AN ECONOMIC ANALYSIS OF POKKALI CULTIVATION SYSTEM IN KERALA - A CASE OF ERNAKULAM DISTRICT

Thesis submitted in part fulfillment of the requirements for the degree of

MASTER OF SCIENCE (AGRICULTURE)** in **Agricultural Economics

to the Tamil Nadu Agricultural University, Coimbatore - 641 003

By

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2001

CERTIFICATE

This is to certify that the thesis entitled " **AN ECONOMIC ANALYSIS OF POKKALI CULTIVATION SYSTEM IN KERALA - A CASE OF ERNAKULAM DISTRICT**" submitted in part fulfillment of the requirements for the award of **MASTER OF SCIENCE (AGRICULTURE) IN AGRICULTURAL ECONOMICS** to the Tamil Nadu Agricultural University, Coimbatore is a record of *bonafide* research work carried out by **K.R.SETHULEKSHMY** under my supervision and guidance and that no part of this thesis has been submitted for the award of any other degree, diploma, fellowship or other similar titles and that the work has not been published in part or full in any scientific or popular journal or magazine.

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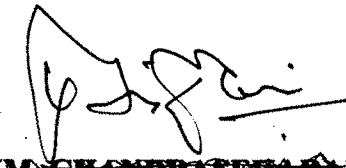

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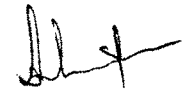

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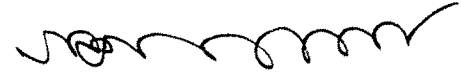

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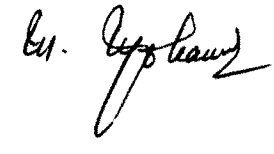

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(K.R.SETHULEKSHMY)

ABSTRACT

Abstract

AN ECONOMIC ANALYSIS OF POKKALI CULTIVATION SYSTEM IN KERALA- A CASE OF ERNAKULAM DISTRICT

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The present study is on the economic analysis of the indigenous cultivation system in the coastal saline soils of Kerala called the Pokkali cultivation system. It is a unique rice-prawn rotational cultivation system, purely organic based on indigenous technology. The rice cultivation in the first season though not very remunerative, compliments the prawn culture thus making it an unique agroecological system. But lately, the trend of putting the land fallow in the first season and resorting to monoculture of prawn has caught up. An economic analysis of the system could bring forth the various issues involved in it. Ernakulam district was purposively selected as the study area because most of the Pokkali lands were concentrated in this region.

Three Krishi Bhavans Varappuzha, Elankunnathupuzha and Ezhikkara were selected randomly for the survey was conducted in the area under these Krishi Bhavans. Simple averages and percentages were used for the analysis of cost and returns. Production function analysis was also employed to analyse the Resource Use Efficiency in prawn culture and rice cultivation.

The sample farmers were post classified into four Classes according to the type of prawn culture resorted to in the second season. The cost and returns were worked out separately for rice and prawn in each of the different classes. The input requirement and the yield obtained in the rice prawn and fallow prawn categories were also worked out.

The results of the study clearly revealed that rice cultivation resulted in losses in all the four Classes and across the three Krishi Bhavans. Marginal variation in yield could also be noticed across the different regions. Labour was found to be the major input and both rice cultivation and prawn culture was found to be labour intensive. Analysis of cost and returns of prawn culture clearly showed that there was significant difference in the total cost and returns obtained across the different classes.

In the case of rice cultivation the total cost ranged between Rs.14900.14 per hectare in Class IV farms and Rs.17093.57 per hectare in Class I farms and the loss per hectare ranged from Rs.6928.54 in Class III farms to Rs.7951.05 in Class I farms. In the case of prawn culture the total cost ranged from Rs.23964.02 in Class III farms to Rs.46890.64 in Class I farms. The net returns from prawn culture ranged from Rs.9043.2 per hectare in Class III farms to Rs.79751.69 per hectare in Class I farms. This could be attributed mostly to the fact that costs involved in the case of different types of prawn differed widely and the price of different types of prawn also showed wide variations. Tiger prawn culture was found to be highly remunerative when compared to other prawns since it had much demand in the export market. Both prawn culture and paddy cultivation was highly labour intensive. In prawn culture material costs were also found to dominate.

