
Mortality of young ones (per cent)	25	50	40	45
Growth rate after 6 months	Low	Medium	High	Medium
Ability to resist diseases				
a. Scabies	High	Medium	Medium	Low
b. Pasteurellosis	High	Very low	Very low	Very low

Performance indicators	*Desi*	*Soviet Chinchilla*	*Grey Giant*	*New Zeland white*
Ability to cope with stress	High	Low	Medium	Lowest
Ability to run away from enemies	High	Low	Medium	Low
Agility	High	Low	Low	Low

Bee keeping was identified as one of the viable activities for income generation to farmers were trained in the initial phase and Indian bee colonies were established. This intervention was not effective in the first instance due widespread damage resulted from virus infection. Twenty five colonies have been established in the second phase after giving training on beekeeping practices to the farmers.

Other interventions

Regular interaction between farmers, extension workers and farm labourers kept the core team well informed about the agricultural situation in the area. Need based interventions with available technologies were planned and implemented as required.

Utilization of homestead wastes / farm wastes for making manure by vermi composing technology was also introduced in the IVLP villages. This ensured recycling of farm wastes as good quality organic manure. Farmers rated the performance of vegetable crops after use of the compost as very good.

Low productivity of vegetable crops was identified as one of the problems in the selected area. Lack of availability of quality seeds, lack of awareness about the technologies for management of pest and diseases problems were identified as the important reasons for the low productivity. Improved varieties of various vegetable crops were provided as critical inputs for the participating farmers. 'Harithasanghams' – the vegetable farmer groups formed by the department of agriculture were given technical guidance for management of pests and diseases.

Table 42. Productivity of improved vegetable varieties in farmer's fields

Crop	Varieties assessed	Productivity t/ ha	Special features
Bitter gourd	*Priya* *Preethi*	18 20	Long, green fruits White / light green fruits
Snake gourd	*Kaumudi*	22	Large fruits
Ash gourd	*KAU local* *Indu*	20 22	Large fruits Small /medium sized fruits
Pumpkin	*Ambili*	18	Small fruits
Cow pea	*Kanakamani* *Bhagyalakshmi* *Vijayanthi*	8 10 12	Dual purpose Vegetable type Yard long bean

Crop	Varieties assessed	Productivity t/ ha	Special features
Bhindi	*Arka Anamika*	8	Long fruits
Winged bean	*Revathy*	6	Protein rich vegetable
Jack bean	—	8	
Chilli	*Jwala sakhi*	6	Wilt resistant
Coleus	*Sreedhara* *Nidhi*	20 24	 harvest in 135-140 days
Amaranthus	*Kannara local* *Arun*	12 14	Multi cut red coloured Multi cut deep red coloured

Banana is an integral component of the homesteads as well as the commercial farming system. Poor productivity of banana was indicated as a limitation. Integrated Plant Nutrient Management practices was assessed in terms yield increase. The problems due to in-balanced nutrition of the crop especially excess nitrogen application could avoided

Training programmes for farmers

Training sessions for creating awareness or skill development formed as integral part of the project activity. Each intervention was preceded and followed by training sessions in which the concept was introduced and evaluated. These training programmes helped to inevitable confidence among the farmers about the feasibility and success of the technology. A variety of topics were included in the training sessions.

Table 43. Training programmes conducted under the project

Sl. No.	Topic	Village	Period	No. of participants
1	Preparation of mat nursery	Ezhuvantha Pattissery	1999-00	30 35
2	Operation of self propelled transplanter	Ezhuvantha Pattissery	1999-00	30 35
3	Harvesting rice with VC reaper	Ezhuvantha Pattissery	1999-00	35 35
4	Threshing rice with thresher	Ezhuvantha Pattissery	1999-00	35 35

Sl. No.	Topic	Village	Period	No. of participants
5	Rice varieties for first & second crop	Ezhuvantha Pattissery Mavunderi	2000-01	100
6	Cattle feed concentrate preparation	Ezhuvantha Pattissery Mavunderi	2001-02	100
7	Vermi composing method	Ezhuvantha Pattissery and Mavundiri	2001-02	100
8	Rat management	Ezhuvantha Pattissery and Mavundiri	2001-02	150
9	Home scale processing of fruits and vegetables	Ezhuvanthala, Pattissery and Mavundiri	2002-03	120
10	Practices in kitchen garden	Ezhuvanthala, Pattissery and Mavundiri	2002-03	90
10	Agro forestry practices	On Campus	2002-03	15

The participant farmers also took part in the Kissan Mela/Farm Day seminar organized at the RARS, Pattambi during 1999, 2000 and 2001; when various topics related to agriculture was discussed. Exhibition of latest technologies in agriculture was also a part of the seminars/Mela.

