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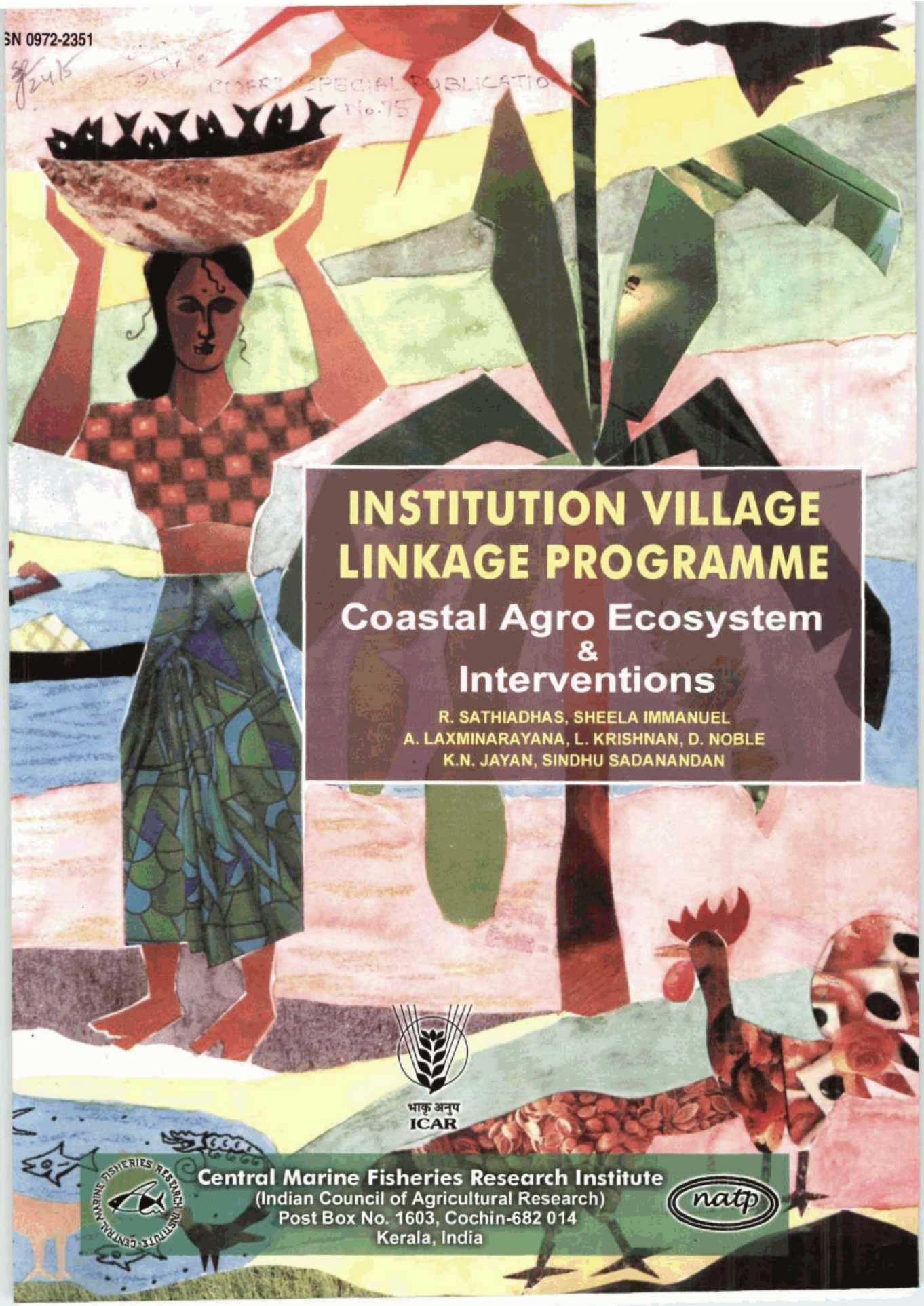

INSTITUTION VILLAGE LINKAGE PROGRAMME

Coastal Agro Ecosystem & Interventions

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Coastal Agro-Ecosystem
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Interventions

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Institution Village Linkage Programme: Coastal Agro Ecosystem & Interventions

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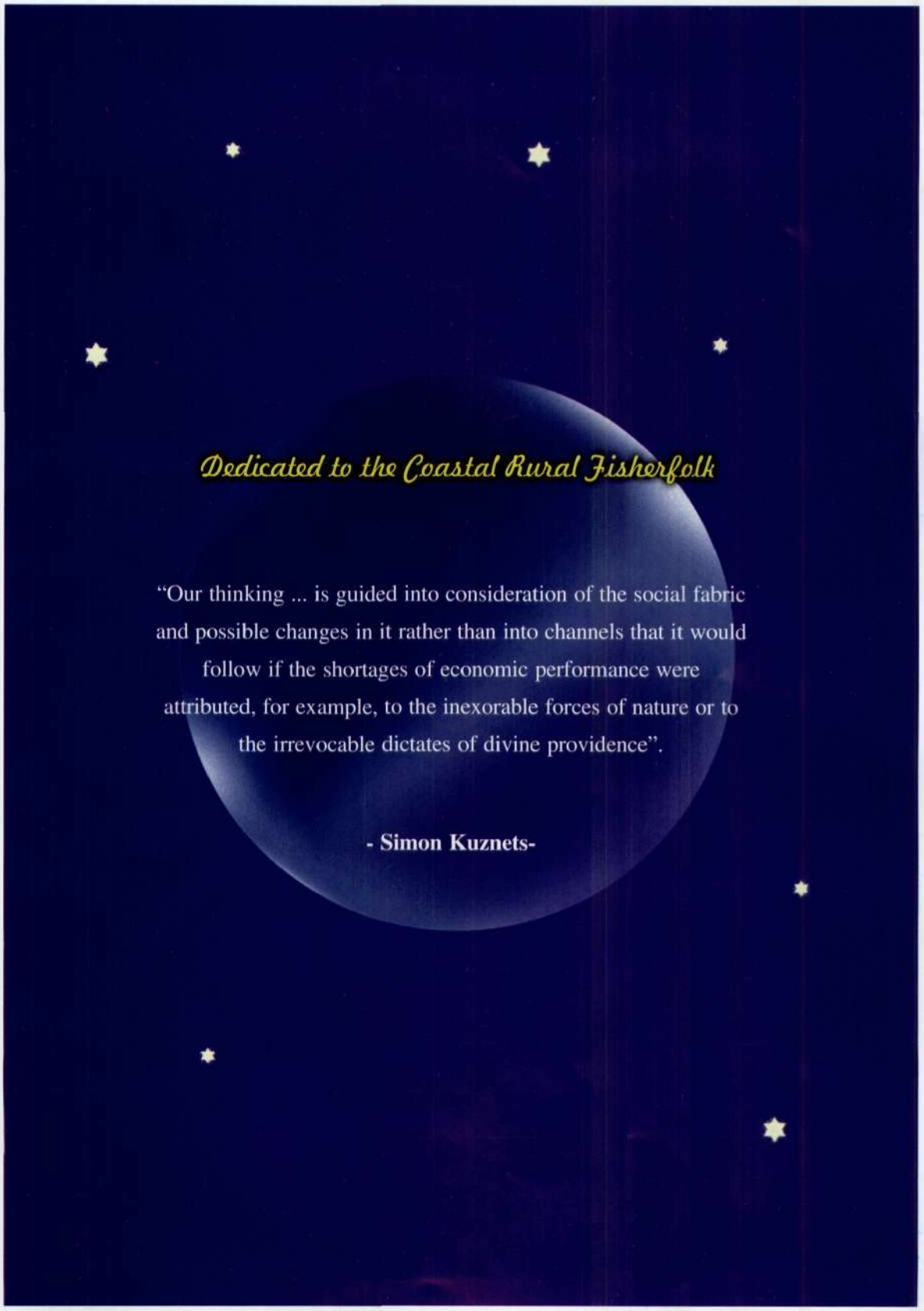

Dedicated to the Coastal Rural Fisherfolk
"Our thinking ... is guided into consideration of the social fabric and possible changes in it rather than into channels that it would follow if the shortages of economic performance were attributed, for example, to the inexorable forces of nature or to the irrevocable dictates of divine providence".
- Simon Kuznets-

FOREWORD

Poverty alleviation by income enhancement among the rural poor through adoption of scientific techniques in production process of the agriculture sector has been accorded top priority in our R & D programmes. The Indian Council of Agricultural Research (ICAR) has launched the National Agricultural Technology Project (NATP) with substantial assistance from the World Bank to upgrade the scientific research in the key sector of agriculture to bring about all round development. One of the main objectives of NATP is to enhance the performance and effectiveness of research response to the location-specific needs of the farmers. As a support for agro-eco-region's development under NATP, Technology Assessment and Refinement (TAR) has been considered as an important sub component of Production System Research (PSR). The Institution-Village-Linkage-Programme (IVLP) under NATP is one such programme taken up at 70 different centres throughout India.

The Central Marine Fisheries Research Institute (CMFRI), established in 1947 is the nodal agency in India, responsible for research support in marine fisheries development. The CMFRI has been one of the organisations entrusted with the task of linking the village with the Institute in testing and refining the technologies generated under the National Agricultural Research System (NARS) with emphasis on fisheries. The prime objective of the project is overall upliftment of the rural people through improvements in the existing production systems by way of introducing scientific management practices. The experiments have succeeded in enhancing productivity with a vision of stable and sustainable development. TAR through IVLP is based on a participatory mode, ensuring greater scientist-farmer linkage and accessibility of farmers to the technologies.

The coastal agro ecosystem analysis done in the IVLP village of Elamkunnapuzha in Vypeen Island of Ernakulam District, Kerala, is presented in the first section of this document. The interventions undertaken so far form the contents of the following sections. I wish to record my appreciation for the sincere efforts taken by Dr.R.Sathiadhas, Ms. Sheela Immanuel, Dr.A.Laxminarayana, Dr.L.Krishnan, Dr.D.Noble, Mr.K.N.Jayan and Dr.Sindhu Sadanandan for the successful implementation of this project and bringing out this excellent publication.

It is envisaged that the strategic assessment of coastal agro-ecology and possible refinements to the production system outlook could be beneficial for the researchers and extension workers involved in fisheries, animal husbandry and agriculture for evolving location oriented resource based action plan for balanced sustainable development of our country.

Cochin
15.03.2003

Prof. Dr. Mohan Joseph Modayil
Director, CMFRI

PREFACE

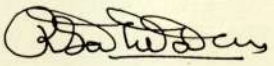
Science and Technology play a crucial role in augmenting production, bringing prosperity among rural poor and rapid transformation of the economy of India. Transfer of technologies to the farming community and their widespread adoption are vital to maximize production, optimise household disposable income and improve the standard of living of people. Technology assessment and refinement are supplementary and complementary to each other in the process of effective dissemination through demonstration of scientific inventions by appropriate interventions. The Institution-Village-Linkage-Programme (IVLP) is providing a suitable platform in promoting operational linkages between scientific institutions and farmers to transfer the technologies in farmers' fields for location specific experiments and refinements to obtain optimum production in different micro-farming situations.

The IVLP for Technology Assessment and Refinement (TAR) in the coastal agro ecosystem, assigned to CMFRI under National Agricultural Technology Project of ICAR is designed in such a way as to introduce need-based techno-interventions to enhance the productivity and profitability of different farming and entrepreneurial activities at Elamkunnapuzha village in Vypeen island of Ernakulam District, Kerala. The geographical location and topographical features of this village with diverse natural resources made it ideal to represent the coastal agro ecosystem providing multiple options of the Institute and the entire National Agricultural Research System (NARS) to be introduced in the form of techno-interventions for assessment and refinement. The Site Committee of IVLP has specifically approved a total number of 32 fisheries, livestock and agriculture-based interventions, in which 17 were implemented in the first phase itself with the active participation of the villagers. The present publication deals with the success of the first phase of programmes. At the very outset, I express my sincere gratitude to the villagers for their wholehearted cooperation in the initial resource inventory exercise of the village and their active participation in the successful implementation of the programme. I wish to express my sincere gratitude to Dr. S. L. Mehta, National Director, NATP, Dr. P. Das, DDG (Agrl. Extn.) and Dr. S. Ayyappan, DDG (Fisheries), ICAR for their guidance and support. I am also thankful to Dr. Aditya N. Shukla, ADG (KVK) of ICAR and Dr. R. K. Samantha, Zonal Coordinator, TOT projects for their constant encouragement in carrying out these interventions. Thanks are also due to Dr. M.J. Chandre Gowda, Senior Scientist (Agrl. Extn.), Zonal Coordinating Unit VIII, TOT projects, Bangalore for his constructive suggestions.

I wish to place on record my utmost gratitude to Prof. Dr. Mohan Joseph Modayil, Director, CMFRI for his timely advice, keen interest and guidance in executing different techno-interventions and critically going through the manuscript of this report. His

persistent visits to the village and farm sites have created a lot of enthusiasm among the IVLP team. Thanks are also due to Dr. K. K. Appukuttan, Nodal Officer and other staff of NATP Cell of CMFRI for their consistent support and co-operation.

I am highly thankful to other members of the IVLP Core Team, Dr. A. Laxminarayana, Chief Training Officer, TTC, Dr. L. Krishnan, Principal Scientist, Dr. D. Noble, Senior Scientist, and Ms. Sheela Immanuel, Scientist, for their sincere involvement and whole hearted cooperation for the successful implementation of this programme. The earnest efforts taken by Mr. K. N. Jayan and Dr. Sindhu Sadanandan, Senior Research Fellows of IVLP are also highly appreciable. Thanks are also due to Dr. R. Narayanakumar, Dr. C. Ramachandran and Dr. S. Ashaletha, Scientists, Ms. Kanagam, Ms. K. P. Shalini, Ms. T. N. Ananthalakshmi, Mr. K. N. Pushkaran and Mr. N. K. Harshan, Technical Staff of SEETTD, CMFRI for their help in one way or other to undertake this work and bring out this publication. The assistance rendered in the collection of data by Ms. Anju Annie Cyriac, former Senior Research Fellow and Ms. Kumari and Ms. Monisha as key informants of the village is also gratefully acknowledged.



Cochin
15.03.2003

Dr. R. Sathiadhas
Head, SEETTD &
Principal Investigator of IVLP

CONTENTS

LIST OF ABBREVIATIONS

AED	Agro Ecosystem Director
ARIS	Agricultural Research Information System
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
ICAR	Indian Council of Agricultural Research
INM	Integrated Nutrient Management
IPNM	Integrated Plant Nutrient Management
IVLP	Institution-Village-Linkage-Programme
KAU	Kerala Agricultural University
KVK	Krishi Vigyan Kendra
MSL	Mean Sea Level
NAAS	National Academy of Agricultural Sciences
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project
NRM	Natural Resource Management
OFT	On Farm Trial
PHT	Post Harvest Technology
PHVA	Post Harvest Value Addition
PI	Principal Investigator
PIU	Project Implementation Unit
PRA	Participatory Rural Appraisal
PSR	Production System Research
RAC	Research Advisory Committee
SAP	Scientific Advisory Panel
SE&P	Socio-Economic and Policy
SEETTD	Socio-Economic Evaluation and Technology Transfer Division
SHG	Self Help Group
SRF	Senior Research Fellow
TAR	Technology Assessment and Refinement
TOT	Transfer of Technology
VT	Verification Trial

SECTION I

INTRODUCTION

Agriculture, animal husbandry and fisheries provide maximum employment in the primary sector and form the major source of income and livelihood security of about 70 percent of the population in India. After the introduction of the liberalisation policy and giving thrust for the adoption of improved technologies, there has been a spectacular increase in production in all these segments and the country has witnessed a rapid structural change. Massive adoption of scientific inventions and technological interventions witnessed revolutionary changes in all sectors of development and quality of life of people. Achieving self-sufficiency on food front has been one of the finest Indian successes of the post independence era. The food grain production increased four times (from 50.8 million tonnes during 1950-51 to 198.7 million tonnes during 2000-01) since independence as compared to the three-fold increase in population. Further significant advances have also been made in the production of milk, fish, oilseeds, fruits and vegetables. In fisheries, the country has ushered in the blue revolution with gross production reaching 5.6 million metric tonnes of fish and edible invertebrates during 2000-2001. India is the second largest Asian country in terms of culture fisheries and the third largest in terms of capture fisheries (NAAS, 2001). Due to concerted efforts on strategic research and production technology in oilseeds sector, the country witnessed yellow revolution with the production reaching 25 million tonnes per annum. This was possible as a result of strong agricultural research support provided by the National Agricultural Research System (NARS).

It is apprehended that the fruits of technological advancement are mostly reaching the well to do farmers leading to the widening of the gap between rich and poor, paving way for lopsided development of the rural economy. Hence the 'integrated whole village development' through the involvement of multi-institutional teams and participatory approach of stakeholders has been accorded prime importance. The unique idea of linking up scientific institutions with the rural primary production system of villages is the motto of the proposed Institution-Village-Linkage-Programme. The programme aims at improving the performance of marginal and small farmers specifically focusing on women for poverty alleviation and distributional equity under the coastal agro-ecosystem.

(a) INSTITUTE AND IVLP

The Central Marine Fisheries Research Institute (CMFRI) has grown significantly in its size and stature by building up adequate research infrastructure and well qualified human resources. The Institute's multidisciplinary approach to research in marine capture and culture fisheries has won the recognition as a premier institute comparable to any well-established scientific Institutions in the world. The multidisciplinary researches in capture and culture fisheries are conducted under eight divisions: Fishery Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment and Management, Physiology, Nutrition and Pathology and Socio-Economic Evaluation and Technology Transfer. The Headquarters at Cochin coordinates the entire activity and the Institute has established three Regional Centres at Mandapam, Visakhapatnam and Veraval and Research Centres at Minicoy, Mumbai, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Chennai and Kakinada and 28 Field Centres all along the Indian coast.

The Indian Council of Agricultural Research (ICAR) has initiated a project on Technology Assessment and Refinement (TAR) through Institution-Village-Linkage Programme (IVLP) under the National Agricultural Technology Project (NATP) funded by the World Bank for joint diagnostic studies of production systems and expands adaptive research by means of location specific assessment

and refinement of technologies. Assessment and Refinement of technology needs to be site specific, holistic, inter-disciplinary, and interactive and ensure the participation of the farmer and offer technical solution to farmer's problems. The TAR through IVLP is based on a participatory mode, ensuring greater scientist-farmer linkage and accessibility for farmers to the technologies generated by the Institute and the entire National Agricultural Research System (NARS) of the country. The project has been located in 70 centres in the country, which include 44 centres in phase-I and 26 centres in phase-II. Out of these, 19 are in irrigated agro-ecosystem, 24 in rainfed agro-ecosystem, 13 in coastal agro-ecosystem, 12 in hill and mountain agro-ecosystem and 2 in arid agro-ecosystem. The project is based on participatory 'bottom-up' approach covering various production systems in all the five agro-ecosystems at a total cost of Rs 23.86 crores for a period of 5 years for assessing and refining technologies generated by the NARS. The activities of these centres are being carried out in 151 villages covering 36,914 farmers with 1,428 technological interventions for technology assessment and refinement.

The CMFRI selected Elamkunnapuzha Village of Vypeen Island in Ernakulam District of Kerala (Fig.1) for the implementation of the TAR through IVLP under the coastal agro-ecosystem. This project is a part of phase II and the total budget allocation for CMFRI under IVLP is Rs.28.27 lakh for three years (2001-2003). The Vypeen Island in Ernakulam District is known for its distinct ecosystem of the co-existence of capture and culture fisheries with almost all kinds of agriculture crops and animal husbandry practices. The Vypeen Island is covering an area of 87.12 sq. km spread out in 6 Panchayats. The site selected for the implementation of Technology Assessment and Refinement Project by CMFRI on the basis of the recommendations of a multi disciplinary committee is a part of Elamkunnapuzha Panchayat (Fig.2) in this island. The seasonal paddy cultivation is slowly vanishing in this region due to increasing operational costs and diminishing returns. The scientific shrimp/fish culture practices have not yet taken its roots in this region due to lack of awareness and adequate knowledge about recommended packages and practices. The bunds of the ponds offer immense scope for the introduction of vegetable crops and multiple cropping systems to enhance the income of the farmers.

The district has an altitude of 1.00 to 7.50meters above Mean Sea Level (MSL). There are some areas, which are lying lower than MSL, and hence flood during rainy season is a common phenomenon. The total population in the district is about 31 lakh with a density of 1050/km^2.

(b) OBJECTIVES OF IVLP

This programme aims at improving the relevance of technology generation, assessing the prevailing technology and suggesting possible and potential refinement, thereby transferring scientific knowledge to the changing needs of farmers and fisherfolk. The imparting of such technologies and scientific know-how with the participation of the rural farmers reckon with the national objectives of food security, economic growth, equity, alleviation of rural poverty and the conservation of natural resources. The specific objectives of the present project on Technology Assessment and Refinement undertaken by CMFRI at Elamkunnapuzha are as follows,

- To assess the needs and identify the coastal agro-ecology and production system perspectives of various technologies of the village.
- To introduce improvements in the existing production systems through better scientific and management practices to enhance productivity without endangering the stability and sustainability of the environment.
- To improve the innovative well defined farm production systems with multiple options for the purpose of refining the technologies in the context of sustaining higher productivity and obtaining profitability.

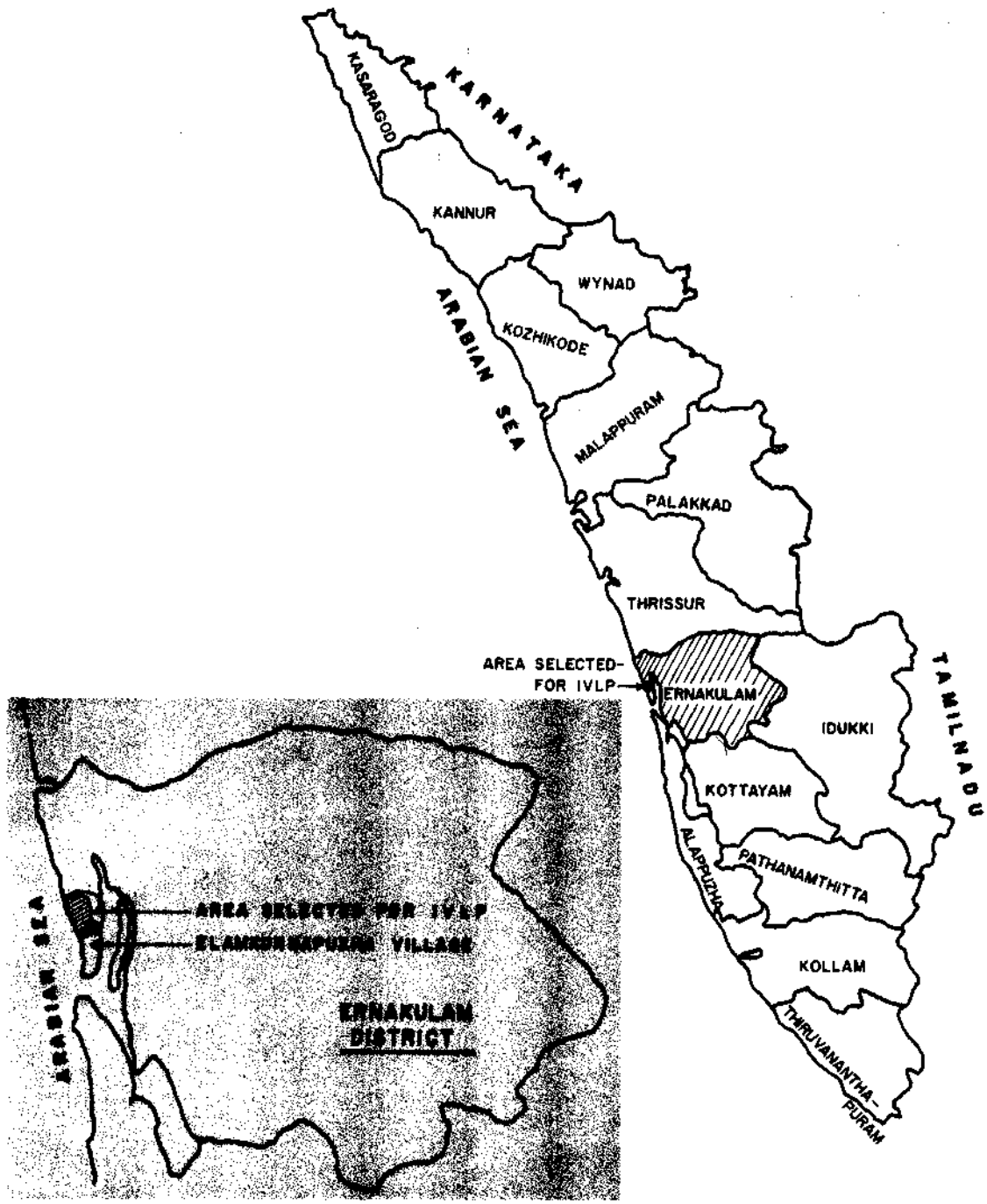


Fig. 1. Map of Kerala showing IVLP site

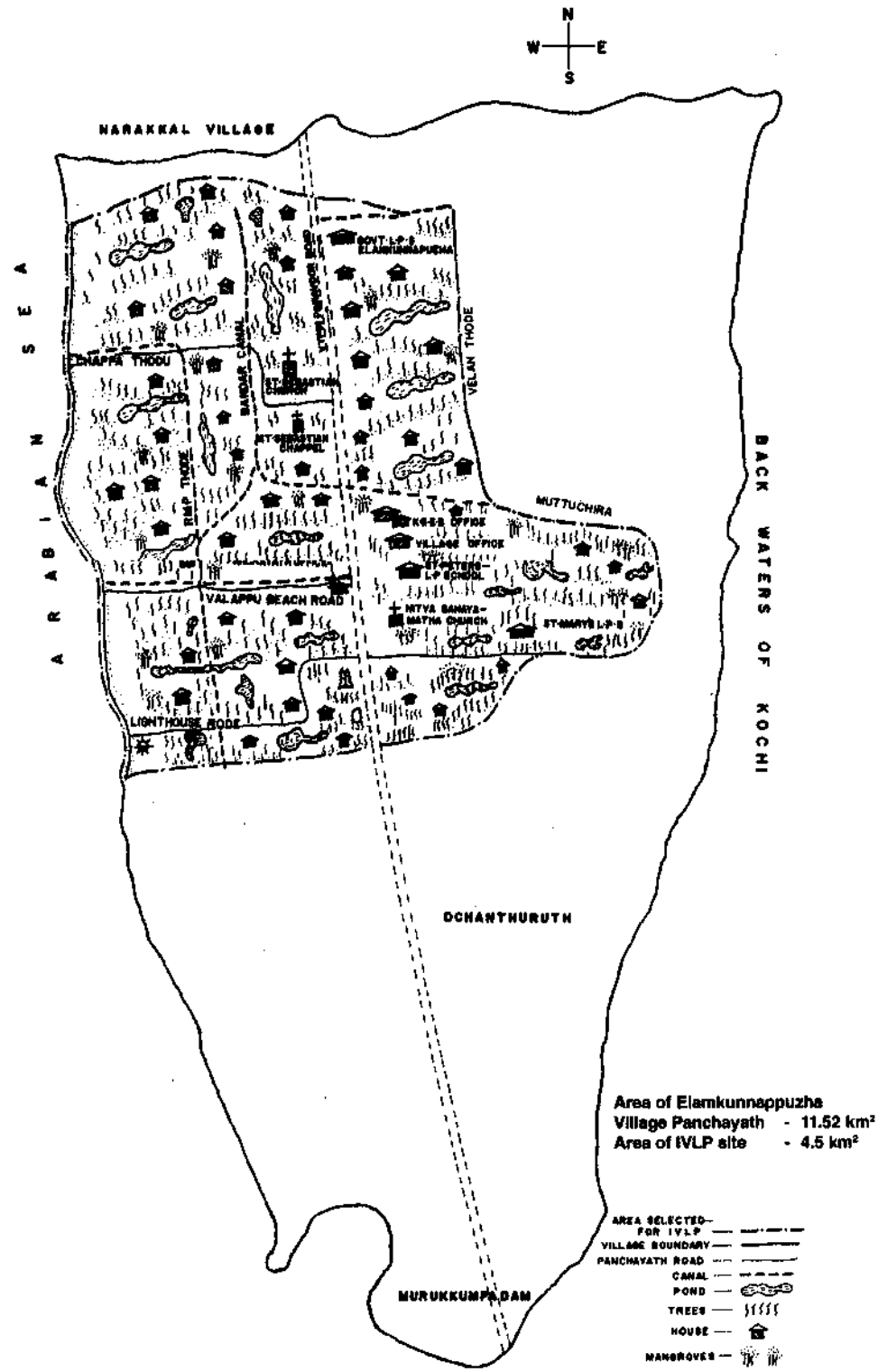
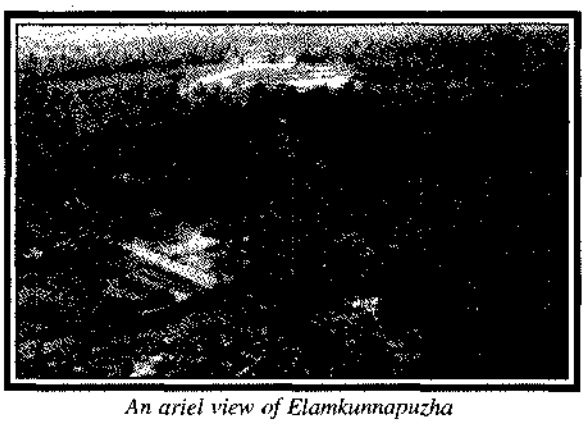
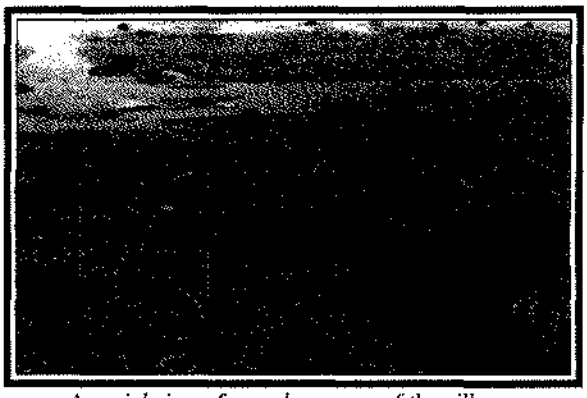


Fig. 2. Elamkunnapuzha Village Map



An ariel view of Elamkunnapuzha



An ariel view of nearshore area of the village

- To give specific considerations in the introduction of income and employment generating activities for the weaker sections of the society and women work force to promote distributive justice and to maintain parity and equity in the village economy.
- To examine the impact of refined production technologies in the coastal agro-ecosystem.
- To transfer the proven refined technologies to the District Extension System for their further propagation and implementation.