A comparison of feed required and yield obtained in rice prawn and fallow prawn conditions clearly revealed that irrespective of the classes the seed requirement was more in the fallow prawn conditions. Yield also registered a significant improvement in rice prawn conditions as compared to fallow prawn sequence. So, going for rice cultivation in the first season significantly benefited the farmers in the long run and helped to off set the losses incurred in rice cultivation, in Class I and Class II farms.

Production function analysis revealed that in the case of prawn culture the feed and seed were significant inputs as expected. The R^2 value for prawn culture was 0.69 which would mean that 69.2 per cent of variations in yield could be captured by the independent variables. In the case of rice R^2 value it was 0.26 indicating that only 26.0 per cent of the variation in yield only could be explained by the independent variables. It indicated that the case of rice cultivation, the independent variables which were not in control of the farmers had a larger influence in yield as revealed by the intercept value which was highly significant.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

CHAPTER I

INTRODUCTION

The State of Kerala is one of the smallest states in India located in the extreme south of the country with an area of 38,863 sq.km and a coastline of 580 km. Rice and coconut occupy the major area and rice is the staple food of Keralites. Though the state is very small in size, it is known for its physiographic diversity, which contributes to its scenic elegance. The state possesses several indigenous cultivation systems unique to it. Many of them still remain untouched by the sophistication of technology.

The Pokkali cultivation is one such system, being followed in the Pokkali lands in the coastal saline soils of the Agro-Ecological Problem Zone of Kerala State. The unique name comes from the peculiar cultivar 'Pokkali' cultivated in this area. The name in the local context indicates prosperity and the cultivar is still the most popular in the Pokkali regions. The Pokkali lands, to an extent of 24000 hectares is mainly spread over nine blocks in the three districts of Ernakulam, Trichur and Alleppey. (Pokkali Development Agency Report, 2000). However, currently the Pokkali cultivation is being practiced only in over 9000 hectares of land with 6000 hectares in Ernakulam District and 3000 hectares both in Trichur and Alleppey Districts. (Pokkali Development Agency Report 2000). Unlike the saline soils found else where in India, the origin, genesis and development of these soils are different especially under peculiar climatic and environmental conditions. Periodic intrusion of seawater during high tide and low tide is one of the fundamental features of this system. The cultivation is purely organic and inspite of the scientific advances in agriculture, it remains basically traditional. The various operations starting from the sprouting of seeds upto water management is done with the help of traditional knowledge and indigenous technology passed on from generation to generation. A single crop of rice followed by prawn culture, is the traditional method of cultivation in the region. The single crop of rice is usually taken at the time of South West Monsoon or *Edavapathi* from May to September. The cultivar is saline tolerant and is also reasonably tolerant to submergence. Modern innovations are yet to replace the indigenous knowledge and technology adopted in the Pokkali fields.

The prawn culture in the early years was basically dependent on the infiltration of the prawn fingerlings from the sea. The most important peculiarity of the system is that it is organic without any application of fertilizers, pesticides and the like. It is basically a gamble with the nature. At the time of harvest of rice the top bearing panicle portion alone is cut off leaving majority of the straw back in the field to rot. This decaying straw which is left as such for more than a month constitutes the most important source of food for the incoming prawn fingerlings. Inturn, the excreta of and residues of fish and prawn left in the field at the end of the season act as manures for the incoming rice crop in the next season. The Pokkali fields thus form a unique ecological habitat for the prawns and different kinds of fishes in the second season from November to April. The traditional prawn cultivation is called "*Chemmeen Kettu*".

The Rice cultivation is a highly risky venture since slight climatic variations like excessive salinity, unprecedented submergence, etc., can impair the entire balance. It is not at all a profitable venture for the farmers(Rajedran *et.al* 1981), especially in the recent years with the added problem of excessive pollution from the industrial effluents (Purushan 2000). In many cases, it ends in the farmers losing the entire crop leading to huge losses. According to past studies (Purushan 2000) the yield of Pokkali rice has come down drastically when compared to 1500 to2000 kgs per hectare yield achieved ten or twenty years ago. The loss is made good by the profit they receive from prawn culture in the second season. So, the two parts of rotational cultivation practically complement each other. However, in the recent years, it has been observed that the increasing instability in environmental conditions, inadequate availability of labour, high wage rate coupled with lack of appropriate care and management has made rice cultivation all the more risky. This forced many farmers to leave the land fallow in the first season and to go for a monoculture of prawn, the effect of which has not been properly documented so far.

