ECONOMIC ANALYSIS OF RICE - FISH SEQUENTIAL FARMING SYSTEM IN THE LOW LYING PADDY FIELDS OF KUTTANAD, KERALA

By

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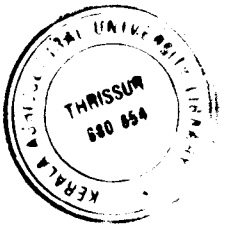

THESIS

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DECLARATION

I hereby declare that this thesis entitled **"Economic analysis of rice-fish sequential farming system in the low lying paddy fields of Kuttanad, Kerala"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis, entitled **"Economic analysis of rice-fish sequential farming system in the low lying paddy fields of Kuttanad, Kerala"** is a record of research work done independently by **Miss. Shanat K. Mathew,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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ABBREVIATIONS

N	:	Nitrogen
P	:	Phosphorus
K	:	Potassium
q	:	Quintal
ha	:	Hectare
kg	:	Kilogram
viz.	:	Namely
G.I	:	Gross Income
MSL	:	Mean Sea Level
SSLC	:	Secondary School Leaving Certificate

To my beloved
Pappa and Mummy

Introduction

INTRODUCTION

India with 2.4 per cent of global area supports 16 per cent of the world population. It is the second most populated country in the world having increased its population from 345 million at the time of independence to a billion plus by 2000 AD. Food grain production estimated to be 208.88 million tonnes during 1999-2000. Producing more food to feed the burgeoning population from shrinking land and water, without eroding the ecological foundation will be an uphill task. The surest means to tide over this challenge is through environmentally sustainable farming methods, which are economically rewarding and intellectually stimulating. Among the food grains rice has a major position. India is the world's second largest producer of rice after China.

Rice is an important crop and is the staple food of the people of Kerala. Area under rice in the state has been declining since mid 1970's, particularly during the last decade when the decelaration was at an alarming rate. The area came down from 5.78 lakh hectare in 1988-89 to 3.53 lakh hectare in 1998-99. Rice production continued to fall from 10.13 lakh tonnes in 1988-89 to 7.27 lakh tonnes in 1998-99. Rice area in the state showed an increasing trend till 1974-75 reaching a peak level of 8.81 lakh hectares during that year. The maximum production so far recorded in an year was 13.76 lakh tonnes during 1972-73. Kerala's agriculture has been witnessing a structural transformation by way of a rapid shift in cropping pattern away from the food crop of rice. The problem has been equally, if not more, serious in Kuttanad, one of the rice bowls of Kerala.

The waning interest of our farmers in cultivation of rice due to low profitability on the one hand and the high risk on the other and the consequent delusive trend in cropping pattern changes in favour of commercial and cash crops is bound to have its deleterious implications in the long run. The food security of the state is already under threat which may lead to dangerous and perpetual

dependency on other states for the staple food. The employment prospects of the rural poor, a highly vulnerable section of the population, which is already bleak, will become more gloomy with the rapid replacement of labour intensive rice crop.

Dairying, an import ancillary occupation in the rural areas will be another casuality since our bovine wealth depends mainly on paddy straw for sustenance. Filling up of perennial rice fields to cultivate other crops is bound to have its deleterious ecological ramifications too. In areas where rice is grown continuously, repeated rice crops using chemical inputs have adversely affected the soil microbial population and the productivity of rice fields resulting in lower yields. To sum up, there is an urgent need to arrest the present trend of large scale area conversion from rice in the state.

The integrated rice fish sequential farming system for low lying rice fields tested and developed by the Kerala Agricultural University at its Regional Research Station at Kumarakom and introduced in Kuttanad a few years ago as demonstration trial in farmer's fields has become an instant success. As a result there has been even an increase, though marginal, in the area under rice in the low lying fields of Kottayam district between 1997-98 and 1998-99 from 13754 hectare to 14393 hectare.

Fish is one of the important items of food all over the world. Due to steady growth of population in India there is a need to bestow better to enrich our food basket by including diverse biological items. Fish is a fairly valuable item of human diet and is gaining great recognition. It is also an important source of protein, iron and Vitamin A. According to National Sample Survey the average consumption in Kerala is 15 kg per capita per annum which is more than the national average of 3 kg per capita per annum. In Kerala 95 per cent of the population consume fish. It is estimated that the total catch of fish was 6.48 lakh tonnes during 1998-99 in Kerala (GOK, 1999). Under the *Janakeeya Matsya*

Krishi being implemented by the Kerala Government with popular involvement, 890 hectare was brought under fish farming during 1998-99 (Anon, 2000).

The rice-fish farming system is a low cost method of producing rice and at the same time the stocked fish provides an environment friendly way of controlling pests and grass and it provides nutrients for farm needs. This farming method promotes maximum utilisation of the farm resources and makes the farmer more self reliant and less dependent on outside farm inputs like chemical fertilizers and pesticides (Velarde, 2000).

Integrated farming involving crop and fish aimed at increasing production through increase in utilisation of land and water is now being practised in many of the padasekharams in Kuttanad. Rice-fish sequential farming enable raising of aquatic animals alternatively in one rice field to obtain aquatic products in addition to rice production. Yield of rice has been stated to increase 10-15 percent through this method (Thampy, 1990). This system has the advantages of low cost and better economic returns. It is an economically attractive and ecologically viable strategy suited for the wet land ecosystems.

Case studies conducted on this new system of rice - fish farming have indicated highly attractive returns from both the fish crop and subsequent rice crop due to complementary effects of organic recycling of resources. The technology appears to be commercially attractive and ecologically viable. Popularization of this farming system in Kuttanad and other low lying rice belts of the state through adequate institutional support can, not only arrest the present unhealthy trend of area conversion from rice but also bring under plough vast areas kept fallow from years.

The present study on economic analysis of rice -fish farming system in the low lying paddy fields of Kuttanad is an attempt to understand the comparative profitabilities and employment generation capacity of the integrated system and the

existing system of rice monocropping. An attempt is also made to workout the economics of rice and fish cultivation.

The specific objectives of the study are

1. To analyse input wise and operation wise cost of cultivation of rice monocropping system and rice-fish sequential farming system in the paddy fields of Kuttanad, Kerala
2. To analyse the comparative profitabilities of the emerging farming systems of rice-fish sequential farming and existing system of rice monocropping.
3. To quantify additional employment generation capacity of the integrated system
4. To identify the constraints in adoption of rice-fish sequential farming system

1.1 Scope of the study

No comprehensive studies have so far been made on the cost and profitability aspects and employment generation capacity of this integrated system. The present study aims to fill this void. The findings of the study may throw light on the socio-political and economic hindrances of speedy adoption of the system. The inferences, it is hoped, will be useful to the planners and policy makers of the state to chalk out suitable agriculture development projects for Kerala.

1.2 Limitations

Results of the study are based on the farm level data, generated through sample survey. Information and data relating to costs and returns were elicited from the memory of the respondents. However, every effort was made to minimise the errors by cross questioning and cross checking.

1.3 Plan of the thesis

This thesis is divided into seven chapters including the present one. The second chapter deals with review of related studies in the light of the present

investigation. The third chapter gives a description of the study area and the fourth chapter deals with the methodology used for the generation of the primary data and analytical tools and techniques employed. The results are presented in the fifth chapter, followed by the discussion of the findings in the sixth chapter. Chapter seven summarises the findings, followed by references and abstract.

Review of Literature

REVIEW OF LITERATURE

The main objective of this chapter is to review the empirical and theoretical information available from similar and related studies. A comprehensive review of past studies could serve as a basis for delineating an ideal conceptual frame work for the present project and relating its empirical findings with those of earlier investigations. Hence an attempt has been made to review the past studies which are relevant to the economics of rice and rice-fish culture in terms of methodology and subject matter. Since literature on fish culture is scanty, studies on different types of integrated farming have also been reviewed.

Lakshman (1974) conducted experiments to compare the differences in growth and production of fishes with and without fertilization and supplementary feeding. A five to seven fold increase in growth and production of fish with those supplemented with artificial feed and fertilization was noticed. About 4500 to 6750 kg feed/hectare/year were required to feed a fish stock of 4500. Since the growth of fish had a direct relationship to the quantity of feed supplied the rate of daily ration might be adjusted to the growth of the fish. According to him minimum wastage and maximum utilisation were the criteria to be observed in adopting supplementary feeding method.

George (1974) in his study on prawn culture in the seasonal and perennial fields of Vypeen island, found that the total expenditure to run the seasonal field was higher than that of the perennial field, the net income realised from the seasonal field was always better. In seasonal fields, paddy was cultivated during May-October and income from paddy cultivation was Rs.2261.45 per hectare. The average total income from paddy as well as prawn amounted to Rs.4278 per hectare from seasonal fields while average total income from perennial fields was estimated to be Rs.2871 per hectare.

Reddi (1978) experimented with mixed culture of fish and prawn. The ponds were generally manured with cattle manure and super phosphate in initial

stages. Very rarely artificial feeding with groundnut oil cake and rice bran was given in small quantities in those ponds when they were found unproductive. A production of 2000 kg of fish plus 260 kg of prawns per hectare per annum was obtained. Total capital investment amounted to Rs.30000 and recurring cost about Rs.3000. Total income realised per hectare was about Rs.19250, net profit being Rs.11250. It was observed that with the increase in pond area the personnel required would be proportionally less. He concluded that there was immense scope for increase in production of fish and prawn with artificial feeding.

Sinha (1979) conducted a study on cost and returns of paddy cum prawn culture at Lembecherra fish seed centre of Tripura state. Application of fertilisers and manuring was done during pond preparation and artificial feeding during the growing season. Analysis of cost and returns showed a total expenditure of Rs.2930 per hectare and a total return of Rs.6600 per hectare with a net profit of Rs.3670 per hectare within three months. According to him fish culture in paddy fields not only yielded an additional income but also augmented productivity of paddy.

Chen and Li (1980) in their study on integrated agriculture-aquaculture in the island fisheries of Taiwan found that the turnover of the pond water was large and the production was low. The application of super phosphate increased the fish yield by 50 to 80 per cent when phytoplankton feeders (silver carp) formed the dominant species.

Huat and Tan (1980) studied rice-fish culture in South East Asia and observed that the yield of rice increased by 15 per cent with the introduction of fish. The excreta of fish and remnants of supplemental food increased the fertility of soil. The income obtained from the sale of fish, however, compensated the losses if any in rice production. The introduction of herbivorous fish controlled weeds and reduced weeding labour costs. He was of the view that since there were extensive areas of irrigated rice fields in Asian countries, there was immense scope of expansion by introducing fish culture.

Tan and Khoo (1980) in their study on integration of fish farming with agriculture in Malaysia estimated that fish farmer's income from fish culture constituted 22 to 60 per cent of farm income in single cropped area of rice and four to nineteen per cent in double cropped area. They concluded that fish formed a significant part of the total income of at least 60 per cent of tenant farmers interviewed. According to him efficient management was of utmost importance in increasing the profit margin.

Muraleedharan (1981) in his article on "Resource use efficiency in rice cultivation in low lying lands of Kerala" observed that inputs such as human labour, bullock labour and fertilizers were not efficiently used.

Rajendran *et al.* (1981) conducted experiments in rice-fish simultaneous culture in Pokkali fields of Kerala during 1977-78 and observed that under ideal conditions production up to 183 kg per hectare could be achieved within 109 days period with *Etroplus* sp. Since paddy cultivation was not so economical, additional income gained through fish culture was of great help to the farmers. There was also possibility of increasing production of paddy as *Etroplus* had helped in removing hydrilla.

Joseph (1982) studied resource use efficiency of paddy farms of Kuttanad region in Kerala. The analysis showed that total cultivation expenses per hectare of paddy cultivation were Rs.4240 in lower Kuttanad and Rs.3011 in upper Kuttanad. Operation-wise break up showed that gap filling and weed control formed the largest expenses followed by fertilizer and its applications. Input-wise study of the cost of cultivation revealed that human labour use per hectare was the most important input cost amounting for about 45 per cent of the total cost. Regression analysis showed that some of the regression coefficients were significant.

Radhakrishnan (1983) conducted a study on economics of paddy cultivation and its impact on production in Palghat, Alleppey and Trichur districts of Kerala. The analysis showed that the relative as well as absolute profitability in paddy

cultivation has declined considerably after 1974-75 and this seems to be only one of the reasons for the recent decline in paddy area and production. The low profitability in paddy cultivation appears to have had a depressing effect on paddy land prices and this might have also contributed to the shifting of land away from cultivation.

Purushan (1986) in his study on recent advances in paddy cum fish culture observed that the culture of fish and paddy together could potentially increase and stabilise income on rice farms and also paddy post fish culture increased the total annual yield. The fish could be beneficial in eliminating weeds mollusces and mosquitoes thus reducing labour cost. He also studied the scope of paddy cum fish culture in Kerala and found that the rate of fish production in paddy fields stood much better and suggested the introduction of this practice in kayal lands of Kuttanad and kole, in addition to 26,000 hectare of Pokkali fields.

Purushan (1987) studied the economics of traditional prawn farming in brackish water fields of Kerala and found that the integration of paddy cultivation and prawn culture was encouraging if properly operated. On comparing the two, it was seen that almost double the profit was realised from traditional prawn culture over paddy cultivation. If improved methods of prawn farming were adopted, prawn production from paddy fields could be raised to atleast one ton per hectare.

Senthiadhas *et al.* (1989) evaluated the economics of paddy cum prawn culture in Kerala during 1981-84 based on data generated through sample survey covering Ernakulam district. The cost of paddy cultivation worked out to about Rs.2020 to Rs.2780 per hectare. Labour accounted for 81 percent of the total cost, seed 10 percent, sluice gate seven per cent and miscellaneous expenditure two per cent. The average yield was 19 quintals per hectare which gave gross return of Rs.3270 to 3900. Analysis of cost and returns of prawn filtration revealed that 80 per cent of the total cost was accounted by lease value, labour cost accounted 10 per cent and sluice gate five per cent. The net returns per hectare of prawn filtration worked out to Rs.1200. The annual net returns worked out to about Rs.8200 per hectare received by owner farmer from both paddy cultivation and prawn filtration, while those who

cultivated paddy and leased for prawn received an annual return of Rs.5130 only. It was also found that on an average 53 mandays and 50 women days were employed per hectare for prawn filtration.

Vyas (1989) in his study on fresh water fish culture in Indonesia observed that common carp was grown in this system very often and yielded 1200 kg per hectare per year as an additional product besides rice. It was also found that 15 per cent higher returns could be obtained by growing fish along with rice.

While comparing the cost and returns of synchronous and sequential rice-fish farming in Kuttanad, Padmakumar *et al.* (1990) found that the sequential system gave a net profit of Rs.10450 per hectare per year as against Rs.6303 per hectare per year in the case of synchronous farming.

Ganesan *et al.* (1991) studied the role of duck cum fish culture as a component in rice farming and also the economics of farming system under small farmers' condition in Cauvery delta region of Tamil Nadu. A net profit of Rs.24117 was obtained in mixed farming with duck cum fish culture and Rs.13790 was obtained from existing cropping system (rice-rice-pulse) from one hectare farm. The introduction of duck-cum-fish culture as a component in mixed farming yielded attractive returns. Besides, 144 mandays of employment was additionally generated by the introduction of mixed farming over the conventional cropping system.

Nasser and Noble (1991) compared prawn culture in seasonal and in perennial fields in Vypeen, Kerala and found that prawn production per hectare per month was higher in seasonal fields than in perennial ponds. Absence of predatory fishes and occurrence of soft prawn disease added to its high production and also due to rich organic matter left behind as paddy stubbles after harvest, selective stocking of prawn seed and supplementary feeding will augment production from perennial ponds. He was of the view that converting extensive system to smaller semi-intensive ones, though costly, would add to the economy of the country by increasing the overall prawn production and providing employment opportunities.

Thomas *et al.* (1991) studied the decline in paddy land and factors leading to it in Trichur district of Kerala and found that during a short span of three years (1987-1990) the decline in the area under paddy was to the extent of 31 per cent. The cost and returns from paddy cultivation showed a benefit-cost ratio of 1.51 over all paid out costs.

Sebastian *et al.* (1992) conducted a preliminary study on intensive farming of fresh water prawn in Kerala and found that taking into account the cost factors a production of 3500 kg per hectare per year of *Macrobachium rosenbergii* could be achieved under the climatic conditions prevailing in Kerala, if proper management measures was followed.

Singh (1992) conducted a study on integrated farming with magur fish among small farmers and proposed a model for integrated farming of magur with poultry, ducks, and horticulture as components. Waste products from duck, cattle and poultry were used efficiently by magur fishes and excess water and nutrient rich sediments were utilised for growing vegetables and fruits. The fish culture gave a yield of four to six tonnes per hectare. A net profit of Rs.41000 per 0.12 hectare was realised from this integrated farming system. He concluded that farming magur fish with other systems of farming was highly profitable and it provides gainful employment to the farm family throughout the year.

Thomas (1992) analysed the cost structures of paddy cultivation in kole lands. The analysis showed that labour input alone was the largest single item of the cost for both local (70.96%) and high yielding varieties (66.41%) followed by fertilizer. The total cost of cultivation per hectare worked out to Rs.10676 for local and Rs.11380 for high yielding varieties and returns obtained from local and high yielding varieties were Rs.15000 and Rs.17000 respectively.

Gupta (1993) in his study showed that application of lime @ 10 g/m^3 or mahua cake at the rate of 200 g/m^3 of water is recommended for small culture areas whereas application of ammonia was recommended for larger fields for the eradication

of predatory organisms. Productivity of the farms could be improved by applying organic or inorganic fertilisers.