Lead farmers participated in a study tour to different research stations under Kerala Agricultural University and Indian Council of Agricultural Research to gain first hand knowledge on advances in production technology of crops.

Refinement of Technologies

Assessment of available technologies under the different micro farming situations brought out the practical limitations of some of them which needed further refinement. Such technologies were fed to the research system for further improvements. Some of the technologies could be refined to suit the requirements of the micro farming systems.

Table 44: Technologies refined/ being refined after assessment

Intervention	Cause of failure/ limitation	Remarks
Different SD/MD HYVs	'Panchami' not suitable, 'Pranava' not acceptable	Ten HYVs tested and recommended
HYVs in the *Koottumundkan* system of paddy	Maturity/ crop growth stage mismatch	'Swarnaprabha' and 'Makaram' selected
Chemical fertilisers for *Koottumundkan* system	Lodging due to excessive vegetative growth	Topping to regulate growth
Green manure crop in dry sown paddy	Delayed rains/over growth of cow pea	Bush type variety *(Pusa komal)* selected
IPNM practices	Availability of organic manure	*In situ* green manure production/vermi composting farm wastes
Mechanisation of transplanting of paddy	Water management, skill in operation, nursery requirements	Training programmes
Back yard poultry	Different breeds assessed	*Grammalakshmi* suitable for backyard rearing
Mechanisation of harvest operation	Reaper unsuitable when field is in wet condition	—
Mechanisation of paddy threshing	Skill required for operation, movement of machine	Training programmes
Use of tractor drawn seed drill for dry sowing rice	Clogging of delivery tube	Length of delivery tube reduced, Size of scoop to be increased

Chapter VII

SUMMARY

The participatory approach in technology selection, testing and evaluation, refinement and adoption had provided one ideal platform to disseminate appropriate technology to the stake holders. The perceptions of individuals and communities in general and their preferences were considered while bringing about changes. The traditional time tested knowledge was blended with modern technology. The stake holders were sensitized to identify bottle necks, evaluate options and opt appropriate technologies, for their own good. The impact of the informal approach by researchers and the participatory way of programme implementation and evaluation had been tremendous. The farmers are now ready to test selected technologies suitable to their conditions.

Other farmers of the village/nearby villages had adopted successful technologies. This was visible in the case of new varieties, cropping intensity, crop management and summer fallow utilization in rice based cropping system. Farmers were raising traditional rice varieties which gave poor yield. Cultivation of the long duration rice varieties also added to the risk of drought damage. New varieties were tested through the on farm trials and has gained popular now. High yielding varieties like *Aiswarya, Kanchana, Jyothi* and *Karuna* are popular now and have a coverage of 60 per cent of the total area. The average yield of paddy has increased from 2000 kg/ha to 2800 kg/ha by the adoption of production technology modules. With the success of OFTs farmers themselves procured seeds from the participant farmers and produced the crop.

A good number of farmers have come forward to try new combinations under *Koottumundakan* system. Realising the potential for improvement in crop performance at the same time giving enough stress on sustainability and conservation of resources in the system, the District Panchayath and Agricultural University has taken up a number of programme under Group Approach for Locally Adapted Sustainable Agriculture (GALASA).

In vegetable crops and pulse crops also farmers are ready to give a try with newly released varieties.

Nutrient management in crops also have witnessed qualitative changes. Earlier system of giving nitrogenous fertilizers alone have been replaced by balance the use of fertilizers and also organic manures.

In pest/disease control also farmers are aware of the negative consequences of pesticide use and are willing to try alternative technologies. Management using botanicals and bio-control agents have become popular.

In situ production of green manure crop *Sesbania aculeata* is a common method widely adopted by farmers for improving productivity of land. This practice is now followed in 90 ha of paddy land when I crop is transplanted.

Fringe cropping concept for utilizing the ideal conditions of field bunds for growing vegetables have also caught up well with the farmers.

The concept of saving costs by adopting indigenous methods were evident when farmers themselves came up with the minimum /zero tillage concept for raising a catch crop of pulses after paddy in single cropped uplands. Seeds were sown before harvest of paddy/immediately after harvest of paddy without any tillage. The crop performance was good. Yield to the tune of 250 kg/ha could be obtained.

The field intervention and interaction by resource personnel, visit to different centers of research also had inculcated a research culture among the local farmers. Farmer participatory research had also been institutionalized. The concept of Technology Assessment and Refinement had been incorporated in to the research programme of the University.

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