The statistics presented in Table 1 shows a marginal increase in land area under Pokkali culture during the last four years.

Table.1 Details on Area under Pokkali Cultivation

	96 - 97	97 - 98	98 - 99	99 - 2000
Area under Pokkali (paddy) in hectares	7710.00	7785.00	7914.00	8000.00
Additional area brought under Pokkali in hectares	-	145.00	204.00	290.00
Production in tonnes	11565.00	12080.00	12600.00	13200.00
Productivity in tonnes per hectare	1.50	1.50	1.60	1.65
Additional production in tonnes	-	515.00	1035.00	1035.00
High yielding variety coverage in hectares	100.00	120.00	200.00	300.00

Source : Records of Collectorate, Ernakulam.

But, this is no where near the 24,000 hectares of land, which existed long back. This further indicates the need for immediate steps to maintain the natural rotation of rice prawn system, which is a standing testimony to this indigenous organic farming system.

Studies reveal that the presence of the rice crop is a necessity for the maintenance of the sustainability of the system (Purushan, 2000). The prevalence of mono-culture throughout the year and practice of putting the land fallow has converted many seasonal Pokkali fields to perennial ones, where rice cultivation can never be taken up. There is a dire necessity to ensure that the rice prawn rotation remains intact since it contributes to the stability of this unique indigenous system.

Moreover the loss incurred by growing rice in certain regions, has led to the practice of leaving the field fallow in the first season prior to rice. This robs off the prawn fingerlings from its natural environmental habitat and ready food necessary for growth. The maintenance of the precarious agro-ecological balance is an absolute necessity for the proper maintenance and sustainability of this peculiar, highly traditional cultivation system. In this context, an economic analysis of the complete system is felt crucial to bring out the important issues involved in this highly traditional system and suggest ways to help the system to sustain.

Objectives

The specific objectives of the study are;

i) to analyse the cost and returns of rice cultivation in the Pokkali cultivation.

ii) to analyse the cost and returns in prawn culture in Pokkali system.

iii) to analyse the resource use efficiency in rice cultivation and prawn culture.

iv) to evaluate the additional cost and returns in the prawn culture when followed after rice.

v) to assess the additional employment created by the system of rice followed by prawn culture, and

vi) to suggest suitable policy measures to improve the Pokkali System as a whole.

Scope of the Study

The study is intended as an economic analysis of the unique 'Pokkali' cultivation. The results of the study can be of use to the various administrative agencies in the Pokkali regions, since it has information on the cost and returns, and Resource Use Efficiency of the various inputs used in the system. The study can help the development agencies to adopt suitable measures to increase the adoption of self supporting Pokkali system by all the farmers.

Limitation of the Study

The data needed for the study were collected by personal interview method using well-structured interview schedules. A study of this nature requires lot of time but because of the time constraint the sample size was kept at 90. Since, the data needed for the study were collected through the recall method, the recall bias of the respondents should be accounted for. However, every effort was taken to minimise the recall bias by cross verification with neighbours. Also, the study is limited to the areas under three randomly selected Krishi Bhavans ie. Varappuzha, Elankunnathupuzha and Ezhikkara and therefore adequate care should be taken while generalising the results obtained.

Organisation of the Thesis

The thesis has been organised in the following chapters.

Chapter I : Introduction: highlights the problem focus, objectives, scope of the study and outlines its limitations.

Chapter II : Concepts and Review: It presents a review of various concepts and results of past studies which are related to the present study.

Chapter III : Design of the Study: It specifies the sampling design, method of investigation and tools of analysis used in the conduct of research and analysing the data.

Chapter IV : Description of Study Area: It deals with general characteristic features of the study area and the infrastructural facilities available within it.

Chapter V : Results and Discussion :The results obtained in the study are presented and discussed to draw meaningful conclusions.

Chapter VI : Summary and Conclusion: It summarises the findings of the study based on which policy suggestions have been made to improve the system.