Lakshmi (1993) studied the supply utilization and repayment performance of crop loans of commercial banks in Alappuzha district. Paid out cost alone were taken into consideration for estimating the cost of cultivation of paddy. Cost of cultivation estimates showed an inverse relationship to the size of holding. Total paid out cost estimated from paddy cultivation in this area was Rs.12706. Input - output ratio was obtained for large farmers (1.87) followed by marginal farmers (1.70) and small farmers (1.64).

Padmakumar *et al.* (1993) again established the economic and ecological superiority of rice-fish rotational farming in Kuttanad paddy fields over rice monoculture and rice-fish synchronous farming.

Santha (1993) studied the cost and returns of paddy cultivation for different seasons in Thrissur, Kerala and found that hired labour was the most important input invariably used for all the seasons. The average net income was lowest in Punja (Rs.1095.19 per hectare). The return per rupee invested was also lowest for Punja.

Thomas (1993) through his study on prawn farming in Ernakulam district of Kerala state threw some light on the major constraints in prawn production. Most important constraint was the lack of finance for the adoption for the new technology. Non availability of prawn seed was another problem faced by prawn farmers. He suggested that more hatcheries should be set up by the State and Central governments to augment the supply. Institutional financial assistance should be extended to the prawn farmers including the landless.

In an attempt to study the economics of rice production in Kuttanad and kole lands of Kerala, Mohandas (1994) observed that in Kuttanad out of the total cost of production, the cost of fertilizer and its application constituted a major share (24.06%) followed by cost of land preparation (13.52%). The cost of weeding, sowing

and plant protection had a share of 12.89 per cent, 6.58 per cent, 5.66 per cent respectively. The benefit cost ratio was worked out to 1.19.

Dube (1995) studied integrated aquaculture and found that, through fish cum crop integration the production cost can be reduced to one third. It also reduced soil erosion by 57 per cent. Due to synergistic effect of fish on paddy, paddy yield increased by 10 per cent. Weeds and insects were controlled by fish as they fed on it. Fish cum crop integration led to increased efficiency of resource utilisation, reduced investment risk through crop diversification and served as additional resource of food and income. It was also found that with improved management practices a production of 50 kg per hectare of *Peanus monodon* (Tiger prawn) 250 kg of mullets, 3000 kg per hectare of telopia, besides 2.4 tonnes of rice could be achieved.

Ghosh *et al.* (1995) opined that biological control of aquatic weeds in rice fields could be achieved by culturing certain fish species. Experiments conducted in the farmer's field gave a 20 to 25 per cent increase in the yield of rice by rearing grass carp. Besides increased rice yield an additional production of fish of 113 kg was achieved.

Pandirajan (1995) conducted a case study on rice-duck-fish farming in 0.2 hectare homestead area and found that the fish growing reduced the need for pesticides as they fed on insects such as stem borer. Ducks in rice fields devoured the sprouting weeds which reduced the cost of labour. The average yield of rice was estimated to be 900 to 1200 kg per 0.2 hectare and that of straw 600 to 800 kg per 0.2 hectare. The cost of cultivation for rice was Rs.2000 per 0.2 hectare including labour cost. The income from rice alone amounted to Rs.9000 per year and Rs.3000 per year from the same of ducks and eggs. He concluded that the practice was cheap requiring no major modifications in existing farming system. Integration of fish in the system increased the yield per unit area, improved the family income and was eco-friendly.

Rangaswamy *et al.* (1995) analysed rice based integrated farming systems in Tamil Nadu comprising of cropping, fisheries, poultry and mushroom production.

For comparison, conventional cropping systems practiced in the local area were also tested. The study was developed for a holding of 0.40 hectare. The result showed that an average net income of Rs.7678 per year was obtained from the crop component and 183 kg fish per year gave a net profit of Rs.2083, Rs.917 per year from poultry and Rs.1347 per year from mushroom. The total net income under rice- poultry- fish-mushroom was Rs.12025. The net income in conventional cropping system was only Rs.6334 per year from 0.40 hectare area. Moreover the integrated farming system generated an additional employment of 453 mandays per year over conventional cropping system from the specified area and thus helped in the effective utilisation of family labour of the farmer round the year.

Sasidharan and Sekhara (1996) studied the cultivation practices of paddy in Pokkali lands, sprouted seedlings were planted on mounds during the monsoon season. Fertilizers and pesticides were not generally used in these fields as they became toxic to fishes and prawns in the following season. Since the brackish water inundated to the field, the weeds were controlled naturally. While harvesting only the panicles were cut and the stubbles left behind in the field which became the habitat for the fishes and prawn juveniles.

The Fish Farmer's Dovelopment Agency, Kottayam (1997) reported that the total net income per hectare from rice fish rotational farming in Kuttanad was Rs.32,400/- as against a net return per hectare of Rs.7350 from monoculture . The internal rate of return in the case of sequential farming worked out to be 48 per cent.

Rao and Raju (1997) estimated the economics of fresh water fish culture in Andhra Pradesh. The per hectare net profit from fish farm was Rs.4423. The technological coefficients showed over-optimal resource use with respect to stocking rate, labour, fertilizer use and electricity charges.

A study undertaken in pond based farming system research and extension programme in Bhubaneswar district of Orissa (Behera and Mahapatra 1998) identified that a small farmer who could divert his pond for fish production could get an

attractive profit and boost his income. Analysis revealed that a gross and net return of Rs.20325 and Rs.16603 per hectare respectively could be generated with a minimal expenditure of Rs.3722.

Comparative study on different prawn culture in Pokkali lands of Ernakulam district (Maryvijaya, 1998) found that prawn yield in traditional methods were comparatively lower than that in improved method. Farm income, family business income, family labour income and benefit cost ratio were substantially higher in improved method as compared to traditional method.

Singh and Swain (1998) in their study in Punjab revealed that by the integration of aquaculture with agriculture and use of supplementary feed, a sustainable fish production of over 10 tonnes per hectare can be easily obtained.

Area of Study

AREA OF STUDY

Kuttanad, one of the granaries of the state, is a sedimentary formation unique among the rice growing regions of the country. The present study attempts a comparative analysis of the new rice-fish sequential farming system in the low lying areas in Kottayam district of Kuttanad area vis-a-vis, the traditional system of rice monocropping.

3.1 Location and geographical distribution

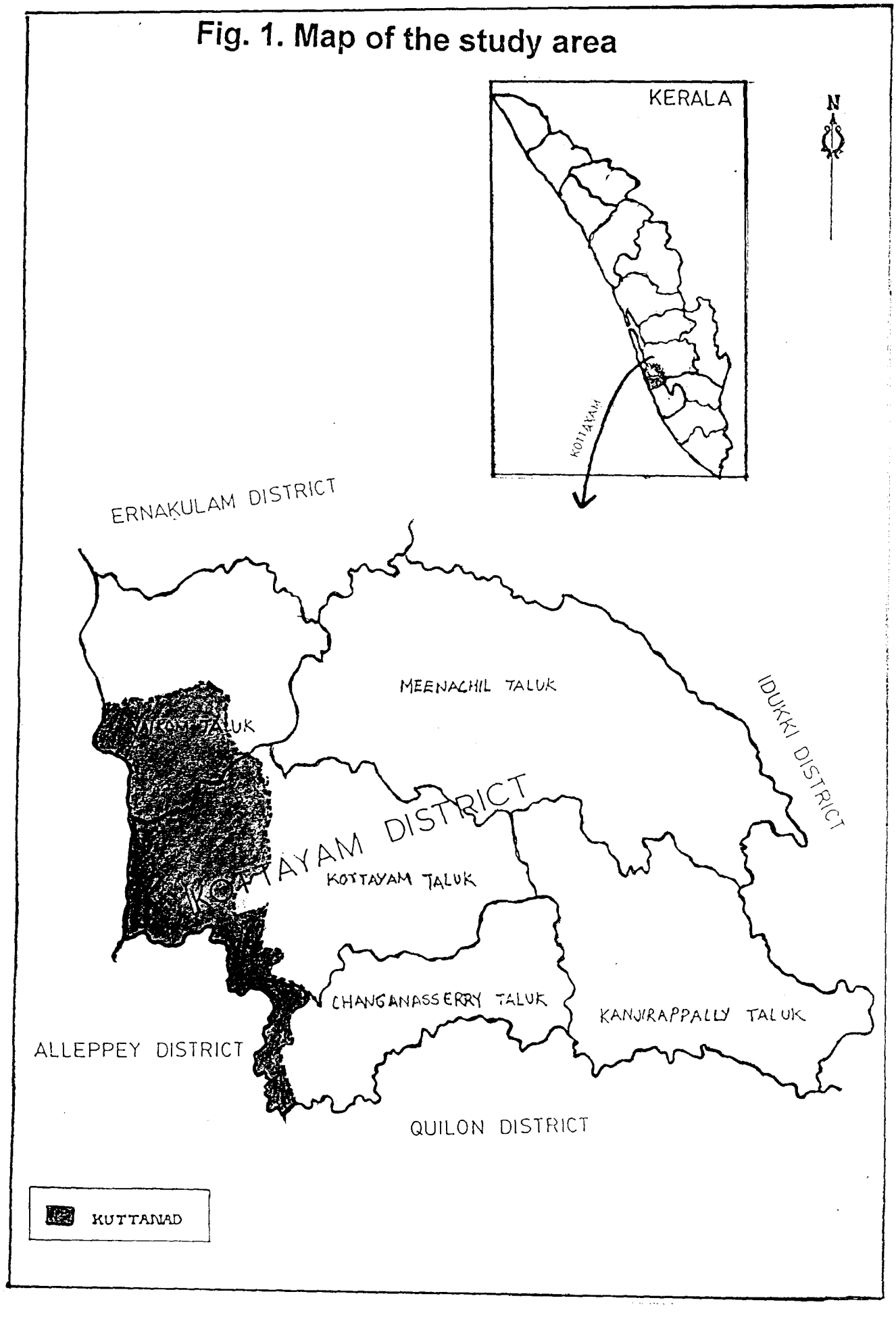
Kuttanad area comprises of the low lying lands and the back water systems in the districts of Alappuzha and Kottayam covering ten taluks and 16 development blocks. This area measures approximately 25 kilometers east -west and 60 kilometers north-south on the west coast of the state, situated between 9°8' and 9°52'north latitude and 76°19' and 76°44' east longitude. Major part of this area lies below Mean Sea Level (MSL). On the western side, it is separated from the Arabian sea by a narrow strip of land. The port town of Alappuzha is on the western side and the taluks of Kottayam and Changanasserry are on the east.

The Kuttanad region extends over 54 villages spread over Kottayam, Changanacherry, and Vaikom taluks of Kottayam district and Thiruvalla, Chengannur, Ambalapuzha, Mavelikara, Karthikapalli and Sherthalai taluks of Alappuzha district. Of this about 304 square kilometers lie approximately one meter above MSL and 500 square kilometers is submerged (0.6 to 2.2 kilometers below MSL). Kuttanad is a sedementary formation shaped by the confluence of four major rivers of Kerala, Meenachil, Manimala, Pamba and Achankoil which drain into Vembenad Lake which is the largest lake in Kerala covering an area of about 80 square kilometers. The lake opens into the Arabian sea.

3.2 Physiography

The main feature of Kuttanad is that it gets flooded during the monsoon. As the areas are connected to the sea through back water lakes, they are subjected to

Fig. 1. Map of the study area



sea water inundation periodically. The paddy lands comprise of the area reclaimed during different periods in the past from the back water and are known as 'Padasekaram'. The area of each padasekaram ranges from a few hectares to above 1000 hectare owned by several cultivators. The Kayal lands represents deeper portion of Kuttanad very close to the Vembanad lake which is situated parallel to the Arabian sea. These areas represent a recent sedimentary formation. It has been established that Arabian sea once extended as far as the eastern border of Kuttanad region. With the upheaval of the 'Varkalay Formation' the tract got elevated forming an extensive bay into which were discharged the waters of Pamba, Achankovil, Meenachil and Manimala rivers. The silt carried by these rivers converted the shallow bay into an extensive water tract. These lagoons gradually silted up and gave rise to wet paddy lands.

These lands are water logged with criss cross rivers, channels, canals and water ways. During south west monsoon period the flow of water through these rivers is estimated to be 189000 m^3/sec. As a result the area is prone to flooding during the period.

3.3 Geological features

Geologists suggest yet another theory about the origin of Kuttanad. According to this theory, millions of years ago, these lands were forest areas abounding in different varieties of trees. In the succeeding geological age, the Arabian sea advanced and engulfed not only these lands but extended in many places up to the foot of the Western Ghats. Years later the sea receded exposing the land which now forms part of the midland and coastal regions of Kerala. During these upheavals the entire forest area was submerged far below the ground level and thereafter silted up to varying levels giving rise to saline marshes and low lying lands of Kuttanad. Soils in these area have vast organic matter deposits and also fossils of timber and shell-fish in varying depths, reminiscent of submersion under the sea for geological periods.

3.4 Climate

A uniform climate prevails in this zone. The minimum temperature of the zone varies from 23.3°C to 26.6°C with an average of 25.2°C. The maximum temperature varies from 30.0°C to 34.6°C with an average of 32.2°C. The relative humidity shows a range of 63.5 to 84.9 per cent with an average of 70.1 per cent. The mean annual rainfall is 2844 mm. The rainiest months are June and July (south west monsoon) during which 40.3 per cent of the total annual rainfall is received. The rainfall during the north west monsoon (October-November) is only 15 per cent of the total. The driest months are January and February.

3.5 Soil

The Soil is a mixture of sand and clay and comes under textural classification silty clay. In some parts the presence of decayed logs of wood are observed. In most of the areas, the soil is slightly acidic or neutral. Occasionally the soil turns saline due to the salt water intrusion or due to rise of salts from below.

The paddy lands of Kuttanad are classified into three broad categories considering the soil type. They are Kayal lands, Karappadams and Kari lands.

3.5.1 Kayal lands

These are found in the low lying parts of this region in the reclaimed lake beds. They lie about two meters below MSL. This category extends over 8163 hectare and is divided into large blocks or padasekarams. Kayal lands are deep, ill drained and dark brown in colour. These soils are alluvial having silty loam to silty clay loam surface texture and are slightly acidic, medium in organic matter and poor in nutrients.

3.5.2 Karappadam

This cover the major portion of Kuttanad i.e., about 42500 hectare and occur along the inland water ways and rivers. Karappadam soils lie one to two meter below MSL. The area under karappadam is 14.8 per cent of the net area sown in

Kottayam District. The soils are poor in lime and available nutrients, especially phosphate. However they contain fairly good amounts of decaying organic matter.

3.5.3 Kari lands

This area lies 1.5 meter below MSL. They are found in the taluks of Ambalapuzha, Shertallai and Vaikom. The name 'kari' is derived from the intense black colour of the soil. The proportion of remnants of logs of wood is more in kari soils. High content of organic carbon imparts the characteristic black colour to the soil. These soils are characterised by heavy texture, poor drainage and very strong acidity. The pH may approach as low as three during summer months. These soils are rich in total nitrogen, but often deficient in phosphorous and calcium. Soluble salts of iron and manganese are observed in toxic concentration in some places.

3.6 Irrigation

The major sources of irrigation in this zone are rivers and canals. As the land is below MSL irrigation is done by gravitational flow of water from the innumerable criss-cross channels of the rivers Meenachil, Pampa, Manimala and Achancovil. The fields are drained by pumping out water to the surrounding channels.

3.7 Cropping pattern

Rice has been the only crop grown in the low lying fields of Kuttanad. Rice is grown during two seasons, the main crop that is known as punja (October-November to February-March). An additional crop of rice is taken during the viripppu season (May-June to September-October). Almost all areas of the low lands are under monocropping. In some areas rice cultivation is adjusted in such a way that the harvest is completed before the recession of flood water. Then the land is used for fish culture from August to April.

Homestead farming is practiced in the garden land with coconut as the main crop and banana, vegetables, yam etc. as intercrop.

The Major crop sequences in the low lying paddy fields of Kuttanad are,

1. Rice (punja- main crop)- rice (virippu- additional crop)
2. Rice (punja - main) - fallow (flood)
3. Rice (punja - main) - fish
4. Rice (virippu) - fish

3.8 Demographic features

3.8.1 Population

There are no separate statistics for the population for the study area. Hence the statistics for the Kottayam district was taken.

According to 1991 census report Kottayam district supports a total population of 18.28 lakhs of which 9.13 lakhs are males and 9.15 are females. Literacy rate is 95.72 percent. Educational status of males and females showed that literacy was more among males (97.46) than females (94%)

3.8.2 Distribution of working population

Distribution of working for the Kottayam district is given in the Table 3.8.2

Table. 3.8.2. Distribution of working population in Kottayam district (1991 Census)

Particulars	No. of persons	Percentage to the total
Cultivators	84327	16
Agricultural labour	125424	23
Household industry workers	12071	2
Other workers	314265	59
Total main workers	537087	100

Source : Farm Guide, 2000 Farm Information Bureau, Government of Kerala

The total working population of the district is 537087 of which, agricultural labour constitute 23 per cent. Cultivators and household industry workers constitute 16 and two per cent respectively. Male agriculture labourers get only 100 to 120 days of work in an year and women labourers, 80 to 100 days of work. The reason

for this is that the bulk of the paddy area in Kuttanad is single cropped. The agricultural labourers get only seasonal work during sowing and harvesting periods.

The other occupations of the labourers are fishing, toddy tapping, lime shell collection, coir making etc. Lime fossil deposits are important resources of the Vembanad lake. The lime shell collected are cleaned and used as a soil ameliorant and building material.

Methodology

METHODOLOGY

The detailed methodology of data generation analytical tools and techniques employed to estimate the cost and returns of rice-fish sequential farming and rice monocropping are discussed in this chapter. The study was conducted in the low lying areas of Kottayam district which forms a part of Kuttanad tract. Kuttanad is a major rice growing tract of Kerala. The low lying areas lie in the western part of the district comprising parts of Vaikom, Kottayam and Changanasserry taluks.