(c) IMPLEMENTATION SEGMENT

Instead of thrusting the research findings on the clients, it will be beneficial to find solution to the felt needs of the fishermen and agricultural labourers, which will ensure participation in any development programmes. Hence there should be a close link between the researcher and the fishermen, which is the basic idea of IVLP. The CMFRI is involved in conducting different research programmes for the improvement of the fisheries sector. It includes stock assessment and monitoring of capture fisheries resources, development of technologies for sea farming and coastal aquaculture, evaluation of techno-economics and socio-economics of marine fishing operations and mariculture practices and technology transfer programmes. Thus CMFRI has been identified to carry out the need based transfer of technologies to empower the coastal rural community and speed up the process of development.

The IVLP is co-ordinated and implemented by the Socio-Economic Evaluation and Technology Transfer Division (SEETTD), of CMFRI. The SEETTD is engaged in transferring the viable technologies generated by CMFRI through well-designed Transfer of Technology (TOT) programmes. This Institute had been conducting training courses on various aspects of fisheries technologies. The regular programmes of extension education have been going on at this Institute for quite a long time now. Several demonstrations are conducted to show first hand information on various technologies developed at this Institute, which works on the principle of 'seeing is believing'. A major thrust in the programme of TOT has been made with the introduction of lab to land programme in which various technologies have been transferred to the end users. The skill training has been the regular feature of the extension activities of this Institute and several training programmes have been organised at various places.

The experiences gained in the past strongly suggest the desirability of having a closer contact of our scientists at this institute with the men and women farmers, which needs to be established on a more regular basis and with consistency. The economically viable technologies like scientific prawn farming, integrated fish culture practices, crab culture/ fattening, edible oyster culture, mussel culture and production of "*Mahima*" Shrimp feeds by women groups were transferred to farmers of different

locations through suitable extension programmes. The Institute has participated in many exhibitions for the last two decades and also has given radio talks in local languages in different States pertaining to sustainable and economic management of marine fishery resources and other issues of current importance. The SEETTD has also prepared pamphlets in local languages pertaining to various technologies and their economic viability for distribution to fisherfolk. The Division has co-ordinated the technology transfer programmes of the Institute and successfully conducted 45 monthly Fishermen-Farmers-Industry-Institution -Meets in different locations.

The costs and earnings studies conducted for all types of fishing units to bring out their profitability and techno-economic viability have helped the entrepreneurs and fishermen in decision-making, identifying technological options for their fishing ventures and helped the financial institutions in formulating their credit policy.

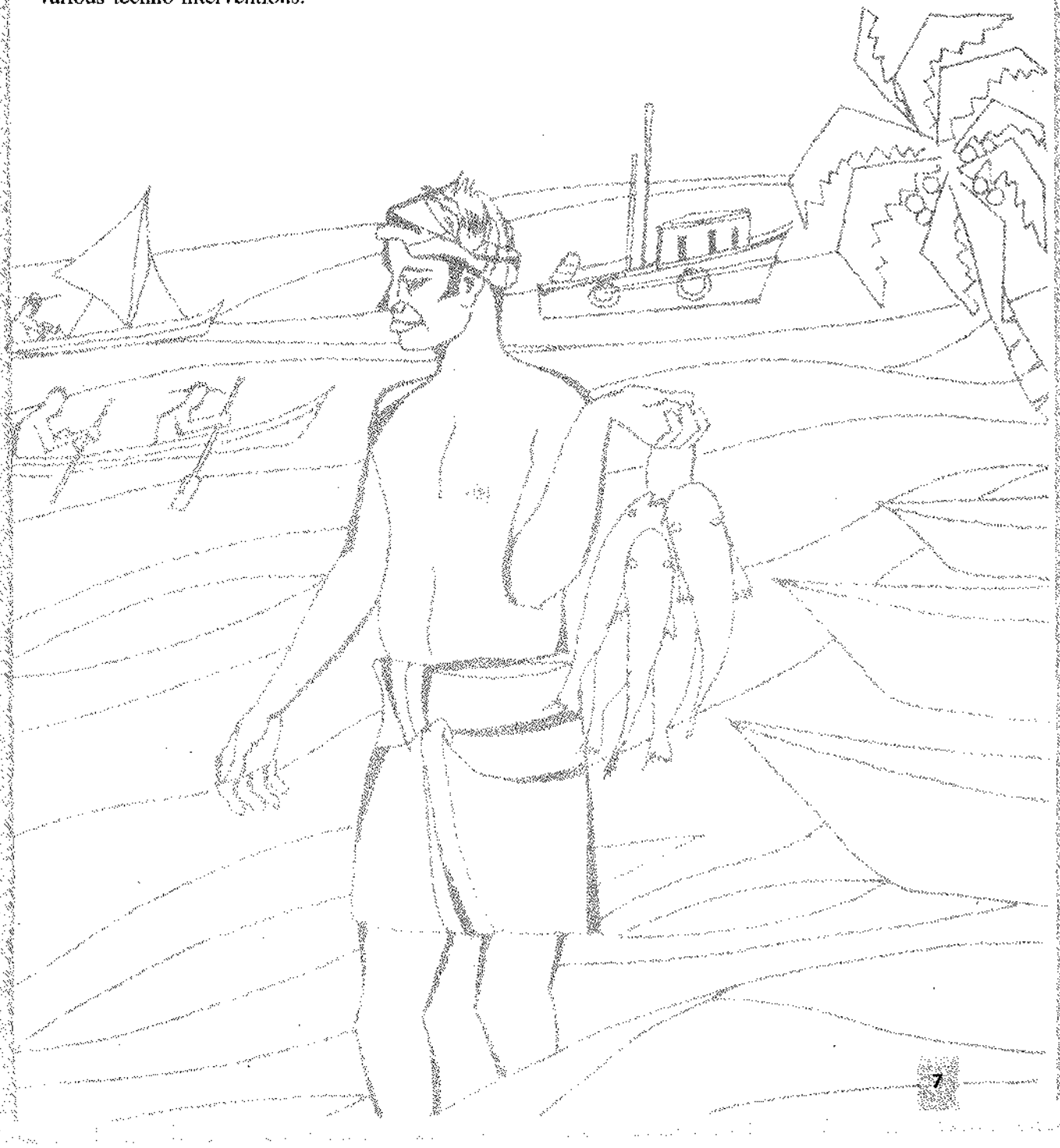
(d) INTER-DISCIPLINARY APPROACH

The IVLP in the coastal agro-ecosystem involves interdisciplinary teamwork as the project has fisheries, livestock and agriculture-based interventions. The interdisciplinary team involved in the implementation of the IVLP at Elamkunnapuzha village is given below.

Inter-disciplinary Team

Name	Designation	Field of Specialisation
Dr. R. Sathiadhas	Head, Socio Economic Evaluation and Technology Transfer Division, CMFRI, Cochin	Fisheries Economics
Dr. A. Laxminarayana	Chief Training Officer, TTC, CMFRI, Cochin	Shrimp/Prawn Hatchery and Crab Farming
Dr. L. Krishnan	Principal Scientist, Demersal Fisheries Division, CMFRI, Cochin	Finfish Culture/Breeding and Integrated Farming
Dr. D. Noble	Senior Scientist, PNPD, CMFRI, Cochin	Livestock Production and Management
Ms. Sheela Immanuel	Scientist, SEETTD, CMFRI, Cochin	Agricultural Extension
Dr. P. K. Vijayan	Principal Scientist, Central Institute of Fisheries Technology, Cochin	Fish Processing Technology
Dr. W.J. Cherian	Deputy Director, District Animal Husbandry Office, Cochin	Veterinary Science
Dr. C. Ramachandran	Scientist, CMFRI, Cochin	Agricultural Extension
Dr. S. Ashaletha	Scientist, CMFRI, Cochin	Agricultural Extension
Dr. D. Prema	Scientist, CMFRI, Cochin	Soil Science, Nutrient Management
Mr. Suresh Kumar	Technical Officer, Krishi Vigyan Kendra,CMFRI, Cochin	Agricultural Extension
Ms. Anju Annie Cyriac	Senior Research Fellow	Agricultural Extension
Mr. K.N.Jayan	Senior Research Fellow	Applied Economics
Dr. Sindhu Sadanandan	Senior Research Fellow	Agricultural Extension

Following the section on introduction, the next section give a note on the coastal agro-ecosystem analysis. This analysis has been carried out in the coastal village of Elamkunnapuzha in Vypeen Island, Ernakulam District selected for IVLP interventions. As part of the analysis, the cropping pattern of the village, the resource flow, indigenous technical knowledge of farmers, micro-farming situation etc. have been identified and discussed. The third section gives a description of the action-plan of interventions under the three broad categories of fisheries, livestock and agriculture and the report of activities undertaken in the first phase. The fourth section gives a description of the Site Committee meetings and also lists out the recommendations made by the NATP Peer Review Team. Section five summarises the work and provides a brief account of the technologies refined through various techno-interventions.



SECTION 2

COASTAL AGRO-ECOSYSTEM ANALYSIS

Agro-ecosystem analysis is a methodology to analyse ecosystems in which basic biological processes are managed to achieve some objectives (Lyan, 2000). Agro- ecosystem is an ecological system partially modified by man for his livelihood (Conway, *et al.,* 1987). Agro-Ecosystem has been traditionally researched and discussed in terms of their physico-biological properties or their socio-economic dimensions, yet an integrated view of the two segments has been inadequate (Damodaran, 2000). The major components of the present analysis included Participatory Rural Appraisal (PRA), which embodied field survey with the key informants and representatives of the rural community and space and time analysis of resource availability and their production relationships. Field analysis of soil and water samples and the impact of climatic variations and ecological changes on production pattern and resource use were also analysed.

(a) VILLAGE BACKGROUND

The coastal agro-ecosystem of Kerala, spreading along 590 km of coast length is endowed with rich and varied natural resources. There are 222 marine fishing villages with one lakh fishermen households inhabited in this region, mostly engaged in capture fisheries. The flow of 41 rivers and 30 estuaries with extensive brackishwater systems like Ashtamudi and Vembanad lakes offer immense and enormous scope for the development of coastal and brackishwater aquaculture. The potential area suitable for aquaculture in Kerala is 65,000 hectares in which hardly 15,000 hectares are currently utilised. Out of this 15,000 ha, the maximum percentage (80%) is in Ernakulam District. The Elamkunnapuzha village in Ernakulam district was selected for implementing sustainable aquaculture as well as agriculture farming systems along with animal husbandry programmes under IVLP for the integrated development of the area. The Elamkunnapuzha village represents the typical and unique coastal topography of West Coast of India, which is congenial for the techno-interventions of capture and culture fisheries, agri-horticulture and animal husbandry. Elamkunnapuzha is a representative village of Ernakulam District, which is located on the north-eastern side of Vembanad lake - the largest lake in Kerala. The topography is without much undulations and the soil type of western parts belongs to fertile clay loam while the eastern side is characterised by typical sandy soil. Elamkunnapuzha Village has a total population of 51,197 within a total area of 11.52 sq.km. Nature has endowed this area with larger expanse of fresh, saline and marine water resources. Presence of a number of rivers, lakes, *pokkali* lands (low-lying paddy fields) and bar mouth make the district congenial for high fish production. The Vembanad Lake is a nursery ground for penaeid prawns and many finfishes of high commercial value.

(b) PARTICIPATORY RURAL APPRAISAL (PRA)

In order to analyse the spatial pattern of the village, various PRA techniques were adhered. PRA came as a research approach by late 1980s. The term PRA was first used in 1988. It is a continuation of Rapid Rural Appraisal (RRA). It is rapid, cost-effective and approximately correct method of research and learning. PRA is used to describe new approaches and methods in which rural people themselves do much of the investigation, presentation, analysis, planning and evaluation of findings. The techniques used are participatory observation, key-informants-interview, individual and group discussions and sketching/diagramming. To supplement this information, data collected from secondary sources like Panchayat, Block office, Revenue office, Krishi Bhavan and Village offices were also used. The stakeholders identified for detailed group discussion comprise the following

1. Fishermen of marine capture fisheries
2. Fishermen of brackish water capture fisheries
3. Farmers engaged in paddy farming and prawn culture fisheries
4. Farmers involved in agriculture
5. Fishing/Agricultural labourers
6. Fisherfolk involved in post-harvest operations
7. Shrimp/fish farmers
8. Crab farmers
9. Farm women/labour engaged in Agriculture & Animal husbandry
10. Government/public sector employees
11. Women engaged in household works
12. Unemployed youth
13. Members of cooperative societies

SPACE ANALYSIS

The Elamkunnapuzha village comes under the Elamkunnapuzha Panchayat in Ernakulam District of Kerala State. The Village map clearly implies the distribution of different ecological zones in the area, patterns of residence, geographical locations of social, political and educational institutions. The village has a Fisheries Research unit of Kerala Agricultural University, Primary Health Centre, Community Health Centre, Ayurvedic Dispensary, Veterinary Hospital, Post Offices and Schools, (Higher Secondary- 1, High School-1, Upper Primary School -6, Lower Primary School -10 and Anganwadi -27). Financial Institutions like State Bank of India, Union Bank of India and Federal Bank are also functioning, in addition to the Cooperative Banks.

Resource inventory of the village

Interactive discussion with farmers

Traditionally paddy and fish culture are practised in rotation. Only one crop of paddy is raised in a year. Coconut plantation exists in 607 ha. About one-lakh coconut trees of local varieties are available in the study area. The paddy season is followed by fish, prawn and crab culture. Tapioca is also cultivated randomly in limited areas. During southwest monsoon, vegetables such as amaranthus, bittergourd, cowpea, ridge gourd, okra, cucumber, sweet potato, and dioscorea are cultivated. Banana cultivars like *Njalipoovan, Palayankodan* and *Monthan* are raised in about 32 ha. Trees like mango,

jackfruit, tamarind, guava, eucalyptus, acacia, casuarinas etc. are also grown. Crops like crotalaria and thespesia are used as green manure in the fields. The canals flowing through the village serve as the source of irrigation. The other sources of water are 2215 wells, 815 ponds and 1102 bore wells. In the sphere of animal husbandry, the picture reveals that about 810 goats, 1175 cows and 10,000 ducks are there and only 10 families practise piggery enterprise.

Interactive discussion with farmers

Village transect

Transects give a clear picture about the natural resources and environment prevailing in a village. They can also be developed to illustrate large amount of information about the territory in a clear and concise form. Transects can be successfully used as graphic representations of places where unexploited or underexploited potential exists in a community. The Elamkunnapuzha village depicts the typical topography of coastal Kerala but it is more or less plain in nature (Fig.3).

Topography	Flat	Low - lying	Low - lying	Flat
Soil Type	Clay Loam	Sandy Loam, Clay Loam	Sandy	Sandy
Crops	Vegetables, Banana, Mangroves	Paddy, Coconut, Mangroves	Coconut, Fruit Crops	Mangroves, Casuarina
Trees	Jack, Coconut	Mango, Tamarind	Coconut, Tamarind	Coconut
Resources	Water bodies, Farm yard Manure (FYM)	Water bodies, Family labour	FYM, Water bodies	Sea, Fishing boats
Water Exchange	Main canal, sluices	Small canals, sluices	Ponds, Canals & Sluices	Tidal influence
Animal Husbandry	Cow, Goat	Goat, Poultry	Cow, Poultry	Poultry, Goat
Problem	Poor water exchange for culture fisheries, traditional varieties of crops	Lack of improved varieties, Poor water exchange	Lack of HYV seeds & improved breeds	Sand erosion & Highly saline & Sandy soil
Potential Solution	Treatment of canals, provision of sluice & improved varieties	Treatment of canals, sluices & improved crop varieties	Hybrid cows, HYV seeds	Fish landing Centres Organic matter addition to soil

Fig. 3. Village Transect, Elamkunnapuzha

On one side of the village, there are two marine fish landing centres, where indigenous inshore fishing is carried out by traditional fisherfolk. The brackishwater canal also passes through the village and its water level varies as per the tidal influence. There is a lighthouse located near the seashore. The main road connecting Vypeen and Munambam passes through the village and a fair transportation system is prevalent in the region. With regard to housing pattern, huts, tiled and concrete houses are prevalent and most of the houses belong to tiled category. The soil type is of sandy loam.

Historical transect

1915	-	Sea erosion
1915	-	Govt. School established
1920	-	Sea erosion
1942	-	Grow more food scheme implemented
1945	-	High School established
1950	-	Indo-Norwegian project-Mechanized fishing
1950	-	PWD Road, Electricity
1951	-	Tenancy
1960	-	Flood
1962	-	Full fledged *Janakeya Panchayat Grama Sabha*
1966	-	Sea erosion
1968	-	Water connection
1970	-	Migration of boat from Kanyakumari
1971	-	3 to 10 cents of land given to people
1979	-	Kerala Agricultural University, Fisheries Station established
1979	-	Kochi Fisheries Harbour established - Prawn peeling stopped - unemployment of women labourer, migration to other states
1979	-	Light House established
1983	-	Drought - Coconut affected (90%)
1994	-	Sea erosion - 54 houses washed away.

A view of the village transect

Assessing the size of traditionally cultured finfish

Rainfall pattern

The rainfall is received both from the Southwest (June-August) and Northeast (October - December) monsoons with an annual average of 309cms. The south-west monsoon provides maximum rain in this region, which brings down the high salinity of the soil and makes it suitable for various seasonal agriculture practices. The inflow of fresh water to a greater extent washes away the salinity of the soil. Hence June - September period is ideal for saline resistant *Pokkali* cultivation and different varieties of seasonal vegetables. On the other side, prolonged water logged conditions during heavy monsoon render fish culture in the tide-fed ponds unsuitable, due to the drop of water salinity. Summer is experienced from March to May. The weather is of moderate type with a maximum temperature of 30.2 °C and a minimum of 20.6 °C with very high relative humidity of 85-95%.

Cropping pattern

Paddy is grown only during rainy season in *Pokkali* lands. Only one crop is raised in a year. Fish, shrimp and crab culture follows the paddy season. Coconut trees are there in the homesteads. Tapioca

is also cultivated on a limited basis. In fish farming monoculture is practised continuously. In shrimp farming continuous monoculture of the same species has led to incidence of virus disease, which has become a menace to the shrimp growers.

During the southwest monsoon, when the salt content is washed away from the soil, different types of vegetables like amaranthus, bitter gourd, ridge gourd, cowpea, ladies finger, sweet potato, dioscorea etc. are cultivated. In homestead gardens of the coconut trees, crops like banana, yam, and colocasia are raised as intercrops. Besides these, different trees like jackfruit, tamarind, and mango are grown. Among the crop rotations followed in the village, paddy-fish culture, and vegetable-fish culture are very common.

Resource flow of the village

The villagers depend on the nearby town for limited resources. The labour requirement is met within the village. The seeds of fish and prawns are taken from their village itself but when deficiency occurs they depend on nearby villages. Feed is being supplied from the shops available in the village. Vegetable seeds are supplied to them from the Krishi Bhavan. The veterinary hospital looks after the needs of animal husbandry in the village. Regarding the inflow from the village the milk produced is sent outside. Fish/prawn cultured and vegetables produced are sold in the local markets. In the case of coconut, tapioca, banana and vegetables, the surplus production is sent for sales outside the village. Flow diagrams visually outline and analyse processes, interactions and linkages between events. The resource flow analysis of the selected village, gathered from the farmers is given in (Fig.4).

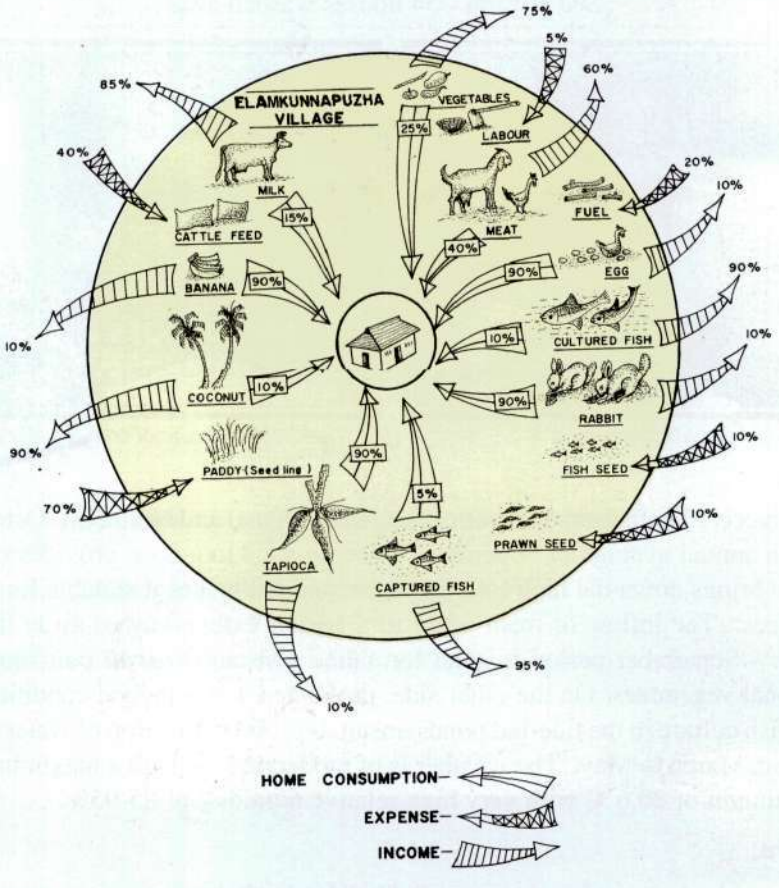


Fig. 4. Resource flow of the village

Other resources

There are 2215 wells, 815 ponds and 1102 borewells to cater water needs of the villagers. Transportation facilities like bus, lorry, car, auto and tempo are available in the village. Most of the households have radio, and a very few have TV sets.

Mobility

An Ayurvedic and an Allopathy hospital are located within the village. The village has higher secondary and high school facilities and for college education, they go outside the village. A Krishi Bhavan and a Village Office are established. A few villagers go to the nearby Ernakulam town to work in banks and other public and private organisations. The villagers frequently visit post office and bank. The village has relatively good conveyance through private buses (Fig.5).