CONCEPTS AND REVIEW

CHAPTER II

CONCEPTS AND REVIEW

An exhaustive and comprehensive review of concepts and past studies is of utmost importance for proper perception and understanding of concepts, research designs, method of analysis and interpretation of results in any research project. An attempt is made to review the past studies, which are relevant to the economics of paddy and prawn culture. Literature on paddy - cum - prawn culture, especially those pertaining to Pokkali cultivation is scanty. So, those studies pertaining to different types of integrated farming have also been included.

REVIEW OF CONCEPTS

Cost

Shukla (1966) in his analysis of input-output relationship classified cost into Cost A_1, Cost A_2, Cost B and Cost C. Cost A_1 included all cash and hired expenses actually incurred less rent. Cost A_2 covered cost A_1 plus rent paid for lease in-land. Cost B included cost A_2 plus rental value of owned land plus interest on working capital minus land revenue on owned land. Cost C covered Cost B plus imputed value of family labour.

Sharma (1969) defined variable cost as wages paid to hired human labour, cost of seeds, manures, and fertilizers, irrigation charges, plant protection charges and interest on variable cost.

Samuelson (1973) classified total cost into fixed cost and variable cost. Fixed cost was referred to that which did not vary with the level of output in short run.

Barnard and Nix (1973) classified cost in farming into fixed cost and variable cost. Fixed cost represented farming expenses of overhead nature and did not change with changes in level of output. Taxes, depreciation, cash rent, interest payment, etc., formed the fixed cost. Variable cost included the farming expenses, which changed with output.

Ramamoorthy and Srinivasan (1974) grouped cost as direct cost and indirect cost. Direct cost included both cost of cultivation and marketing cost and indirect cost covered rent equivalent for the crop land, depreciation assigned proportionately to area under the crop, interest on fixed capital imputed in proportion to the total cropped area of the farm and interest on working capital employed in the production of the crop.

According to Mittal and Saxena (1974) fixed costs in agriculture were those which were independent of the level of production where as variable costs were those which vary with the production.

Raju and.Rao (1990) divided costs into two major categories i.e. Fixed costs and Variable costs. Fixed costs were defined as those which would be incurred even if no output were produced and variable costs were defined as those costs incurred only when production was carried on. Variable costs were considered relevant in making production decisions.

According to Sumathi, (1992) cost of cultivation referred to the expenditure incurred by the farmers on various inputs to obtain the final produce. There were two kinds of cost, viz., fixed cost and variable cost. Fixed cost included rent, interest on fixed capital, depreciation of implements and machinery, taxes, insurance premium etc. Variable cost included the expenditure incurred towards seeds, human labour, bullock and machine power, manures and fertilizers, interest on working capital etc.

Sarathi (1994) defined cost as the value of the entire factor and material input expenses actually incurred as well as imputed.

The Directorate of Economics and Statistics, Government of India (1997) used the Cost Classification I which included operational and fixed costs. Operational cost included the amount incurred on human labour (casual + attached + family), bullock labour (hired + owned), machine labour (hired + owned), seeds, fertilizers and manures, insecticides, irrigation charges and interest on working capital. Fixed cost included rental value of owned land, rent paid for leased in land, land revenue, cesses, taxes, depreciation on implements and farm buildings and interest on fixed capital.

In its, Cost Classification II costs were grouped into Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1 and Cost C_2. Cost A_1 included all the expenses incurred in cash and kind by the operator. It consisted of expenditure on human labour (casual + attached), bullock power (hired + owned), machine power (hired + owned), seeds, fertilizers and manures, pesticides, irrigation charges, interest on working capital, land revenue, taxes and depreciation on implements and farm buildings. Cost A_2 included Cost A_1 plus the rent paid for leased in land. It indicated the expenses incurred in cash and kind by the tenant farmer. Cost B_1 included Cost A_1 plus interest on value of owned capital assets with the exception of land. Cost B_2 included Cost B_1 plus rental value of owned land (net of land revenue) and rent paid for leased in land. Cost C_1 included Cost B_1 plus imputed value of family labour and Cost C_2 included Cost B_2 plus imputed value of family labour.