4.1 Sampling procedure

The present study is based on data collected from a sample of 200 farmers. Two stage random sampling was employed with padasekaram as primary unit and individual farmers as the secondary unit for generating primary data. Hundred farmers adopting rice-fish sequential farming which forms five per cent of the population was selected for detailed study. During the year 1997-98 out of the total area of 4156 acres where rice-fish sequential farming was practiced in the three selected taluks, more than 50 per cent area was in Kottayam and about one third in Vaikom. Out of the 2060 farmers, 53 per cent was in Kottayam and 36 per cent in Vaikom. So the sample size was distributed among the taluks of Kottayam, Vaikom and Changanasserry in the ratio 5:3:2. A complete list of padasekarams practicing the integrated system was collected from Fish Farmers Development Agency, Kottayam. Nine padasekarams were selected randomly from this list. From selected padasekarams 100 farmers were selected randomly in the ratio 5:3:2. for the three taluks viz. Kottayam, Vaikom and Changanasserry. Another 100 farmers following rice monocropping were selected randomly from the neighbourhood of each of the selected rice-fish farmers for comparison. Thus a total of 200 farmers were selected from both the systems. The sample was post-stratified based on the area under rice cultivation and analysis was carried out separately for different group. The classification adopted based on area under rice cultivation is given below.

Classification	Area
Class I	less than 1 acre (less than 0.40 hectare)
Class II	1.01-2 acres (from 0.41 to 0.80 hectare)
Class III	2.01 - 4 acres (from 0.81 to 1.60 hectare)
Class IV	Above 4 acres (more than 1.60 hectare)

4.2 Collection of data

Farm level data were collected from the respondents by personal interview method using a well structured and pre-tested schedule. Information about the socio-economic conditions of farmers, cost and returns, problem encountered by farmers in paddy as well as fish cultivation were collected. Secondary data were collected from various published and unpublished sources.

4.3 Period of study

Reference period of the study was the agricultural year 1999-2000. Data collection was done during the months of May- July 2000

4.4 Analytical frame work

4.4.1 Cost and returns

The collected data were tabulated and subjected to percentage analysis to workout the cost of cultivation both operation wise and input-wise. This was done separately for different classes and for the three region.

The following 'ABC' cost concept were also used to estimate various income measures for the regions separately and for different classes.

i) Cost A_1:

(a) Value of hired human labour

In the case of paddy cultivation, human labour employed for various cultural operations like land preparation, sowing, intercultural operations like

weeding, application of fertilisers and plant protection measures and harvesting were included in determining the value of hired human labour.

The wage rate prevailing in the area were different in different regions. In Changanassery and some parts of Kottayam the average wage rate was Rs.150 per man per day and in Vaikom and remaining part of Kottayam was Rs.125 per day. In the case of woman labour, wage rate was Rs.60 per day in all regions. During post harvest operations the wage rate of hired male labour was Rs.250 per day.

In the case of fish cultivation hired human labourers employed for nursery preparation, bund formation, field protection, feeding, harvesting and marketing operations determine the value of hired human labour.

(b) Value of machine use

Machines are used by all farmers for the preparation of land as well as the threshing and winnowing operations. Value of threshing was Rs.300 per acre and for winnowing Rs.100 per acre. The value of machine labour in land preparation was varied.

(c) Value of seeds

In the case of paddy cultivation purchased seeds are evaluated on the basis of their purchase price. The same price was used for evaluating farm produced seeds.

In the case of fish cultivation, Fish Farmers' Development Agency provides fingerlings to almost all farmers free of cost. Purchased fingerlings were evaluated on the basis of their purchase price.

(d) Value of manure and fertilisers

Cost incurred for the purchase of manures and fertilisers was estimated at the purchase price. Farm produced items were valued at their market price.

(e) Value of plant protection chemicals viz, insectisides and fungicides was calculated at their market price.

(f) Interest on working capital

The rate of interest charged by the commercial banks for short term agriculture loan was 12.50 per cent per annum. Interest was charged for only half the duration of the crop as all the costs are not incurred at the beginning itself.

g) Miscellaneous expenses

In the case of paddy cultivation, cost incurred for electricity, dewatering, irrigation, land revenue and transportation of the inputs were included under this item.

In the case of fish cultivation, cost on water management, transportation of inputs, electricity and rent were included in the miscellaneous item.

ii) Cost A_2

CostA_2= cost A_1+rent paid for leased in land

In the areas under study leasing in of land by the respondents was not found. Hence cost A_2 is the same as cost A_1.

iii) Cost B_1

Cost B_1= Cost A_1+interest on owned fixed capital asset

In the study interest on owned fixed capital was not included, since farmers generally do not use any other own fixed capital in the cultivation. The labourers generally bring their own implements to the field and the wages they get included the rent for implements too. Therefore cost B_1 is same as cost A_1

iv) Cost B_2

Cost B2= cost B_1 + rental value of owned land .Rental value of owned land was imputed on the basis of the rate which was prevalent in the region. In some region

rental value of land was calculated based on one fifths (1/5) of the value of the total produce where as in other region it was 1/6 of value of the total produce.

v) Cost C_1

Cost C_1= cost B_1+Imputed value of family labour

The cost of family labour was imputed based on the prevailing wage rates paid to the hired labour in the study area.

vi) Cost C_2

Cost C_2=Cost B_2+ Imputed value of family labour.

vii) Cost C_3

Cost C_3 = Cost C_2 + 10% of cost C_2 to account for the value of management input of the farmer (Acharya and Agarwal, 1994).

viii) Cost of cultivation

Cost of cultivation refers to the total expense incurred in cultivation per hectare. Cost of cultivation both input-wise and operation-wise and their percentage to total were worked out.

ix) Cost of production

Cost of production is the cost of producing one quintal of rice and fish. The return from the byproduct was also accounted for calculating the cost of production.

4.4.2 Income measures

In order to study the efficiency of rice and fish cultivation the following income measures associated with the different cost concepts were used.

i) Gross income

It is the total value of farm produce. It includes the total value of the main product and byproduct. This was calculated based on the harvest price prevailing in the area.

ii) Farm business income

It is calculated by taking the difference between gross income and cost A_1. This represents income to the farmer, when only production expense are considered as costs.

iii) Family labour income

It was calculated by adding the imputed wages for family labour to the net income or the difference between gross income and cost B_2.
(Family labour income = net income + imputed value of family labour or Gross income – Cost B_2).

iv) Net income

This is the difference between the gross income and cost C_3.

4.5 Benefit - cost ratio

It is the ratio of benefits to the costs. This ratio will serve as a measure which would indicate whether the costs incurred commensurate with the returns obtained.

Results

RESULT

Socio–economic characteristics of the sample cultivators, general practices of rice and fish cultivation, detailed economic analysis of rice and rice fish cultivation and constraints in the cultivation of rice and fish of the study area were monitored in the present chapter.

5.1 General socio-economic characteristics of the sample

A brief idea about the social and economic conditions in which sample farmers operate would be very useful for proper understanding of their farming activities. In this section therefore, an attempt is made to present salient features of the social and economic conditions viz. family size, age, sex, literacy, occupation, ownership holding and cropping pattern for the two farming systems, rice monocropping and rice–fish sequential farming.

The study was conducted in the three taluks of Kottayam, Vaikom and Changanasserry. The selected farms were grouped into four size classes based on the area of holding. Farmers cultivating below 0.40 hectare of paddy were grouped as Class I, Class II consisted of farmers having 0.41 to 0.80 hectare. Farmers having 0.81 to 1.60 hectare were considered as Class III and those above 1.60 hectare as Class IV. Class I and Class II farmers constituted one–third each of the total sample. Class III farmers accounted for 25 per cent and Class IV farmers constituted just 10 per cent of the sample. The distribution of sample farmers of the three taluks among the size classes is presented in Table 5.1.

Table 5.1
Distribution of sample farmers according to different classes

Size group	Rice Monocropping			Rice–fish Farmers			Total
	Kottayam	Vaikom	Changa-nasserry	Kottayam	Vaikom	Changa-nasserry	
Class 1	18	11	5	17	11	5	67 (33.50)
Class II	17	10	7	14	8	7	63 (31.50)
Class III	11	7	7	11	9	5	50 (25.00)
Class IV	4	2	1	8	2	3	20 (10.00)
Total	50	30	20	50	30	20	200 (100.00)

(Figures in parentheses show percentages to the total)

5.1.1 Family Size

The respondent farmers were classified based on their family size and the results are presented in Table 5.1.1a and 5.1.1b separately for rice monocropping and rice–fish farming respectively. Among rice monocroppers as much as 44 per cent of the sample families came under the size group of five to six members and 39 per cent under the size group of two to four members. The remaining 17 percentage had seven and above members. In the case of rice–fish farmers 58 percentage of the sample families came under the size group of two to four members and 32 percentage came under the size group of five to six members, remaining 10 percentage had seven and above members.

Average family size of the respondent farmers cultivating rice alone was 4.93. The size was largest in Kottayam (5.55) and smallest in Vaikom (4.5). In the case of rice–fish farmers, the average family size was 4.67, without much variation among the taluks.

Table 5.1.1a
Classification of the respondents according to family size (rice monocropping)

Taluks	Family size (number)				Average size of the family
	2 – 4	5 – 6	7 and above	Total	
Kottayam	18 (36.00)	23 (46.00)	9 (18.00)	50 (100.00)	5.55
Vaikom	12 (40.00)	13 (43.30)	5 (16.70)	30 (100.00)	4.50
Changanasserry	9 (45.00)	8 (40.0)	3 (15.00)	20 (100.00)	4.75
Total	39 (39.00)	44 (44.00)	17 (17.00)	100 (100.00)	4.93

(Figures in parenthesis are percentages to the row total)

Table 5.1.1b
Classification of the respondents according to family size (rice–fish farming)

Taluks	Family size (numbers)				Average size of the family
	2 – 4	5 – 6	7 and above	Total	
Kottayam	30 (60.00)	14 (28.00)	6 (12.00)	50 (100.00)	4.90
Vaikom	16 (53.33)	10 (33.34)	4 (13.33)	30 (100.00)	4.80
Changanasserry	12 (60.00)	8 (40.00)	0 (0)	20 (100.00)	4.30
Total	58 (58.00)	32 (32.00)	10 (10.00)	100 (100.00)	4.67

(Figures in parenthesis are percentages to the row total)

5.1.2 Age and Sex

Classification of the members of respondent's families on the basis of age and sex is given in Table 5.1.2a and 5.1.2b for rice monocropping and rice–fish farming respectively. In the rice monocropping group 36.69 per cent of the total members came under the age group of 40 to 59 and 25.64 per cent came under the age group of 0–17. About 22.88 per cent was in the age group of 18 to 39 and remaining 14.99 per cent in the age group of 60 and above. Males accounted for 51.09 per cent of the total members and females accounted for 48.91 per cent.

Table 5.1.2a
Distribution of respondent family members according to age and sex
(rice monocropping)

Taluk	Age group years										Grand Total
	0–17		18–39		40–59		60 and above		Total		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
Kottayam	34 (12.27)	40 (14.44)	29 (10.47)	36 (13.00)	45 (16.25)	48 (17.33)	24 (8.66)	21 (7.58)	132 (47.65)	145 (52.35)	277 (100.00)
Vaikom	16 (11.85)	20 (14.82)	15 (11.11)	14 (10.37)	29 (21.48)	26 (19.26)	10 (7.41)	5 (3.70)	70 (51.85)	65 (48.15)	135 (100.00)
Changanasserry	12 (12.63)	8 (8.42)	10 (10.53)	12 (12.63)	23 (24.21)	14 (14.71)	12 (12.63)	4 (4.21)	57 (60.00)	38 (40.00)	95 (100.00)
Total	62 (12.33)	68 (13.41)	54 (10.65)	62 (12.23)	97 (19.13)	88 (17.36)	46 (9.07)	30 (5.92)	259 (51.09)	248 (48.91)	507 (100.00)
Group total	130 (25.64)		116 (22.88)		185 (36.69)		76 (14.99)		507 (100)		

(Figures in parenthesis indicate percentages to the total)

In the case of rice–fish farmers 34.31 per cent of the total members came under the age group of 40–59 and 26.74 per cent come under the age group of 0–17. About 24.21 per cent was in the age group of 18-39 and remaining 14.73 per cent in the age group of 60 and above. Males accounted for 49.26 per cent of the total members and females accounted the rest 50.74 per cent.

Table 5.1.2b
Distribution of respondent family members according to age and sex
(rice–fish farmer)

Taluk	Age group years										Grand Total
	0–17		18–39		40–59		60 and above		Total		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
Kottayam	30 (12.25)	36 (14.69)	28 (11.43)	32 (13.06)	33 (13.47)	41 (16.74)	25 (10.20)	20 (8.16)	116 (47.35)	129 (52.65)	245 (100.00)
Vaikom	19 (13.19)	23 (15.97)	15 (10.42)	18 (12.50)	30 (20.83)	20 (13.89)	12 (8.33)	7 (4.86)	76 (52.78)	68 (47.22)	144 (100.00)
Changanasserry	7 (8.14)	12 (13.95)	12 (13.95)	10 (11.63)	19 (22.09)	20 (23.26)	4 (4.65)	2 (2.33)	42 (48.84)	44 (51.16)	86 (100.00)
Total	56 (11.79)	71 (14.95)	55 (11.58)	60 (12.63)	82 (17.26)	81 (17.05)	41 (8.63)	29 (6.10)	234 (49.26)	241 (50.74)	475 (100.00)
Group total	127 (26.74)		115 (24.2)		163 (34.31)		70 (14.73)		475 (100.00)		

(Figures in parenthesis indicate percentages to the total)

It can be seen that in both the systems about 40 per cent of the population belonged the dependent group of fewer than 17 and above 60 years.

5.1.3 Literacy

Classification of respondents according to their educational status is given in Table 5.1.3a and 5.1.3b for both farming systems. Analysis showed that none of the farmer was illiterate. In the case of those farmers following rice monocropping 59 per cent were educated below SSLC 27 per cent up to SSLC 12 per cent up to pre–degree and 2 per cent up to degree level.

Table 5.1.3a
Classification of respondents according to education level
(rice monocropping)

Taluk	Below SSLC	SSLC	Pre–Degree	Degree	Total
Kottayam	36 (72.00)	9 (18.00)	5 (10.00)	0 (0)	50 (100.00)
Vaikom	10 (33.33)	11 (36.67)	7 (23.33)	2 (6.67)	30 (100.00)
Changanasserry	13 (65.00)	7 (35.00)	0 (0)	0 (0)	20 (100.00)
Total	59 (59.00)	27 (27.00)	12 (12.00)	2 (2.00)	100 (100.00)

(Figures in parenthesis indicate percentages to the total)

In the case of rice fish farmers as much as 37 per cent were educated below SSLC, 31 per cent up to SSLC, 22 per cent up to pre–degree and 10 per cent upto degree level.

Table 5.1.3b
Classification of respondents according to education level (rice–fish farming)

Taluk	Below SSLC	SSLC	Pre–Degree	Degree	Total
Kottayam	18 (36.00)	12 (24.00)	13 (26.00)	7 (14.00)	50 (100.00)
Vaikom	11 (36.67)	9 (30.00)	7 (23.33)	3 (10.00)	30 (100.00)
Changanasserry	8 (40.00)	10 (50.00)	2 (10.00)	0 (0)	20 (100.00)
Total	37 (37.00)	31 (31.00)	22 (22.00)	10 (10.00)	100 (100.00)

(Figures in parenthesis indicate percentages to the total)

5.1.4 Occupation

Distribution of respondents according to their occupation is shown in Table 5.1.4a and Table 5.1.4b for rice monocropping and rice–fish farming respectively. Agriculture was only a subsidiary occupation for 43 per cent of the

sample farmers in rice monocropping system. For 29 per cent of the total farmers agriculture was the only occupation and for 28 per cent it was main occupation.

Table 5.1.4a
Classification of respondent according to the occupation (rice monocropping)

Taluk	Agriculture as the only occupation	Agriculture as main occupation	Agriculture as sub occupation	Total
Kottayam	10 (20.00)	15 (30.00)	25 (50.00)	50 (100.00)
Vaikom	10 (33.33)	6 (20.00)	14 (46.67)	30 (100.00)
Changanasserry	9 (45.00)	7 (35.00)	4 (20.00)	20 (100.00)
Total	29 (29.00)	28 (28.00)	43 (43.00)	100 (100.00)

(Figures in parenthesis indicate percentages to the total)

In the case of rice–fish farmers it was found that for 45 per cent of the cultivators were under the first category i.e. agriculture as the sole occupation. Agriculture was the sub occupation for 29 per cent of the total rice–fish farmers and for the remaining 26 per cent had agriculture as main occupation. It is interesting to note that farmers with agriculture as the only or main activity constituted only 57 per cent among rice monocroppers whereas it was 71 per cent in the integrated system.

Table 5.1.4b
Classification of respondent according to the occupation (rice–fish farming)

Taluk	Agriculture as the only occupation	Agriculture as main occupation	Agriculture as sub occupation	Total
Kottayam	21 (42.00)	13 (26.00)	16 (32.00)	50 (100.00)
Vaikom	14 (46.67)	9 (30.00)	7 (23.33)	30 (100.00)
Changanasserry	10 (50.00)	4 (20.00)	6 (30.00)	20 (100.00)
Total	45 (45.00)	26 (26.00)	29 (29.00)	100 (100.00)

(Figures in parenthesis indicate percentages to the total)

5.1.5 Ownership Holding

The respondents were classified based on their holding size and are given in Tables 5.1.5a and 5.1.5b. In case of rice monocropping, it was found that 50 per cent of the total respondents had 51.81 per cent of the total area. Farmers who constituted 30 per cent of the total had 27.45 per cent of the total area. Remaining 20.74 per cent of total area belonged to 20 per cent of the total respondents. Average size of holding was 0.93 hectares.