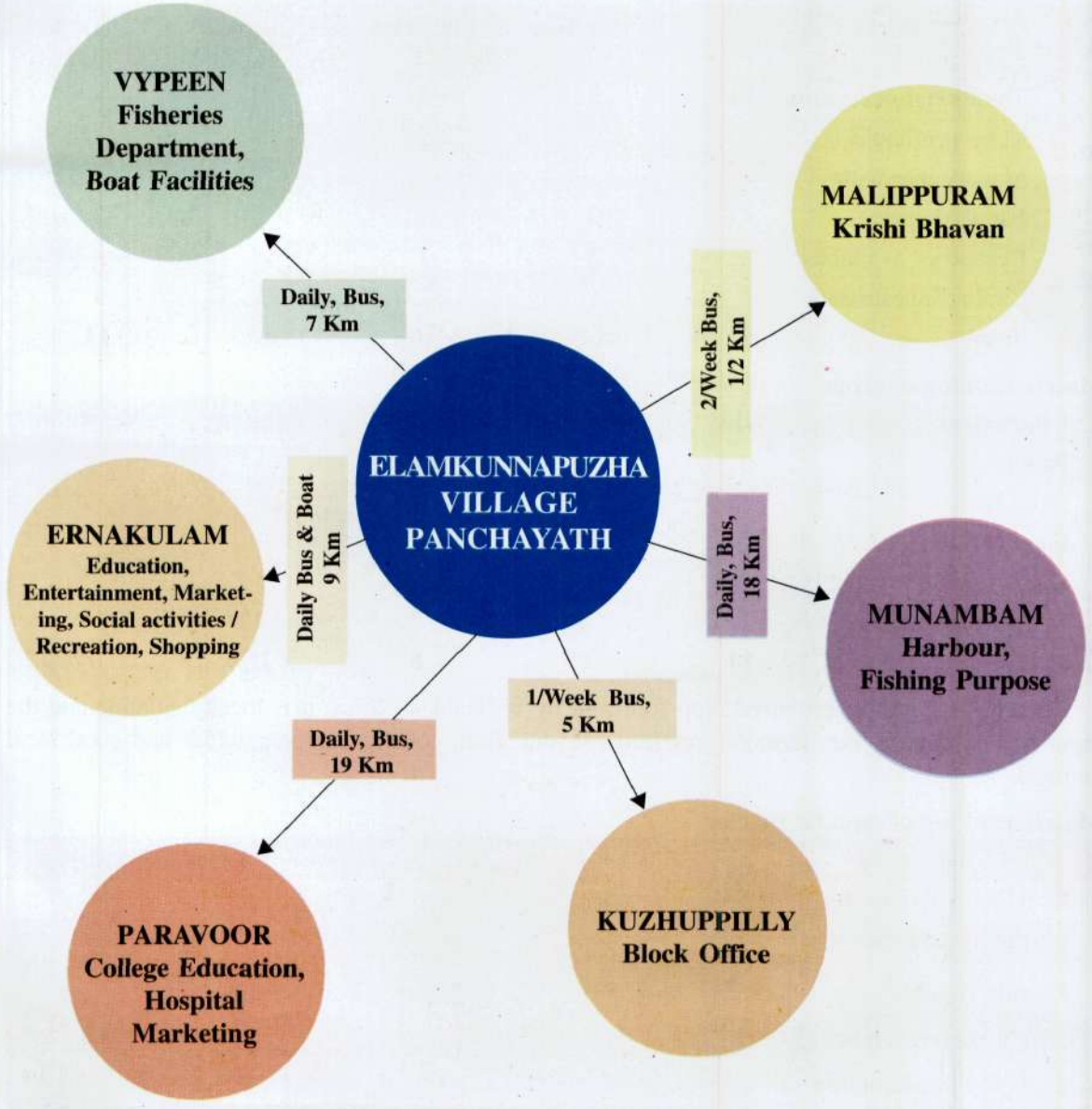


Fig. 5. Mobility Diagram

Decisions

Decision means the individual farmer's choice in selection of the enterprises, what and how to cultivate and when to purchase inputs. They are represented in the form of matrices. Various matrices were constructed in discussion with farmers.

Enterprises Ranking

An enterprise ranking was attempted to study the farmers' preferences towards various enterprises and the factors drawing them towards it. It is seen that fisheries enterprise secured the maximum score since it is a coastal village and also because it is practised as a tradition bound activity, which is more profitable than the other enterprises. Animal husbandry is ranked low because of high capital investment and poor upkeeping facilities.

Matrix ranking of enterprises

Criteria	Agriculture	Fisheries	Animal Husbandry	Vegetable
Traditional occupation	5	5	-	-
More profitable	2	5	3	2
Manageable with Family labour	3	-	5	3
Resources available	3	4	4	5
Capital investments	1	2	1	4
Total	**14**	**16**	**13**	**14**

Matrix ranking of crops

Characters	Paddy	Coconut	Tapioca	Banana	Vegetable
Profitable	1	3	1	1	3
Input less	1	5	1	2	2
Food security	5	2	2	1	3
Locally suitable	5	5	2	5	5
Marketing potential	2	4	2	2	4
Total	**14**	**19**	**8**	**11**	**17**

Coconut is the most preferred crop followed by vegetables. Since it is locally suitable and the input requirement is less, farmers preferred coconut. Both coconut and vegetables had good local demand.

Matrix ranking of aquatic species

Characters	Crabs	Prawns	Finfish
Good market demand	3	5	5
Profitable	4	5	5
Locally feasible	1	5	5
Risk involved is less	2	1	4
Domestic consumption	1	1	3
Total	**11**	**17**	**22**

Fish is mostly preferred because it is locally feasible, profitable and has got good market value.Even though crab is profitable, it commands a comparatively lesser preference, due to lack of seed availability.

TIME ANALYSIS

Time trend

A very simple means of establishing the sequence and relative importance of events is through the creation of a time line with the important events reported by local people being shown in chronological order along a single line. Information for this was gathered through interviews and some secondary sources such as institutional records, Panchayat level documents etc.

Social Map

The social map depicts the different infrastructure facilities existing in the village, like Village Office, Krishibhavan, Matsyafed etc. The size of circle indicate the level of utilization of the particular infrastructure (Fig. 6).

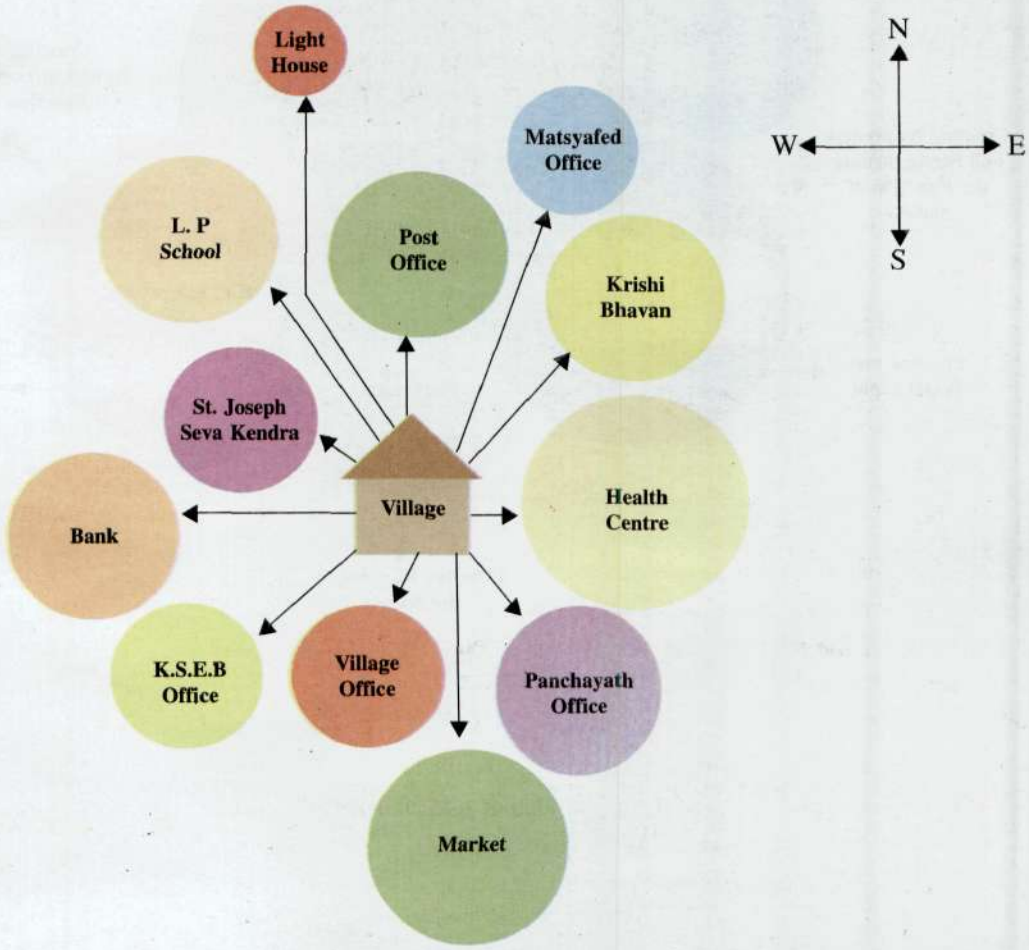


Fig. 6. Social Map

Venn diagram

The Venn diagram depicts the support given by different individuals and institutions in starting a cooperative society (Fig. 7).

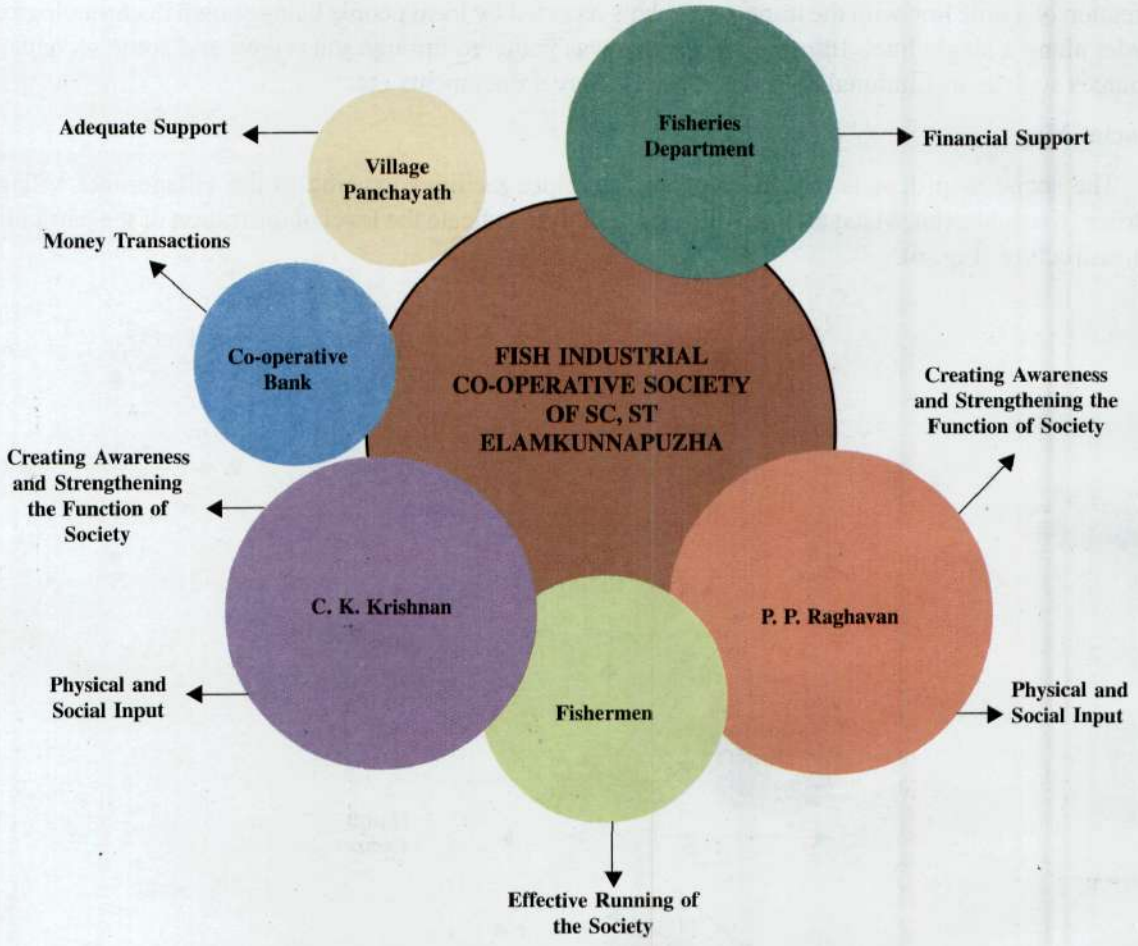


Fig. 7. Venn Diagram

Seasonality of pests and diseases

The incidence of pest and disease is dominant in coconut, as reported by the farmers. In the case of prawn culture, white spot is the major disease. The overall problem in vegetable production is the excessive soil salinity. In paddy cultivation, the major problems are stem borer and leaf roller (Fig.8).

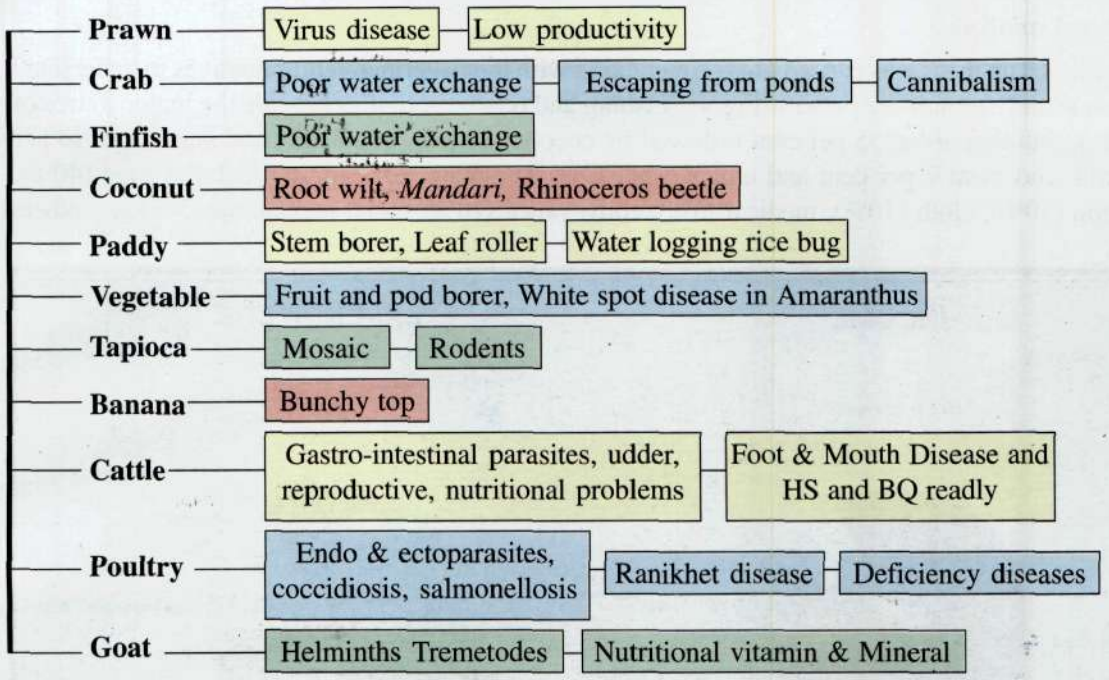


Fig. 8. Seasonal diagram of pests &diseases in different farming practices

Yield/Market trends

The trends in productivity of major crops/fish were analysed using the information given by farmers and triangulated using secondary data. In agriculture as perceived by farmers, the productivity has declined over the past 20 years. In the case of vegetables, banana, and other tree crops, the yield has not shown any increasing trend, as the high yielding varieties were not introduced in a big way. The farming practices followed were also traditional. Earlier, large quantities of dried shrimps were traded of to distant places. Recently this trade has been declined considerably due to decreased catch and constraints in processing. The livestock production has not improved though there were attempts to introduce superior genotype. The yield rate is much below the potential productivity and there is scope for improvement by better management and health cover. Though there is 200-250 litres of marketable surplus of milk, there is no proper collection and marketing infrastructure to fully exploit the good local demand.

CHOICE MATRICES

Labour availability (demand and supply)

The village is almost self-sufficient in labour availability. However, a declining trend is observed during the peak season. The returns for labour in agriculture are comparatively low when compared to that in fisheries. The labour requirement is high during the peak season (Feb- April). Among the total labour force, five per cent has emigrated from Tamil Nadu. During May - December, the locally available labour force is adequate.

Fodder availability

A locally available fodder shrub, *uppootha* is grown for the purpose of both fencing and fodder. Apart from this, another variety locally known as *Karukapullu (Cynadon dactylon)* is also given as feed, but is available on limited basis. No fodder is brought from outside the village. The paddy straw is supplied as a roughage and its availability is also very less. There is not much scope for fodder/perennial grass cultivation due to limited land availability. Para grass can be tried in marshy/ shallow water bodies, which are not suitable for any other cultivation. Fast growing saline resistant fodder shrubs/trees can be grown on fences.

Livelihood analysis

Livelihood analysis was carried out by interacting with the fishermen representatives to understand the income and expenditure pattern (Fig.9). Fishing and related activities provide the major source of income accounting about 55 per cent followed by coconut 20 per cent, Paddy and vegetables 10 per cent, milk and meat 7 per cent and others 5 per cent. The major expenditure includes food (40%), education (10%), cloth (10%), medical (5%), conveyance (10%) social recreations (5%) and others (10%).

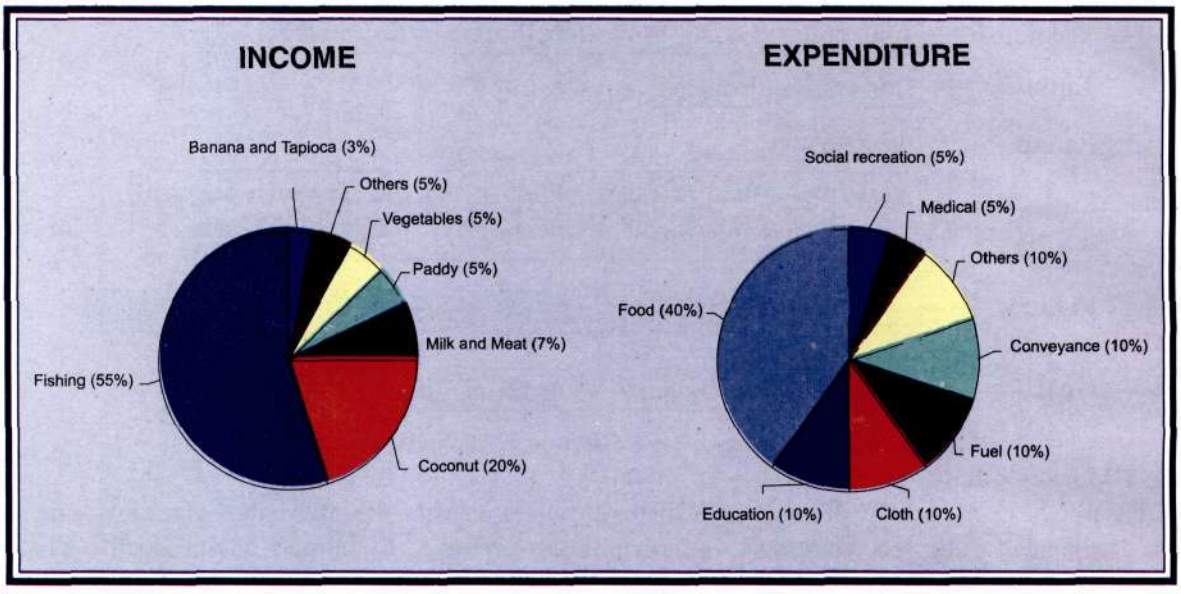


Fig. 9. Income - Expenditure pattern

Gender analysis

The extent to which women in a community are able to make autonomous decisions is clarified with this analysis. The factors which are likely to influence women's ability to make independent decisions need to be understood and taken into account.

Gender involvement in decision-making and implementation

Criteria	Who initiates	Who decides	Who implements
Enterprises selection	Both	Both	Men
Selection of fish seed	Both	Both	Both
Purchase/collection of seeds	Both	Men	Men
Feed	Both	Men	Women
Livestock management	Both	Both	Both
Vegetable cultivation	Women	Both	Both
Money management	Men	Men	Both
Social commitment	Women	Both	Both
Child education	Both	Men	Men

It is observed that men and women together make most of the decisions regarding farm and home activities. Women take active role in livestock rearing and money management. It is interesting to note that women initiates the social commitment activities and gender equity is observed in the decision-making and implementation processes. In children's education men play a dominant role.

(c) INDIGENOUS TECHNICAL KNOWLEDGE OF FARMERS

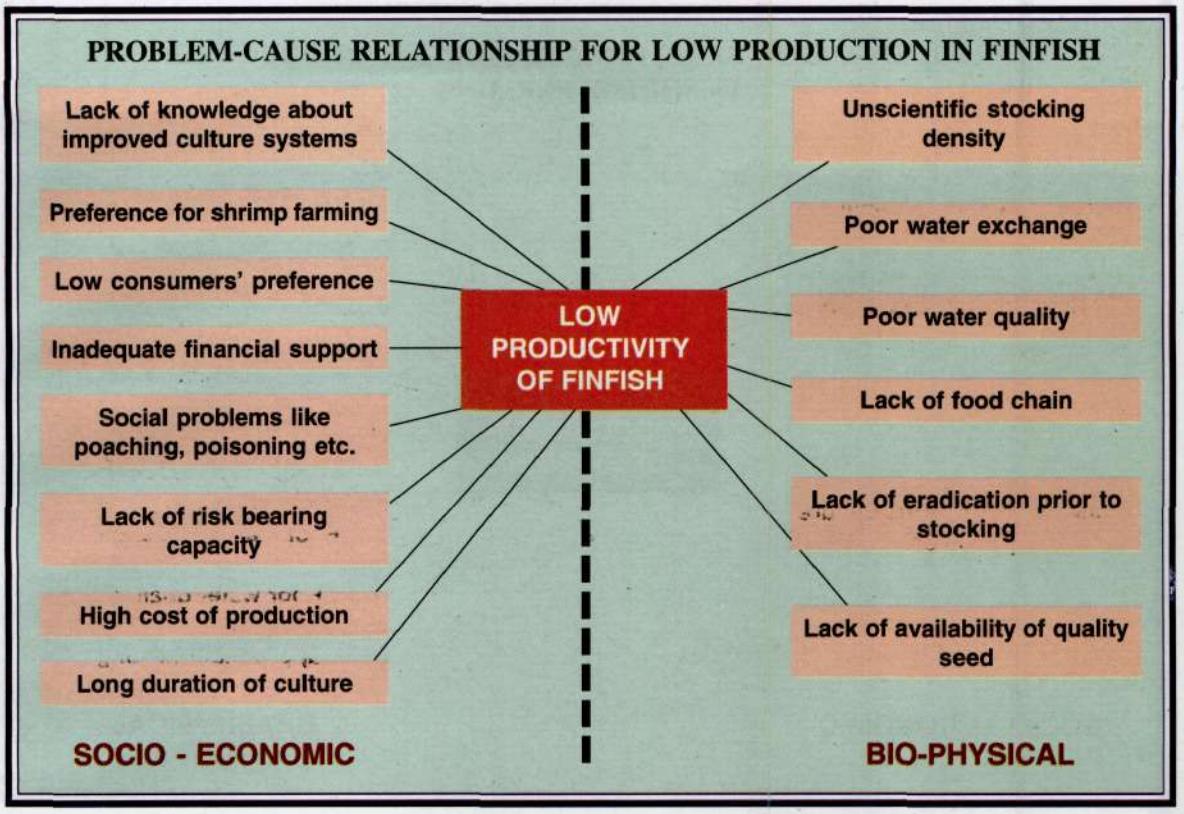
Indigenous knowledge system refers to a pool of knowledge or practices that have been developed by day-to-day activities. It is the local knowledge that is unique to a given culture or society. It is the basis for local level decision-making in agriculture, health care, food preparation, education, natural resource management and a host of other activities in rural communities (Warren, 1991). Indigenous Knowledge System pertaining to Elamkunnapuzha Village is given below.

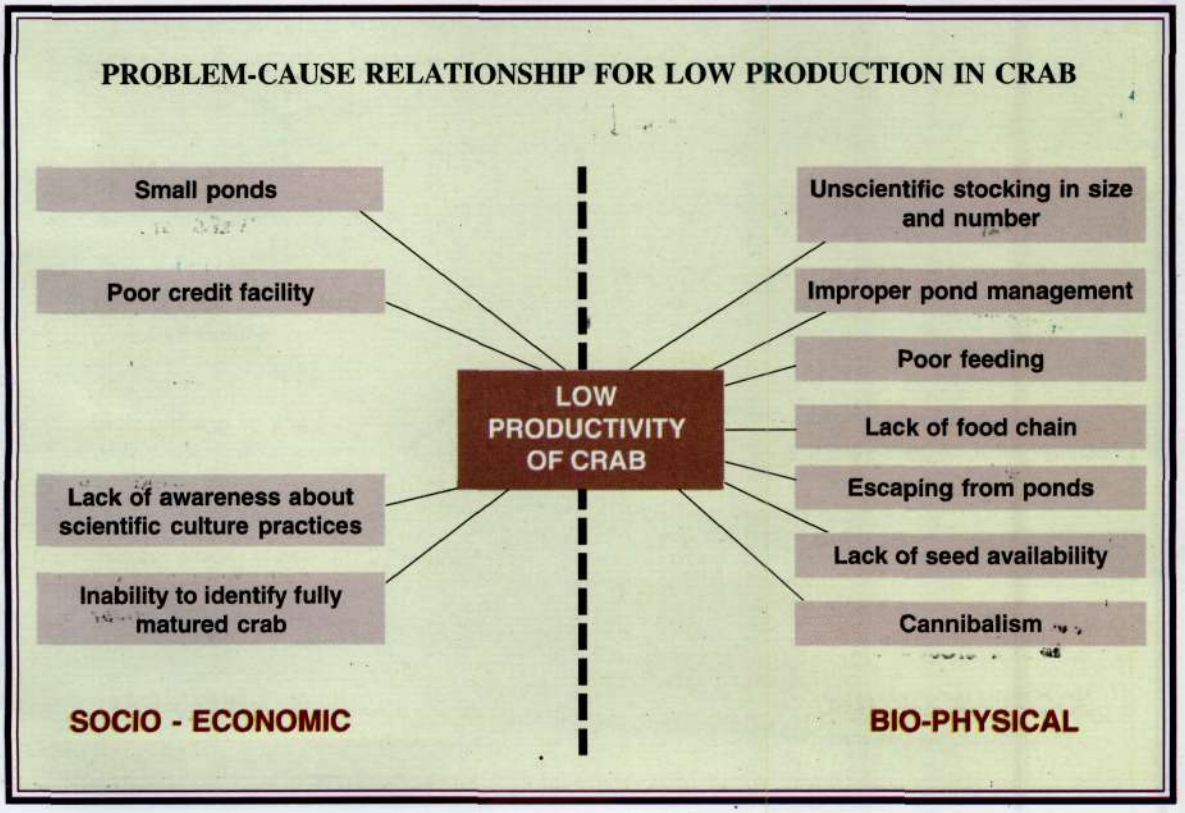
	Name of the Indigenous Technical Knowledge (ITK)	Scientific Rationale
1.	**Capture fisheries**	
a)	On a high tide day (*Ekadasi)* a phenomenon locally called *Thakkam* is observed characterised by particular direction of water current and colour change of water	Chakara occurs. (i.e., mud bank formation)
b)	Experiencing a particular smell	Identifying shoals of sardine
c)	Observing a particular movement and colour change of waves	Identifying shoals of mullet
d)	Algal bloom colour change	Influence on fish quality
2.	**Culture fisheries**	
a)	Noting indicators like dull eye reflex, sluggish movement, erratic swimming and crowding at surface	To identify the disease incidence
b)	Bubbles in the water surface	Indication of disease incidence
c)	Using cone shaped bamboo baskets, arrows made of spoiled umbrella rod, earthen pots, sprinkling ground nut cake during harvesting	To facilitate harvesting
d)	Protection of mangroves	Good breeding place and shelter for fish
e)	Use of different mesh sized nets in sluices	To prevent escaping of grown up fishes from culture ponds
3.	***Pokkali* / Fish culture**	
a)	Mostly prawn is cultured in *pokkali* fields	Short duration of prawn farming and also the lower depths of ponds make it suitable for seasonal paddy (*pokkali*)
b)	Leftovers of paddy serve as feed and reduces the operational cost of fish farming	Rotation of crops depending on seasonal suitability
4.	**Fish drying**	
a)	Soaking of fish in salt solution before drying	To enhance shelf-life
b)	Sun-drying of poor quality fish	Sun drying clears all the impurities in fish and makes it edible