In the present study the operational costs involved in the cultivation of both rice and prawn cultivation including the rental value imputed at the rates existing in the region has been computed.

Returns:

Malya (1961) defined the income of agricultural household to include the receipts from occupation, dairy enterprise, rent received and interest on loans and remittances if any.

Chauhan *et al.*, (1972) defined the gross income as the value at prevailing prices of retained as well as marketed crop output and also income from allied activities such as dairy and poultry.

Kaul and Mehta (1972) defined gross income of the farm as the value of farm produce which consisted of cash value of produce actually sold and the value of the remaining produce evaluated at the harvest price prevailing in the village. The values of both main and by products were considered in estimating the gross farm income.

Forster (1973) defined net income of the farm as gross income less of variable cost of the farm business as a whole.

Shukla and Mishra (1974) stated that net income could be obtained by subtracting the total cost of the farm business from the gross income. Farm business income equaled gross income minus Cost A_1 in owner operated farms and gross income minus Cost A_2 in tenant operated farms.

Johl and Kapur (1977) defined gross income of the farm as total production times the price.

Sisodia (1978) defined farm business income as the gross value of farm output minus the value of hired human labour, hired and owned bullock labour, seeds, manures and fertilizers, pesticides, irrigation charges, land revenue, depreciation and interest on working capital.

Ramasubramanian (1979) also expressed a similar view about the farm business income. The net income here was obtained by subtracting cost from the gross income.

Kahlon and Tyagi (1983) defined farm business income as a measure of earning of the farmer and his family for management, risk and their labour and capital investment. It was arrived at by deducting cost A_1/cost A_2 from gross farm income. Family labour income was defined as the income received by the farmer and his family for management, risk and their physical labour. It was equivalent to gross farm income minus cost B_1/Cost B_2. Net income (profit or loss) was arrived at by deducting Cost C_1 and Cost C_2 from gross farm income for owner operated and tenant operated farms respectively.

Directorate of Economics and Statistics (1997) adopted the farm business income, family labour income and net income measures in working out returns from farm enterprises.

In the present study, the net income was computed as the difference between the total returns and the operational cost defined earlier.

Production Function and Resource Use Efficiency

Ferguson (1966) defined production function as the relationship that described the maximum possible output for the given combination of inputs.

Saini (1969) studied resource use efficiency in Agriculture using Cobb-Douglas production function. He studied the resource use efficiency in different categories of farms. The study was conducted in the sample farms of Uttar Pradesh and Punjab. It was concluded that farmers in the region were responsive to economic stimuli. Possibilities of increasing farm income through adjustment were also noted.

Klein (1973) defined production function as a technical or engineering relationship between input and output. As long as the natural law of technology remained unchanged, the production function remained unchanged.

Singh *et al.*, (1974) fitted that Cobb-Douglas production function to study the resource use for various size of farms for commercial crops in Haryana. He also examined the returns to scale in the case of different crops.

Aiyasamy *et al.* (1975) analysed the labour use efficiency in small farms of Tamil Nadu. They concluded that family labour involvement in farm activities was complete since the farmers actually worked with the hired labourers, rather than mere supervision and management.

Koustsoyiannis (1975) defined production function as a purely technical relation, which connects factor inputs and outputs.

Johl and Kapur (1977) defined the relation between inputs and outputs as production function. They classified production function to two types: the continuous function and the discontinuous or discrete function.

Herdt and Mandac (1981) defined production function as the function that describes the greatest possible output from a given combination of inputs. Therefore they concluded that failure to operate on the production function reflected technical inefficiency.

Sankhyan (1988) defined production function as the mathematical counter part of the applied term input-output relationship, which can either be discrete or continuous.

Pandey and Shanti (1989) conducted a study on rice production function in India. They confirmed that selected inputs used in rice production had affected the level of yields in various states in different ways. They included the percentage of irrigated area under rice, percentage of HYV area under rice, nutrient consumption in kg per hectare and the time trend to explain the variation in the yield of rice. The estimated production function highlighted the significant role of fertilizers in most of states during pre green revolution as well as post revolution period. The study also indicated that improved rice technology, though not uniformly spread in all states had led to increased rice productivity in the country.