Table 5.1.5a
Distribution of respondents according to ownership holding (rice monocropping)

Taluk	No. of farmers in each taluk	Area (in hectares)	
		Area	Average size of holding
Kottayam	50	48.64 (51.81)	0.97
Vaikom	30	25.77 (27.45)	0.86
Changanasserry	20	19.47 (20.74)	0.97
Total	100	93.88 (100)	0.94

(Figures in parenthesis indicate percentages to the total)

In the case of rice - fish farmers, 50 per cent of the total farmers have 59.66 per cent of the total area and 30 per cent of the total respondents have 22.96 per cent of the total area and remaining 17.38 per cent area belonged to 20 per cent of the total respondents. Average size of holding, in the case of rice-fish farmers was 1.04 hectares.

Table 5.1.5b
Distribution of respondents according to ownership holding (rice–fish farming)

Taluk	No. of farmers in each taluk	Area (in hectares)	
		Area	Average size of holding
Kottayam	50	65.75 (59.66)	1.32
Vaikom	30	25.3 (22.96)	0.84
Changanasserry	20	19.16 (17.38)	0.96
Total	100	110.21 (100)	1.04

(Figures in parenthesis indicate percentages to the total)

5.1.6 Cropping Pattern

Cropping pattern of respondent farmers in both the systems are given in Table 5.1.6. The major crops grown in the area were rice, coconut, banana, tapioca and vegetables. Rice was grown 91.21 per cent of the gross cropped area. Rice is an important food grain crop in the area. Coconut occupied second position with 4.56 per cent of the gross cropped area. Then tapioca, banana and vegetables occupied 1.02, 1.4, and 0.21 per cent respectively. Other perennials accounted 1.59 per cent of the total gross cropped area.

Table 5.1.6
Cropping pattern of respondent farmers

Crops	Area (in hectare)	Percentage of gross cropped Area
Rice	186.15	91.21
Coconut	9.31	4.56
Tapioca	2.09	1.02
Banana	2.86	1.4
Vegetables	0.43	0.21
Other perennials	3.25	1.59
Gross cropped Area	204.09	100

5.1.7 Methods of rice cultivation

The rice cultivating seasons of the Kuttanad are punja (October–November to February - March) and virippu (May–June to September–October). The following cropping systems were observed in the study area.

Changanasserry

Rice (Punja) – Fish

Rice (Punja) - Flood fallow

Kottayam

Rice (Virippu) – Fish

Rice (Punja) – Flood fallow

Rice (Virippu) – Fallow

Vaikom

Rice (Virippu) – Fish

Rice (Virippu) – Fallow

None of the respondents was taking two crops of rice a year. Some padasekarams were taking fish as the second crop and the remaining fields were kept as flood fallow.

5.2 General practices of rice cultivation in Kuttanad

In the low lying fields of Kuttanad only one crop of rice is taken generally. Paddy fields of Kuttanad are separated into blocks of contiguous area. Such blocks are known as 'padasekarams'. The 'padasekarams' are extensive areas mostly owned by small farmers with slender resources. The padasekarams lie about one to two meters below Mean Sea Level. Inundation during the monsoons and off-season prevents the capillary rise of salts in soil.

5.2.1 Dewatering

Just before the crop season begins water from the field is bailed out. Dewatering is done by special type of pumpsets. i.e., pumps fitted with electric motors of high Horse Power. Irrigation is by gravitational force through main and secondary channels with sluices for every field in the padasekarams. The dewatering operations and other incidental items of work are carried out on the basis of contract given out by the padasekaram committee. A part of the cost of dewatering is borne by the Government in the form of subsidy. After completely draining out water, the outer bunds of the 'padasekaram' are strengthened and the fields made ready for cultivation.

Before dewatering, the fields are first ploughed, often in waist deep water. This helps to stir up the soil and allow fresh water to percolate into the soil, ploughing would also help in removing acidity and other toxicants from the soil.

5.2.2 Repair to inner bunds and channels

Bunds are made to demark individual plots. Repair of these bunds are carried out and the operation is known as 'edavarambukuthal'. Along with this work small channels are made, that is necessary for irrigation as well as drainage. The channels are known as `vachals'.

5.2.3 Levelling

The clods are broken by hand and then the weeds and stubbles are removed. Likewise the field is levelled so that the soil obtains a fine tilth. This is carried out by women labourers. After leveling is completed, fresh water is let into the field.

5.2.4 Sowing

Direct sowing by broadcasting is practiced in Kuttanad. Even though the seed rate recommended in the area is 100 kg per hectare, the farmers use a

higher rate up to 125 kg per hectare. This is to prevent weed growth and the losses by bird picking etc. Seeds packed in screw–pine baskets or mat bags and soaked for about 8 to 12 hours and drained to induce sprouting. Sprouted seeds are broadcast in the prepared field in ankle–deep water. Three to four days after sowing, the fields are completely drained and kept for about a week with the soil moist and not dry completely.

5.2.5 Gap filling

This is the removal of overcrowded portions in the field by thinning out the excess seedlings and filling the gaps. This is done 25 to 30 days after sowing. First weeding is also given along with this. Top dressing is carried out soon after gap filling.

5.2.6 Weeding

In direct sown crop, weeds pose a major problem. Weeds are removed by hand weeding, and by chemicals like 2,4–D. Manual weeding is done twice in a season. First weeding is usually done along with gap filling. Second weeding is given 15 to 20 days after first weeding.

5.2.7 Liming

Liming is essential in Kuttanad as the soil pH is below six. The recommended dose of lime in these areas is 600kg per hectare in two splits. But here the farmers by and large use less than the recommended dose i.e., 400 kg/hectare or even below. Burnt lime is the most popular soil ameliorant.

5.2.8 Fertilizer Application

Chemical fertilizer is the major source of nutrients for paddy in Kuttanad. The recommended dosage of the major nutrients N, P and K are 70:35:35 kg per hectare for short duration high yielding varieties and 90:45:45 kg

per hectare for high yielding medium duration varieties. Usually fertilizers are applied in two or three split doses. Half the quantity of phosphatic fertilizer and one third of nitrogen and potassium are applied as basal dose. This is at about 10 days after sowing. Second application is made 15-20 days after the first. For that remaining quantity of phosphatic fertilizers and 1/3rd N and K are applied. Remaining quantities of nitrogen and potassium are given about 15–20 days after the second application i.e., at the panicle initiation stage. The fields are drained before the application of fertilizers and kept moist for about two days after which water is let in. In the fields where rice–fish sequential farming is practiced, the dosage of fertiliser can be reduced.

The recommended N, P_2O_5 and K_2O level and their application through chemical fertilizers for rice under both the systems are given in Table 5.2.1 and 5.2.2.

Table 5.2.1
Class-wise nutrient use in rice cultivation under monocropping system
(kg/ hectare)

Nutrient	Recommended dose	Actual Quantities used by farmers				Aggregate
		Class I	Class II	Class III	Class IV	
N	90	120.95	115.43	113.57	107.9	114.46
P	45	46.51	45.57	43.82	45.5	45.35
K	45	58.74	55.88	56.25	53.04	55.98

In the case of rice monocropping for sample as a whole, nitrogen was used above the recommended level, phosphorous was used in the right quantity and potassium was also used above the recommended level.

Table 5.2.2
Class-wise nutrient use in rice cultivation under sequential farming system
(kg/ hectare)

Nutrient	Recommended dose	Actual Quantities used by farmers				Aggregate
		Class I	Class II	Class III	Class IV	
N	90	93.31	73.43	71.15	73.94	77.95
P	45	36.85	33.07	29.60	31.85	32.84
K	45	48.93	43.60	40.75	42.00	43.82

In the case of rice under sequential farming all the fertilizers were applied below the recommended level except potassium, which was applied slightly below the recommended level.

5.2.9 Plant Protection

The high yielding varieties necessitate intensive use of plant protection chemicals. A regular pattern of plant protection is not seen adopted. Plant protection operations are essentially need based. The insects attack found in the study area were galmidge, leaf roller, and stem borer. The farmers were generally used the insecticides like, ekalux, monocrotophos, metacid, demacron etc..

5.2.10 Water Management

Water is let in and drained occasionally (every 10 to 15 days) so as to maintain a continuous water level of about five centimeter in the field. Field is completely drained about 10 days before harvest.

5.2.11 Harvesting

The paddy fields are ready for harvest (Plate 1) 110-125 days after sowing. Harvesting is done manually. The earheads are cut and collected while harvesting. These are tied to bundle known as 'katta'. Then this 'katta' is taken for threshing and winnowing using mechanical thresher. Grains are collected after threshing and winnowing. Rice is usually sold at the farm itself or transported to the farmers' house where it is stored. The wages for harvesting is paid in kind as 18 to 20 per cent of the total grain harvested known as 'patham'.

5.2.12 General practices of fish culture in kuttanad

After the harvest of paddy, the fields are prepared for fish cultivation. A specific feature of fish farming is that the entire padasekaram is considered as a

Plate 1.

Luxuriant rice crop in the rice-fish sequential farming field: the evidence of complementarity

single unit (Plate 2). So unless there is co–operation among the farmers, fish cultivation is not possible in the area.

As in the extensive cultivation of fish in such large paddy fields, it is not possible to eliminate all predator and weed fishes so first the nursery is prepared (Plate 3), then fingerlings are stocked and feeding is given for two to three months so that the fingerlings get adapted to the environment. After this the fingerlings attain approximately 10-15 cm size and then released into the grow-out field.

Preliminary operations include strengthening the outer bunds, increasing its height and covering the nursery by net to prevent the loss of fish.

Species of fish generally grown in the padasekarams are grass carp (*Clentenopharyngodon idella*), catla (*Catla catla*), common carp (*Cyprinus carpio*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*), silver carp (*Hypophthalmichthys molitrix*) etc. Farmers obtain fish seeds through Fish Farmer's Development Agency and from commercial hatcheries.

Water conditions such as salinity, pH etc. were monitored regularly. Liming is essential to control the acidity of the water.

Manuring the farms with cowdung is a general practice. Fertilizers like urea and phosphatic fertilizers are used in the fields to activate the growth of phytoplankton and zooplankton that form the food for the fingerlings.

Fishes are fed with supplementary feeds comprising rice polish, groundnut cake, black gram powder, tapioca waste etc. Feeding is done in a particular spot at regular intervals. Water is let into the field to about 1.50 to 2.00 meter depth.

Harvesting is carried out after 6-8 months. The entire stock of fish is harvested within a month. Agricultural labourers and fishermen do harvesting

Plate 3.

The nursery pond of an integrated farm: exuberance of prosperity

together. In the final stage field is totally drained and fish is fully harvested. The fishing cost in Kuttanad region varies from Rs.4 to Rs.5 per kg of fish caught. Harvested fish (Plate 4) is either sold at the farm itself or deep freezed and transported to distant markets by the padasekharam management committee.

5.3 Cost of cultivation

5.3.1 Operation-wise cost of cultivation of rice

Operation-wise cost of cultivation per hectare of rice, (both monocropping and sequential farming) for different classes as well as for different regions were estimated.

Operation-wise costs included land preparation, seeds and sowing, fertilizer and application, liming, weeding, post harvesting operation, cost on miscellaneous items, rental value of own land, interest on working capital and cost of management aspect.

In the case of harvesting, labour charges were paid in kind. Thus the operation charges for post harvesting included only the machine charges for threshing, winnowing and the labour cost for transportation of paddy and straw from the field to transporting vehicle. Hence the kind portion of the produce was not included for the estimation of gross income. The yield and returns of rice excluding the kind portion (harvesting charges) were worked out. Neither depreciation charges nor interest on fixed capital have been included in the cost. This is because farmers generally do not use any of their own fixed capital in rice cultivation. The labourers generally brought their own implements to the field and the wages they got included the rent for the implements too. The farmers were not using their own fixed assets since the padasekharam committee did the operations like dewatering, irrigation etc. for the padasekharam as a whole.

Operation-wise cost of cultivation of rice is shown in Table 5.3.1. In the case of rice monocropping, the cost on rental value of own land was the most

Plate 4.

The harvested fish: off to the market or freezing plant

important item at the aggregate level. It accounted for 17.91 per cent of the total cost (Rs.23419.48). Land preparation accounted for 14.79 per cent of the total cost. The third major operation was weeding (13.60%) followed by cost on fertilizer application (13.49%). This was followed by post harvesting that accounted for 11.83 per cent of the total cost, which included cost on machine and hired labour cost. Expenditure on miscellaneous item came next with 6.37 per cent of the total cost.

Table 5.3.1.
Operation wise cost of cultivation of rice for different classes (Rs./hectare)
(Rice monocropping)

Operation	Class I	Class II	Class III	Class IV	Aggregate
Land preparation	4264.35 (16.78)	3368.60 (14.31)	3112.28 (13.94)	3114.3 (13.91)	3464.88 (14.79)
Seeds and Sowing	1133.53 (4.46)	1057.45 (4.49)	1036.7 (4.64)	1019.85 (4.56)	1061.88 (4.53)
Fertilizer application	3228.1 (12.71)	3197.85 (13.58)	3156.2 (14.13)	3056.6 (13.65)	3159.68 (13.49)
Plant protection	643.38 (2.53)	688.95 (2.93)	639.98 (2.87)	682.48 (3.05)	663.7 (2.83)
Liming	1007.4 (3.97)	839.3 (3.57)	715.33 (3.20)	637.95 (2.85)	800 (3.41)
Weeding	3708.15 (14.60)	3262.93 (13.86)	2803.8 (12.56)	2968.78 (13.26)	3185.9 (13.60)
Post harvesting	2972.9 (11.70)	2708.78 (11.51)	2725.4 (12.20)	2679.65 (11.97)	2771.68 (11.83)
Rental value of own land	4320.7 (17.01)	4059.13 (17.24)	4149.13 (18.58)	4247.58 (18.97)	4194.13 (17.91)
Interest on working capital	546.85 (2.15)	505.15 (2.15)	470.38 (2.10)	469.23 (2.09)	497.93 (2.13)
Miscellaneous	1271.6 (5.01)	1715.8 (7.29)	1491.9 (6.68)	1483.35 (6.62)	1490.68 (6.37)
Management input	2309.69 (9.09)	2140.39 (9.09)	2030.11 (9.09)	2035.98 (9.09)	2129.04 (9.09)
Total	25406.65 (100)	23544.32 (100)	22331.19 (100)	22395.73 (100)	23419.48 (100)

Figures in parenthesis indicate percentages to the total

Class-wise analysis showed that the total cost of cultivation in Class I was Rs.25406.65, for Class II Rs.23544.32, for Class III Rs.22331.19 and

Rs.22395.73 for Class IV. Total cost of cultivation was higher in Class I (Rs.25406.65) and lowest in Class III (Rs.22331.19).

Region-wise analysis is presented in the Table 5.3.2. Region-wise analysis showed the total cost of cultivation per hectare in Changanassery (Rs.23960.20) as the highest and the lowest in Kottayam (Rs.22563.04). In Vaikom, the total cost of cultivation was Rs.23735.20.

Table 5.3.2
Operation wise cost of cultivation of rice for three distinct regions (Rs./hectare)
(Rice monocropping)

Operation	Changanassery	Vaikom	Kottayam	Aggregate
Land preparation	3374.45 (14.08)	3845.35 (16.20)	3174.6 (14.07)	3464.88 (14.79)
Seeds & Sowing	1018.5 (4.25)	1102.5 (4.65	1064.63 (4.72)	1061.88 (4.53)
Fertilizers & Application	3382.95 (14.12)	3180.4 (13.39)	2915.65 (12.92)	3159.68 (13.49)
Plant protection	808.33 (3.37)	640.08 (2.69)	542.7 (2.41)	663.7 (2.83)
Liming	1100 (4.59)	590 (2.48)	712.5 (3.15)	800 (3.42)
Weeding	3254.35 (13.58)	3238.23 (13.64)	3062.88 (13.57)	3185.9 (13.60)
Post harvesting	2750 (11.48)	2665 (11.23)	2900 (12.85)	2771.68 (11.83)
Rental value of Own land	4199.58 (17.53)	4258.73 (17.94)	4124.1 (18.28)	4194.13 (17.91)
Interest on working capital	512.1 (2.14)	504.43 (2.13)	477.25 (2.11)	497.93 (2.05)
Miscellaneous	1381.75 (5.76)	1552.75 (6.54)	1537.55 (6.81)	1490.68 (6.36)
Management aspect	2178.20 (9.09)	2157.75 (9.09)	2051.19 (9.09)	2129.04 (9.09)
Total	23960.20 (100)	23735.20 (100)	22563.04 (100)	23419.47 (100)

Figures in parenthesis indicate percentages to the total

Cost of cultivation of rice in rice–fish sequential farming is depicted in the Table 5.3.3. and Table 5.3.4. Here the rental value of own land was the most important item at the aggregate level. It accounted for 26.08 per cent of the total

cost (Rs.19725.40). Cost of weeding came to 13.39 per cent of the total cost. The next major items of operation were fertilizer application (11.13%) and post harvesting (11.10%), followed by cost on land preparation (10.24%) and cost on management aspects accounted for 9.09 per cent. Expenditure on miscellaneous items came next with 5.95 per cent of the total cost.