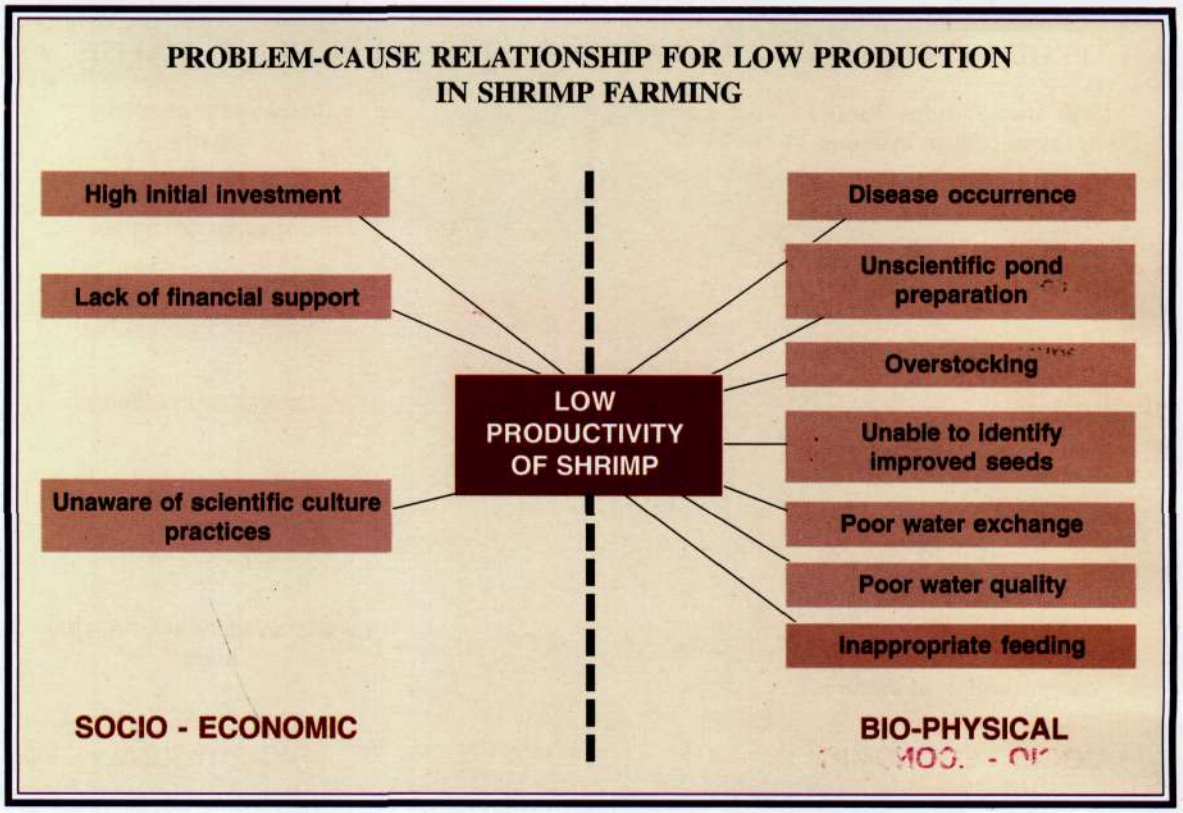
5.	**Paddy farming**	
a)	Paddy seeds sprinkled with cow-dung slurry and dried under shade	Promotes good germination
b)	Erecting coconut leaf bases in paddy field with white cloth tied on it	Avoids birds attack
6	**Coconut farming**	
a)	Application of crushed small onion (1 kg) and salt (2 kg) in the basin of coconut trees per year	To control root wilt. Prevent nut fall
b)	Clay collected from the traditional shrimp fields dried and applied in the basin @ 100 kg/year/tree	Acts as organic fertilizer and increase yield
c)	Application of salt mixed with sand in the crown of coconut trees	Prevents attack of rhinoceros beetle, Encourages easy root growth, drainage of water and gives mulching effect
7.	**Vegetable cultivation**	
a)	Application of turmeric powder on nursery bed	Prevents ants attack
b)	Mixing burnt ash of coconut leaf with seeds before sowing	Prevents ants attack and fungal infection
c)	Dipping of seeds of cucurbitaceous group in fresh cow dung and drying it	Seed preservation techniques viable for one year
d)	Hanging of matured pods of okra, cowpea, and ridgegourd near chimney	The smoke dries the seeds and prevents from the attack of fungus and insects till the next season (seed preservation)
e)	Application of mixture of turmeric powder and lime solution on the prepared field	Antiseptic action
8.	**Livestock**	
a)	Application of turmeric powder and coconut oil paste on wounds of cattle as well as poultry	Heals wounds because of the antiseptic properties
b)	Administering alcohol in smaller quantities to poultry	Cures ranikhet disease
c)	Application of ash and salt on wounds of cattle as well as poultry	Cures the wounds because of the antiseptic properties
d)	Application of onion and garlic for gaping disease in poultry	Antiparasitic effect
e)	Application of neem oil in maggot wounds of cattle and fly repellent	Insecticidal properties of neem

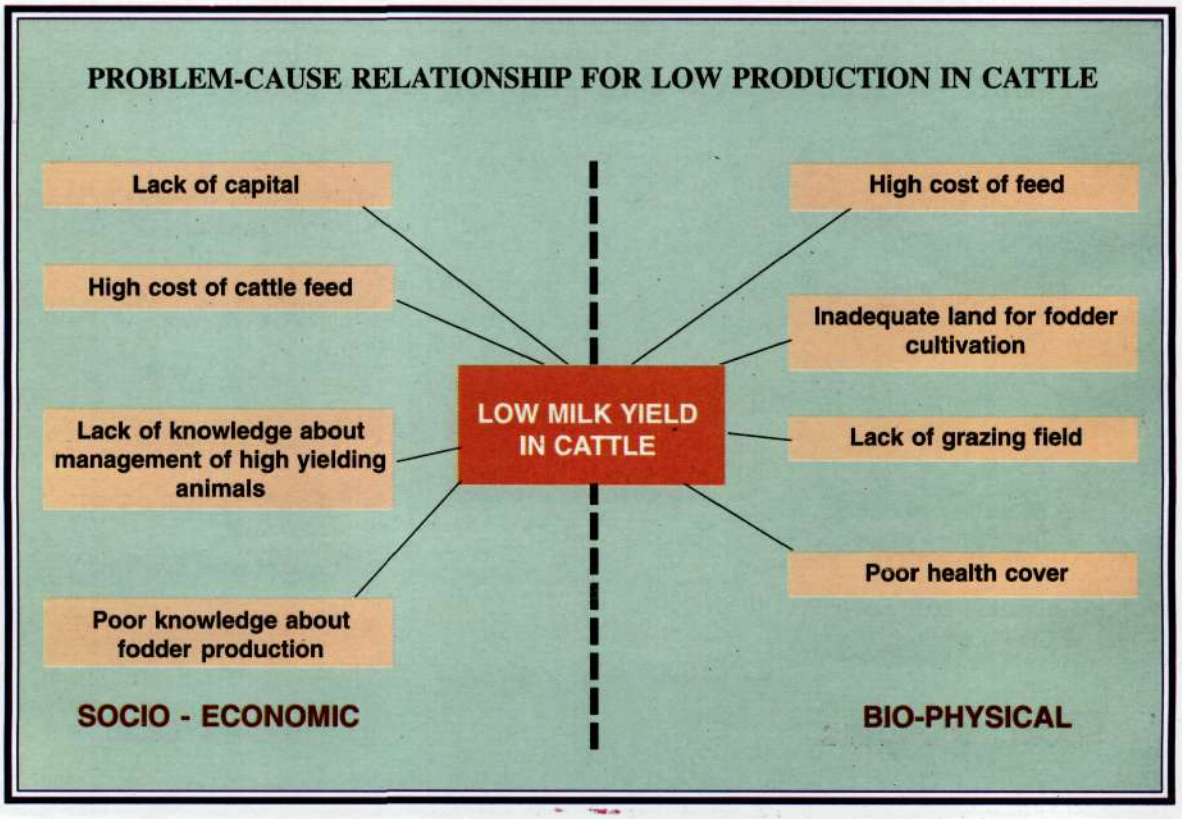
(d) PROBLEM-CAUSE RELATIONSHIPS AND PRODUCTION SYSTEMS

The assessment of production lacunae based on the analysis of the causal relationship of the socio-economic and bio-physical features of different farming systems is described in this section. Based on the problems identified, interventions have been designed to solve the problems of farmers.

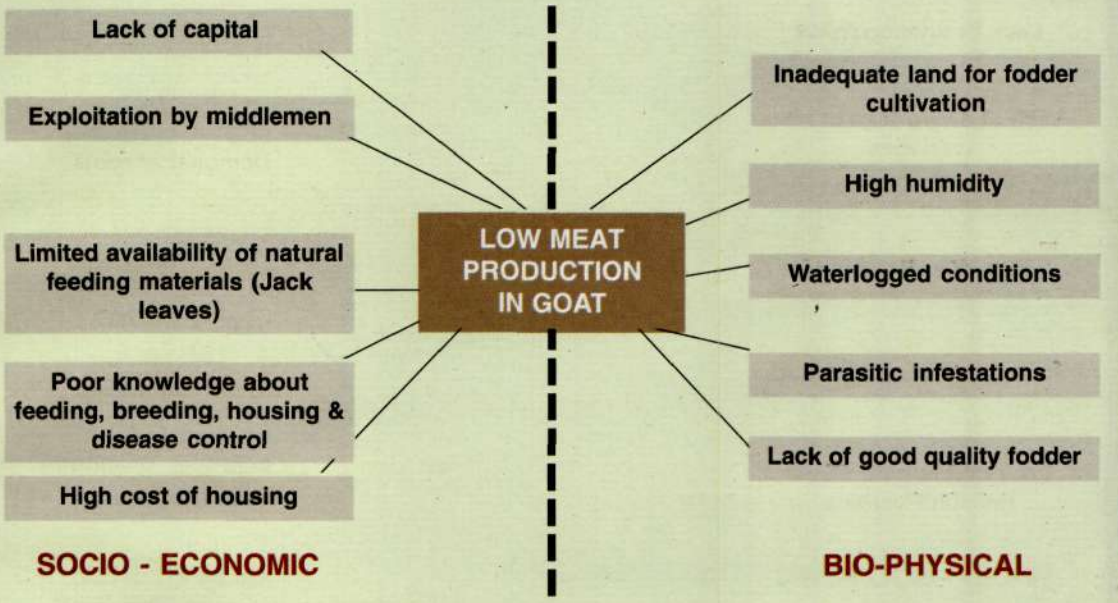

PROBLEM-CAUSE RELATIONSHIP FOR LOW PRODUCTION IN FINFISH
Lack of knowledge about improved culture systems
Preference for shrimp farming
Low consumers' preference
Inadequate financial support
Social problems like poaching, poisoning etc.
Lack of risk bearing capacity
High cost of production
Long duration of culture
LOW PRODUCTIVITY OF FINFISH
Unscientific stocking density
Poor water exchange
Poor water quality
Lack of food chain
Lack of eradication prior to stocking
Lack of availability of quality seed
SOCIO - ECONOMIC
BIO-PHYSICAL


PROBLEM-CAUSE RELATIONSHIP FOR LOW PRODUCTION IN CRAB
Small ponds
Poor credit facility
Lack of awareness about scientific culture practices
Inability to identify fully matured crab
LOW PRODUCTIVITY OF CRAB
Unscientific stocking in size and number
Improper pond management
Poor feeding
Lack of food chain
Escaping from ponds
Lack of seed availability
Cannibalism
SOCIO - ECONOMIC
BIO-PHYSICAL

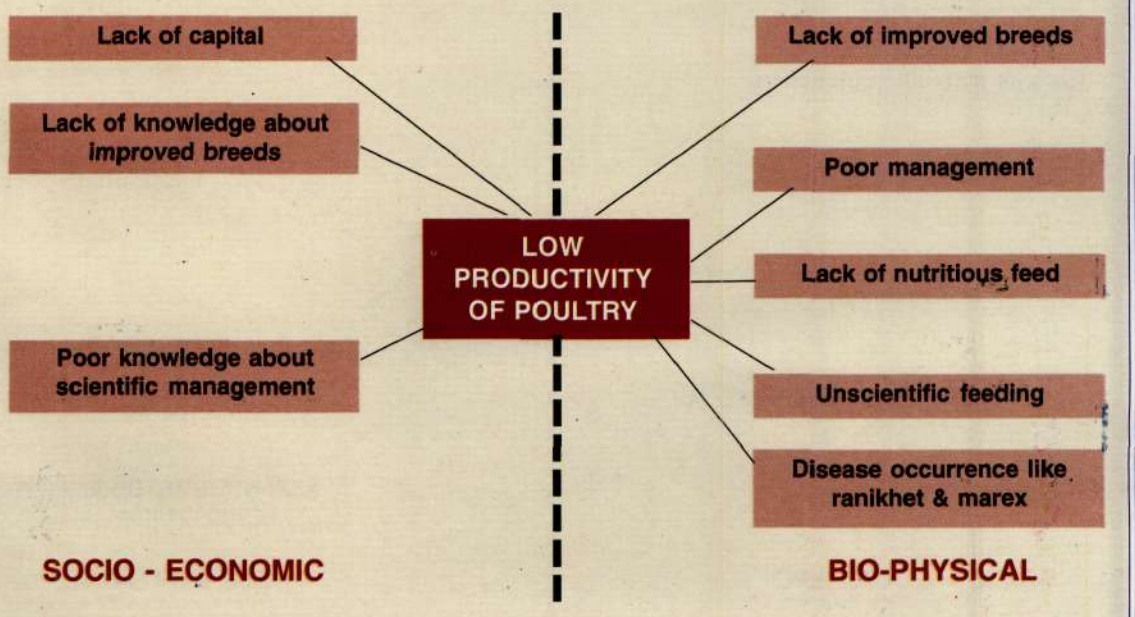

PROBLEM-CAUSE RELATIONSHIP FOR LOW PRODUCTION IN SHRIMP FARMING
High initial investment
Lack of financial support
Unaware of scientific culture practices
LOW PRODUCTIVITY OF SHRIMP
Disease occurrence
Unscientific pond preparation
Overstocking
Unable to identify improved seeds
Poor water exchange
Poor water quality
Inappropriate feeding
SOCIO - ECONOMIC
BIO-PHYSICAL

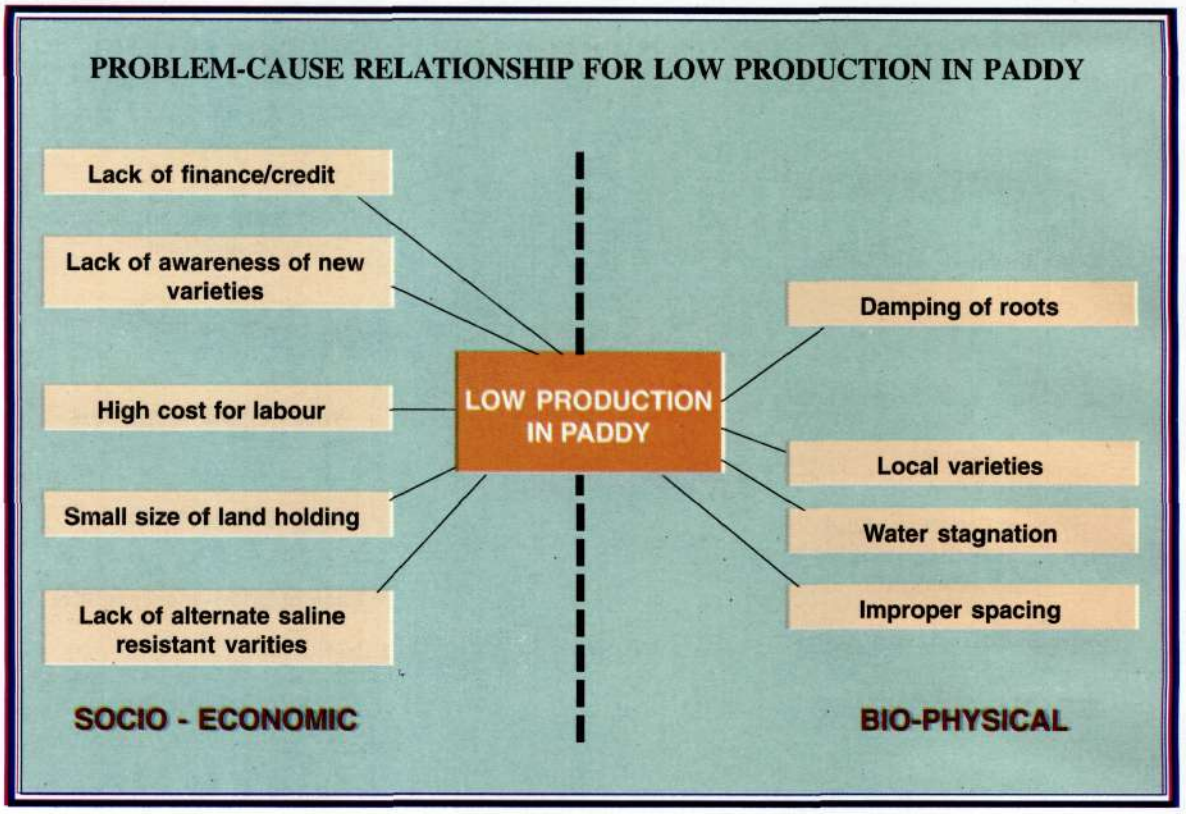

PROBLEM-CAUSE RELATIONSHIP FOR LOW PRODUCTION IN CATTLE
Lack of capital
High cost of cattle feed
Lack of knowledge about management of high yielding animals
Poor knowledge about fodder production
LOW MILK YIELD IN CATTLE
High cost of feed
Inadequate land for fodder cultivation
Lack of grazing field
Poor health cover
SOCIO - ECONOMIC
BIO-PHYSICAL

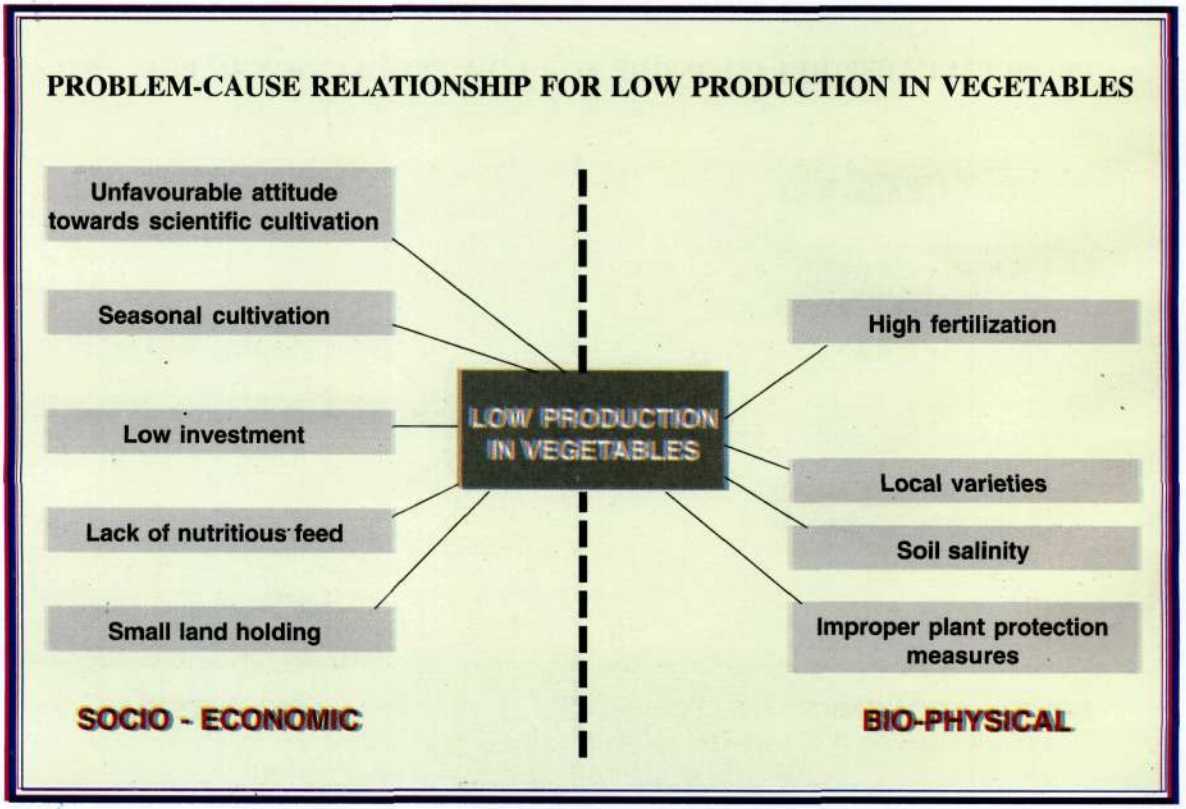
PROBLEM-CAUSE RELATIONSHIP FOR LOW PRODUCTION IN GOAT

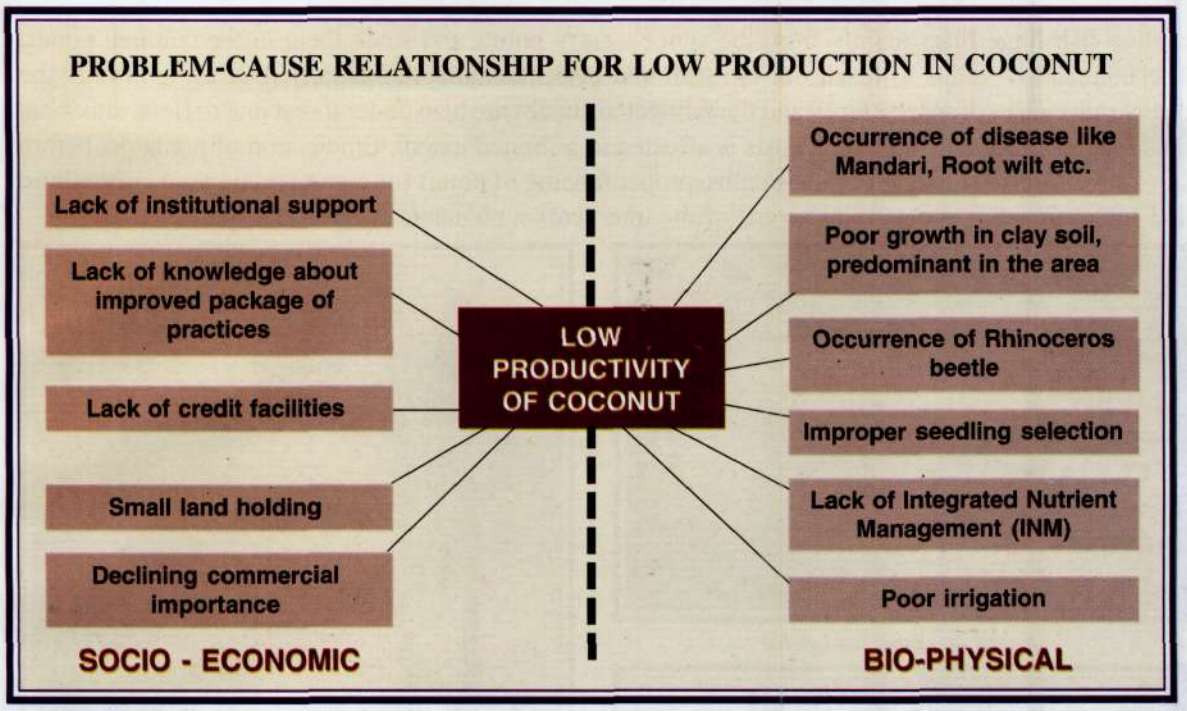


PROBLEM-CAUSE RELATIONSHIP FOR LOW PRODUCTION IN POULTRY




PROBLEM-CAUSE RELATIONSHIP FOR LOW PRODUCTION IN PADDY
Lack of finance/credit
Lack of awareness of new varieties
High cost for labour
Small size of land holding
Lack of alternate saline resistant varities
LOW PRODUCTION IN PADDY
Damping of roots
Local varieties
Water stagnation
Improper spacing
SOCIO - ECONOMIC
BIO-PHYSICAL


PROBLEM-CAUSE RELATIONSHIP FOR LOW PRODUCTION IN VEGETABLES
Unfavourable attitude towards scientific cultivation
Seasonal cultivation
Low investment
Lack of nutritious feed
Small land holding
LOW PRODUCTION IN VEGETABLES
High fertilization
Local varieties
Soil salinity
Improper plant protection measures
SOCIO - ECONOMIC
BIO-PHYSICAL



(e) MICRO-FARMING SITUATION

Five micro farming situations are identified through the agro ecosystem analysis, such as Tide-fed brackish water system, Open sea based coastal ecosystem, Homestead animal husbandry and poultry farming system, Rain-fed agri-horticulture system on embankments and homesteads and Low-lying seasonal paddy farming system. The techno interventions are structurally designed in accordance with the identified micro farming situations. Details of the micro farming situations are given below.

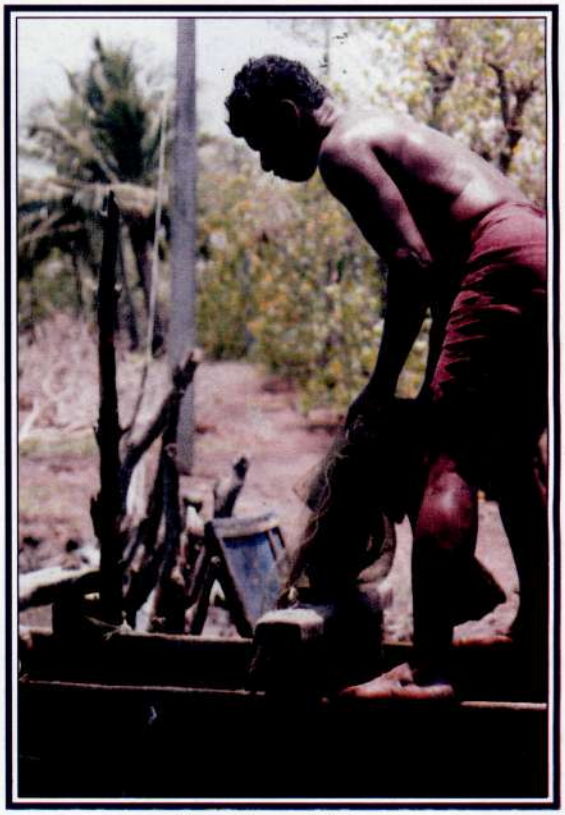
Tide-fed brackish water system

This system includes the rivulets having inlets from the sea or a brackish water locale. In Elamkunnapuzha Village, the bar mouth and the major rivulet, *Kuzhali* (connecting *Bandhar-Canal* at Malippuram North) and originating from the Cochin estuary are connected to the minor rivulets. The bar mouth is situated around 1500 metres away from the major fishery based operational centres. These canals function as the lane for water flowing into the fish culture ponds making it congenial for brackish-water fish farming. This water-lane itself is also bestowed with fishery resources. Fishing on commercial basis is usual in the major rivulet, a common property resource, connected to the minor rivulets and the fish farms in the village. The Villagers need to get sanction from the Cochin Port Trust for fixing Chinese dip-nets on the coasts of *Kuzhali.* The mangrove aside the channels and the fishing ponds act as the breeding ground for shrimps as well as finfishes throughout the year. These fish farms have the advantage of convenient exchange of water from the sea to the ponds during high tide and back to the sea during low tides. The tidal flow into the fishponds usually takes place "before sunrise" and outflow of water (low tide) happens by nearing sunset time. The exchange of water and the entry of fish resources are controlled through fabricated sluices, locally known as *thoompu*. Such exchange enables the culturing of prawns and finfishes in the ponds. During high tide, the farmers open the sluice gates for the inflow of water along with the fish resources, thus allowing natural entry. To prevent the escape of grown up fishes from the culture ponds, the fishermen use nets of different mesh size in the sluice. Moreover, they use basket nets and other equipments to

capture fish fingerlings mainly from the sluice's entry points and stock them in the cultured ponds. The tidal inflow helps to leach out the filth and also maintains the salinity. During monsoon, the heavy rain causes drop in salinity and the fabricated sluices are also under threat due to flood situation, thus fish farming on commercial basis is affected to a limited extent. Eradication of predators before stocking, uniform stocking of fishes/crabs, proper fencing of ponds for commercial based crab culture and scientific feeding pattern are some of the intervention elements suggested as part of IVLP.