Mendis (1990) analysed the returns to scale by fitting a Cobb-Douglas production model to three inputs namely land, labour and fertilizer subjected to management control and two environmental factors viz., rainfall and altitude in tea production in Sri Lanka. He found out that land, labour, fertilizer and rainfall were found to significantly influence tea production.

Raju and Rao (1990) defined production function as a technical and mathematical relationship describing the manner and extent to which a particular product depended upon the quantities of inputs or services of inputs used at a given level of technology and in a given period of time. They classified production function into four types - continuous, discontinuous, short run and long run.

Beena (1992) used power function to study the socio economic characters of prawn farmers in Ernakulam district. The variables considered were cost of seed and labour charge. She specified the following functional form:

$$Y = a\ X_1^{b1}\ X_2^{b2}$$

where , Y: income from prawn culture (in rupees)

X_1 : cost of seed(in rupees)

X_2: labour charge (in rupees)

a: intercept

Mishra (1992) analysed resource use efficiency in the cultivation using data available from the tea producing regions of West Bengal. The model suggested increased response of output to input on larger farms. They also concluded that there was over utilization of manpower in smaller farms.

Singh and Grewal (1994) studied the economic efficiency in paddy production in Punjab. The transcendental type production function was used. The optimum level of input was worked out by the bisection method of numerical analysis. It was noted that per hectare yield of paddy increased with an increase in cost of cultivation. Also the role of intangible factor like management was found to be very important. It was also noted that the farmers should be educated to achieve a higher level of production and profits through rational use of the resources at their command.

Moorti and Pathania (1995) studied the resource use efficiency of the cultivation of tea in Kangra district (H.P.). Cobb-Douglas production function analysis had been used for estimation of relationship between the production and other explanatory factors namely expenses of labour and expenses of other inputs. It was concluded that the planters should use more of the required variable inputs, which were found to be important or significant for the cultivation.

Mohandas and Thomas (1997a) used the Cobb-Douglas type of production function for the Economic Analysis of Rice Production in Kole lands of Kerala. They concluded that the rice production in Kole lands was comparatively less remunerative and its profits could be improved by better management and reallocation of factors of production. They specified the following model including the cost of machine power, human labour, fertilizers and gross income as variables. The specification of the model was :

$$Y - a X_1^{b1} X_2^{b2} X_3^{b3}$$

where X_1, X_2, X_3 were cost on machine labour, human labour and fertilizer respectively while Y represented the gross income. They also studied the Resource Use Efficiency of the system.

Mohandas and Thomas (1997b) also used Cobb-Douglas production function for the economic analysis of Rice production in Kuttanad area of Kerala. The production function was specified to work out the resource use efficiency. Gross income, cost of machine power, human labour and fertilizer used were the components of the production function. The authors concluded that cost escalation was the most important factor which made rice cultivation a relatively less remunerative enterprise. They also studied the resource use efficiency of the system.

Jain (2000) studied the resource use efficiency in Paddy and wheat producing states of India. He used Cobb-Douglas production function for the purpose. He concluded that labour and fertilizer inputs were not effectively utilised in many regions.

In the present study,

(i) the production of prawn was conceptualized to be influenced by seed used per hectare, feed used per hectare, number of sluices per hectare, labour used in mandays per hectare and three dummy variables .

(ii) the production of rice was conceptualized to be influenced by seed used per hectare, labour used in mandays per hectare, age, experience and family size of the farmers and a single dummy variable to capture the variation across the Krishi Bhavans.

REVIEW OF PAST STUDIES

Studies pertaining to Pokkali System of Cultivation

George (1974) in his study on prawn culture in Vypeen Island made a comparison of total expenditure required for a seasonal and a perennial field. He found that the total expenditure in the seasonal field was higher than the perennial field, but the net income from seasonal field was always better. In seasonal fields, paddy was also cultivated during May-October and about Rs.2261.45 was realised as income per hectare of paddy. The average total income from the perennial fields was estimated as Rs.2871/hectares while it amounted to Rs.4278/hectare from seasonal fields. He thus concluded that paddy-cum prawn culture was more profitable than the culture of prawn alone.