Table 5.3.3
Operation wise cost of cultivation of rice for different classes (Rs./hectare)
(Rice-fish farming)

Operation	Class I	Class II	Class III	Class IV	Aggregate
Land preparation	2462.9 (11.57)	2039.18 (10.17)	1862.9 (9.56)	1720.4 (9.51)	2021.53 (10.24)
Seeds and Sowing	1195.73 (5.62)	1065.28 (5.31)	1051.5 (5.39)	1032.48 (5.70)	1086.25 (5.50)
Fertilizer application	2486.55 (11.68)	2159.55 (10.77)	1976.75 (10.14)	2159.2 (11.94)	2195.6 (11.13)
Plant protection	366.7 (1.72)	654.93 (3.27)	492.93 (2.53)	238.05 (1.32)	438.15 (2.22)
Liming	767.6 (3.64)	719.78 (3.59)	634.18 (3.25)	547.43 (3.02)	667.25 (3.38)
Weeding	3023.33 (14.21)	2627.55 (13.11)	2597.08 (13.32)	2321.75 (12.84)	2642.43 (13.39)
Post harvesting	2160 (10.15)	1962.05 (9.79)	2560 (13.13)	2080.75 (11.50)	2190.7 (11.10)
Rental value of own land	5279.18 (24.81)	5318.53 (26.53)	5062.6 (25.96)	4913.53 (27.17)	5143.45 (26.08)
Interest on working capital	409.25 (1.92)	376.05 (1.88)	368.75 (1.89)	335.75 (1.86)	373.45 (1.89)
Miscellaneous	1190 (5.59)	1302.5 (6.49)	1114.9 (5.71)	1090 (6.02)	1174.35 (5.95)
Management aspect	1934.13 (9.09)	1822.55 (9.09)	1772.24 (9.09)	1643.95 (9.09)	1793.22 (9.09)
Total	21275.46 (100)	20048.04 (100)	19494.67 (100)	18083.45 (100)	19725.40 (100)

Figures in parenthesis indicate percentages to the total

Class-wise analysis of cost of cultivation showed that class 1 registered the highest cost of Rs.21275.46 per hectare. This was followed by Class II (Rs.20048.04), Class III (Rs.19494.67) and Class IV (Rs.18083.45).

next major item was cost on feeds and feeding which accounted 17.92 per cent of the total cost. Marketing costs came to 7.50 per cent, which includes cost on ice, boxes and labour charges, weighing materials etc.

Table 5.3.5
Operation wise cost of cultivation of fish for three distinct regions (Rs./hectare)
(Rice-fish farming)

Operation	Changanassery	Vaikom	Kottayam	Aggregate
Nursery formation	364.48 (5.29)	200.90 (3.21)	141.68 (1.99)	235.69 (3.48)
Fingerlings	84.17 (1.22)	123.80 (1.98)	514.08 (7.21)	240.68 (3.56)
Nursery Protection	268.29 (3.88)	149.30 (2.38)	95.18 (1.34)	170.92 (2.53)
Field preparation	163.51 (2.36)	182.20 (2.91)	156.58 (2.19)	167.43 (2.47)
Feeds and Feeding	1415.66 (20.45)	905.59 (14.46)	1317.55 (18.49)	1212.93 (17.92)
Field protection	234.94 (3.39)	189.60 (3.03)	116.47 (1.63)	180.34 (2.66)
Harvesting	1589.35 (22.97)	1728.02 (27.59)	1613.90 (22.64)	1643.76 (24.29)
Marketing	380.8 (5.50)	416.77 (6.65)	724.67 (10.17)	507.41 (7.50)
Miscellaneous	304.59 (4.40)	219.50 (3.50)	139.20 (1.95)	221.10 (3.27)
Interest on working capital	144.17 (2.08)	123.47 (1.97)	144.58 (2.03)	137.41 (2.03)
Rental value of own land	1335.39 (19.30)	1455.36 (23.23)	1515.48 (21.26)	1435.41 (21.21)
Management aspects	628.94 (9.09)	569.46 (9.09)	647.93 (9.09)	615.31 (9.09)
Total cost	6918.29 (100)	6264.06 (100)	7127.23 (100)	6768.39 (100)

Figures in parenthesis indicate percentages to the total

Region-wise analysis showed the total cost of cultivation of Rs.7127.23 in Kottayam to be the highest. Total cost in Changanasserry was Rs.6918.29 and Rs.6264.06 in Vaikom.

5.3.2 Input-wise cost of cultivation

Input-wise analysis on cost of cultivation worked out for different classes and for different regions.

Inputs expended for the cultivation of paddy were grouped into four viz. labour input, material, machine and other items. Labour input included hired and family labour (i.e., both for male and female). Material inputs included seed, chemical fertilizer, weedicides lime and plant protection chemicals. Machine included cost on ploughing operation, cost of threshing and winnowing. The other items included interest on working capital, rental value of own land, miscellaneous expenses and cost on management input.

Inputs used up in fish cultivation were grouped into three viz labour, material inputs and other items. Material inputs include cost of manures and fertilizer, cost of feed, fingerlings, protection items like net, rope, electrical items (bulbs, wire, etc.), marketing device i.e., ice, boxes, weighing equipments etc. Other items include interest on working capital, rental value of own land, miscellaneous expenses and cost on management inputs.

In the case of rice monocropping, the result revealed that labour cost and the sub group 'other items' had an almost equal share of the total cost, which accounted for 35.35 per cent (Rs. 8279.10) and 35.49 per cent (Rs. 8311.78) of the total cost (Rs. 23419.48) at the aggregate level. The cost on material inputs accounted for 20.57 per cent (Rs. 4816.91) of the total cost followed by machine input (8.59%).

Class wise analysis presented in the Table 5.3.6. It showed that in Class I the most important input of expenditure was labour, which constituted 38.22 per cent of the total cost. This was followed by other items, cost of materials and machine input constituted 33.25, 20.15 and 8.41 per cent of the total cost respectively. On the whole proportion of the expenditure on labour and material input were high in Class I. Family labour contribution was also more in Class I compared to other classes. Therefore total cost of cultivation was high in Class I (Rs. 25406.65) and low in Class III (Rs. 22331.19).

Table 5.3.6
Input wise cost of cultivation of rice for different classes (Rice monocropping)
(Rs./hectare)

Inputs	Class I	Class II	Class III	Class IV	Aggregate
1. Labour					
Hired Male	3076.99	3674.59	4006.34	3832.29	3647.55
	(12.11)	(15.61)	(17.94)	(17.11)	(15.57)
Female	4219.88	3692.68	3186.58	3268.08	3592.43
	(16.60)	(15.68)	(14.27)	(14.59)	(15.34)
Family Male	2125.88	686.48	385.98	554.2	938.13
	(8..37)	(2.92)	(1.73)	(2.47)	(4.01)
Female	288.45	76.68	42.98	0.00	102.00
	(1.14)	(0.33)	(0.19)	(0.00)	(0.44)
Sub total	9710.7	8129.43	7621.86	7654.56	8279.1
	(38.22)	(34.53)	(34.13)	(34.18)	(35.35)
2. Materials					
Seed	1011.83	906.45	883.53	870.23	918.13
	(3.98)	(3.85)	(3.96)	(3.89)	(3.92)
Fertilizer	2775.03	2740.78	2699.98	2636.13	2712.98
	(10.92)	(11.64)	(12.09)	(11.77)	(11.58)
Weedicides	121.1	161.63	145.5	136.5	141.18
	(0.48)	(0.69)	(0.65)	(0.61)	(0.60)
Plant Protc.chem.	340.75	456.8	369.35	391.55	389.63
	(1.34)	(1.94)	(1.65)	(1.75)	(1.66)
	896.6	691.75	568.5	490.25	655.00
Lime	(3.42)	(2.94)	(2.55)	(2.19)	(2.80)
Sub total	5118.31	4957.41	4666.85	4524.65	4816.91
	(20.15)	(21.06)	(20.90)	(20.20)	(20.57)
3. Machine					
Ploughing	1299.38	1215.35	1094.33	1103.88	1178.23
	(5.11)	(5.16)	(4.90)	(4.93)	(5.03)
Harvesting	838.05	830.7	815.7	848.55	833.25
	(3.30)	(3.53)	(3.65)	(3.79)	(3.56)
Sub total	2137.43	2046.05	1910.03	1952.43	2011.48
	(8.41)	(8.69)	(8.55)	(8.72)	(8.59)
4. Other items					
Rental Value of own land	4320.7	4059.13	4149.13	4247.58	4194.13
	(17.01)	(17.24)	(18.58)	(18.97)	(17.91)
Interest on working capital	546.85	505.15	470.38	469.23	497.93
	(2.15)	(2.15)	(2.11)	(2.10)	(2.13)
Management input	2309.69	2140.39	2030.11	2035.98	2129.04
	(9.09)	(9.09)	(9.09)	(9.09)	(9.09)
Miscellanious	1271.6	1715.8	1491.9	1483.35	1490.68
	(5.01)	(7.29)	(6.68)	(6.62)	(6.37)
Sub total	8448.84	8420.47	8141.52	8236.14	8311.78
	(33.25)	(35.76)	(36.46)	(36.78)	(35.49)
Total	25406.65	23544.32	22331.19	22395.73	21290.43
	(100)	(100)	(100)	(100)	(100)

Figures in parenthesis indicate percentages to the total

Table 5.3.7
Inputwise cost of cultivation of rice for three distinct regions (Rs./hectare)
(Rice monocropping)

Inputs	Changanasserry	Vaikom	Kottayam	Aggregate
1. Labour				
Hired Male	3788.25	3532.00	3622.40	3647.55
	(15.81)	(14.88)	(16.05)	(15.58)
Female	3716.80	3630.00	3427.50	3591.43
	(15.51)	(15.29)	(15.19)	(15.34)
Family Male	991.75	964.58	858.08	938.13
	(4.14)	(4.06)	(3.80)	(4.01)
Female	123.75	77.50	105.00	102.00
	(0.52)	(0.33)	(0.47)	(0.44)
Sub total	8620.55	8204.08	8012.98	8279.10
	(35.98)	(34.57)	(35.51)	(35.35)
2. Materials				
Seed	843.50	977.50	933.38	918.125
	(3.52)	(4.12)	(4.14)	(3.92)
Fertilizer	2869.78	2806.50	2462.65	2712.98
	(11.98)	(11.82)	(10.91)	(11.58)
Weedicides	150.00	123.23	150.30	141.18
	(0.63)	(0.52)	(0.67)	(0.60)
Plant protection	514.50	371.50	282.90	389.63
chemicals	(2.15)	(1.57)	(1.25)	(1.66)
Lime	937.50	465.00	562.50	655.00
	(3.91)	(1.96)	(2.49)	(2.80)
Sub total	5315.28	4743.73	4391.73	4816.90
	(22.18)	(19.99)	(19.46)	(20.57)
3. Machine				
Ploughing	1002.75	1563.75	968.20	1178.23
	(4.19)	(6.59)	(4.29)	(5.03)
Harvesting	750.00	750.00	1000.00	833.25
	(3.13)	(3.16)	(4.43)	(3.56)
Sub total	1752.75	2313.75	1968.20	2011.48
	(7.32)	(9.75)	(8.72)	(8.59)
4. Other items				
Rental value of	4199.58	4258.73	4124.10	4194.13
own land	(17.53)	(17.94)	(18.28)	(17.91)
Interest on	512.10	504.43	477.25	497.93
working capital	(2.14)	(2.13)	(2.12)	(2.13)
Management input	2178.20	2157.75	2051.19	2129.04
	(9.09)	(9.09)	(9.09)	(9.09)
Miscellaneous	1381.75	1552.75	1537.55	1490.68
	(5.77)	(6.54)	(6.81)	(6.36)
Sub total	8271.63	8473.66	8190.09	8311.78
	(34.52)	(35.70)	(36.30)	(35.49)
Total	23960.20	23735.20	22563.04	23419.47
	(100)	(100)	(100)	(100)

Figures in parenthesis indicate percentages to the total

In region wise classification (Table 5.3.7), Labour cost accounted for 35.98 per cent of the total cost in Changanasserry followed by Kottayam with 35.59 per cent. Other items, which accounted for 36.30 per cent in Kottayam, 35.70 per cent in Vaikom and 34.52 per cent in Changanasserry. This was followed by material cost, which was highest in Chaganasserry (22.18%) followed by Vaikom (19.99%).

Analysis of rice-fish sequential farming, cost of cultivation of rice showed that 'Other items' accounted for the major share of 43.01 per cent of the total cost (Rs.19725.40) followed by labour cost constituting 33.67 per cent. Next major item was material cost which accounted for 19.09 per cent of the total cost. Among the material cost, fertililzer, which accounted 9.62 per cent, was the highest.

Class-wise analysis (Table 5.3.8) showed that, in Class I and Class III labour cost was single most major input, which accounted for 34.86 per cent and 25.24 per cent respectively. In these classes other items was also the major input (41.42% and 42.67% respectively). In the case of class II and Class IV, 'other item' was accounting for 43.99 per cent and 44.15 respectively. Next important item was labour cost which accounted for 32.07 per cent and 32.35 per cent respectively. In all the classes material cost registered the third position. Among the material cost, cost of fertilizer accounted for the major share.

Region wise analysis (Table 5.3.9) showed that 'other items' registered the major share in Kottayam and Changanassery accounting for 43.85 per cent and 41.93 per cent respectively. For Vaikom it was 43.32 per cent. Labour cost had the second major share in these two regions which accounted for 34.65, 33.79 and 32.64 per cent respectively for Vaikom,Kottayam and Changanasserry. In all the three regions, material cost was in the third position. Material cost for Changanasserry was 21.78 per cent. Among the material cost fertilizer accounted

Table 5.3.8
Input wise cost of cultivation of rice for different classes (Rice-fish farming)
(Rs./hectare)

Inputs	Class I	Class II	Class III	Class IV	Aggregate
1. Labour					
Hired Male	1962.58	2960.68	3868.88	3406.88	3049.75
	(9.23)	(14.77)	(19.85)	(18.84)	(15.46)
Female	2743.6	2727.25	2810.60	2393.83	2668.83
	(12.90)	(13.60)	(14.42)	(13.24)	(13.53)
Family Male	2195.7	609.6	118.95	49.45	743.43
	(12.32)	(3.04)	(0.61)	(0.27)	(3.77)
Female	515.33	132.83	72.33	0.00	180.08
	(2.42)	(0.66)	(0.37)		(0.91)
Sub total	7417.2	6430.35	6870.75	5850.15	6642.08
	(34.86)	(32.07)	(35.24)	(32.35)	(33.67)
2. Materials					
Seed	1033.55	906.3	896.03	871.05	926.73
	(4.86)	(4.52)	(4.60)	(4.82)	(4.70)
Fertilizer	2171.33	1922.05	1664.98	1835.53	1898.48
	(10.21)	(9.59)	(8.54)	(10.15)	(9.62)
Weedicides	106.25	131.15	121	116.15	118.65
	(0.50)	(0.65)	(0.62)	(0.64)	(0.60)
Plant protection	281.1	443.48	321.7	119.1	291.35
chemicals	(1.32)	(2.21)	(1.65)	(0.66)	(1.48)
Lime	619.68	569.39	486.8	448.81	531.18
	(2.91)	(2.84)	(2.50)	(2.48)	(2.69)
Sub total	4211.91	3972.37	3490.51	3390.64	3766.38
	(19.80)	(19.81)	(17.90)	(18.75)	(19.09)
3. Machine					
Ploughing	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)
	833.80	825.7	815	858.75	833.33
Harvesting	(3.92)	(4.12)	(4.18)	(4.75)	(4.22)
Sub total	833.80	825.7	815	858.75	833.33
	(3.92)	(4.12)	(4.18)	(4.75)	(4.22)
4. Other items					
Rental value	5279.18	5318.53	5062.6	4913.53	5143.45
of own land	(24.81)	(26.53)	(25.97)	(27.17)	(26.08)
Interest on working	409.25	376.05	368.75	335.75	372.45
capital	(2.92)	(1.88)	(1.89)	(1.86)	(1.89)
Management input	1934.13	1822.55	1772.24	1643.95	1793.22
	(9.09)	(9.09)	(9.09)	(9.09)	(9.09)
Miscellaneous	1190	1302.5	1114.9	1090	1174.39
	(5.59)	(6.50)	(5.72)	(6.03)	(5.95)
Sub total	8812.56	8819.63	8318.49	7983.23	8483.47
	(41.42)	(43.99)	(42.67)	(44.15)	(43.01)
Total	21275.46	20048.04	19494.67	18083.45	19725.40
	(100)	(100)	(100)	(100)	(100)

(Figures in parenthesis indicates percentages to the total)

Table 5.3.9
Input wise cost of cultivation of rice for three distinct region (rice-fish farming)
(Rs./hectare)

Inputs	Changanasserry	Vaikom	Kottayam	Aggregate
1. Labour				
Hired Male	3147.75	3077.23	2924.33	3049.75
	(15.30)	(15.84)	(15.24)	(15.46)
Female	2915	2582.5	2509	2668.83
	(14.17)	(13.30)	(13.08)	(13.53)
Family Male	505.43	887.5	837.38	743.43
	(2.46)	(4.57)	(4.37)	(3.77)
Female	146.25	182.9	211.50	180.08
	(0.71)	(0.94)	(1.10)	(0.91)
Sub total	6714.43	6729.73	6482.21	6642.04
	(32.64)	(34.65)	(33.79)	(33.67)
2. Materials				
Seed	745.00	1108.63	926.55	926.73
	(3.62)	(5.71)	(4.83)	(4.7)
Chemical fertilizer	2426.7	1710.4	1558.33	1898.48
	(11.79)	(8.81)	(8.12)	(9.62)
Weedicids	136.95	78.00	141.00	118.65
	(0.67)	(0.40)	(0.73)	(0.60)
Plant protection chemicals	508.63	169.38	196.05	291.35
	(2.47)	(0.87)	(1.02)	(1.48)
Lime	662.50	463.23	467.80	531.18
	(3.22)	(2.39)	(2.44)	(2.69)
Sub total	4479.78	3529.64	3289.73	3766.38
	(21.78)	(18.17)	(17.15)	(19.09)
3. Machine				
Ploughing	0	0	0	0
	(0)	(0)	(0)	(0)
Harvesting	750	750	1000	833.33
	(3.65)	(3.86)	(5.21)	(4.22)
Sub total	750	750	1000	833.33
	(3.65)	(3.86)	(5.21)	(4.22)
4. Other items				
Rental value of own land	5217.5	5116.45	5096.43	5143.45
	(25.37)	(26.34)	(26.57)	(26.08)
Interest on working capital	392.75	365.25	359.38	372.45
	(1.91)	(1.88)	(1.87)	(1.89)
Management input	1869.95	1765.66	1744.02	1793.21
	(9.09)	(9.09)	(9.09)	(9.09)
Miscellaneous	1145	1165.55	1212.5	1174.35
	(5.57)	(6.00)	(6.32)	(5.95)
Sub total	8625.40	8412.91	8412.33	8483.46
	(41.93)	(43.32)	(43.85)	(43.01)
Total	20569.40	1942.26	19184.25	19725.31
	(100)	(100)	(100)	(100)

(Figures in parenthesis indicates percentages to the total)

for the major share of 9.62 per cent at the aggregate level. Highest use of fertilizer was seen in Changanasserry (11.79%).