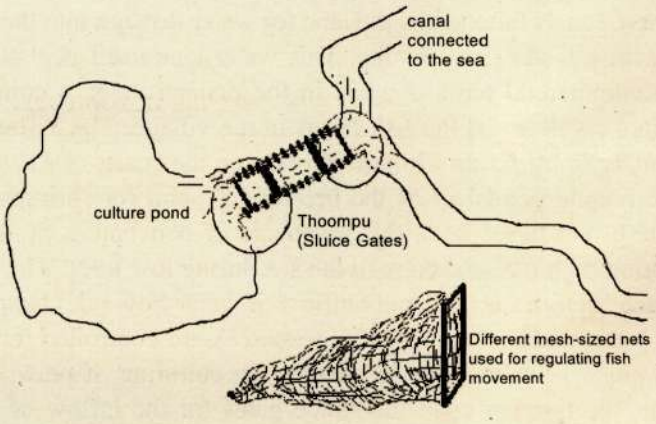
A view of a fabricated sluice

Water exchange through sluice



Operating a sluice

Sluice gates fabricated to regulate the entry of water and other resources, are usually made of bamboo, woods of coconut etc. Usually, gates are of 60cm to 75cm width, and 180 cm to 240 cm length, mostly depending on the distance between the culture ponds and tributary channel connected to the sea. Most of the farmers use electric bulbs for attracting fishes and shrimps to the sluices. Field level observation show that the geographic appropriateness and the quality of the sluices are directly proportional to the fish catch from the culture ponds.



Poaching is a real social problem, especially in the remote culture ponds of the village. Cultured fishes nearing harvest are more prone to poaching. Farmers use small branches of trees and other wooden sticks in their ponds to prevent poaching; the branches and sticks of different sizes are either fixed or dispersed randomly in the cultured ponds, thus restricting the anti-social activity as the bulk poaching using cast net during night becomes impossible because of these branches and sticks in the ponds. Apart from the prime objective of prevention of theft, the wooden materials are also considered as a natural medium for the congenial growth of fishes. Fishes like *Pallathi* (*Etroplus maculates*), *Karimeen* (*Etroplus suratensis*) and *Kanambu* (Mullets) are seen rubbing their body parts in these sticks to get rid of external parasites such as *leach* and *lernea*.

Traditional method of preventing poaching in culture ponds

Open sea based coastal ecosystem

The village has a coastal stretch of around 5 km. Fishing is the main activity in the coastal ecosystem throughout the year except for the monsoon season. Usually, trawlers, purse-seiners, gill-netters, ring-seiners and other types of motorised and non-motorised fishing units with different craft and gear combinations are the major fishing vessels operated in this coastal ecosystem. The village has got two major fish landing centres and a seafood export firm. Secondary to fishing, the major commercial activities included in the system are fish marketing (including auctioning), sub contracting of fish vending to the women labourers, peeling and sun drying of fish. With the advent of the People's Plan Campaign and the consequent upraise of the decentralised governance have given a new strength to women through Self-Help-Groups (SHGs). The SHGs have contributed an organisational cohesiveness to the women in the Village and around 70 per cent of the SHGs are engaged in fishery related ventures, especially in the processing and marketing of value added fish products. Earlier with respect to drying of fish, it was only a supply-induced business, since the fish-lot which was taken for drying would be from the surplus quantity, mostly second quality or those that left over in fresh fish trade. Obviously, peak season of fish catch has a proportionate supply of fish for drying purpose and during off season the opposite. Thus whatever employment being created as part of drying fish is seasonal in nature. Preservation of fish for drying and an established mode of commercial drying units are totally missing among the rural fisherfolk in this region. The supply-induced ventures could be transformed to demand-pulled enterprises in the open sea based coastal ecosystem. The current traditional mode of sun-drying of fish could be replaced with rack-drying and the poor quality of drying could be improved with new technology to provide a sustainable livelihood for the womenfolk.

The Coastal Zone Regulation Act offers a 500-metre width of coastal area especially in the Western boundary of the Village for developing pastures. This vast area of common property resource under the coastal ecosystem is well suited as a grazing ground for the livestock in the village. The largely stall-fed livestock in the village could make use of this pastureland.

Homestead animal husbandry and poultry farming systems

Homestead denotes those areas around the house, which are used for farming and other income generating activities. There is no category-wise demarcation of the area under a particular homestead; it may range between 5 cents to 150 cents in case of Elamkunnapuzha Village. The village is densely

populated with a total population of 51,197 [1996] within the total area of 11.52 sq.km and about 70 percent of the residential plots are less than 20 cents area of land. Organised livestock farming is absent in the area, but keeping few birds and rearing one or two goats are popular practice. Very few people prefer to keep cows for milk production. Ducks, pigs and rabbits are also reared on a smaller scale. The poor economic performance of animal husbandry led to lesser adoption of scientific methods of farming and more dependence on indigenous practices and this vicious circle continue.

Poultry forms an integral part of homestead farming. Generally few birds are let out in the premises and during night they are kept closed by bamboo baskets or in cages. Some birds even perch on treetops. No proper feeding is done except providing leftovers from the kitchen. Often the birds are left to find their feed themselves whatever they come across – insects, worms, grass and so on. No special arrangements for drinking water are made. Water running through drains and dripping from pipes are used by the birds. Most of the poultry are country birds having long brooding periods and poor producing ability. The average production is about 50 eggs per annum. No preventive vaccination or periodic de-worming is done. Many farmers feel that this type of "backyard" poultry keeping is profitable since no inputs or labour is utilised. But really it is not so. Poor producing ability of the birds, small size of the egg, high mortality due to diseases and parasitic infestation make backyard poultry farming less remunerative and uneconomic. The profits can be significantly increased by adopting the scientific strategies such as supplementing the existing feed by compounded feed mineral and vitamins, gradual replacement of the existing stock with birds of high genetic make up and grading up with male birds of superior genotypes, providing better health coverage by preventive vaccinations and periodic de-worming.

Among the livestock based farming systems, goat farming is one of the popular avocations of the area. The high price for goat meat and ready local demand has prompted many to take up goat rearing. The milk of goat has only limited market demand and rarely been sold out. It is mostly used for feeding kids. The goats reared are mostly of good variety – Malabari/Tellichery type and crossbreds of exotic breeds like Sannon / Alpine breeds, introduced by various developmental agencies. High humidity and waterlogged conditions favour parasitic infestations. Limited availability of fodder grasses is also a constraint for goat production. Poor farmers used to sell goats frequently as and when money is needed. With all the limitations there are good prospects for goat rearing owing to ease of maintenance within the smallholdings and the market demand it commands. Above all, the animal fits well in the homestead-farming region of the coastal ecosystem. Proper parasitic control and supplementary feeding coupled with timely disease management can improve the production.

Dairy farming suffer from socio-economic bottlenecks like deficiency of capital, high cost of cattle feed, lack of know-how about management of high producing animals, inadequacy of land for fodder production, poor disease control and scarcity of natural grass and water. High salinity of soil and water makes the problems worse. Usually, the farmers prefer *Uppootha*, a mangrove leaf, as feed. Cattle-sheds are usually thatched or covered with polythene sheets. Making *pucca* sheds is cost intensive and generally not done. Cows are mostly purchased in advanced stage of pregnancy or in early lactation. Home raised replacements are rare. All animals are crossbreds but difficult to be graded according to the extent of exotic inheritance mostly derived from Jersey, Swiss Brown and Holstein-Friesian breeds. Jersey crossbreds are

Uppootha - mangrove leaves used as feed for cattle

popular in this ecosystem and they appear to fare better compared to other genotypes. Udder, reproductive and nutritional problems are rampant. The parasitic and other diseases adversely affect the output. A great deal of work has to be done to make dairying a viable proposition in the coastal agro-ecosystem, starting from marketing of milk to disposal of dung and shed washings.

Rain fed agri-horticulture system on embankments and homesteads

1. Coconut based system under rainfed conditions: Coconut is the dominant crop of embankments and homesteads. Vegetables, tuber crops and banana are grown as inter crops. The high soil salinity in the region is found to be ideal for coconut plantations. Fertilisation based on scientific management practices is lacking for the plantations and this cultivation requires Integrated Nutrient Management [INM] for enhancing production.

Coconut based system under rain fed conditions

2. Vegetable based system on embankments: Vegetables like amaranthus, snakegourd, cucumber, bittergourd and ridgegourd are grown on commercial scale in the embankments mainly during monsoon season around fishponds. The nutrient-rich pond-bed soil is used for fertilising vegetable farms on the embankments. The high demand for the fresh vegetable in the region is reflected in the large number of vegetable vendors engaged in the local marketing sector. Most of the household requirements are met with the vegetables produced within their own land. Farmwomen can very well manage these activities, as it requires less effort. Even, family as a whole can take up this activity.

3.Banana based system under rain-fed low lands: Banana is raised in lowland under rain-fed conditions. Most of the farmers cultivate banana on commercial basis. The availability of fresh water for irrigating banana is relatively good in the interior places of the village. *Palayankodan*, *Njalipoovan* and *Monthan* are the varieties used for cultivation.

4. Low-lying seasonal paddy (pokkali) lands: Growing of paddy in monsoon season is the main practice. This will be followed by fish/shrimp culture. The farming of paddy as well as shrimp in the paddy fields is done mainly on group farming basis. There are three major *padasekharam* (group farm) such as Kattachal, Kurichippadom and Thekkeppallampilly in the region. Paddy is cultivated during June-September exclusively depending on rain and usually mono-cropping pattern is followed. The paddy lands typically have loamy soil at an average depth of 0.5 metres. The monsoon rain along with the tidal currents from adjacent brackish water area maintains the salinity of soil. Sowing of paddy is done after constructing *kanni* (blockade) along the fields. Followed by the sowing of paddy, the *kanni* will be dismantled within four or five days for the outflow of water into the fields. Later, the water level in the fields is maintained in accordance with the growth of seedlings. Harvesting of paddy is done within 110-130 days from the time of sowing. Shrimp culture is the alternative farming in the *pokkali* lands after paddy cultivation. Leasing of paddy lands for shrimp farming during November/December-March/April is common in the region.

Low lying seasonal paddy lands (pokkali)

SECTION III

INTERVENTIONS

The implementation of location specific techno-interventions commenced in February 2001 with the active participation of farmers. Altogether 17 interventions were carried out in the first phase. This included 8 fisheries-based, 3 livestock-based and 6 agriculture-based programmes. Already, 6 fisheries-based, 3 livestock-based and 6 agriculture-based interventions were completed. The remaining interventions are progressing and the performance indicators are closely observed on a regular basis. Technologies are refined taking clues from the completed interventions. Initially the present practices followed in various farming situations are analysed and production problems identified. Available technologies are verified and modified through scientifically formulated interventions, ultimately aimed at enhancing the productivity. This section gives information on the completed and ongoing interventions initiated in the first phase.

(a) COMPLETED INTERVENTIONS

FISHERIES BASED INTERVENTIONS

INTERVENTION No. 1

1	Name of technology	:	**Assessment of monoculture of uniform sized juvenile crabs**
2	Micro farming situation	:	Tide-fed brackish water system
3	Nature of intervention	:	Verification Trial
4	Treatments	:	**T1 - Farmers' practice**: Traditional crab farming **T2 - Potential solution**:Uniform stocking at the rate of 4,800 crabs/ha with a uniform size of 150-200 g.
5	Plot/ unit size	:	0.1 ha (1000 m^2)
6	No. of replications/ Families	:	10

Traditionally, crab culture is followed on a limited scale along with fish culture in the micro-farming situation of Tide-fed brackish water system. Shrimp culture was the popular farming predominantly practiced and widely accepted as more profitable than any other venture in the village. In reality, crab culture was given least importance. Lack of fabricated sluices or the absence of its maintenance were identified as problems. Lack of good quality seeds and cannibalism were the associated production problems. Boiled slaughter wastes and kitchen wastes were usually given as feeds and the feeding rate were very uneven.

Recommended technology is the monoculture of uniform sized juvenile crabs [mud crab - *Scylla tranquebarica*]. The major components of the technology are proper water exchange through fabricated sluices [size of the sluice: 60cm width and 135cm height], stocking of uniform sized juvenile crabs [stocking rate: 4800nos/ha, size: 150-200g], feeding rate of 8-10 % of the body weight with feeds such as trash fish and slaughter waste in the ratio of 2:1, and fencing of ponds [45^0 angle] using nylon nets to prevent escaping of crabs. Crabs attained a maximum weight of 1.46kg and the yield increased by 48.48 % with the treatment. The benefit-cost ratio for the treatment is worked out to be 2.10:1 as against the 1.36:1 in farmers' practice.

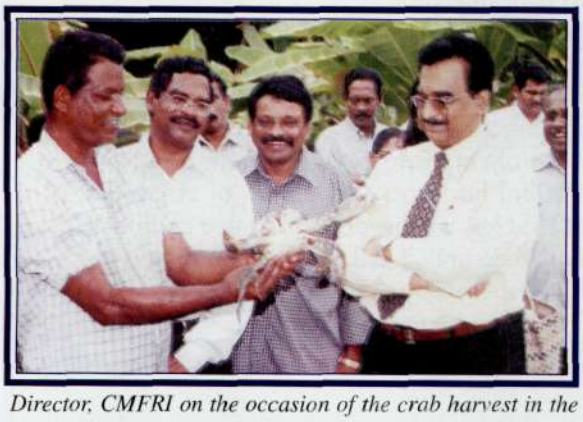
PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATION

INDICATORS	FARMERS' PRACTICE	TREATMENT
WEIGHT (kg) (harvest)	0.600 – 1.200	0.950 - 1.460
SIZE (cm) (harvest)	13.5 – 16.00	21.25 - 25.75
SURVIVAL RATE (%)	60	85
PERIOD OF MATURITY	5-6 months	4-5 months

B) ECONOMIC INDICATORS

INDICATORS	FARMERS' PRACTICE	TREATMENT
OPERATING COST (Rs/ha)	2,96,200	3,54,312
YIELD (Kg/ha)		
1. Hard shell crabs	2,000.00	3,304.00
2. Soft shell crabs	500.00	408.00
TOTAL	2,500.00	3,712.00
GROSS RETURNS (Rs./ha)		
1. Hard shell crabs	6,30,000	10,40,760
2. Soft shell crabs	70,000	57,120
TOTAL	7,00,000	10,97,880
NET RETURNS (Rs./ha)	4,03,800	7,43,568
B-C RATIO	1.36: 1	2.10: 1



Director, CMFRI on the occasion of the crab harvest in the IVLP farms

Mud crab (Scylla tranquebarica)

C) FARMERS' REACTION

POSITIVE ASPECTS

- Disease resistance.
- Trash fish is a good feed for crab.
- Slaughter waste - the preferred feed is available free of cost.
- Net used for fencing to prevent escaping of crabs.
- High marketability.

NEGATIVE ASPECTS

- Slaughter waste used as feed, on boiling emits foul smell and also makes pond water dirty.
- Nylon net used for fencing get worn out (portion below water level at later stages of farming).

- The method is time consuming but better than other methods which damage crabs in capturing.
- Difficulty of capturing crabs from natural hideouts.
- Significantly lower price for damaged crabs (eg.50-75% price reduction for crabs without legs).

A successful crab farmer with his family

FARMER SAYS

Mr.Sylvi Figerado
Pathissery, Malippuram Post
Elamkunnapuzha

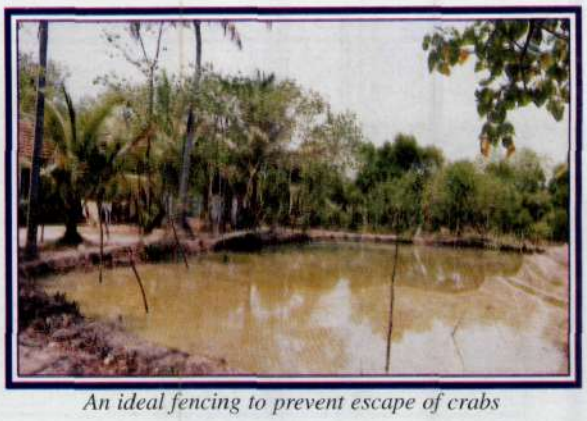
Sylvi Figerado (52) is a farmer selected for the intervention on monoculture of crab. Figerado, a matriculate, possesses around 2 acres of pond. Initially he was interested in active fishing and he was an owner of two boats during 1980s. He could not sustain his fishing business for a long period as he incurred heavy losses. His two male children were too young to support him economically during his difficult period. He shifted over to shrimp culture and his livelihood depended heavily on it. From shrimp culture he managed to reap net profit of about 1 lakh per annum during the early 1990s. But due to widespread disease occurrence in shrimps, the profit margin came down. During that period of financial crisis he came across the IVLP team. He was selected for the IVLP intervention on March 2001. Now he says that,

"When the IVLP team approached me with their intervention on crab farming, I was little reluctant to accept it as I had a negative attitude towards crab farming. But after attending the training given as part of the intervention, my attitude towards crab farming gradually changed. I became aware of the requirement of proper water exchange, farming, quality seeds for stocking, selection of uniform sized seeds, feed requirements and the feeding pattern. During 2001-2002, I earned a profit of Rs.46,500/- from my pond in a single harvest. Later by the end of February 2002, I had stocked the next lot of juvenile crabs which earned a profit of around Rs.50,000/-. Now whenever I am in need of money, I just sell the crabs and earn the required amount in no time. I feel that crab farming is the best technology for obtaining maximum profit without much risk".

D) MATRIX RANKING (10 - Point Scale)

SI.No.	Items	Farmers' practice	Treatment
1	Weight	07	09
2	Size	05	08
3	Period of maturity	06	08
4	Yield	05	07
5	Susceptibility to diseases	06	07
6	Ease of adoption	06	07
7	Feed availability	07	07
8	Survival rate	07	08
9	Marketability	06	08

Mud crab (Scylla tranquebarica)



An ideal fencing to prevent escape of crabs

Farmers have very favourable attitude towards the monoculture of uniform sized juvenile crabs. The crabs cultured through this practice have better growth parameters. At the very outset, the economic returns from crab culture has increased. Though there is no marked difference in the availability of feeds, the size and yield showed significant difference.

INTERVENTION No. 2

1	Name of technology	**Assessment of polyculture of finfish in tide-fed ponds**
2	Micro farming situation	Tide-fed brackish water system
3	Nature of intervention	Verification Trial
4	Treatments	**T1-Farmers' practice**: Improper stocking of species and eradication **T2-Potential solution**: Eradication of predators using mahua oil cake, Stocking of seeds of pearl spot, milk fish and grey mullet
5	Plot/ unit size	0.06 ha (600 m^2)
6	No. of replications/ Families	5

Visit of NATP Peer Review Team to the finfish farm

A farmer with the harvested finfish (C. chanos and M. cephalus)

Successful farmer with his family

FARMER SAYS

Mr.Karthikeyan. T.S
Thirunilathu, Puthuvyppu
Elamkunnapuzha

Mr.Karthikeyan (48), having primary level of education, is an identified finfish farmer for the intervention on 'polyculture of finfish (*Chanos chanos* and *Mugil cephalus*)'. He entered into the field of fish culture during 1996, in his own farm. He owns 42 cents of land. The location was very bushy obstructing the inflow and outflow of saline water from the sea. This resulted in silt deposition and increase in weed population. The bushy land was cleared and deepened for culturing fish. He constructed temporary sluices in the eastern corner of the pond. No additional labourers were employed; rather the work was done by the family members. His wife Mrs Isha engaged herself fully in the farm operations. Natural entry of various species of grey mullets, pearl spot, milkfish was allowed. Apart from this, selective stocking of *Mugil cephalus* was also done at times. No specific stocking rate was maintained in such selective stocking. The economic returns were very minimal and were inadequate to make both ends meet. Irregular stocking and feeding pattern might be the reason for the low yield and less profit during those periods. He became a member of IVLP programme during 2001. He says that,

"I was given training regarding different aspects of finfish farming. I learned the importance of maintaining sluice gates for the proper water exchange. Stocking of fish and their feeding pattern were followed as per the suggestions of Scientists. My income earning from fish culture has increased from Rs. 32000/- to around Rs. 55000/-. I could manage to provide good education to my daughters. With no doubt in my mind I proudly say that all this is possible only because of IVLP".

In the traditional system of fish farming, fabricated sluices were not properly maintained and in some cases sluices were not used at all. In such cases worn out wooden pieces were arranged and kept as temporary sluices. Predators in the ponds were rarely eradicated. Uneven stocking of various species of fish resulted in low level of productivity. Apart from this, natural entry of fish is also allowed resulting in overstocking and low growth rate.

Polyculture of finfish is the recommended technology. Predators are eradicated using *mahua* oil cake. Water exchange is maintained through fabricated sluices and natural entry of fish is regulated. Combination of *Chanos chanos* and *Mugil cephalus* are stocked at the rate of 20,000nos/ha. *Mugil cephalus* at the harvesting stage attained a mean weight of 440g and mean length of 35cm, where as mean weight and length of *Chanos chanos* are 200g and 26.5cm respectively. The period of culture was 11 months.

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATION

PARAMETERS	FARMERS' PRACTICE		TREATMENT	
SPECIES	***M.cephalus***	***C.chanos***	***M.cephalus***	***C.chanos***
WEIGHT (g)	350	150	440	360
LENGTH (cm)	28.8	23.0	35.0	26.5
SURVIVAL RATE (%)	70	65	88	90
PERIOD OF CULTURE	Irregular	Irregular	11 months	11 months

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE	TREATMENT
OPERATING COST (Rs/ha)	2,64,000	2,70,000
YIELD (Kg/ha)		
Mugil.cephalus	3,267	4,195
Chanos chanos	2,438	3,000
TOTAL	5,705	7,195
GROSS RETURNS (Rs./ha)		
Mugil.cephalus	3,59,326	5,03,352
Chanos chanos	1,58,437	2,10,000
TOTAL	5,17,763	7,13,352
NET RETURNS (Rs./ha)	2,53,763	4,43,352
B-C RATIO	0.96:1	1.64:1

C) FARMERS' REACTION

POSITIVE ASPECTS

- High marketability.
- Large size.
- Less prone to diseases.

NEGATIVE ASPECTS

- Limited availability of seeds in some season.
- Long period of culture.

D) MATRIX RANKING (10 - Point Scale)

SI No.	Items	Farmers' practice	Treatment
1	Weight	05	07
2	Size	06	08
3	Period of maturity	06	06
4	Yield	05	07
5	Susceptibility to diseases	05	06
6	Ease of adoption	06	05
7	Feed availability	06	06
8	Survival rate	05	07
9	Marketability	06	07

Polyculture of selected finfish is preferred over the traditional practice. Increased weight and size of fishes have improved the economic returns. Farmers felt a slight difficulty in getting adapted to the technology since the traditional practice fetched income throughout the culture period. But in the case of scientific polyculture of finfish, the period of culture is 11 months and fish could be caught only by the end of the culture period. However the returns of recommended technology of polyculture is much better than the traditional practice.

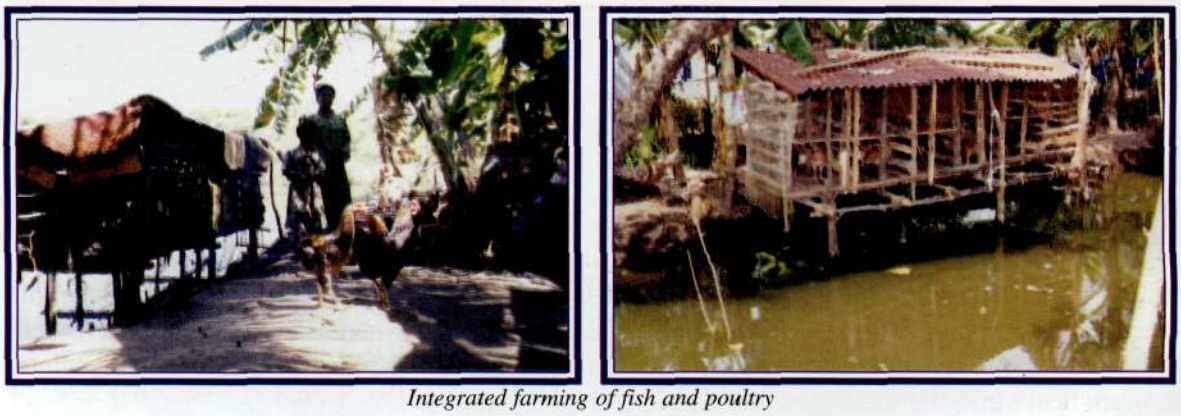
INTERVENTION No. 3

1	Name of technology	**Assessment of integrated farming of fish and poultry**
2	Micro farming situation	Tide-fed brackish water system
3	Nature of intervention	Verification Trial
4	Treatments	**T1 – Farmers' practice**: Uneconomic farming practices **T2 –Potential solution**: Fertilization of ponds using poultry droppings and stocking of *M.cephalus* and *C.chanos*
5	Critical inputs	Mahua oil cake, lime, organic fertilizers, supplementary feed, fish seed, medicine for poultry
6	Plot/ unit size	0.06 ha (600 m^2)
7	No. of replications	5

Uneconomic utilisation of land is identified as one of the problems in the coastal agro ecosystem. Lack of an integrated approach in the farming system is found to be a major constraint in optimising the income from farming. Fish farming in the homestead ponds could be more income generating with the integration of poultry farming. No such integration existed among farmers. Though two forms of farming situations existed, the lack of its integration is an obstacle in attaining the maximum output. Placing of poultry cages atop the fishpond is the suggested method to overcome the impasse.

The poultry droppings fertilize the fishponds thereby enhancing the production of both fish and plankton through direct and indirect utilisation of nutrients. Chicken manure is one of the best organic fertilizers in the growing of natural food in the brackish water ponds. It can convert crude, inedible nutrient materials into high quality fish food [Pudadera, *et al.*, 1986]. Fresh chicken manure contains 1.6 per cent nitrogen, 1.5 per cent phosphorous and 0.9 per cent of potassium [Woynarovich, 1979]. The protein content of it ranges between 20-30 per cent. About 80 per cent of the manure represents undigested feedstuffs with 25 per cent dry matter content. This is due to the very short digestive tract of chickens and most of their excreta are only partly digested [Chen, 1981]

The operational expenses of fish culture is reduced by 8-12 per cent through this fertilization. Supplemental feeding and inorganic fertilization are not required during the culture period. Apart from the output from fish culture, the farmers receive a good amount of additional income from poultry farming utilising same land and manpower. Improved variety of poultry birds [*Gramasree*] is introduced. The egg yield of country birds is 120 /bird/year. The yield for the *Gramasree* variety is 200 /bird/year.