Nair (1975) attempted to compare the production and revenue obtained from paddy-cum-traditional method of prawn culture and scientific method of prawn cultivation alone. Prawn production by the traditional method of prawn culture with *Metapenaeus dobsoni* varied from 500-1200 kg per hectare per year and fetched average revenue of Rs.3500/- per year. Adoption of scientific practices would make it possible to reach even a production rate of 1000 kg/hectare of *Penaeus indicus* and *Penaeus monodon* alone twice a year bringing in about Rs.30,000/- per hectare per year. He observed that selective stocking of desirable species and adoption of systematic cultural operations could certainly increase the yield considerably.

George (1978) attempted to study the economics of traditional prawn culture in paddy fields in Kerala and compared its profitability with that of intensive prawn culture in the fields. Results of various experiments conducted in Vypeen Island, one of the most prominent fishing islands in Ernakulam near Cochin, during 1977 showed that the income realised per hectare for paddy was Rs.2261.45. The net profit was Rs.674.25per hectare. The yield of prawn from traditional infiltration fields was 734.6 kg per hectare realising an income ofRs.6,888.87 per hectare as against an expenditure of Rs.6237.50 per hectare with a net profit of Rs.651.37. The low priced small species of prawn Thelli usually dominated the catch. Intensive prawn culture in perennial fields yielded about 1040-1560 kg.of Naran per hectare per year. Naran, being better priced than Thelli, was more remunerative. The author thus concluded that intensive prawn culture is comparably more remunerative than traditional infiltration based prawn culture.

Rajendran *et al.*, (1981) experimented culturing fish along with paddy in the Pokkali fields of Rice Research Station Vyttila during 1977-78. This simultaneous culture, under ideal conditions yielded upto 183 kg per hectare. With the paddy cultivation highly uneconomical and risk prone the additional income from fish would be highly beneficial to farmers. Also, the variety *Etroplus* helped in the removal of the dreaded acquatic weed in the area, *Hydrilla*. He concluded based on the conducted experiments that *Etroplus suratensis* [which was locally available and highly sought after in the domestic market], common carp and *Ospironemus goramy* were the suitable species for culture along with paddy in the Pokkali fields.

Purushan (1986) studied the recent advance in paddy cum fish culture and came to the conclusion that the simultaneous culture of fish and paddy crop, considerably increased and stabilized the farm income in rice farms. He observed that the total annual yield increased in the case of post fish culture paddy - the major reason being the elimination of weeds and mollusces by the cultured fish. This also helps in reducing the labour cost. He studied the scope of paddy cum fish culture in Kerala and found that the rate of fish production in paddy fields was high. He recommended the introduction of this practice in Kayal lands of Kuttand and Kole in addition to 26,000 hectares of Pokkali fields.

Jose *et al.* (1987) conducted preliminary experiments on selective culture of *P.indicus* in Pokkali fields. The study was mainly aimed to assess the feasibility and economic viability of *P.indicus* in Pokkali Fields. For rearing the prawn no fertilizer or supplementary feeding was used. The prawn yield was 17 kg and production rate worked out to 100 kg per hectare per 36 days. If sufficient growing period was given the yield could have been significantly higher. Groundnut oilcake was used in two adaptive trials conducted in two farmers' fields and the production was 552 kg of prawn in 83 days with net profit of Rs.13,958. The results of the study was a clear indication of the fact that selective culture of *P.indicus* in Pokkali fields was much more advantageous than the traditional prawn culture both in terms of yield and economy.

Mathew and George (1987) conducted experiments in the traditional Pokkali fields in the Panangad area of Cochin with a view to assess the feasibility of prawn culture along with paddy in Pokkali lands. Fresh water fish (carp) and brackish water fish (milk fish) were cultured in two fields along with cultivation of improved variety of paddy Vyttila-1. The yield from paddy ranged between 1452 and 1641 kg per hectare. The fish production was in the range of 147 to 418 per hectare for 4 months. Common crop showed the maximum performance among all the varieties cultured. The brackish water fish *Chanos chanos* proved to be highly satisfactory in terms of both retrieval rate and average final weight. From the studies it was concluded that with judicious and timely manipulation of species combination and stocking rates, along with efficient scientific management practices one could raise the fish production upto 500 kg per hectare for four months. This would definitely help in making Pokkali Cultivation more economical and cost effective.