5.3.3 Input-wise cost of cultivation of fish

Input wise analysis across size classes of cost of cultivation of fish could not be conducted due to non-availability of data. This was because fish cultivation was conducted collectively on a padasekaram basis managed by a democratically elected committee of the farmers of the padasekaram and profits divided based on the area pocessed.

In fish cultivation other items, was the highest subgroup among inputs accounting for 35.60 per cent of the total cost (Rs.6768.39). Next important input was labour accounted for 33.12 per cent followed by material cost (31.29%). Among the material cost feed constituted the major share of 16.23 per cent of the total cost. Within the other items rental value of own land was the largest component (21.21%) followed by management input (9.09%).

Region wise analysis (Table 5.3.10) showed variability in the cost structure from region to region. In Changanassery, the major input was material inputs (36.88%) followed by 'other items' (34.88%) and labour (28.23%). In Vaikom labour (42.63%) was the most important input followed by 'other items' (37.87%) and material inputs (20.17%). In Kottayam, material cost was the highest (35.65%) followed by other items (34.34%) and labour (30.01%).

5.3.4 Cost of cultivation of rice under different cost concepts

Cost concept refers to the classification of cost which regroups the components so as to distinguish between constituents that are price determining from those that are price determined.

Table 5.3.10
Input wise cost of cultivation of fish for three distinct region (rice – fish farming)
(Rs./hectare)

Inputs	Changanasserry	Vaikom	Kottayam	Aggregate
1. Labour	1952.78	2632.9	2138.5	2241.39
	(28.23)	(42.03)	(30.01)	(33.12)
Sub total	1952.78	2632.9	2138.5	2241.39
	(28.23)	(42.03)	(30.01)	(33.12)
2. Materials				
Manures & Fertilizers	93.09	89.2	61.58	81.29
	(1.36)	(1.42)	(0.86)	(1.20)
Feed	1527.78	526.88	1241	1098.55
	(22.09)	(8.41)	(17.41)	(16.23)
Net, rope, electrical items	551.31	198.18	184.17	311.22
	(7.98)	(3.16)	(2.58)	(4.60)
Fingerlings	70.00	99.8	482.42	217.41
	(1.01)	(1.59)	(6.77)	(3.21)
Ice, box, weighing etc.	306.79	349.63	571.48	409.3
	(4.44)	(5.58)	(8.02)	(6.05)
Sub total	2548.97	1263.69	2540.65	2117.77
	(36.88)	(20.17)	(35.65)	(31.29)
3. Other items				
Interest on working capital	144.17	123.47	144.58	137.41
	(2.08)	(1.97)	(2.03)	(2.03)
Rental value of own land	1335.39	1455.36	1515.48	1435.41
	(19.30)	(23.23)	(21.26)	(21.21)
Management input	628.59	569.49	647.84	615.31
	(9.09)	(9.09)	(9.09)	(9.09)
Miscellaneous				
	304.59	219.5	139.2	221.1
	(4.40)	(3.50)	(1.95)	(3.27)
Sub total	2412.74	2367.82	2447.10	249.23
	(34.88)	(37.80)	(34.34)	(35.60)
Total	6918.29	6264.06	7127.23	6768.39
	(100)	(100)	(100)	(100)

Figures in parenthesis indicate percentages to the total

The cost concepts used in this study are Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1, Cost C_2. These costs were worked out for both the existing and introduced farming systems and compared. Here cost A_1, A_2 and B_1 are one and the same because farmers included in the sample did not use any fixed assets or leased in land for cultivation.

Table 5.3.11
Cost of cultivation of rice and fish under different cost concepts
(Rs./hectare)

Cost	Rice (Under monocropping)	Rice (Sequential farming)	Fish (Sequential farming)
Cost A_1 (All actual expenses incurred in production)	16056.17	11865.22	4717.67
Cost A_2 (Cost A_1+rent for leased in land)	16056.17	11865.22	4717.67
Cost B_1 (Cost A_1+interest on own fixed capital)	16056.17	11865.22	4717.67
Cost B_2 (Cost B_1+rental value of own land and rent paid for leased in land)	20250.30	17008.67	6153.08
Cost C_1 (Cost B_1+imputed value of family labour)	17096.30	12788.73	4717.67
Cost C_2 (Cost B_2+ imputed value of family labour)	21290.43	17932.18	6153.08
Cost C_3 (Cost C_2+imputed value of management input)	23419.47	19725.31	6768.39

Cost A_1, A_2, B_1, B_2, C_1, C_2 and C_3 per hectare in rice under monocroping worked out to Rs.16056.17, Rs.16056.17, Rs.16056.17, Rs.20250.30, Rs.17096.30, Rs.21290.43 and 23419.47 respectively. For rice

under sequential farming with fish are Rs.11865.22, Rs.11865.22, Rs.11865.22, Rs.17008.67, Rs.12788.73, Rs.17932.18 and 19725.31. For fish, all the cost except B_2 and C_2 were same because, there was no family labour, all the labours were considered as hired labour. Cost B_2 and C_2 were Rs.6153.08 each. Cost C_3 was 6768.39.

5.3.5 Income measures in relation to different cost concepts.

Table 5.3.12 depicts the different income measures conventionally used in economic analysis computed from the cost concepts. Gross income was worked out to Rs.25252.50, Rs.28371.00 and Rs.8782.95 for rice under monocropping system, rice (sequential system) and fish respectively. Farm business income worked out to Rs.9196.33, Rs.16505.78 and Rs.4065.28 for rice (monocropping), rice (sequential farming) and fish respectively. Family labour income for rice under monocropping was Rs.5002.20, Rs.11362.33 for rice (sequential farming) and Rs.2629.87 for fish. Net income at cost C_3 were Rs.1833.03, Rs.8645.69, Rs.2014.56 for rice (monocropping), rice (rice fish) and fish respectively. Benefit cost ratio estimated for rice (monocrop) was 1.08, for rice (under sequential farming) was 1.44 and for fish (under sequential farming) was 1.30. Benefit cost ratio at explicit cost level worked out to be 1.57, 2.39, 1.86 for rice (monocropping), rice (sequential farming) and fish respectively.

Table 5.3.12
Income measures in relation to different cost concepts
(Rs./ hectare)

Particulars	Rice (Monocropping)	Rice (Sequential farming)	Fish (Sequential farming
Gross income (G.I)	25252.50	28371.00	8782.95
Farm business income (G.I- Cost A_1)	9196.33	16505.78	4065.28
Family labour income (G.I-Cost B_2)	5002.20	11362.33	2629.87
Net Income at Cost C_3 (G.I-Cost C_3)	1833.03	8645.69	2014.56
Benefit cost ratio (G.I : C_3)	1.08	1.44	1.30
Benefit cost ratio at explicit cost level (G.I : A_1)	1.57	2.39	1.86

5.3.6 Yield and Returns

The average yield, income from main product and by-product, gross expenditure, net income and cost of production per quintal were worked out. They are presented in the Table 5.3.13.

The average yield of paddy per hectare was 36.30 q and 40.92 q for rice monocropping and rice-fish sequential farming system respectively. For fish average yield was 439.90 kg.

Income from main product was Rs.24502.50 for rice (monocrop) Rs.27621.00 for rice (rice-fish) and Rs.8782.95 for fish. Income from the by-product straw, was Rs.750.00 each in both systems. Cost of production per quintal of paddy was Rs.645.16 in rice monocropping, Rs.482.05 in rice integrated cropping. For fish it was Rs.1538.62.

Table 5.3.13
Yield and Returns
(per hectare)

	Rice (Mono)	Rice (Rice-fish)	Fish (Rice-fish)
Average yield	36.30 q	40.92 q	439.90 kg
Gross Income	25252.50	28371.00	8782.95
Income from main product	24502.50	27621.00	8782.95
Income from by pdt.	750.00	750.00	-
Gross expenditure	23419.47	19725.31	6768.39
Net income	1833.03	8645.69	2014.56
Cost of production/quintal	645.16	482.05	1538.62

5.3.7 Comparison of rice under different systems

Table 5.3.14a shows the operation wise comparison of the cost of rice under two systems. Cost of cultivation of rice sequential farming system

was found to be 25.59 per cent less when compared to rice monocropping. While comparing the cost of different operations in the two systems showed that highest reduction in the cost was in land preparation which accounted for 41.66 per cent of the cost for rice under monocropping. The next higher reduction was in plant protection it was only 33.98 per cent of that, followed by fertilizer application (30.50%), weeding (17.06%) and liming (16.59%). Post harvest handling showed a reduction of 20.96 per cent in sequential farming. This was due to reduction in the labour component. Seeds and sowing gave a higher use of 2.24 per cent, which was due to higher price of seed during sowing time and all the farmers were using a higher seed rate in sequential farming.

Table 5.3.14a
Operation wise cost comparison of rice under monocropping and sequential system Rs./hectare

Operation	Rice (Monocropping)	Rice (Sequential farming)
Land preparation	3464.88	2021.53 (-41.66)
Seeds and sowing	1061.88	1086.25 (2.24)
Fertilizer application	3159.68	2195.50 (-30.50)
Plant protection	663.70	438.15 (-33.98)
Liming	800.00	667.25 (-16.59)
Weeding	3185.90	2642.43 (-17.06)
Post harvest handling	2771.68	2190.70 (-20.96)
Total	15107.72	11241.81 (-25.59)

(Figures in parenthesis are percentage reduction in the cost of each operation in sequential farming system as compared to those of rice monocropping)

The input-wise comparison is presented in Table 5.3.14b. Since the fields developed into a fine tilth after fish cultivation, paddy could be sown without ploughing. So the entire cost on ploughing could be saved. The next important

item was fertilizer, which could be saved by 30.20 per cent in rice- fish sequential farming system. The cost on plant protection could be reduced by 25.22 per cent. Next important item was labour which could be reduced by 19.77 per cent, followed by lime (18.90%) and weedicides (15.96%). Thus a reduction in the total input cost of 25.59 per cent was achieved through rice fish sequential farming system compared to the existing rice monocropping.

Table 5.3.14b
Inputwise cost comparison of rice under monocropping and sequential farming system (Rs./hectare)

Inputs	Rice (Monocrop)	Rice (Sequential system)
Labour	8279.10	6642.08 (-19.77)
Seed	918.13	926.73 (0.93)
Fertilizer	2712.98	1898.48 (-30.02)
Weedicides	141.18	118.65 (-15.96)
Plant protection chemicals	389.63	291.35 (-25.22)
Lime	655.00	531.18 (-18.90)
Ploughing operations	1178.23	0.00 (-100.00)
Machine labour	833.25	833.25 (0.00)
Total	15107.50	11241.72 (-25.59)

(Figures in parenthesis are percentage reduction in the cost of each operation in sequential farming system as compared to those of rice monocropping)

Yield difference was also worked out and is presented in the Table 5.3.15. Rice yield of monocropped area was 36.30 quintals per hectare and that for rice -fish sequential farming area, it was 40.92 quintal per hectare. An increase of 12 per cent in the yield of rice could be achieved by introducing the new system of sequential farming.

Table 5.3.15
Difference in yield of rice in both the systems

	Rice (Monocropping)	Rice (Sequential farming)	Difference
Yield in q/ha	36.30	40.92	4.62
Value (Rs.)	24502.50	27621.00	3118.50

Total cost and returns from monocropped and sequential farming area were worked out and presented in Table 5.3.16. Gross income from monocropped area was Rs.25252.50 per hectare and that from sequential system was Rs.37153.95 per hectare. Gross expenditure of rice monocropping was Rs.23419.47 per hectare. And gross expenditure of rice and fish was Rs.26493.70 per hectare. Net income from rice under rice monocropping was only Rs.1833.03 per hectare. Net income from rice and fish under sequential farming was Rs.10660.25 per hectare. Benefit cost ratio of these two systems were 1.08 and 1.40 respectively.

Table 5.3.16
Cost and returns from monocropping and sequential farming
(Rs./hectare)

Particulars	Rice (Monocropping)	Rice-Fish (Sequential farming)
Gross income	25252.50	37153.95
Gross expenditure	23419.47	26493.70
Net income	1833.03	10660.25
Benefit cost ratio	1.08	1.40

5.4 Employment generation capacity

Labour use pattern in rice monocropping and sequential farming were analysed. Labour employed for harvesting of rice was not included in the study. In the case of rice cultivation operation wise labour use were estimated under different size classes for both the system and presented in the Table 5.4.1 and Table 5.4.2.

Table 5.4.1
Operation wise labour use pattern in rice cultivation (mandays / hectare)
(rice monocropping)

Operations	Class I	Class II	Class III	Class IV	Aggregate
Land preparation	38.24 (30.75)	21.88 (23.37)	27.10 (2.84)	24.64 (26.50)	27.97 (27.53)
Sowing	2.50 (2.01)	2.50 (2.67)	2.50 (2.62)	2.50 (2.69)	2.50 (2.46)
Lime application	2.50 (2.01)	2.50 (2.67)	2.50 (2.62)	2.50 (2.69)	2.50 (2.46)
Fertilizer application	7.50 (6.03)	7.50 (8.00)	7.50 (7.86)	7.50 (8.07)	7.50 (7.38)
Plant protection operations	7.50 (6.03)	7.50 (8.00)	4.50 (4.72)	4.60 (4.95)	6.03 (5.94)
Weeding	57.50 (46.24)	44.13 (47.13)	43.66 (45.78)	44.54 (47.90)	47.46 (46.72)
Post harvest handling	8.61 (6.92)	7.63 (8.15)	7.60 (7.97)	6.70 (7.21)	7.64 (7.52)
Total	124.35 (100)	93.64 (100)	95.36 (100)	92.98 (100)	101.58 (100)

Figures in parenthesis indicate percentages to the total

Table 5.4.2
Operation wise labour use pattern in rice cultivation (mandays / hectare)
(rice-fish farming)

Operations	Class I	Class II	Class III	Class IV	Aggregate
Land preparation	30.15 (31.89)	18.92 (22.99)	18.50 (2.39)	16.16 (22.49)	20.93 (25.68)
Sowing	2.50 (2.65)	2.50 (3.07)	2.50 (3.23)	2.50 (3.48)	2.50 (3.07)
Lime application	2.50 (2.65)	3.00 (3.64)	2.50 (3.23)	2.50 (3.48)	2.62 (3.21)
Fertilizer application	6.25 (6.61)	5.00 (6.08)	5.25 (6.79)	5 (6.96)	5.38 (6.60)
Plant protection operations	3.36 (3.56)	5.00 (6.08)	2.75 (3.56)	3.00 (4.17)	3.53 (4.33)
Weeding	46.63 (49.33)	41.65 (50.60)	42.45 (54.88)	37.31 (51.91)	42.01 (51.54
Post harvest handling	3.13 (3.31)	6.24 (7.58)	3.40 (4.39)	5.40 (7.51)	4.54 (5.57)
Total	94.52 (100)	82.31 (100)	77.35 (100)	71.87 (100)	81.51 (100)

Figures in parenthesis indicate percentages to the total

In both the systems, highest labour use was observed in Class I. Weeding was the operation which consumed more labour in both the systems. In fish cultivation, harvesting used up 61.84 percentage of the total labour. Operation wise labour use pattern of fish cultivation is presented in the Table 5.4.3.

Table 5.4.3
Operation wise labour use in fish cultivation (man days per hectare)
(rice – fish farming)

Operations	Mandays	Percentages to the total
Nursery formation and protection	3.98	11.58
Feeding (nursery)	0.48	1.40
Mainfield formation	1.15	3.34
Mainfield protection	1.94	5.64
Feeding (main field)	0.55	1.60
Harvesting	21.26	61.84
Marketing	2.32	6.75
Watching	2.70	7.85
Total	34.38	100.00

Total number of labour employed per hectare in rice monocropping was 101.58 mandays. In the case of rice-fish sequential farming, total labour used in rice cultivation was 81.51 mandays per hectare and 34.38 mandays per hectare for fish cultivation. Here the rice-fish sequential farming system used up 115.89 mandays per hectare. Hence the new system had an additional employment generation capacity of 14.31 mandays per hectare.

Region wise analysis of labour use were also analysed and presented in the Table 5.4.4. The incremental employment generation of the rice-fish sequential farming was high in Vaikom taluk (15.04 man days per hectare) followed by Changanasserry (14.29 man days per hectare) and Kottayam (13.60 man days per hectare).