Integrated farming of fish and poultry

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATION (Fish farming)

PARAMETERS	FARMERS' PRACTICE		TREATMENT	
SPECIES	*M.cephalus*	*C.chanos*	*M.cephalus*	*C.chanos*
WEIGHT (g)	350	150	500	400
LENGTH (cm)	28.8	23.0	35.0	26.5
SURVIVAL RATE (%)	70	65	90	90
PERIOD OF CULTURE	Irregular	Irregular	11 months	11 months

B) BIOMETRIC OBSERVATION (Poultry farming)

PARAMETERS	FARMER'S PRACTICE	TREATMENT
WEIGHT OF EGG (g)	32	38
COLOUR OF EGG	White	Cream and White
AVERAGE No. OF EGGS (15birds/day)	4	6
BIRD WEIGHT (Kg)	1.5	2.2
SUSCEPTIBILITY TO DISEASES	High	Low

C) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE	TREATMENT
OPERATING COST		
a) Fish farming (Rs/ha)	2,64,000	2,70,000
b) Poultry farming	21,750	27,600
TOTAL	2,85,750	2,97,600
YIELD		
a) Fish farming (Kg/ha)		
1) *Mugil cephalus*	3,267	4,860
2) *Chanos chanos*	2,438	3,312
b) Poultry farming (total number of eggs/annum)	14,400	27,800
GROSS RETURNS		
a) Fish farming (Rs/ha)		
1) *Mugil cephalus*	3,59,326	5,83,200
2) *Chanos chanos*	1,58,437	2,31,840
b) Poultry farming	33,300	34,300
TOTAL	5,51,063	8,49,340
NET RETURNS		
a) Fish farming (Rs/ha)	2,53,763	5,45,040
b) Poultry farming	11,550	6700
TOTAL	265313	5,51,740
B-C Ratio	0.93:1	1.85:1

D) FARMERS' REACTION

POSITIVE ASPECTS

- Good economic returns.
- Easy to combine fish farming with poultry farming.
- No additional feed supplements required for fish.
- More accurate mode of homestead poultry farming.
- Increased egg yield.
- Improved weight of the birds.

NEGATIVE ASPECTS

- Stall feeding of birds.
- Birds are attacked by snakes, dogs and other animals.
- Cage construction is expensive.
- Wooden pillars (on which the cages are constructed) are not adequate.
- Fear of disease incidence (from poultry to fish).

E) MATRIX RANKING (10 - Point Scale)

Sl.No.	Items	Farmers' practice	Treatment
1	Weight of fish	07	08
2	Length of fish	07	08
3	Period of maturity	06	08
4	Yield	05	07
5	Ease of adoption	06	07
6	Egg yield	05	07
7	Fertilisation of ponds	05	08
8	Cost effectiveness of fish farming	06	08
9	Cost effectiveness of poultry farming	06	06

Matrix ranking of the preference of farmers indicates that there is significant cost effectiveness in fish farming. The *cost-savings* became possible with the alternative fertilisation provided by poultry droppings. They also opined that the integrated farming practice has increased the yield from the hybrid birds, since special care was given to poultry farming in view of the fertilisation of ponds.

INTERVENTION No. 4

1	Name of technology	**Assessment of monoculture of *P.monodon* under modified extensive method of farming**
2	Micro farming situation	Tide-fed brackish water system
3	Nature of intervention	Verification Trial
4	Treatments	**T1 - Farmers' practice**: Traditional filtration methods **T2 - Potential solution**: Farming of *P.monodon* employing modified extensive method
5	Plot/ unit size	0.18 ha (1800m^2)
6	No. of replications/ Families	3

Shrimp culture fetched low income mainly due to improper stocking and widespread use of low quality seeds. Feeding schedule was not at all scientific and systematic. Eradication of predators before stocking was virtually absent leading to low productivity. Accumulation of weeds, at times also negatively affected the water quality.

Dr. S. D. Tripathi, Director (Rtd.), CIFE & Member, Research Advisory Committee, CMFRI, appraising P. monodon culture

Farming of *Penaeus monodon* employing modified extensive method [pond preparation with tilling, liming and fertilization, having additional water exchange facilities with pump sets] is the recommended technology. Seeds are stocked at the rate of 50000nos/ha [size: PL-20]. Treatment is carried out in three ponds and the results varied significantly. Low survival rate [30 per cent] is recorded in pond no.1. This is due to entry of predators after stocking because of the overflow of water during heavy rain. Mortality is caused due to sudden drop of salinity and pH (6.00) of water. The stocked shrimps recorded good growth rate in 80 days in pond no.2. Sudden drop in the salinity (0-1) and pH (6.00) due to heavy rain caused severe stress to the shrimps resulting in heavy mortality and the survival rate is recorded to be only 15 percent. The heavy rains did not adversely affect the stocked shrimps in pond no.3 since this pond is deeper (5ft) than other selected ponds. Growth performance indicates 'stress-free' development of shrimps in this pond and the survival rate is 60 per cent. The result of the best pond is given below.

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATION

PARAMETERS	FARMERS' PRACTICE	TREATMENT
WEIGHT (g)	35	40
SIZE (cm)	15-17 cms	16-18 cms
SURVIVAL RATE (%)	70	60
PERIOD OF CULTURE	3 months	3 months

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE	TREATMENT
OPERATING COST (Rs./ha)	2,45,000	2,50,000
YIELD (Kg/ha)	1,300	1,565
GROSS RETURNS (Rs./ha)	5,20,000	6,26,000
NET RETURNS (Rs./ha)	2,75,000	3,76,000
B-C RATIO	1.12:1	1.50:1

C) FARMERS' REACTION

POSITIVE ASPECTS

- High marketability.
- Large size.
- High growth in deep ponds.

- Less prone to diseases.
- Stress free movement in ponds as there is good water exchange.

NEGATIVE ASPECTS

- Low adaptation to changing water conditions.
- High feed requirement.
- Low survival rate.

D) MATRIX RANKING (10 - Point Scale)

SI No.	Items	Farmers' practice	Treatment
1	Weight	05	06
2	Size	05	06
3	Period of maturity	06	06
4	Yield	04	05
5	Susceptibility to diseases	05	05
6	Ease of adoption	05	05
7	Feed availability	06	06
8	Survival rate	05	05
9	Marketability	06	07
10	Consumers' preference	06	08

As per the matrix ranking, though there is no difference in the degree of susceptibility to diseases in both farmers' practice and treatment, the monoculture of *P.monodon* increased the size, weight and yield. It fetched good price and the consumer preference is also found to be high.

INTERVENTION No. 5

1	Name of technology	**Assessment of rack drying over the traditional method of sun-drying of fish by selected women groups**
2	Micro farming situation	Open sea based coastal ecosystem
3	Nature of intervention	Verification Trial
4	Treatments	**T1 – Farmers' practice**: traditional sundrying of fish (seasonal employment only) **T2 - Potential solution**: Rack drying over traditional method of sun drying
5	Plot/ unit size	5 families / unit
6	No. of replications/ Families	2

Traditionally, fish was dried on coir mats, palmirrah mats, gunny bags and on plain grounds. Fish was treated with contaminated salt-solution before drying, resulting in microbial attack. The shelf life of the traditionally treated fish is 7-10 days. Drying for commercial purpose was not given much importance.

Women groups manage the drying and marketing of fish products. Rack drying of fish in wooden or iron racks [size: 4.5m X 1m X 0.75m] is the technology recommended by Central Institute of

Drying of fish on fabricated racks - An innovative technology

Dr. E. G. Silas, Former Vice Chancellor, KAU and Member, SAP of NATP, ICAR inaugurating the sales

Processed products ready for sale

Director, CMFRI in discussion with women group

Fisheries Technology (CIFT). The major components of the technology include, dip-treatment of fish in saturated brine solution with 5 % calcium propionate. The treated fish is packed in Polyester polythene polyethylene (12 micron, Inner layer -50 micron) for sale. The treated fish resisted microbial attack and consequently increased the shelf-life to an average of 125 days. This intervention is proved to be self-sustaining and provides self-employment opportunities to women.

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATION

PARAMETERS	FARMERS' PRACTICE	TREATMENT
WASTAGE OF FISH	10%	2%
METHOD OF DRYING	Non hygienic (Treated in contaminated salt solution)	Hygienic (Dip treatment - saturated brine solution with 5 % calcium propionate)
MICROBIAL ATTACK	Severe	Nil
LONGEVITY (shelf-life)	7-14 days	120-130 days
APPEARANCE OF FISH	Muddy, light yellow colour	Silvery white colour
PACKING MATERIAL QUALITY	Low (paper, low quality plastic)	High (Polyester polythene polyethylene (12 micron, Inner layer -50 micron)

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE	TREATMENT
Cost of Rack (3600x3) (Rs)	-	10,800.00
Cost of equipment (Rs)	-	4,081.00
INITIAL INVESTMENT (Rs)	-	**14,881.00**
TOTAL VARIABLE COST (Rs)		
I fish lot*	4,156	4,346
II fish lot	848	888
III fish lot	4,295	4,480
IV fish lot	1,443	1,400
GROSS RETURNS (Rs)		
I fish lot	4,370	4,900
II fish lot	990	1,225
III fish lot	5,895	6,693
IV fish lot	3,428	4,167
NET RETURNS (Rs)		
I fish lot	214	554
II fish lot	142	337
III fish lot	1,600	2,213
IV fish lot	1,985	2,797
B-C RATIO		
I fish lot	0.05: 1	0.13: 1
II fish lot	0.17: 1	0.38: 1
III fish lot	0.37: 1	0.50: 1
IV fish lot	1.37: 1	1.98: 1

***Fish lot**

I Dry prawns – 25kg
II Dry silverbellies and flat fish – 50kg
III Dry prawns – 25kg, Lizard fish – 25kg
IV Flat fish – 45kg, Dry prawns – 10kg, Lizard fish – 20kg

As could be seen from the Table, the benefit-cost ratio rose to 1.98:1 with the processing of fourth lot of fish. On the other hand, in the traditional practice of fish drying, the benefit-cost ratio worked out to be only 1.37:1 with processing of the fourth fish-lot. Since the investment is higher for the drying of fish using racks and recommended treatment solutions, farmers experienced a lower benefit-cost ratio in the initial stages. The variable cost of the unit included cost of fish-lot, packing charges, cost of raw materials and wages (@ Rs.75/labour-day). The observations on economic indicators do not consider the initial investment while estimating the benefit-cost ratio. The intervention was initiated in March 2002 and the estimations were based on the actual operational months. The women members were engaged for a total of 90 labour-days for both processing and marketing of fish products. Inadequate credit facilities have created problems for the women groups. The marketed products were mostly being credited by the shop-owners; that is they pay money only after the final selling of the product. Hence the reinvestment of surplus profit for the women group highly depended on the final selling outlets. Apart from this, the inadequate availability of fresh fish, especially during lean seasons of June and July, also affected the number of labour-days.

C) FARMERS' REACTION

POSITIVE ASPECTS

- Low wastage of fish while processing.

- More hygienic.
- Increased shelf-life.
- Free from microbial attack.
- High consumers' preference.
- Healthy appearance.

NEGATIVE ASPECTS

- High investment.
- More labour involvement.

WOMEN GROUP MEMBER SAYS

Janani Women's Group

Janani Women's Group
Puthuvyppu Post, Elamkunnapuzha

Trinity Women's Group
Malippuram Post, Elamkunnapuzha

Janani and Trinity Women's Groups, located in the study area were selected for the intervention on rack drying of fish. The groups have 15 members each and were engaged in the drying of fish. Drying of fish was not new to them since they were doing it on individual basis on a limited scale. They used to dry the fish in the traditional way. The President of Janani group, Mrs.Chandramathi Appukuttan says that, she settled at Elamkunnapuzha village after her marriage 20 years back. She became a part of the 13-member women-group in 1997. They used to make use of the market surplus of bumper catch for drying purpose. The operational cost was less, but they could get very less profit as the unhygienic practice followed at that time caused high amount of wastage of fishes. Most of the dried fish were taken for own consumption. They also engaged in door-to-door selling of the products. The dried fish was mostly marketed at the local market. She says that,

"It is our luck that our group is selected for the IVLP intervention on rack drying of fish. With the advent of this programme of IVLP, we process first quality fish on commercial basis. The products are marketed to distant places with good packing conditions, replacing our earlier paper packing. The training given by the Scientists from CMFRI on dip-treatment has increased our awareness regarding the hygienic method of drying fishes using 'calcium powder'. They also gave information regarding new marketing outlets. The 'special racks' that were provided for the drying of fish helped us in maintaining the fish products in good condition and reduced the wastage of fish during processing. Now more and more people are coming forward to take up a similar venture".

Trinity Women's Group

D) MATRIX RANKING (10-point scale)

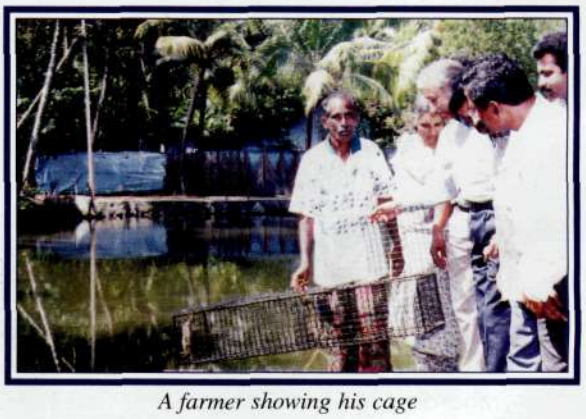
SI No.	Items	Farmers' practice	Treatment
1	Wastage of fish	06	08
2	Method of drying	07	09
3	Hygienic practice	06	09
4	Shelf-life	03	09
5	Packing material	04	08
6	Appearance	05	09
7	Commercial value	06	08
8	Consumers' preference	06	09

Rack drying method is preferred over the traditional method of drying fishes, as it has reduced the wastage of fish and has increased the shelf life. Consumers preferred the fish dried using the improved technology. Farmers feel that the consumers' choice is closely related to the healthy appearance of the product. The treated fish could be sold out at comparatively higher prices.

INTERVENTION No. 6

1	Name of technology	**Assessment of cage culture of crabs in tide-fed ponds**
2	Micro farming situation	Tide-fed brackish water system
3	Nature of intervention	Verification Trial
4	Treatments	**T1 - Farmers' practice**: Traditional crab farming **T2 - Potential solution**: Stocking of uniform sized crabs of 150-200 gm in cages
5	Plot/ unit size	0.04 ha (400 m^2)
6	No. of replications/ Families	5

Director, CMFRI, distributing cages for crab culture



A farmer showing his cage

Traditionally crab culture was carried out along with finfish. In this system, crabs were unevenly stocked resulting in cannibalism. Catching grown-up crabs from natural hideouts was also observed to be a serious problem. Thus, a complete harvest of matured crabs became difficult in the traditional *modus operandi*. Rearing of crabs in fabricated cages was recommended to address the problems. The possible high density of stocking, better management and complete harvest are some of the advantages of cage culture.

Metallic cages of size 1.2m X 0.3m X 0.2m, having two compartments with doors and lid, 6mm rod frame and net having a mesh size of 1.55mm was used in the present assessment of crab rearing. Cages were coated with anti-corrosive paints. Two crabs each were stocked in the two compartments. The cages tied to floats were fully immersed in ponds having a depth of 0.9m to 1.2m. Cages were placed at the rate of 500 nos./ha and crabs at the rate of 2 nos./cage. Feeds such as trash fish and boiled slaughter waste were given at 2:1 ratio. The feed rate was 8-10 per cent of body weight of the crab. Cages were lifted up to the water level using floats for feeding the crabs. In this aquaculture system, simultaneous fish farming is possible along with crab culture.

Since there is no indigenous practice in cage culture, the present intervention, on experimental basis was restricted to 5 replications. Heavy mortality of crabs is observed for the cage culture. The lifting of iron cages for feeding crabs now and then by farmers caused severe stress. Heavy water pollution in the selected ponds also added to the mortality. Almost total mortality occurred in 110 days for two replications. Crabs attained an average weight of 0.77kg and an average size of 12.8cm within this period. Though the growth is reasonable, the low survival rate made the venture not advisable in the region.

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATION

PARAMETERS	FARMERS' PRACTICE (harvest)	TREATMENT (110 days)*
WEIGHT (Kg)	0.900	0.770
SIZE (cm)	14.75	12.8
PERIOD OF MATURITY	155 - 165 days	Mortality in 110 days

**Since the farmers do not practice cage culture, performance of traditional crab culture is shown under farmers' practice.*

B) FARMERS' REACTION

POSITIVE ASPECTS

- Practised simultaneously with traditional finfish farming.
- Prevents cannibalism.

NEGATIVE ASPECTS

- Heavy mortality.
- Loss of legs at the time of feeding.
- Rusting of iron cages.

C) MATRIX RANKING (10 - Point Scale)

SI No.	Items	Farmers' practice	Treatment
1	Weight	07	05
2	Size	08	06
3	Period of maturity	06	02
4	Yield	08	05
5	Susceptibility to diseases	06	06
6	Ease of adoption	06	03
7	Feed availability	06	06
8	Survival rate	05	02
9	Marketability	07	05

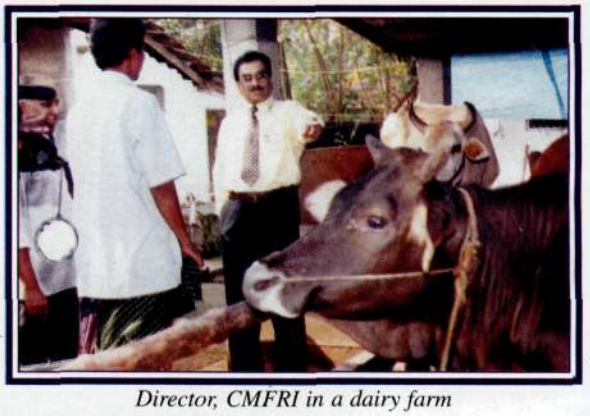
Comparatively lower ranks were obtained for the treatment due to various aspects such as heavy mortality and the difficulty in adopting the technology. There is no marked difference recorded for the treatment with respect to feed availability and susceptibility to disease parameters.

LIVESTOCK BASED INTERVENTIONS

INTERVENTION No. 7

1	Name of technology	**Assessment of deworming, micronutrient supplementation and prophylactic immunization on the productive performance of dairy cows**
2	Micro farming situation	Homestead animal husbandry system
3	Nature of intervention	Verification Trial
4	Treatments	**T1 - Farmers' practice**: Inadequate and improper medication, deworming, vaccinations against infectious diseases are not practiced regularly **T2 - Potential solution**: Mineral/Vitamin supplementation, Vaccination against Foot and Mouth Disease (FMD)
5	Unit size	5 cows / unit
6	No. of replications	6

Scientific management practices in the breeding, feeding and disease control of dairy cattle are absent in the selected village. Farmers follow a crude pattern of rearing cattle, which made the animals less adaptive to the specific coastal agro-ecosystem. Paucity of natural grass and water are other major problems in this system. Soil salinity and waterlogged conditions coupled with poor management resulted in widespread prevalence of diseases in cattle.



Director, CMFRI in a dairy farm

The existing status of cows was assessed by recording the histories of 30 cows selected for the intervention. Based on the information collected, medicines / feed supplements / prophylactic measures were recommended and supplied. Dung samples were tested for assessing parasitic infestation. Oocysts of Coccidia were recovered from few samples. Intensity of the infection was observed to be light. Nematode eggs and few eggs of *Trichuris* species were also identified. The productive performance of cows were assessed in relation to the measures adopted such as deworming, vaccination against Foot and Mouth Disease and mineral / vitamin supplementation.

Medicines supplied for cows (Unit size – 5)

Sl. No.	Critical Inputs	Qty. supplied/unit
1	Albendazole (Minthal Susp.)	1 litre
2	Mineral Supplement (Minal Forte)	15 kg
3	B-Complex Liq. (Groviplex)	2 bottles

Vaccination of dairy cows

Vaccination in progress

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATION

PARAMETERS	FARMERS' PRACTICE	TREATMENT
MILK YIELD (litre/cow/day)	7.5	9
DISEASE INCIDENCE	High	Low

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE	TREATMENT
OPERATIONAL COST (Rs./day)	37	39
GROSS RETURNS (Rs./day)	78.75	94.5
NET RETURNS (Rs./day)	41.75	55.5
B-C RATIO	1.12:1	1.42:1

C) FARMERS' REACTION

POSITIVE ASPECTS

- Increased milk yield.
- Low incidence of diseases.
- Improved health.
- More systematic way of dairy farming.

NEGATIVE ASPECTS

- Labour intensive.
- Unhealthy competition in milk marketing.

D) MATRIX RANKING (10 - Point Scale)

Sl.No.	Items	Farmers' practice	Treatment
1	Milk yield	07	08
2	Resistance to diseases	05	07
3	Cost of feed	05	06
4	Cost of medicine	07	05
5	Ease of adoption	07	06

The increase in milk yield has encouraged the farmers in the adoption of the recommended package of practices. They also observed that their cows are less prone to diseases as a result of deworming and micro nutrient supplementation. But they feel that the added expenditure on medicine and the feed supplement will raise the cost of production. Still they adopt the improved practices as it gives better returns, which could outweigh the cost factors.

INTERVENTION No. 8

1	Name of technology	**Assessment of de-worming, micronutrient supplementation and disease control on the performance of goats**
2	Micro farming situation	Homestead animal husbandry system
3	Nature of intervention	Verification Trial
4	Treatments	**T1 - Farmers' practice**: Traditional practice, indigenous medicines **T2 - Potential solution**: Deworming, Mineral/ Vitamin supplementation, Vaccination against Foot & Mouth Disease
5	Unit size	5 kids/ unit
6	No. of replications	20

Goats are reared mainly for meat. They are observed to be less productive mainly due to high parasitic infestation caused by the humid and waterlogged conditions. Lack of good quality fodder is also a problem. Limited availability of natural feeding materials, poor knowledge of farmers about feeding, breeding, housing and disease are other associated problems. The present average adult weight of goat in the selected area is about 15 kg. The meat yield is much lesser than the average optimum dressed meat yield of 50 percent of the live weight.

Vaccination in progress

The village Veterinary Doctor assisting the IVLP team : inter-institutional linakges

The intervention assessed the performance of goats based on the measures taken on de-worming, mineral/vitamin supplementation and vaccination against Foot and Mouth Disease. As the first step, the requirements of goats were assessed. Faecal samples were collected and tested for internal parasites. Oocysts of Coccidia were found in all samples. Eggs of *Monezia* species recovered and the infection observed to be moderate to heavy. Nematode eggs were also seen in all the samples.

Medicines supplied for goats (Unit size- 5)

Sl. No.	Critical Inputs	Qty. supplied/unit
1	Albendazole (Minthal) 200mg	5 tablets
2	Mineral Mixture (Alvite-M 250 g)	20 pkts.
3	B-Complex Liq. (Groviplex)	2 bottles
4	Cestonil (Praziquintal 50 mg)	10 tabs.
5	Mebendazole (Eben100 mg)	3 tabs.
6	Fenbendazole (Curaminth 150 mg)	3 tabs.

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATION

PARAMETERS	FARMERS' PRACTICE	TREATMENT
TOTAL WEIGHT (kg)	16	20
DRESSED MEAT WEIGHT (kg)	7	10
INCIDENCE OF DISEASES	High	Low

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE	TREATMENT
OPERATIONAL COST (Rs)	400	482
GROSS RETURNS (Rs)	805	1,150
NET RETURNS (Rs)	405	668
B-C RATIO	1.00:1	1.39:1

C) FARMERS' REACTION

POSITIVE ASPECTS

- Increased meat yield.
- Low incidence of diseases.
- Improved health.

- More systematic way of goat farming.

NEGATIVE ASPECTS

- Increased labour involvement.

D) MATRIX RANKING (10 - Point Scale)

SI.No.	Items	Farmers' practice	Treatment
1	Meat yield	06	08
2	Resistance to diseases	05	07
3	Cost of feed	05	06
4	Cost of medicine	05	07
5	Ease of adoption	07	06

The farmers have favourable attitude in adopting the technology though the "easiness" ranked comparatively low. The total weight of the animal and also the dressed meat yield has improved along with lower incidence of diseases for the treated animal.

INTERVENTION No. 9

1	Name of technology	**Assessment of the performance of *Gramalakshmi* breed of poultry in comparison to country birds**
2	Micro farming situation	Homestead poultry farming system
3	Nature of intervention	On Farm Trial
4	Treatments	**T1 - Farmers' practice**: Grow country birds of low productivity and long broodiness, No practice of controlling parasites or prophylactic vaccination **T2 - Potential solution**: New breed, Mineral/ Vitamin supplementation, Vaccination
5	Unit size	10 birds/ unit
6	No. of replications	30

Farmers' visit to poultry farm, KAU, Mannuthy

Distribution of poultry birds

Locally procured chicks are of low quality and their laying capacity is much below the optimal average of 200 eggs per annum. Lack of awareness of proper management practices and health cover are some of the problems in poultry farming. An improved variety of bird, *Gramalakshmi*, developed by Kerala Agricultural University was introduced and their performance assessed in comparison to the local variety. *Gramalakshmi* (Austra-White) is a suitable bird for backyard rearing.

Training session on scientific poultry farming

Medicines supplied for poultry birds (Unit size- 10)

Sl. No.	Critical Inputs	Qty. supplied/unit
1	Albendazole Susp. (Minthal 30 ml)	4 bottles
2	Mineral Mixture (Alvite-M 250 g)	2 pkts.
3	B-Complex Liq.(Groviplex)	2 bottles
4	Tetracycline (W.sol.100gm)	2 pkts.

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATION

PARAMETERS	FARMERS' PRACTICE	TREATMENT
EGG WEIGHT (g)	32	40
EGG COLOUR	White	Cream
AVERAGE NUMBER OF EGGS (10 birds/day)	3	5
BIRD WEIGHT (Kg)	1.5	2
SUSCEPTIBILITY TO DISEASES	High	low

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE	TREATMENT
OPERATIONAL COST (Rs/day)	4	5.34
GROSS RETURNS (Rs/day)	6.42	11.3
NET RETURNS (Rs/day)	2.42	5.96
B-C RATIO	0.61:1	1.12:1

C) FARMERS' REACTION

POSITIVE ASPECTS

1) Increased egg yield.
2) Improved weight of the birds.

NEGATIVE ASPECTS

1) More care is required.

2) Required better feeding.

D) MATRIX RANKING (10 - Point Scale)

Sl.No.	Items	Farmers' practice	Treatment
1	Egg yield	06	08
2	Weight of the bird	05	07
3	Feed consumption	06	08
4	Resistance to diseases	07	08
5	Suitability to homestead raring	06	08
6	Broodiness	07	00

Farmers favoured *Gramalakshmi* birds because of the better egg yield. The weight of the hybrid bird is comparatively high and their feed consumption is also equally higher. However, their higher production potential will compensate other negative aspects.