Table 5.4.4
Total labour use per hectare in man days for the two systems of farming : Region-wise

Farming system	Changanasserry	Kottayam	Vaikom	Aggregate
1. Rice monocropping	95.74	105.4	103.60	101.58
2. Rice in the sequential farming	81.75	83.28	79.50	81.51
3. Fish in the sequential farming	28.28	35.72	39.14	34.38
4. Total labour use in sequential farming (2+3)	110.03	119.00	118.64	115.89
Incremental employment generation of the sequential farming system (4-1)	14.29	13.60	15.04	14.31

5.5 Major constraints to rice and fish cultivation

The major constraints of rice under monocropping and the sequential system and fish were identified and ranked by the respondents based on the severity as perceived by them.

5.5.1 Rice (Monocropping)

Table 5.5.1. shows the ranked constraints in rice cultivation under monocropping. The non-availability of labour during the peak agricultural operations was considered as the major constraint of the rice cultivation. All the respondents considered non-availability of labour to be the most important constraint.

Marketing was the second important constraint according to 65 per cent of the respondent. The same was identified as the third, fourth and fifth important problem by another 10, 15 and 10 per cent of the farmers respectively.

Weeds were the third important constraints as reported by 44 per cent of the sample farmers. This also formed second and fifth important problem by another 20 and 26 per cent of the sample farmers.

Pest and diseases formed the third important problem as felt by 30 percent of the respondents while another ten per cent considered it was second important problem. It was ranked 4th, 5th and 6th important constrains by 10, 16 and 14 per cent of the respondents respectively.

Problem due to salinity was ranked sixth by 50 per cent of the respondents. The same was fourth important problem to 15 per cent to the respondents.

Twentyfour per cent respondents considered natural calamities as the fourth important problem. It was ranked fifth, sixth and seventh by 20, 26 and 30 per cent of the respondents respectively.

Table 5.5.1

Constraints of rice production under rice monocropping ranked by respondents (percentages)

Constraints	Ranking of Constraints						
	I	II	III	IV	V	VI	VII
Labour problem (non availability)	100	-	-	-	-	-	-
Marketing	-	65	10	15	10	-	-
Weeds	-	20	44	-	26	-	10
Pest & disease	-	10	30	10	16	14	20
Input cost	-	5	16	36	28	10	5
Salinity	-	-	-	15	-	50	35
Natural calamities	-	-	-	24	20	26	30

5.5.2 Rice (Sequential farming)

Table 5.5.2 shows that ranked constraints of rice cultivation in sequential farming. Most important constraint as perceived by 90 per cent of the respondent was unavailability of labour and resultant increase in their cost. It was the second major problem by another 10 per cent of farmers.

Table 5.5.2
Constraints of rice cultivation under sequential farming (percentages)

Constraints	Ranking of constraints						
	I	II	III	IV	V	VI	VII
Labour (unavailability)	90	10	-	-	-	-	-
Marketing	10	65	-	20	-	5	-
Input price	-	-	35	20	40	-	5
Weeds	-	-	15	25	5	50	5
Pest and diseases	-	-	10	-	50	25	15
Salinity	-	-	20	35	5	-	40
Natural Calamities	-	25	20	-	-	20	35

Marketing was the second important problem felt by 65 per cent of the respondents. It was first important problem for 10 per cent of the farmers. The same was fourth and sixth problem for 20 and 5 per cent of the farmers respectively. High input price was the third and fourth important constraint to 35 and 40 per cent of the farmers respectively. The same was fourth and fifth problem by another 20 and 5 per cent of the total respondent respectively.

Weed infestation was the sixth ranked constraint to 50 per cent of the sample farmers. The same was third, fourth and fifth problem for 15, 25 and 5 per cent of the respondents. 50 per cent of the respondents considered pest and disease infestation as the fifth constraint. Another 10 per cent farmers considered it as third problem. The same was sixth and seventh problem by 25 and 15 per cent of the farmers.

Salinity was ranked seventh constraint by 40 percent of the respondents. It was third, fourth and fifth problem 20, 35 and 5 percent of respondents respectively.

Natural calamities was seventh important problem by 35 per cent of the sample farmers But it was second problem by 25 per cent of the respondents. The same was third and fifth problem by 20 per cent and 20 per cent respondents respectively.

5.5.3 Fish (Sequential farming)

Constraints of fish production was analysed and presented in the Table 5.5.3. Inadequacy of fish seed and untimely supply was the most important constraint as felt for 56 per cent of the sample farmers. It was second and third important problem for another 33 and 11 per cent of the respondents respectively.

Table 5.5.3
Constraints to fish production (percentages)

Constraints	Ranking by respondent						
	I	II	III	IV	V	VI	VII
Seed availability	56	33	11	-	-	-	-
Marketing	44	45	11	-	-	-	-
Farmers non co-operation	-	-	11	33	45	11	-
Labour	-	-	11	22	22	34	11
Finance	-	-	-	-	22	44	34
Reduced size	-	22	34	22	-	-	22
Natural calamities	-	-	22	23	11	11	33

Marketing was the first and second important problems as considered by 44 and 45 per cent of the respondents respectively. Another 11 per cent considered as third important problem. Reduced size of fish was the second, third and fourth important problem by 22, 34 and 22 per cent of the respondent. Lack of co-ordination among the farmers was the fifth important problem by 45 per cent of the respondent. The same was third and fourth important problem by 11 and 33 per cent of the sample farmers. Another 11 per cent considered this was the sixth important problem.

Non availability of labour was the sixth important problem by 33 per cent of the farmers. This was considered third, fourth, fifth problem by another 11, 22 and 22 per cent of the sample farmers. Finance and natural calamities were the other problems faced by the farmers in the study area to a lesser extent.

5.6 Constraints in the adoption of the rice-fish sequential farming system

These were identified as follows.

1. For cultivating fish in the rice field, the bunds of the field should be strengthened to a specific height to prevent escape of fish during heavy rain. A sizeable investment is again required to prepare the fish nursery. Due to financial problem the farmers were unable to adopt the system in several padasekarams.
2. Whole hearted co-operation among farmers of a padasekaram is a 'sine qua non' for the successful implementation of the new integrated system. This was absent in many cases and posed a major constraint to the adoption of the new system.
3. Lack of awareness and knowledge were also constraints in adoption.
4. Farmers generally lack skills in rearing fish.
5. Most important constraint was that most of the farmers were not ready to take risk by shifting to the new system of cultivation.

Discussion

DISCUSSION

Kuttanad, the study area, is often referred to as one of the granaries of Kerala. But of late; there has been a steady reduction in the area under rice in this region. Because of low profitability from rice farming, farmers in these areas are in search of more remunerative alternate enterprise. Integration of fish, a compatible crop with rice, will be a viable alternative in the prevailing situation to utilize effectively the vast amount of fertile waters available and thereby earn more income. It is a sustainable farming system that conserves environment and promotes synergism between enterprises through biological diversification and nutrient recycling. Such a system will be best suited for a region like Kuttanad where per capita land availability is considerably low (Anon, 1989).

The study was undertaken in the rice fields of Kuttanad to compare the newly introduced system of rice-fish sequential farming with the existing practice of rice monocropping. The results based on the present study have been presented in the previous chapter. They are being discussed in this chapter under the following headings.

1. Input-wise cost of cultivation
2. Operation -wise cost of cultivation
3. Benefit cost ratio
4. Comparative profitabilities of the two systems
5. Employment generation capacity of the integrated system
6. Constraints experienced by the farmers in the rice and fish cultivation

6.1 Input-wise cost of cultivation

6.1.1 Input-wise cost of cultivation of rice

Input-wise cost of cultivation of rice (Fig.2) revealed that human labour was the most important input of rice monocropping accounting to 35.35 per cent of the total cost at the aggregate level. Class-wise and region-wise analysis also

confirmed this finding. In the case of rice after the fish cultivation also, human labour was the most important input of expenditure accounting to 33.67 per cent of the total cost at the aggregate level. Similar results were reported by Joseph (1982) who estimated the labour cost as 45.21 per cent of the total cost, which was the highest among other inputs. The finding reiterates the high labour intensive nature of rice.

Second important item of expenditure in rice under monocropping as well as rice under integrated farming was the rental value of own land, which accounted to 17.91 per cent and 26.08 per cent respectively of the total cost at the aggregate level. This finding is in conformity with that of Mohandas (1994) who estimated it to be 23.70 per cent of the total cost.

Material cost which was the third major item in all classes and regions under both system of cultivation accounted for 20.57 per cent and 19.09 per cent at aggregate level for rice (monocropping) and rice (sequential system) respectively. Chemical fertilizer was the major component in material inputs in both the system. The relative share of chemical fertilizer was 11.58 per cent under rice monocropping and 9.62 per cent under rice cultivation under sequential farming. This is supported by the finding of Lakshmi (1993) in which the material cost alone accounted for 21.58 per cent of the total cost of rice in Alappuzha District. Farmers used chemical fertilizers, viz. urea, factomphos, mussoriphos and muriate of potash. None of the respondents applied these fertilizers at the exact recommended dose. While some applied at higher doses, others applied at lower doses. Usually a lower dose was applied in the integrated farm. These fertilizers were usually applied in three splits in monocropping fields and two splits in integrated farms.

Next important input among material input was seed, which accounted for 3.92 per cent of the total cost in rice monocropping. It was 4.70 per cent in the integrated system. All the respondents used high yielding variety seeds like Jyothi

and Uma. None of the farmers adopted the recommended seed rate. All the cultivators were used higher seed rates up to 125 kg per hectare. Mohandas (1994) estimated that the cost on seed accounted for 5.98 per cent to the total cost, which was comparable with the result of the present study. Other items in the material input were lime, pesticides, weedicides, etc. accounted for 2.80 per cent, 1.66 per cent, 0.60 per cent respectively in the rice monocropping and 2.69 per cent 1.48 per cent and 0.60 per cent respectively in rice-fish farming. This is supported by the findings of Mohandas (1994).

Another important input was machine. Machines were used two times in single cropped area, for ploughing and harvesting operations like threshing and winnowing. But in the integrated system ploughing the field was not required during the preparatory cultivation since the previous fish crop would ensure a fine tilth for the ensuing rice crop. So the machine cost accounted for 8.59 per cent of total cost in rice monocrop and only 4.22 per cent for rice crop under integrated farming.

6.1.2 Input wise cost of cultivation of fish

Input wise cost of cultivation of fish (Fig.4) revealed that human labour was the most important input accounted for 33.12 per cent of the total cost at the aggregate level. Harvesting and post harvest handling consumed a lot of human labour. More labour was required for watching, feeding etc. in the field. So fish farming was also a highly labour intensive activity.

Next important item was cost on material input, which accounted for 31.29 per cent of the total cost. Among material inputs the most important item was feed which consumed 16.23 per cent of the total cost at aggregate level. Region wise analysis showed that Changanacherry recorded the highest expenditure on feed (22.09%) followed by Kottayam and Vaikom accounted for 17.41 per cent and 8.41 per cent respectively. This was because the farmers in Changanacherry were feeding fish both in nursery and in main field, thereby

getting a comparatively higher yield than that of Kottayam and Vaikom. Raju and Rao (1994) estimated the cost of feed as 37.71 per cent of the total cost in fresh water fish culture in Andhra Pradesh which was higher than the finding of the present study. Other items in the material cost were manures and fertilizers, field protection materials (net, rope), cost of fingerlings and marketing devices (ice, box, weighing balance etc.) accounted for 1.20 per cent, 4.60 per cent, 3.21 per cent and 6.05 per cent respectively.

At the aggregate level the subgroup 'other items' accounted for 35.60 per cent of the total cost. Within the subgroup rental value of own land formed the major share (21.21%) followed by miscellaneous items (3.27%) and interest on working capital (2.03%). Region wise analysis showed that Vaikom registered 23.23 per cent of the total expenditure on rental value of own land, followed by 21.26 per cent in Kottayam and 19.30 per cent in Changanacherry. This is because the total cost of cultivation per hectare is less in Vaikom comparaed to the other two regions. So the rental value became one of the major items of the cost of cultivation.

6.2 Operation wise cost of cultivation

6.2.1 Operation wise cost of cultivation of rice

Rental value of own land came to 17.91 per cent of the total cost (Rs.23419.48) under rice monocropping and 26.08 per cent of the total cost (Rs.19725.40) for rice-fish sequential farming (Fig.3). This is in confirmity with the result of Mohandas (1994) who estimated the rental value of own land as 23.70 per cent of the total cost in Kuttanad. The percentage difference between the costs on rental value was due to the yield and cost difference in the two systems of cultivation. Relatively higher yield was achieved in rice-fish integrated system than that of rice monocropping and the cost of cultivation were higher in rice monocropping field. Relative proportion of the produce was taken as rental value

of own land. So, when the yield of rice increased, the rental value of land also increased.

Cost on land preparation registered one of the major operations in the rice cultivation. Land preparation in the rice cultivation accounted for 14.79 per cent of the total cost of cultivation under rice monocropping. But the same was 10.24 per cent in the case of rice under integrated farming was the fifth important operation in sequential system of farming. The reason is that ploughing was not required in the integrated system; the previous fish crop would ensure a fine tilth. Weeding become the next important operation, which had accounted for 13.60 per cent of the total cost under rice monocropping and 13.39 per cent under rice-fish sequential system.

Next important item was fertilizer application, which accounted for 13.49 per cent in rice monocropping and 11.13 per cent under rice-fish sequential farming system. In rice-fish sequential farming, the fields were manured with fish excreta and other waste materials. So the following rice crop required lower levels of fertilizer. Hence the percentage share of fertilizer was less than that of rice under monocropping system.

The percentage share of the post harvesting operations was 11.83 per cent of the total cost under rice monocropping and 11.10 per cent under integrated system. A labour charge on post harvest handling was as high as Rs.250. Threshing and winnowing costs were also included under this. All these reasons led to higher percentage share for post harvest operations in the total cost. In both the systems percentage share of post harvesting was almost similar.

Other operations like liming, sowing and plant protection also have significant share of the total cost accounted for 3.41 per cent, 4.53 per cent and 2.83 per cent respectively under monocropping system and 3.38 per cent, 5.50 per cent and 2.22 per cent respectively for integrated system. Here the percentage cost on liming was almost same in both the systems, but sowing charges recorded a

slight difference within the two systems. This was due to the fact that most of the cultivators under the integrated farming used a higher seed rate up to 125 kg per hectare. So the cost on seed led to such a difference in the percentage share. In the case of plant protection, the farmers under integrated farming were not using as much plant protection chemicals as that of rice monocropping. This was because most of the pests were controlled (eaten away) by the fish. So the pest infestation was comparatively low in the integrated system.

6.2.2 Operation wise cost of cultivation of fish

Harvesting was the single important operation accounted for 24.29 per cent of the total cost (Fig.5). This was because harvesting was highly labour intensive. In the case of harvesting, farmers paid a wage rate of Rs.4 to Rs.5 per kg of fish harvested. Because of this the harvesting operations were most laborious and costly. Region wise classification showed that cost of harvesting was higher in Vaikom. This is because per kg harvest cost was higher in Vaikom compared to the other two regions. Rental value of own land accounted for Rs.21.21 per cent of the total cost.

Fish feed and feeding, the next important operation accounted for 17.92 per cent of the total cost. Region-wise analysis revealed that this operation ate up 20.45 per cent of the total cost in Changanasserry followed by Kottayam (18.49%) and Vaikom (14.46%). Raju and Rao (1997) estimated the cost of feed and feeding to be 37.70 per cent of the total cost, much higher than that of the present study. The reason could be that in the sequential system since the fish fingerlings are released into the paddy field soon after the harvest of paddy, the shed rice, plant stubbles and other wastes provided enough supplementary feed for the fish. So the farmers could save considerably on the quantity of purchased fish feed.

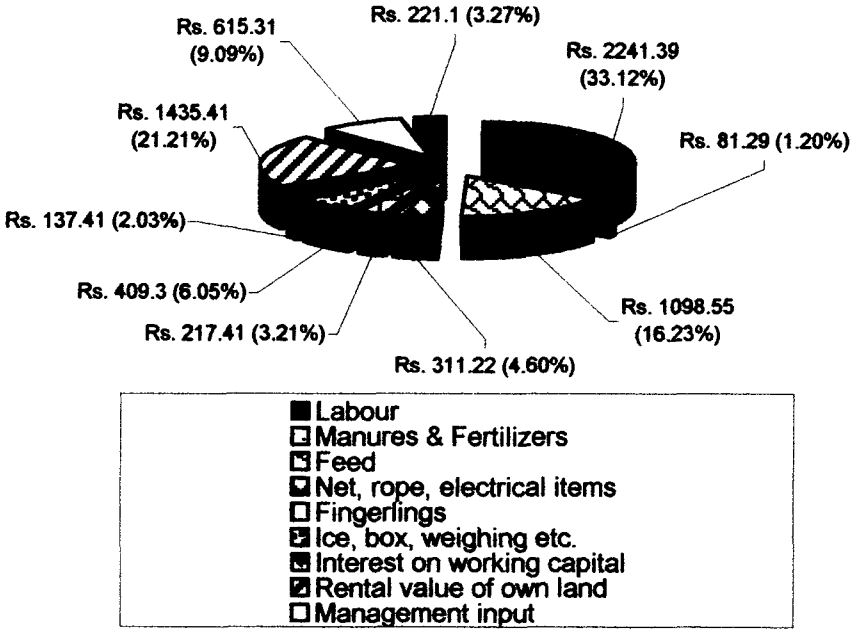


Fig. 4. Input wisecost of cultivation of fish

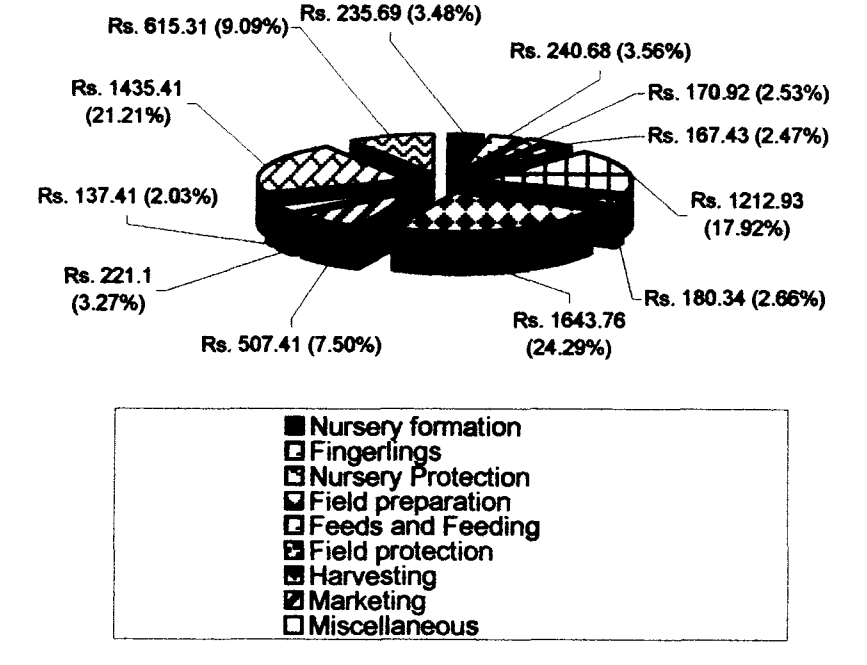


Fig. 5. Operation wise cost of cultivation of fish

Marketing accounted for 7.50 per cent of the total cost at aggregate level. It included the cost of ice and boxes for post harvest handling of fish and also for weighing, packing etc.

Other expenses on different operations like nursery preparation, fingerlings, nursery protection, field protection, field preparation and miscellaneous items accounted for 3.48 per cent, 3.56 per cent, 2.53 per cent, 2.66 per cent, 2.47 per cent and 3.27 per cent respectively.

6.3 Benefit cost ratio

Benefit cost ratio naturally indicate the efficiency of production and it was calculated by dividing the total benefits by total costs. In the case of rice under monocropping, the benefit cost ratio at cost C_3 has been worked out to be 1.08 at the aggregate level. For rice under sequential farming with fish, it was 1.44 and for fish alone 1.30. From the results we can infer that rice cultivation under sequential system was more beneficial than that of rice under monocropping. The benefit cost ratio of rice and fish cultivation together was 1.40. So it can be concluded that sequential farming can reduce cost of cultivation and increase the yield of rice. The result is in conformity with that reported by Mohandas (1994) who estimated that the benefit cost ratio from rice monocropping in Kuttanad to be 1.19 at aggregate level. Maryvijaya (1998) estimated the benefit cost ratio of paddy cum prawn culture in Pokkali fields to be 1.39, which is less than that of the present study. Raju and Rao (1997) reported that the benefit cost ratio for fish monoculture was 2.0 which was higher than that obtained in the study.

6.4 Comparative profitabilities of the rice-fish sequential system

Comparative profitabilities were estimated and summarised in the Table 5.3.14a and 5.3.14b and for both operation-wise and input-wise.

In the case of land preparation, cost was reduced to 41.66 per cent than that of monocropping. This is because ploughing operation was not required in the

The net returns from rice monocropping, rice under sequential farming and fish were Rs.1833.03, Rs.8645.69 and Rs.2014.56 per hectare respectively. Comparative studies on sequential farming of rice-fish and rice monocropping are rather scanty. However the result showed the production levels achieved under sequential farming system was higher than that of rice monocropping.

6.5 Employment generation

A comparison of labour absorption in the two systems of rice monocropping and rice-fish sequential farming revealed a substantial increase in labour use in sequential farming. Bisaliah (1978) opined that a new technology could mitigate the problem of seasonal unemployment in paddy cultivation with peaks and troughs in employment occur due to the season bound nature of operations.

The present study showed that the quantum of labour used for rice under monocropping system was 101.58 mandays per hectare excluding harvesting operations. The labour used in the new technology farms that is rice-fish sequential farm was 115.89 mandays per hectare. It gives an additional labour force of 14.31 mandays per hectare under integrated farming system. For fish cultivation the labour requirement was 34.38 mandays per hectare, thus giving additional employment to the tune of 14.31 mandays per hectare in the integrated system over the traditional system. The integrated system now followed in Kuttanad has enough potential to use much more labour days per hectare if farming is undertaken on an extensive scale. The rice-fish sequential system, if adopted in the entire area of 57015 hectare of low lying paddy fields of Kuttanad, the additional employment generation potential would be 815884.65 mandays. Therefore the new farming system has undoubtedly, the advantage of mitigating the unemployment problem among agricultural labourers on one hand and smoothening the major constraint of rice farming namely scarcity of labour during peak seasons on the other hand as the increased employment potential of the sequential system is

spread over the entire year. Mao and Ge (1996) observed that labour absorption in sequential farming of rice-fish was 311 mandays per hectare.

6.6 Major constraints in rice production

Non-availability of labour during the peak seasons of agricultural operations was considered as the major constraint of rice production in both systems. This led to delay in operations like preparatory cultivations and harvesting operations. Sometimes a resultant lose in rice may also occur.

According to 65 per cent of the respondents, marketing was second important problem under both the systems of cultivation. At the time of harvest the price of the paddy is generally very low. Private agencies were offering a price, which was less than the support price. Due to lack of storage facilities and financial crisis the farmers were forced to sell their produce at cheap rate.

Weed infestation and pest attack were other problems faced by most of the respondents in the monocropped area. Weed floras in this area are often removed manually two times. Chemical weeding was also resorted to. Farmers had to spend more for control of pest and disease.

High input prices and natural calamities were other constraints explained by respondents of integrated farm. Price of the inputs such as lime, weedicides, pesticides etc. was high. During monsoon, flood causes submergence of rice field in Kuttanad. Problem due to salinity was mostly encountered in the northern Kuttanad region comprising Vaikom Taluk.

6.7 Major constraints in the fish production

Most important constraint in fish cultivation was unavailability of seed in time, which was expressed by 56 per cent of the respondents. Fish seeds supplied by the Fish Farmer's Development Agency were not sufficient to meet the requirement of the farm. The farmers were dependent on other private hatcheries

for their requirement. But only a few hatcheries are operating in the region. So lack of fish seed was a major problem.

In fish production, marketing was another major difficulty according to 44 per cent of the respondents. Due to lack of storage facilities, the farmers were forced to sell the whole product with in a specified time. So the entire fish catch was marketed to some private agencies or to a processing unit at a low price.

Non-attainment of the potential size of fish was another problem. This was due to poor management, lack of awareness and lack of scientific farming practices. Other problems were lack of finance, natural calamities like flood, unavailability of labour and lack of co–operation among the farmers.

Summary and Conclusion

SUMMARY AND CONCLUSION

Rice, the principal food crop of Kerala is raised by small farmers to meet the food needs of the population. Integration of rice ecosystem with livestock, fishery etc. are the best alternatives. These systems provide scope not only to augment the income of the rice farmers but also to bring improvement in soil through recycling of organic manures and thereby increase production of rice.

The present study on economic analysis of rice-fish sequential farming system in the low lying paddy fields of Kuttanad in Kerala was undertaken on the basis of data pertaining to the agricultural year 1999. The data were collected from May 2000 to July 2000. The study aimed at comparing the cost and returns of rice monocropping and rice-fish sequential farming systems, to quantify the employment generation capacity of the integrated system and to identify the constraints in the wide spread adoption of rice-fish sequential system.

The study is based on a sample of 200 farmers, 100 each from rice monocropping and rice-fish integrated farm. Two stage random sampling was employed with padasekarams as primary units and individual farmers as secondary units. List of 'Padasekarams' coming under three distinct taluks viz., Kottayam, Changanasserry and Vaikom, were first prepared. From these lists, nine padasekaram in the ratio of 4:3:2 for three taluks of Kottayam, Vaikom and Changanasserry were selected randomly as the primary units. From each padasekaram individual farmers were selected at random thus making a total of 100 for each system of cultivation and a total sample size of 200 farmers for the study.

Post stratification of the samples based on the region and class wise were done and analysis was carried out for the different strata. Tabular analysis was used to estimate the per hectare cost of cultivation of rice and fish both input

wise and operation wise, employment generation, and in the identification of constraints.

Total cost of cultivation for rice in monocropping system was Rs.23419.47 and for the integrated system Rs.19725.31. For fish the cost of cultivation was Rs.6768.39. Class wise analysis showed that cost of cultivation of rice was the highest for farmers under the size group of Class I in both the systems. They were Rs.25406.65 and Rs.21275.46 for rice monocropping and rice integrated farming respectively. Region wise anslysis showed that the total cost of cultivation of rice was highest in Changanasserry (Rs.23960.20 and Rs.20569.40 respectively for rice monocropping and integrated system) for both the systems. For fish the cost of cultivation was highest in Kottayam Rs.7127.23 and lowest in Vaikom Rs.6264.06.

Operation wise analysis of rice cultivation indicated that cost of land preparation was the most important item of expenditure in rice monocropped areas and it accounted for 14.79 per cent (Rs.3464.88) of the total cost. The same was accounted for 10.24 per cent (Rs.2021.53) of the total cost in the integrated farming, which was fourth most important in the system. In land preparation 41.66 per cent reduction in the cost could be observed in the integrated system compared to monocropping. The next important operations in the monocropped areas were weeding, fertilizer and its application, which accounted for 13.60 per cent (Rs.3185.90) and 13.49 per cent (Rs.3159.68) of the total cost respectively. These two operations accounted for 13.39 per cent (Rs.2642.43) and 11.13 per cent (Rs.2195.50) of the total cost respectively for weeding and fertilizer application in the integrated system. Cost of weeding was reduced by 17.06 per cent and fertilizer and its application was reduced by 30.50 per cent, in the rice-fish sequential farming system compared to rice monocropping. While comparing the cost of plant protection a significant reduction in the cost could be seen in the integrated farm, which was 33.98 per cent compared to rice monocropping.

Input wise analysis of total cost of rice cultivation revealed that the major input in both the system was labour followed by materials, which accounted for 35.35 per cent (Rs.8279.1) and 20.57 per cent (Rs.4816.91) respectively of the total cost in rice monocropped area. In rice-fish sequential farming system labour input accounted for 33.67 per cent (Rs.6642.08) and material input accounted for 19.09 per cent (Rs.3766.38) of the total cost. While comparing rice cultivation in the two systems labour cost was lower by 19.77 per cent in the integrated than that of monocropping. While comparing total cost of cultivation of rice under both the systems, the rice-fish sequential farming can reduce 25.59 per cent of cost on production than that of rice monocropping.

Operation wise analysis of cost of cultivation of fish indicated that harvesting was the major operation that accounted for 24.29 per cent (Rs.1643.76) of the total cost. Next important operation was feeds and feeding which accounted for 17.92 per cent (Rs.1212.93) of the total cost. Input wise analysis of cost of fish cultivation revealed that cost of human labour was the most important input which accounted for 33.12 per cent (Rs.2241.39) of the total cost followed by material cost which accounted for 31.29 per cent (Rs.2117.77) of the total cost.

A, B, C cost concept were also used to estimate the cost of cultivation of rice and fish. Cost A_1, Cost A_2 and Cost B_1 were same for each crop, which was 16056.17, 11865.22 and 4717.67 respectively for rice monocropping, rice in the sequential farming and fish. Cost B_2, Cost C_1, Cost C_2 and Cost C_3 per hectare were Rs. 20250.3, Rs.17096.3, Rs.21290.43 and Rs.23419.47 respectively for rice under monocropping, Rs.17008.67, Rs.12788.73, Rs.17932.18 and Rs.19725.31 respectively for rice under integrated farm and Rs.6153.08, Rs.4717.67, Rs.6153.08 and Rs.6768.39 respectively for fish cultivation in the integrated farm. The cost of cultivation per hectare calculated under various cost concepts revealed that the cost was higher for rice-fish sequential farming (a total cost of Rs.26493.70) than paddy alone (Rs. 23419.47).

A comparison of yield of paddy in both system excluding harvesting charges paid in kind were computed. The average per hectare yield of paddy in the monocropping system was 36.30 q and 40.92 q in integrated system. Average per hectare yield of fish was 439.90 kg.

Income measures in relation to different cost concepts in rice and fish were estimated. Gross income from rice (monocrop), rice (integrated system) and fishwere Rs.25252.5, Rs.28371.63 and Rs.8782.95 respectively. Therefore gross income from rice and fish crop under integrated farm was Rs.37153.95. Farm business income, Family labour income and net income were Rs.9196.33, Rs.5002.07 and Rs.1833.03 respectively for rice under monocropped farm; Rs.16505.78, Rs.11362.33, Rs.8645.69 for rice under integrated farm and Rs.4065.28, Rs.2629.87 and Rs.2014.56 respectively for fish crop. Net income from (rice-fish together) was Rs.10660.25.

Benefit cost ratio of rice (monocropping), rice (sequential system) and fish were 1.08, 1.44 and 1.30 respectively. And Benefit cost ratio of rice-fish integrated farm (while considering both the crop together) was 1.40. Cost of production per quintal of rice (monocrop), rice (integrated system) and fish were Rs.645.16, Rs.482.05 and Rs.1538.62 respectively.

The new system of rice-fish sequential farming had an additional employment generation capacity of 14.31 man days per hectare. Labour used for rice cultivation excluding labour employed in harvesting of paddy was 101.58 man days per hectare in monocropping and 115.89 man days per hectare in sequential farming of both rice and fish.

Non-availability of labour during the peak agricultural season was reported to be the most important problem in both the systems of cultivation. Marketing was the second important constraint as explained by 65 per cent of the farmers in paddy cultivation. Weed infestation and pest and disease were other

important problems of farmer in rice under monocropping. Input prices and natural calamities as other constraints reported by the respondents.

In the case of fish farming, seed availability was the major constraint as reported by 56 per cent of the respondents. Marketing was the second important constraint for 45 per cent of the respondents and the major constraint for 44 per cent of the respondents. Other problems faced by the farmers were nonco-operation among farmers, financial problem, unavailability of labour etc. Constraints in the adoption of the new integrated rice-fish system were lack of finance, lack of co-operation among the farmers, unawareness, lack of knowledge etc.

Suggestions for improvement

1. For cultivating fish in the rice field, the bunds of the rice field, should be strengthened to a specific height to prevent escape of fish during heavy rain and to control burrowing by water snakes, moles etc. Due to financial constraints the farmers were unable to take up the system. Therefore credit with low interest rate must be provided and supported by the government agencies with incentives for non-defaulters.
2. Government should provide subsidies to the inputs like fertilizers, insecticides, fungicides, weedicides etc. So that farmers are encouraged to take up this sustainable farming practice.
3. The development and transfer of aquaculture-agriculture technology are vital for food self sufficiency in the state. To enable transfer of technology, planning and organisation of this practice in the region like regional demonstrations, training programme and extension messages in simple vernacular language should receive greater attention.
4. Research and development efforts in both biological and economic aspects should be further promoted so that successful results of rice-fish farming can be extended to larger areas in the region.

5. Ensure timely availability of fingerlings.
6. The post harvest technology should be promoted so as to ensure long shelf storage of fish for facilitating stability of supplies to meet overseas demands and thereby reducing marketing constraints.
7. In depth studies for development of marketing infrastructure, marketing channels and price structure at different level both in domestic and international markets are called for marketing activities.
8. Farm mechanisation should be encouraged wherever possible in the context of the acute labour shortage during the peak season.
9. The production and popularisation of organic manures and biofertilisers should emphasise, which will maintain the soil fertility.

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ECONOMIC ANALYSIS OF RICE - FISH SEQUENTIAL FARMING SYSTEM IN THE LOW LYING PADDY FIELDS OF KUTTANAD, KERALA

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ABSTRACT OF THE THESIS

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ABSTRACT

The present study on "Economic analysis of rice-fish sequential farming system in the low lying paddy fields of Kuttanad, Kerala" was aimed to analyse comparative economics of rice monocropping and rice-fish sequential farming systems, to quantity the employment generation capacity of the integrated system and to identify the constraints in the wide spread adoption of rice–fish sequential farming system.

The study was undertaken during May – July 2000 and the data pertains to the year 1999. Data for the study was generated through sample survey of farmers by personal interview method using a pretested structured interview schedule. The study was conducted with a sample of 100 farmers for each system of cultivation. Two stage random sampling was adopted for the study. Tabular analysis was used to analyse the data.

The cost of cultivation (cost C_3) of rice under monocropping (Rs.23419.47 per hectare) and of rice under sequential farming system (Rs.19725.31 per hectare) was estimated. For fish, the cost of cultivation per hectare was Rs.6768.39. The major expenditure on input for rice cultivation under both systems and for fish was human labour. In rice monocropping, land preparation was observed to be the most expensive operation, whereas, in sequential farming weeding was the most expensive operation. In the case of fish cultivation, harvesting of fish turned out to be the most cost consuming operation.

Gross income per hectare realized from the main as well as by product at the aggregate level was Rs.25252.50, Rs.28371.00, and Rs.8782.95 for rice (monocropping), rice (sequential farming) and fish respectively. Cost of production per quintal of rice (monocropping) was Rs.645.16 and for rice (sequential farming) was Rs.482.05. For fish, cost of production per quintal of fish estimated to be Rs.1538.62.

Benefit cost ratio at cost C_3 was found to be highest (1.44) in the rice cultivation under sequential farming. The corresponding figures for rice monocropping and fish were 1.08 and 1.30 respectively.

This new system could provide on additional employment of 14.31 mandays per hectare. Even though this new integrated systems was profitable, lack of finance and non co-operation among farmers to an extend hinder the adoption of this practice. The major constraints experienced by the farmers in the cultivation were also identified.