Mrs. Chinnamma with her family

FARMER SAYS

Mrs.Chinnamma
Arakkal, Puthuvyppu
Elamkunnapuzha

Chinnamma (49), with primary level of education, is a woman farmer identified for poultry based intervention. She is one of the 30 women farmers selected for the intervention. Earlier, the farmer was rearing *Giriraja* birds. The farmer says,

"As part of the IVLP project of CMFRI, I received 10 *Gramalakshmi* birds. Earlier I had three country birds, each laying 10-15 eggs per month. I had been receiving Rs.60 per month. Now I get around 150-175 eggs in a month from the birds supplied by CMFRI, thus an additional income of Rs.300-350/month. Vaccinations and other disease control measures were also provided to the birds. This has boosted our confidence in poultry farming. Earlier, though we used to rear poultry in our backyards, the disease occurrence was severe resulting mostly in the death of the birds. In such situations, a sustainable income from poultry keeping was not at all possible. I did not give much importance to the cages mainly due to this unevenness. Moreover, the cages were expensive and hence were avoided. Visit to the Poultry Farm at Mannuthy, Kerala Agricultural University on 28.8.2001, revealed the importance of cages and made us aware of the feeds given to poultry. The training class at Mannuthy was proved to be very useful in understanding the types of diseases and the common preventive measures.

AGRICULTURE BASED INTERVENTIONS

Agriculture-based interventions were carried out in the identified micro-farming situation of Rainfed agri-horticulture system on embankments and homesteads. Three categories of interventions under coconut-based, vegetable-based and banana-based systems were initiated. Improved varieties of vegetables were introduced and their performances were tested on the embankments. The improved varieties of four vegetables such as *Kannara Local*, *Arka Anamika*, *Preethi* and *Kaumudi* were compared with the performance of local variety.

The nutrient rich pond-bed soil on the embankments are not properly utilised for vegetable cultivation. Uneven spacing pattern combined with uneconomic seed rate results into lower output. Though there is vast potential for vegetable cultivation on commercial scale, it is not utilised to its full extent. Improved variety of vegetable is also not introduced in the village due to the lack of awareness among traditional farmers.

INTERVENTION No. 10

1	Name of technology	**Assessment of the performance of improved variety of Amaranthus (*Kannara Local*) during kharif**
2	Micro farming situation	Vegetable based system on embankments
3	Nature of intervention	On Farm Trial
4	Treatments	**T1 - Farmers' practice**: Traditional farming of local variety **T2 - Potential solution**: *Kannara Local* a) Seed rate: 8 g/ cent b) Spacing: 30cm X 20cm
5	Plot/ unit size	0.06 ha (600 m^2)
6	No. of replications/ Families	25

The improved variety of amaranthus, viz., *Kannara local* is found to be more productive than the local variety. It is resistant to attack by leaf eating caterpillar and white spot disease. Adoption of recommended spacing and seed rate resulted in better returns per unit area. An increase in yield by 25.7% is recorded for the improved variety compared to local variety. The seeds were sown during June-July 2001 and harvest was completed in the third month. Farmers prepare ponds for fish culture by removing the pond-bed soil to strengthen the embankments. The high manurial pond-bed soil used for vegetable farming, reduces the operational cost, hence a high benefit-cost ratio (3.37: 1) is recorded.

Amaranthus cultivation on embankments

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATIONS

PARAMETERS	FARMERS' PRACTICE (Local)	TREATMENT (*Kannara Local*)
GERMINATION (%)	75	83
QUALITY OF LEAVES	Satisfactory	Very good
FOLIAGE SPREAD	15-20 leaves / plant	20-25 leaves / plant
PLANT HEIGHT	1.8 feet	2.8 feet
COLOUR OF FOLIAGE	Yellowish red	Dark red
CROP DURATION	64 days	58 days
PEST AND DISEASE INCIDENCE	Leaf eating caterpillars, white spot [significant]	Leaf eating caterpillars, [not significant]
NUMBER OF BRANCHES/PLANT	5	7
YIELD (t/ha)	7.0	8.8

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE (Local)	TREATMENT (*Kannara local*)
OPERATING COST (Rs./ha)	15,500	16,125
GROSS RETURNS (Rs./ha)	56,000	70,400
NET RETURNS (Rs./ha)	40,500	54,275
B-C RATIO	2.61: 1	3.37: 1

C) FARMERS' REACTION

POSITIVE ASPECTS

- High yield.
- Good appearance.
- Less susceptible to lodging, pests and diseases.
- Excellent growth on embankments.
- High marketability.

NEGATIVE ASPECTS

- Insignificant growth on less fertile soil.

D) MATRIX RANKING (10 - Point Scale)

SI.No.	Items	Farmers' practice (Local)	Treatment (*Kannara Local*)
1	Quality of leaves	06	08
2	Foliage spread	05	08
3	Plant height	06	07
4	Appearance	05	06
5	Disease resistance	06	08
6	Yield	06	09
7	Marketability	07	08
8	Cooking quality	06	07

Matrix ranking reveals that farmers preferred *Kannara local* due to its better yield, marketability and cooking quality. Farmers ranked *Kannara local* as better with respect to the spread of leaves, resistance to diseases and the quality of leaves.

INTERVENTION No. 11

1	Name of technology	**Assessment of the performance of improved variety of Okra (Arka anamika) during kharif**
2	Micro farming situation	Vegetable based system on embankments
3	Nature of intervention	On Farm Trial
4	Treatments	**T1 - Farmers' practice**: Traditional farming of local variety **T2 - Potential solution**: *Arka anamika* a) Seed rate: 30 g/ cent b) Spacing: 60cm X 45cm
5	Plot/ unit size	0.06 ha (600 m^2)
6	No. of replications/ Families	25

In the case of okra, the improved variety introduced was *Arka anamika*. Seeds were sown during October 2001. The local variety outperformed the improved variety. Though the vegetative growth of *Arka anamika* was more than the local variety, yield was significantly lower for the improved variety. The average weight of local variety is 31.25g whereas it was 17.80 g for the improved variety. Though local variety is more prone to diseases like mosaic, the yield was significantly higher compared to improved variety. The benefit-cost ratio for the local variety is worked out to be 5.68:1. The crop duration of the improved variety was found to be 35 days.

PERFORMANCE INDICATORS

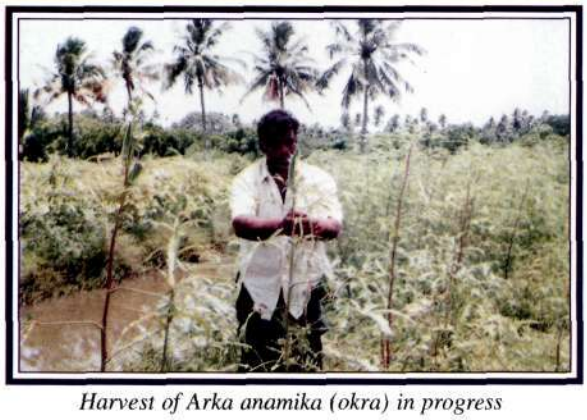
A) BIOMETRIC OBSERVATIONS

PARAMETERS	FARMERS' PRACTICE (Local)	TREATMENT (*Arka anamika*)
GERMINATION (%)	95	90
WEIGHT OF THE FRUIT (Average)	31.25 g.	17.8 g.
QUALITY OF FRUITS	Good	Medium
PLANT HEIGHT	2.5-3.5 feet	4.5-6.5 feet
PERIOD OF MATURITY [flowering]	20 days	15 days
CROP DURATION	45 days	35 days
PEST AND DISEASE INCIDENCE	Mosaic	Leaf roller
NUMBER OF FRUITS/Kg [average]	32	56
YIELD (t/ha)	14.5	11.0

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE (Local)	TREATMENT (*Arka anamika*)
OPERATING COST (Rs./ha)	17,375	18,875
GROSS RETURNS (Rs./ha)	1,16,000	88,000
NET RETURNS (Rs./ha)	98,625	69,125
B-C RATIO	5.68:1	3.66:1

Local variety of okra-ready for harvest



Harvest of Arka anamika (okra) in progress

C) FARMERS' REACTION

POSITIVE ASPECTS

- Less prone to diseases.
- Survive in heavy rainy season.
- Vegetative spread is less.

NEGATIVE ASPECTS

- Long duration variety.
- Inferior cooking quality.
- Appearance is inferior to local.

D) MATRIX RANKING (10 - Point Scale)

SI.No.	Items	Farmers' practice (Local)	Treatment (*Arka anamika*)
1	Appearance	07	07
2	Period of maturity	07	06
3	Disease resistance	07	05
4	Yield	06	05
5	Marketability	06	06
6	Cooking quality	07	06
7	Fruit weight	08	06
8	No. of fruits/plant	06	08

The local variety of okra preferred over the treatment variety, *Arka anamika*. Though the number of fruits per plant for the improved variety is more, the total yield is less because of lesser fruit weight. However, the marketability of both varieties ranked same.

INTERVENTION No. 12

1	Name of technology	**Assessment of the performance of improved variety of Bittergourd (*Preethi*) during kharif**
2	Micro farming situation	Vegetable based system on embankments
3	Nature of intervention	On Farm Trial
4	Treatments	**T1 - Farmers' practice**: Traditional farming of local variety **T2 - Potential solution:** *Preethi* a) Seed rate: 20 g/ cent b) Spacing: 2m X 2m
5	Plot/ unit size	0.06 ha (600 m^2)
6	No. of replications/ Families	25

Performance of improved variety of bittergourd,viz., *Preethi*, was assessed and found to be more productive than the local variety. The seeds were sown in September 2001. The recommended spacing (2m X 2m) and seed rate (5 kg/ha) resulted in an increase in yield of 88.72 per cent compared to local variety. Fruit fly attack is not severe in *preethi*. The average weight of the fruit is 300g where as that of local variety is 195g only. Benefit-cost ratio for the *preethi* variety is worked out to be 6.80:1 where as it is 3.50:1 for the local variety.

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATIONS

PARAMETERS	FARMERS' PRACTICE (Local)	TREATMENT (*Preethi*)
GERMINATION (%)	85	85
AVERAGE WEIGHT OF THE FRUIT	170-220 gm	280-320 gm
QUALITY OF FRUITS	Medium	Good
PERIOD OF MATURITY [flowering]	85 days	70 days
CROP DURATION	120 days	95 days
PEST AND DISEASE INCIDENCE	Fruit flies, downy mildew, Powdery mildew	Fruit flies [not severe]
NUMBER OF FRUITS/Kg	5.13	2.86
YIELD (t/ha)	9.75	18.4

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE (Local)	TREATMENT (*Preethi*)
OPERATING COST (Rs./ha)	17,375	18,875
GROSS RETURNS (Rs./ha)	78,000	1,47,200
NET RETURNS (Rs./ha)	60,625	1,28,325
B-C RATIO	3.50:1	6.80:1

C) FARMERS' REACTION

POSITIVE ASPECTS

- High marketability
- Good cooking quality
- Less susceptible to diseases
- Bigger sized fruits

D) MATRIX RANKING (10 - Point Scale)

SI.No.	Items	Farmers' practice (Local)	Treatment (*Preethi*)
1	Appearance	05	07
2	Period of maturity	06	07
3	Disease resistance	04	06
4	Yield	06	08
5	Marketability	06	08
6	Cooking quality	05	07
7	Fruit weight	06	08
8	No. of fruits/plant	06	07

Farmers prefer the improved variety *preethi* to the traditional variety, due to its better yield, marketability and cooking quality. The farmers also appreciate disease resistance and early maturity of the improved variety.

Mr. George in his farm

FARMER SAYS

Mr.George.M.J
Mathirappilly, Karthedom
Elamkunnapuzha

Mr.George, aged 60, was a High School Teacher by profession resides in Karthedom. He owns 64 cents of cultivable land. This farmer is interested in cultivating only bittergourd. He is a diabetic patient and his doctor suggested to add bittergourd juice to his daily menu. As he was in need of bittergourd fruits everyday, he decided to cultivate it in his own land. Apart from the cultivation of numerous other short and long duration crops such as coconut, aracanut, mango, nutmeg, banana etc, this is the only vegetable item cultivated in his land. He is also a member of the *Haritha Sankham* (Agricultural Famers' Organisation) of the Elamkunnapuzha Agricultural Office. The farmer was selected for IVLP-intervention 'Assessement of the performance of improved variety of bittergourd (*Preethi*) during kharif'. He says,

"I was very much interested in all types of vegetable cultivation. However, presently I am dedicating most of my resources towards bittergourd cultivation. This was mainly due to the daily need of bittergourd fruit as I am a diabetic patient. Usually it is cultivated with the onset of monsoon. Last year I got altogether around 350kg of fruits. More than three forth of it was sold out. I store the seeds for sowing in the next season. My neighbours too buy seeds from me. Some seeds are even sold through *Haritha Sankham*. I was selected as a farmer for IVLP during 2000-2001. They introduced *Preethi* variety of bittergourd, which was found to be better than the earlier one. I became aware that productivity could be enhanced with proper 'spacing pattern', and 'seed rate'. The IVLP team taught me about the spacing pattern and the appropriate seed rate to be followed while cultivating vegetable. The production has almost doubled".

INTERVENTION No. 13

1	Name of technology	**Assessment of the performance of improved variety of Snakegourd (*Kaumudi*) during kharif**
2	Micro farming situation	Vegetable based system on embankments
3	Nature of intervention	On Farm Trial
4	Treatments	**T1 - Farmers' practice**: Traditional farming of local variety **T2 - Potential solution**: *Kaumudi* a) Seed rate: 16 g/ cent b) Spacing: 2m X 2m
5	Plot/ unit size	0.06 ha (600 m^2)
6	No. of replications/ Families	25

Assessment of improved variety of snakegourd, *Kaumudi* proved that the variety is suitable for the cultivation on embankments. The recommended spacing and seed rate resulted in better returns per unit area. An increase of 32.50 per cent in yield is noticed for the *Kaumudi* variety compared to local. It is resistant to downy mildew and powdery mildew diseases. The benefit-cost ratio is worked out to be 2.93:1 for the *Kaumudi* variety.

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATIONS

PARAMETERS	FARMERS' PRACTICE (Local)	TREATMENT (*Kaumudi*)
GERMINATION (%)	85	90
WEIGHT OF THE FRUIT	0.80-1.20 kg	1.00-1.80 kg
QUALITY OF FRUITS	Medium	Good
PERIOD OF MATURITY [flowering]	85 days	70 days
CROP DURATION	115 days	95 days
PEST AND DISEASE INCIDENCE	Fruit flies, downy mildew and powdery mildew	Fruit flies
YIELD (t/ha)	16.0	21.2

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE (Local)	TREATMENT (*Kaumudi*)
OPERATING COST (Rs./ha)	17,375	18,875
GROSS RETURNS (Rs./ha)	56,000	74,200
NET RETURNS (Rs./ha)	38,625	55,325
B-C RATIO	2.22:1	2.93:1

C) FARMERS' REACTION

POSITIVE ASPECTS

- High marketability.
- Good cooking quality.
- Bigger sized fruits.
- Early maturity.

NEGATIVE ASPECTS

- Susceptible to fruit-fly attack.

D) MATRIX RANKING (10 - Point Scale)

SI.No.	Items	Farmers' practice (Local)	Treatment (*Kaumudi*)
1	Appearance	06	07
2	Period of maturity	06	08
3	Disease resistance	05	07
4	Yield	06	08
5	Marketability	06	07
6	Cooking quality	07	08
7	Weight of the fruit	06	08

The higher yield of improved variety of snake gourd, *Kaumudi*, as well as the weight of the fruit and the marketability has made it preferable. Farmers are having very favourable attitude towards cultivating *Kaumudi* due to its specific features of early maturity, superior cooking quality and high resistance to diseases.

INTERVENTION No. 14

1	Name of technology	**Assessment of the performance of tissue culture Dwarf - Cavendish with local varieties of banana**
2	Micro farming situation	Banana based system under rain-fed low lands
3	Nature of intervention	On Farm Trial
4	Treatments	**T1 - Farmers' practice**: Traditional farming of local varieties **T2 - Potential solution**: Cultivation of *Dwarf Cavendish* a) 10 suckers/cent b) Spacing: 2m X 2m
5	Plot/ unit size	0.06 ha (600 m^2)
6	No. of replications/ Families	20

Banana cultivation is more suitable in the tropical humid low lands and is grown from sea level to 1000m. Soils with good fertility and an assured supply of moisture are best suited. Though banana is

cultivated on commercial basis, the actual potential is not fully exploited. *Palayankodan*, *Njalipoovan* and *Monthan* are usually cultivated in this region. Suckers purchased from the local market are used. Uneven spacing and improper fertilizer application are the problems identified.

Tissue culture variety, Dwarf Cavendish is introduced and its performance is assessed in comparison to the local varieties. Being a tissue culture variety, Dwarf Cavendish is resistant to pest and diseases. Dwarf Cavendish performed better than the local variety in terms of yield and the fruits have high market demand.

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATIONS

PARAMETERS	FARMERS' PRACTICE (Local)	TREATMENT (Dwarf Cavendish)
SURVIVAL RATE	75	70
HEIGHT OF THE PLANT	300cm	210 cm
GIRTH OF THE PLANT	43cm	48cm
NUMBER OF HANDS	6-8	7-9
NUMBER OF FINGERS	92-102	100-111
LENGTH OF THE FINGER	12 cm	14 cm
GIRTH OF THE FINGER	10 cm	11.5 cm
WEIGHT OF THE BUNCH	18 kg	22 kg
CROP DURATION	9 months	10 months
PRICE/BUNCH (Rs.)	108	220

Dwarf Cavendish variety

A happy farmer in his farm

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE (Local)	TREATMENT (Dwarf Cavendish)
OPERATING COST (Rs./ha)	1,53,750	1,57,500
GROSS RETURNS (Rs./ha)	2,02,500	3,57,500
NET RETURNS (Rs./ha)	48,750	2,00,000
B-C RATIO	0.32:1	1.27:1

C) FARMERS' REACTION

POSITIVE ASPECTS

- High marketability.
- Good taste.
- Bigger fruit size.
- Better price.

NEGATIVE ASPECTS

- Comparatively lower survival rate.

D) MATRIX RANKING (10 - Point Scale)

SI.No.	Items	Farmers' practice (Local)	Treatment (Dwarf Cavendish)
1	Survival rate	07	06
2	Availability of seeds	08	06
2	Period of maturity	08	06
3	Disease resistance	05	06
4	Yield	05	08
5	Marketability	06	08
6	Taste of fruit	07	08
7	Size of fruit	06	08

Farmers experience difficulty in getting suckers of Dwarf Cavendish variety. This variety has comparatively longer maturity period and less survival rate. But the farmers prefer Dwarf Cavendish because of its better yield, marketability, good taste, bigger size of fruits and high disease resistance.

INTERVENTION No. 15

1	Name of technology	**Assessment of nutrient management practices [chemical fertilizer, green manure] in coconut plantations based on soil test data**
2	Micro farming situation	Coconut based system under rainfed condition
3	Nature of intervention	On Farm Trial
4	Treatments	**T1 - Farmers' practice**: Application of nutrients and fertiliszers are not in appropriate quantity. **T2 - Potential solution**: Nutrient management based on soil test data
5	Plot/ unit size	0.05 ha (500 m^2)
6	No. of replications/ Families	25

Coconut is grown in different soil types such as laterite, coastal sandy, alluvial and also in reclaimed soils of marshy lowlands. They tolerate wide range of pH from 5.0-8.0. It requires an equable climate

A farmer applying fertiliser

with high humidity. The performance of coconut in the selected village is very dismal mainly due to lack of attention given to it. It is cultivated both in homesteads and embankments and the high soil salinity in the region is found to be ideal for coconut plantations. Proper fertilization of coconut palms is generally lacking. The yield is significantly lower than the actual potential.

The present intervention based on the theme of Integrated Nutrient Management, tested the soil for assessing the nutrient deficiency. Based on soil test data, suitable nutrients were recommended for enriching the fertility of the soil. For the soil test, the farmers were grouped into five, based on the geographical distribution of the farms. The results of soil test are given in the Table. The biometric observations and economic indicators given are based on the observations in the second year since the application of fertilizers.

Results of soil test for assessing the performance of coconut

Group	pH	Organic Nitrogen (Percent)	Available Phosphorus (ppm)	Available Potassium (ppm)
A	6.28	88	120	112
B	7.05	59	63	88
C	6.15	65	47	64
D	6.63	52	45	100
E	6.51	52	31	76

Recommended nutrient dosage based on soil test data per palm [One third of the recommended dosage applied in the first month]

Lime	Urea	Super Phosphate	Murate of Potash	Magnesium Sulphate
1 kg	1 kg	2 kg	2 kg	1 kg

PERFORMANCE INDICATORS

A) BIOMETRIC OBSERVATION

PARAMETERS	FARMERS' PRACTICE	TREATMENT
NUMBER OF LEAVES	23	28
NUMBER OF BUNCHES	7	9
NUMBER OF NUTS /BUNCH	6	10
COLOUR OF LEAVES	Yellow-Green	Green
WEIGHT OF COPRA (g)	88	120
WATER CONTENT (ml)	200	275
WEIGHT OF NUT (g)	550	1025

B) ECONOMIC INDICATORS

PARAMETERS	FARMERS' PRACTICE	TREATMENT
OPERATING COST (Rs./ha)	20,000	25,000
GROSS RETURNS (Rs./ha)	35,000	75,000
NET RETURNS (Rs./ha)	15,000	50,000
B-C RATIO	0.75:1	2.00:1

C) FARMERS' REACTION

POSITIVE ASPECTS

- Bigger sized nuts.
- More water content.
- Healthy leaves.
- Weight of copra is higher.
- More oil yield.

D) MATRIX RANKING (10 - Point Scale)

SI.No.	Items	Farmers' practice	Treatment
1	Number of nuts	06	08
2	Size of the nuts	06	08
3	Water content	07	08
4	Disease resistance	05	06
5	Copra yield	05	07

The micro nutrient management practices using chemical fertilizer and green manure increased the yield per palm. The size of nuts as well as the water content and copra yield has significantly improved.

(b) ONGOING INTERVENTIONS

FISHERIES BASED INTERVENTIONS

INTERVENTION No. 16

1	Name of technology	**Assessment of scientific monoculture of *Mugil cephalus* in tide-fed ponds**
2	Micro farming situation	Tide-fed brackish water system
3	Nature of intervention	Verification Trial
4	Treatments	**T1- Farmers' practice**: Improper eradication and stocking of species **T2 - Potential solution**: Eradication of predators using mahua oil cake, Stocking of *Mugil cephalus*
5	Critical inputs	Mahua oil cake, lime, organic fertilizers, fish seeds and supplementary feed
6	Plot/ unit size	0.04 ha (400 m^2)
7	No. of replications/ Families	5

Farming of finfish such as grey mullets, tilapia, pearl spot and milkfish is common in the selected village. However, scientific farming practices are lacking in the farmers' practice. Natural entry along with preparatory stocking of uneven sized seeds is practiced. Overstocking is the consequent problem resulting in lower productivity. 'Monoculture of *Mugil cephalus*' is the identified techno-intervention to solve the intricate problem of low productivity.

Mugil cephalus is widely cultured and the nutritional requirements of adults are easily met. They are hardy animals withstanding a wide range of environmental conditions [Landau, 1992]. This species is more saline tolerant and the food habits are predominantly herbivorous [Bardach,*et al.*, 1972].

Prior to the stocking of fish, predators in the ponds were eradicated using mahua oil cake. A positive trend in growth of fish is observed. Fish attained a mean length of 30 cm in 120 days, from the initial size of 3 cm at the time of stocking; whereas, the mean length of fish is 22.5 cm under the traditional farming practices. Harvest is expected in 330 days from the day of stocking.

Monoculture *of M.cephalus*– Performance Indicators

OBSERVATION PERIOD	LENGTH (cm)	WEIGHT (g)
INITIAL DAY OF STOCKING	2-4	5-10
AFTER 15 DAYS	6-8	25-30
45 DAYS	10-12	50-80
60 DAYS	16-20	100-150
120 DAYS	28-32	250-350
180 DAYS	31-35	270-365
210 DAYS	33-36	275-370
270 DAYS	36-40	290-385

INTERVENTION No. 17

1	Name of technology	**Assessment of scientific monoculture of milk fish in tide-fed ponds**
2	Micro farming situation	Tide-fed brackish water system
3	Nature of intervention	Verification Trial
4	Treatments	**T1-Farmers' practice**: Improper stocking of species and improper eradication of predators **T2- Potential solution**: Eradication of predators using mahua oil cake, stocking of seeds of milk fish
5	Critical inputs	Mahua oil cake, lime, organic fertilizers, *Chanos chanos* seeds and supplementary feed
6	Plot/ unit size	0.04 ha (400 m^2)
7	No. of replications/ Families	5

Uneven and simultaneous stocking of various species normally resulted in the lower productivity of fishes in the village. Natural entry of seeds of milkfish along with grey mullets are allowed whenever available. Milkfish is one of the fishes best suited for monoculture practice. They have high disease resistance, good quality food fish and grow rapidly. It feeds near the bottom of the food chain, mostly on algae, so that large amounts can be supported in a restricted area (Bardach. *et.al.*, 1972). Another major quality of cultured milkfish is that it is relatively free of parasites.

Vypeen Island is gifted with the abundance of *Chanos chanos* seeds. The seeds procured by the hatchery of Fisheries Station, Puthuvyppu, Kerala Agricultural University, is used for the treatment. The seeds are stocked at the rate of 15000nos/ha. Rice bran, wheat bran and various kinds of oil cakes are recommended as supplementary feed. The stocked fish attained an average length of 19cm with a mean weight of 175g in 180 days from the day of stocking. The duration of culture is expected to be 11 months.

Monoculture of milk fish - Performance Indicators

OBSERVATION PERIOD	LENGTH (cm)	WEIGHT (g)
INITIAL DAY OF STOCKING	2-4	3-7
AFTER 15 DAYS	5-7	4-8
45 DAYS	8-12	30-40
60 DAYS	10-15	50-65
120 DAYS	14-18	60-80
180 DAYS	16-22	150-200

CRAB HARVEST IN IVLP FARMS

Harvesting of farm-grown crabs was inaugurated by Prof. Dr. Mohan Joseph Modayil, Director, CMFRI, in Elamkunnapuzha Village of Vypeen Island on 25th January 2002. Ten farms each having 25-30 cents area in Elamkunnapuzha village was selected for scientific crab culture technology. Mud crabs *(Scylla tranquebarica)* were stocked in the selected ponds for which water quality was maintained through proper water exchange. Uniform stocking of crabs having an initial average weight of 250 g were done. Trash fish was given as feed and the grown up crabs had attained a weight of 1 kg to 1.4 kg in 4-5 months. These crabs have excellent demand in the international market fetching around Rs.315 per kilogram.

RAC MEMBER'S VISIT

Dr.S.D.Tripathi, Director (Rtd.), CIFE & Member, Research Advisory Committee, CMFRI visited and appraised the progress of IVLP based interventions on 14th February 2002 .He appreciated the work done by the IVLP team members in the Elamkunnapuzha village of Vypeen island and also the progress made.

Dr. S. D. Tripathi evaluating the growth of cultured crabs

SECTION IV
SITE COMMITTEE

As per the guidelines for the implementation of Institution-Village-Linkage-Programme issued by ICAR, a Site Committee was constituted for deciding the techno-interventions and advising the Core Team.

List of Site Committee Members (First meeting)

Sl. No	Officials	Designation
1	Prof.Dr.Mohan Joseph Modayil, Director, CMFRI	Chairperson
2	Head, Demersal Fisheries Division, CMFRI	Member
3	Head, Crustacean Fisheries Division, CMFRI	Member
4	Head, Pelagic Fisheries Division, CMFRI	Member
5	Head, Molluscan Fisheries Division & Nodal Officer, NATP Cell, CMFRI	Member
6	Head, PNPD, CMFRI	Member
7	Head, FEMD, CMFRI	Member
8	Shri. P.K.Babu, Principal Agricultural Officer, Ernakulam	Member
9	Assistant Director General [MF], ICAR Nominee / Management Committee Member	Member
10	Dr.R.K.Samantha, Zonal Coordinator, ICAR Zonal Coordinating Committee	Member
11	Director, CIFT, Cochin	Member
12	Deputy Director of Fisheries, Ernakulam	Member
13	Dean, Fisheries College, Kerala Agricultural University	Member
14	Representative From Veterinary Discipline, Kerala Agricultural University	Member
15	Director, CPCRI, Kasargod	Member
16	Ms. Sheela Immanuel, Scientist, SEETTD, CMFRI	Member
17	Dr.R.Sathiadhas, Head, Socio Economic Evaluation and Technology Transfer Division	Thematic Leader & Member Secretary

The Site Committee in its first sitting gave approval to 30 interventions after a thorough analysis by the experts concerned. The modifications suggested were discussed in detail and incorporated in the action plan.

The second Site Committee meeting was held on 18 June 2002 and given approval to 15 interventions for implementation in Elamkunnapuzha Village. The Site Committee members who participated in the second meeting are listed in the table.

First Site Committee meeting held on 8th December 2000

List of Site Committee Members (Second meeting)

Sl. No	Officials
1	Prof.Dr. Mohan Joseph Modayil, Director, CMFRI, Cochin
2	Asha Devi Varma, Deputy Director of Agriculture, Ernakulam
3	Ms. Sheela Immanuel, Scientist, SEETTD, CMFRI, Cochin
4	Dr. C. Ramachandran, Scientist, SEETTD, CMFRI, Cochin
5	Dr. Ashaletha. S, Scientist, SEETTD, CMFRI, Cochin
6	Dr. L. Krishnan, Principal Scientist, DFD, CMFRI, Cochin
7	Dr. P.K.Martin Thompson, Technical Officer, KVK
8	Dr. Krishna Srinath, Head, EIS Division, CIFT, Matsyapuri, Cochin
9	Dr. D.Noble, Sr. Scientist, PNPD, CMFRI, Cochin
10	Dr. M.Srinath, Head, FRAD, CMFRI, Cochin
11	Dr. R. Paul Raj, Head, PNPD, CMFRI, Cochin
12	Dr. M.J.Chandre Gowda, Zonal Coordinating Unit, Bangalore
13	Dr. S. Arulraj, Head, Social Sciences Division, CPCRI, Kasaragod
14	Dr. K.K.Appukuttan, Head, MFD and Nodal Officer, NATP, CMFRI,Cochin
15	Dr. V.S.R.Murty, Head, DFD, CMFRI, Cochin
16	Dr. E.V.Radhakrishnan, Head, CFD, CMFRI,Cochin
17	Dr. N.G.K.Pillai, Head, PFD, CMFRI, Cochin
18	Dr. R.Sathiadhas, Head, SEETTD and Thematic Leader, IVLP, CMFRI, Cochin

The progress of ongoing interventions and the results of completed interventions were presented before the Site Committee. A total number of 17 interventions were proposed for the approval of Site Committee. Each intervention was analysed thoroughly by the experts and the modifications suggested were discussed in detail. Final approval was accorded for 15 interventions, which included 6 fisheries-based, 3 livestock-based and 6 agriculture-based programmes

NATP Peer Review Team in a discussion with the Trinity Women's Group

Director, CMFRI, inaugurating the second Site Committee meeting held on 18th June, 2002

NATP PEER REVIEW TEAM

The NATP Peer Review Team reviewed the first phase of IVLP on May 20, 2002. The Review Team comprising of Dr.E.G.Silas (Chairman), Dr.M.Devaraj, Dr.A.Selvakumar, and Dr. T. C. Santiago critically evaluated the progress of the project. They also visited the IVLP village and interacted with farmers. The review remarks and recommendations made by the Peer Review Team are given below.

Recommendations of NATP Peer Review Team

REVIEW REMARKS	RECOMMENDATIONS
PHYSICAL PERFORMANCE	
The programme is well organized and progressing in the right direction.	The project should develop self-supporting techno-management expert groups among the participants in the project village for a long-term sustainability of the integrated farming system. Group management in rice farming adopted in the state earlier may be taken up as a guideline for forming the village level techno-management groups.
BUDGET	
Good	Nil
TECHNICAL PERFORMANCE	
A calendar of farming activities has to be developed in view of the diversity in the integrated farming systems.	The results of the case studies of all interventions should be well documented and extension literature brought out to be used by the state and other organizations to adopt them in all potential villages.

(a) PROPOSED INTERVENTIONS APPROVED BY SECOND SITE COMMITTEE

INTERVENTION No. 1

1.	Intervention code	F9
2	Name of technology	**Performance evaluation on biculture of crab and *M.cephalus***
3.	Micro farming situation	Tide-fed brackish water system
4.	Nature of intervention	Verification Trial
5.	Source of technology	CMFRI, Cochin
6.	Treatments	T1 - Farmers' practice: Monoculture of crab/Monoculture of *M.cephalus* T2 - Potential solution: Biculture of crabs and *M.cephalus*
7.	Plot/ unit size	0.20 ha
8.	No. of replications	15
9.	Critical inputs	Juvenile Crabs, *M.cephalus* seeds

INTERVENTION No. 2

1.	Intervention code	F10
2	Name of technology	**Performance evaluation of *P.indicus* with polyculture of finfish in tide-fed ponds**
3.	Micro farming situation	Tide-fed brackish water system
4.	Nature of intervention	Verification Trial
5.	Source of technology	CMFRI, Cochin
6.	Treatments	T1 - Farmers' practice: Monoculture of *P.indicus*/ Polyculture of finfish. T2 - Potential solution: Biculture of *P.indicus* and finfish
7.	Plot/ unit size	0.20 ha
8.	No. of replications/ Families	10
9.	Critical inputs	*P.indicus*, Grey mullets, Milkfish, Pearlspot

INTERVENTION No. 3

1.	Intervention code	F11
2	Name of technology	**Assessment of crab fattening in tide-fed ponds**
3.	Micro farming situation	Tide-fed brackish water system
4.	Nature of intervention	Verification Trial
5.	Source of technology	CMFRI, Cochin
6.	Treatments	T1 - Farmers' practice: Farming of water crabs T2 - Potential solution: Stocking of water crabs and hardening them using better feeding management practices for a period of 20-30 days
7.	Plot/ unit size	0.06 ha / unit
8.	No. of replications/ Families	5
9.	Critical inputs	Water crabs

INTERVENTION No. 4

1.	Intervention code	F12
2	Name of technology	**Assessment of scientific monoculture of *M.cephalus* in tide-fed ponds**
3.	Micro farming situation	Tide-fed brackish water system
4.	Nature of intervention	Verification Trial
5.	Source of technology	CMFRI, Cochin
6.	Treatments	T1 - Farmers' practice: Improper stocking of species and no proper eradication T2 - Potential solution: Eradication of predators using mahua oil cake and stocking of seeds at the rate of 20,000 nos/ha
7.	Plot/ unit size	0.04 ha
8.	No. of replications/ Families	10
9.	Critical inputs	*M.cephalus* seeds

INTERVENTION No. 5

1.	Intervention code	F13
2	Name of technology	**On farm trial of Pearl spot seed production in tide-fed ponds**
3.	Micro farming situation	Tide-fed brackish water system
4.	Nature of intervention	On Farm Trial
5.	Source of technology	CMFRI, Cochin
6.	Treatments	T1 - Farmers' practice: Less number of seeds of Pearl spot for culture lead to dependence on natural seeds T2 - Potential solution: Pond breeding technology of pearl spot to farmers
7.	Plot/ unit size	0.04 ha / unit
8.	No. of replications/ Families	3
9.	Critical inputs	Brood fish, egg attachment devices

INTERVENTION No. 6

1.	Intervention code	F14
2	Name of technology	**Assessment of new antifouling paints for increasing longevity of fishing boats**
3.	Micro farming situation	Open sea-based coastal ecosystem
4.	Nature of intervention	Verification Trial
5.	Source of technology	CMFRI, Cochin and CIFT, Cochin
6.	Treatments	TI - Farmers' practice: Use of cashew oil for the maintenance of crafts T2 - Potential solution: New antifouling paints evolved by CIFT will be applied to the recommended level
7.	Plot/ unit size	10 vallams
8.	No. of replications/ Families	3
9.	Critical inputs	Antifouling paints

INTERVENTION No. 7

1.	Intervention code	L5
2	Name of technology	**Assessment of the performance of broiler rabbit farming in homesteads**
3.	Micro farming situation	Homestead animal husbandry system
4.	Nature of intervention	On Farm Trial
5.	Source of technology	CMFRI, Cochin, Kerala Agricultural University and Department of Animal Husbandry
6.	Treatments	T1 - Farmers' practice: Grow local breeds of poor productivity T2 - Potential solution: Introduction of hybrid varieties of rabbits, better feeding, scientific vaccination and de-worming schedule
7.	Plot/ unit size	5 rabbits/ family
8.	No. of replications/ Families	20 families
9.	Critical inputs	Improved varieties of rabbits, medicines

INTERVENTION No. 8

1.	Intervention code	L7
2.	Name of technology	**Assessment of the performance of duck rearing practices**
3.	Micro farming situation	Homestead poultry farming system
4.	Nature of intervention	On Farm Trial
5.	Source of technology	CMFRI, Cochin and Kerala Agricultural University
6.	Treatments	T1 - Farmers' practice: Country birds of low productivity are reared T2 - Potential solution: Good quality ducklings of high genetic potential, better feeding, scientific vaccination and deworming schedule
7.	Plot/ unit size	5 ducklings/family
8.	No. of replications/ Families	20 families
9.	Critical inputs	Improved varieties of ducklings, medicines.

INTERVENTION No. 9

1.	Intervention code	L8
2	Name of technology	**Assessment of performance of fodder cultivation on unutilised marshy lands**
3.	Micro farming situation	Agri-based cropping system under rainfed conditions
4.	Nature of intervention	On Farm Trial
5.	Source of technology	Kerala Agricultural University
6.	Treatments	T1 - Farmers' practice: Paddy straw (by-product of paddy cultivation) and *uppootha*, T2 - Potential solution: Introduction of paragrass
7.	Plot/ unit size	0.04 ha /unit
8.	No. of replications/ Families	10
9.	Critical inputs	Fodder slips/cuttings

INTERVENTION No. 10

1.	Intervention code	A8
2	Name of technology	**Assessment of the performance of amaranthus (*Kannara Local*) as an intercrop with Banana (*Nendran*)**
3.	Micro farming situation	Banana based production system
4.	Nature of intervention	On Farm Trial
5.	Source of technology	Kerala Agricultural University
6.	Treatments	T1 - Farmers' practice: monocropping of banana and amaranthus T2 - Potential solution: Intercropping of Banana with amaranthus
7.	Plot/ unit size	0.04 ha/unit
8.	No. of replications/ Families	10 families
9.	Critical inputs	Suckers, amaranthus seeds

INTERVENTION No. 11

1.	Intervention code	A9
2.	Name of technology	**Assessment of rice cultivation using bio-fertilizers under group farming system**
3.	Micro farming situation	Low-lying seasonal paddy lands
4.	Nature of intervention	On Farm Trial
5.	Source of technology	KVK of CMFRI, Cochin and Kerala Agricultural University, Thrissur.
6.	Treatments	T1 - Farmers' practice: use of chemical fertilizers T2 - Potential solution: Application of bio-fertiliser *Azolla*, Application of bio-fertiliser*Azospirillum*, Application of bio-fertiliser *Mycorhiza*, Application of bio-fertiliser *Blue Green Algae*
7.	Plot/ unit size	0.80 – 2.00 ha / unit
8.	No. of replications/ Families	10 group farms
9.	Critical inputs	Bio fertilizers

INTERVENTION No. 12

1.	Intervention code	A8
2	Name of technology	**Assessment of the performance of improved variety of ridgegourd**
3.	Micro farming situation	Vegetable based system on embankments
4.	Nature of intervention	On Farm Trial
5.	Source of technology	Kerala Agricultural University
6.	Treatments	T1 - Farmers' practice: local variety T2 - Potential solution: Improved variety of ridgegourd
7.	Plot/ unit size	0.12 ha/unit
8.	No. of replications/ Families	5 women groups (5 members/ group)
9.	Critical inputs	Vegetable seeds

INTERVENTION No. 13

1.	Intervention code	A10
2	Name of technology	**Assessment of the performance of improved variety of salad-cucumber**
3.	Micro farming situation	Vegetable based system on embankments
4.	Nature of intervention	On Farm Trial
5.	Source of technology	Kerala Agricultural University
6.	Treatments	T1 - Farmers' practice: local variety T2 - Potential solution: Improved variety of salad cuccumber
7.	Plot/ unit size	0.12 ha/unit
8.	No. of replications/ Families	5 women groups (5 members/ group)
9.	Critical inputs	Vegetable Seeds

INTERVENTION No. 14

1.	Intervention code	A10
2	Name of technology	**Assessment of the performance of improved variety of vegetable cowpea**
3.	Micro farming situation	Vegetable based system on embankments
4.	Nature of intervention	On Farm Trial
5.	Source of technology	Kerala Agricultural University
6.	Treatments	T1 - Farmers' practice: local variety T2 - Potential solution: Improved variety of cowpea
7.	Plot/ unit size	0.12 ha/unit
8.	No. of replications/ Families	5 women groups (5 members/ group)
9.	Critical inputs	Vegetable Seeds

INTERVENTION No. 15

1.	Intervention code	A 11
2.	Name of technology	**Assessment of integrated farming of improved variety of Vegetable on the embankments along with paddy farming in collective farms (padasekharam)**
3.	Micro farming situation	Low-lying seasonal paddy lands
4.	Nature of intervention	On Farm Trial
5.	Source of technology	KVK of CMFRI, Cochin and Kerala Agricultural University, Thrissur.
6.	Treatments	T1 - Farmers' practice: Irregular pattern of vegetable farming on embankments T2 - Potential solution: Scientific farming of vegetable on embankments
7.	Plot/ unit size	10-40 ha/unit
8.	No. of replications/ Families	3 *padasekharam* (collective farm - 75 persons / farm)
9.	Critical inputs	Vegetable seeds

SECTION V
SUMMARY

The coastal agro ecosystem analysis done as part of the Institution-Village-Linkage-Programme is replicable to other coastal agro-ecosystems with similar features. The rural wisdom evolved over the generations is a real wealth and should be considered as the base for any sort of scientific enterprise. Innovative farm production systems with multiple options are primarily aimed at improving productivity and enhance profitability. Specific considerations to the weaker sections of the society and the women workforce in effect lead the non-beneficiary farmers also towards better production opportunities. They emulate the refined methods of technologies imparted as part of the intervention programmes.

Elamkunnapuzha village in the Vypeen Island of Ernakulam District is selected for the implementation of IVLP. Agro-ecosystem analysis and resource inventory of the selected Village indicated five micro-farming situations such as, 1) Tide-fed brackish water system, 2) Open sea-based coastal agro-ecosystem, 3) Homestead animal husbandry and poultry farming system, 4) Rain-fed agri-horticulture system and 5) Low-lying seasonal paddy (*pokkali*) lands.

The general problems faced by the fishermen are low productivity of finfishes, crabs and shrimps. The major causes for low productivity are lack of knowledge about improved farming practices, inadequate financial support, social problems like poaching, lack of risk bearing capacity, high cost of production, long duration of culture, unscientific stocking of species, poor water exchange, lack of eradication of predators prior to stocking, lack of availability of quality seeds, disease occurrence and inappropriate feeding. The interventions, which addressed the aforesaid problems, convinced the farmers about the need for proper water exchange, uniform stocking size and eradication of predators prior to stocking. The results of the projects are useful for preparing a comprehensive development plan for the coastal agro-ecosystem. The fishery-based interventions ultimately motivated more fish farmers to go in for improved practices and to bring more unutilised area under aquaculture. The livestock in the region are highly susceptible to parasitic infestations, micronutrient deficiencies and infectious diseases. Lack of availability of improved breeds, low productivity, high mortality rate and lack of adequate health cover are other problems associated with livestock production. The interventions address most of the health-related problems of the animals and augment production.. The hybrid *Gramalakshmi* breed of poultry coupled with better management practices would gradually replace the low producing country birds for enhanced profitability. The results of the agriculture-based interventions would help to improve the yield of crops and also the income of the farmers through scientific cultivation practices of the improved varieties of vegetables and tissue culture banana variety.

Altogether 17 interventions were proposed during first phase, in which, 15 have been completed; 6 fisheries-based, 3 livestock-based and 5 agriculture-based. Out of the 15 interventions completed, 12 technologies refined are summarised below.

1. Monoculture of uniform sized juvenile crabs (NRM)

Recommended technology is the monoculture of uniform sized juvenile crabs [mud crab - *Scylla tranquebarica*]. The major components of the technology are proper water exchange through fabricated sluices [size of the sluice: 60cm width and 135cm height], stocking of uniform sized juvenile crabs [stocking rate: 4800nos/ha, size: 150-200g], feeding rate 8-10 % of the body weight with feeds such as trash fish and slaughter waste in the ratio 2:1, and fencing of ponds [45^0 angle] using nylon nets to prevent escaping of crabs. Crabs attained a maximum weight of 1.46kg and the yield increased by 48.48 % with the treatment. The benefit-cost ratio for the treatment is worked out to be 2.10:1 as against the 1.36:1 in farmers' practice.

2. Polyculture of finfish [*Mugil cephalus and Chanos chanos*] (NRM)

Polyculture of finfish is the recommended technology. Predators are eradicated using mahua oil cake. Water exchange is maintained through fabricated sluices. Natural entry of fish through sluices is regulated. Combination of *Chanos chanos* and *Mugil cephalus* (20,000/ha) are stocked. *Mugil*

cephalus at the harvesting stage attained a mean weight of 440g and mean length of 35cm, where as the mean weight and length of *Chanos chanos* are 200g and 26.5cm respectively. The gross returns from the polyculture of finfish recorded an increase of 38%. The benefit-cost ratio was worked out to be 1.64:1 for the treatment as against 0.96:1 in the farmers' practice.

3. Assessment of integrated farming of fish and poultry (NRM)

Integrated farming of fish and poultry was proposed for maximising the economic returns from a given land / water resource. Poultry droppings fertilised the ponds and consequently enhanced fish production. The operational expenses of fish farming was reduced by 8-12 per cent through such kind of fertilization. Fish species such as *Mugil cephalus* and *Chanos chanos* were stocked at the rate of 20,000nos/ha. Poultry birds of improved variety, *Gramasree,* were placed in cages atop the pond, at a stocking rate of 175birds/ha. The weight of the *Mugil cephalus* and *Chanos chanos*, at the time of harvest, was 500g and 400g respectively as against 350g and 150g in the farmers' practice. The average egg yield of *Gramalakshmi* birds was 66 per cent higher than that of country birds. The benefit-cost ratio of integrated farming of fish and poultry was worked out to be 1.85:1 as against that of 0.93:1 in farmers' practice.

4. Rack-drying of fish by women groups (PHT/PHVA)

Women groups manage the drying and marketing of fish products. Rack-drying of fish in wooden or iron racks [size: 4.5m X 1m X 0.75m] is the recommended technology. The major components of the technology include, dip-treatment of fish in saturated brine solution with 5% calcium propionate. The treated fish is packed in Polyester polythene polyethylene (12 micron, Inner layer -50 micron) for sale. The treated fish resisted microbial attack and consequently increased the shelf life. The net returns from the sale of fish products increased by 55.83%, with a benefit-cost ratio of 0.51:1 for the treated fish as against 0.37:1 in the farmers' practice. The scientifically processed fish products are hygienic and having high consumers' preference. This intervention is proved to be self-sustaining and provides better employment opportunities to women.

5. Assessment of de-worming, micronutrient supplementation and prophylactic immunization on the productive performance of dairy cows (SE&P)

Deworming, micronutrient supplementation and prophylactic immunization on productive performance of dairy cows is the intervention implemented. The recommended dosage per unit of 5 animals was: Albendazole (Minthal Susp.) – 1 litre, Mineral supplement (Minal Forte) – 15kg and B-Complex liquid (Groviplex) – 2 litres. The milk yield improved by 1.5 litres / cow / day. The gross returns from dairy farming recorded an increase of 16 % with the treatment. The benefit-cost ratio was worked out to be 1.42:1 for the treatment as against 1.12:1 in the farmers' practice.

6. Assessment of de-worming, micronutrient supplementation and disease control on the performance of goats (SE&P)

Measures were taken for de-worming, mineral / vitamin supplementation and vaccination against Foot and Mouth Disease. The recommended dosage per unit of 5 animals was Albendazole (Minthal) -5 tablets, Cestonil (Praziquintal 50mg) – 10 tablets, Mebendazole (Eben 100mg) – 3 tablets, Fenbendazole (Curaminth 150 mg) – 3 tablets, Mineral Mixture (Alvite-M, 250g) – 20 packets, B-Complex liquid. (Groviplex) – 2 litres. The treatment improved the total weight of the animal by 25 per cent and the increase in the weight of dressed meat was 42 percent, with a very low incidence of diseases. Consequently the economic returns were also enhanced with a benefit-cost ratio of 1.39:1 as against 1.00:1 in the traditional practice of rearing goats.

7. Assessment of the performance of *Gramalakshmi* breed of poultry in comparison to country birds (SE&P)

An improved variety of bird *Gramalakshmi* evolved by Kerala Agricultural University specially for backyard keeping was introduced as treatment. The country birds as well as the *Gramalakshmi*

birds were given vaccination and vitamin / mineral supplementation at the recommended dosage (a unit of 10 birds – Albendazole Susp. (Minthal 30ml): 1 litre, Mineral mixture (Alvite-M): 500g, B-Complex liquid (Groviplex): 1 litre and Tetracycline (Water Soluble): 200g. The egg yield for the improved variety is higher compared to that of the country birds. They produced around 70 per cent more eggs than the country birds. The benefit-cost ratio for the treatment and farmers' practice is worked out to be 1.12:1 and 0.61:1 respectively. Since women are mostly practising this as a supplementary occupation, it enables them to enhance the household disposable income.

8. Farming of improved variety of Amaranthus (*Kannara Local*) during Kharif (IPNM)

Improved variety of amaranthus seed, *Kannara Local* is introduced for cultivation on embankments. The recommended spacing pattern [30cm X 20cm] and seed rate [2 kg/ha] increased the yield by 25.7 per cent. The high manurial pond-bed soil used for vegetable farming reduces the operational cost and hence a high benefit-cost ratio (3.36:1) is recorded. The improved variety is resistant to the attack by leaf eating caterpillars and white spot diseases. Embankments, which were not properly used for cultivation, are now increasingly used for cultivating improved variety of vegetable seeds.

9. Farming of improved variety of Bittergourd (*Preethi*) during Kharif (IPNM)

Vegetable is grown in pond-bed soil on the embankments rich in organic matter. An improved variety of bittergourd seed, viz., *Preethi* is introduced. Recommended spacing pattern [2m X 2m] and seed rate [5 kg/ha] resulted in better returns per unit area [88.72% increase in yield]. The average weight of the fruit (*preethi*) is 300g where as that of local variety is 195g. Benefit-cost ratio for the cultivation of *preethi* variety is worked out to be 6.79:1 where as it is 3.50:1 in the farmers' practice.

10. Farming of improved variety of Snakegourd (*Kaumudi*) during Kharif (IPNM)

Improved variety of snakegourd, namely, *Kaumudi* is introduced as treatment. The recommended spacing pattern [2m X 2m] and seed rate [4kg/ha] increased the yield by 32.50 %. The benefit-cost ratio for the cultivation of improved variety is worked out to be 2.93:1 as against the ratio of 2.22:1 in the cultivation of local variety. *Kaumudi* variety is resistant to downy mildew and powdery mildew diseases. The vegetable is raised in the nutrient rich pond-bed soil on the embankments.

11. Assessment of the performance of tissue culture Dwarf Cavendish with local varieties of banana (IPNM)

Tissue culture variety, *Dwarf Cavendish* is introduced and their performance is assessed in comparison to the local varieties. The number of suckers required per hectare is 2500 and spacing recommended is 2m X 2m. The number of fingers per plant is found to be 100-111 for the Cavendish variety, while it is 92-102 for the local variety. The benefit-cost ratio worked out for the Cavendish variety and the local variety are 1.27:1 and 0.32:1 respectively.

12. Assessment of nutrient management practices [chemical fertilizer, green manure] in coconut plantations based on soil test data (INM)

The intervention based on the theme of Integrated Plant Nutrient Management, tested the soil for assessing the nutrient deficiency. Based on soil test data, suitable nutrients were recommended for enriching the health of the soil and thereby enhancing the coconut yield. The recommended nutrient dosage per palm, based on the soil test data are, lime –1kg, urea – 2kg, super phosphate – 2kg, murate of potash – 2kg and magnesium sulphate – 1kg and sunhemp seed – 500g. The recommended practice increased the total number of bunches per palm by 30 per cent. The nut yield improved by 66 per cent. Consequently, the benefit-cost ratio of coconut farming increased from 0.75:1 (farmers' practice) to 2.00:1 (treatment).

The techno-interventions based on a thorough understanding of the coastal agro-ecosystem in the selected village supplement the broad objectives of National Agricultural Research System.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BIBLIOGRAPHY

Bardach. J.E, Kytter J.H, Mclarnern W.O (1972) Aquaculture. John Wiles & Sons Inc. pp 285-312

Chen. Y (1981) Chicken Farming. In Integrated Fish Farming,. Regional Aquaculture Lead Centre, Wuxi, China. Vol II pp 4-30

Conway, Gorden R.,Mc Cracken, Jennifer,A and Pretty Jules, N (1987). Training notes for Agro-ecosystem analysis and Rapid Rural Appraisal. International Institute for Environment and Development

Damodaran. A (2000) Towards an Agro-ecosystem policy for India: Lessons from two case studies. ISBN-0-07-043547-2

Simon Kuznets (1954) Proceedings of the World Population Conference, Papers Volume V. United Nations Organisation

Landau M, (1992) Introduction to Aquaculture (Commonly Cultured Saltwater Fishes). John Wiles & Sons Inc. pp 255

Tim Lyan (2000) Participatory Agro Ecosystem Research in Communal Areas of Zambezi Valley Zimbabwe. http://www.msu.edu/user/lynamtim/agecoresrch.htm

NAAS (2001) Sustainable fisheries and aquaculture for nutritional security. Policy Paper 8. National Academy of Agricultural Sciences. New Delhi, India

Pudadera B.J., Corre K.C, Coniza E, Taleon G.A (1986) Integrated Farming of Broiler Chickens with Fish and Shrimp in Brackishwater Ponds. In Maclean J.L, Dizon L.B, Hosillos.L.V (eds.) Proceedings of the First Asian Fisheries Forum. Manila, Philippines

Warren, D.M (1991) Indigenous Knowledge System and Development. Agriculture and Human Values, Vol. 8. (Special Issue)

Woynarovich, E (1979) The Feasibility of Combining Animal Husbandry with Fish Farming with Special Reference to Duck and Pig Production, pp 203-208. In T.V.R. Pillay and W.A. Dill (eds.) Advances in Aquaculture Fishing News Books Ltd., Famham, Surrey, England