Mukundan (1987) studied the Pokkali Cultivation system in Kerala and estimated the economics of paddy cultivation and prawn cultivation in the fields. T he total income from paddy amounted to about Rs.5086 per hectare and the net profit realised was Rs.506 per hectare. Traditional prawn culture yielded a net profit of Rs.1402 per hectare when compared to improved traditional prawn culture which yielded a net profit of Rs.22,000 per hectare. The benefit cost ratio worked out for traditional prawn culture and improved

prawn culture was 1.10 and 1.69, respectively. He suggested pooling of land, establishment of more number of hatcheries and organized marketing system for an improved and more beneficial prawn farming system.

Purushan (1987) studied the economics of traditional prawn farming in the Pokkali fields in Kerala and concluded that if properly operated the proposition of paddy cultivation and prawn culture in the Pokkali fields in Kerala had much larger scope. By comparison he found that double the profit was realised from traditional prawn culture as compared to paddy cultivation. He concluded that the adoption of improved method of prawn culture could raise the prawn production from Pokkali fields to atleast 1 tonne per hectare which would definitely boost the economic returns from Pokkali fields.

Sethiadas *et al.*, (1989) evaluated the economics of paddy cum prawn culture in Kerala during 1981-84 based on data collected through sample survey covering Ernakulam district. The cost of paddy cultivation was worked out to about Rs.2020-2780 per hectare. Out of the total cost, labour accounted for 18 per cent. Seed accounted for 10 percent, sluice gate 7 per cent and miscellaneous expenditure 2 per cent. The average yield per hectare worked out to about 19 quintals yielding a gross return of Rs.3270-3900/-. On the other hand the analysis of cost and returns of prawn filtration revealed that 80 per cent of the total cost was accounted for the lease value. Labour cost accounted for about 10 per cent, sluice gate 5 per cent and miscellaneous expenditure accounted for about 5 per cent. The net returns per hectare from prawn filtration worked out to be Rs.1200/-. Farm owners realised an annual net return of Rs.8200/- per hectare from both paddy cultivation and prawn filtration. Those cultivating paddy and then leasing out for prawn cultivation realised annual net returns of Rs.5130/-. It was also found that an average of 53 mandays and 50 women days were employed per hectare for paddy cultivation and 81 mandays per hectare for prawn filtration.

Mathew *et al.*, (1990) conducted experimental culture of giant fresh water prawn (*Macrobrachium rosenbergii*) to study the culture potential of Pokkali lands of Kerala. Juvenile prawn were stocked at the rate of 3 prawns per m^2 and supplementary feeding

was undertaken daily approximately at the rate of 5 percent of body weight. A food conversion ratio of 0.91 was obtained for supplementary feed. A net profit of Rs.7962 per hectare was realised in 115 days. The benefit cost ratio was worked out to be 1.68 which showed that Pokkali fields in Kerala were well suited for farming of giant fresh water prawn during low saline period.

Mathew (1990) also studied and compared the production and yield in selective culture of prawn and traditional prawn culture in Pokkali fields in Ernakulam district during 1987-89 and found that production rate in selective culture of prawns varied from 305 kg per hectare for 68 days to 728 kg per hectare for 73 days as compared to production rate of 231 kg per hectare for 83 days to 419 kg per hectare for 151 days as per traditional prawn culture. The net profit realised from selective culture ranged from Rs.2478 per hectare for 68 days to Rs.6757 per hectare for 73 days. On the other hand the net profit realised from traditional prawn filtration ranged from Rs.1415 per hectare for 83 days to Rs.2310 per hectare per 151 days. The percentage contribution of *P.indicus* in selective prawn culture ranged from 36.7 to 81.7, while it ranged from 17.2 to 35.4 in prawn filtration. Though the performances of *P.monodon* were not satisfactory, *P.indicus* was found to be the ideal variety to be cultivated in Pokkali fields. Lateral entry of metapenauds into selective cultural fields was noted as a serious problem affecting prawn culture as a whole.

Nasser *et al.*, (1991) compared prawn culture in seasonal and perennial fields in Vypeen, Kerala and found that prawn production per hectare, per month was higher in seasonal fields than in perennial fields. Absence of predatory fishes and rare occurrence of soft prawn disease in seasonal fields added to its high production. The rich organic matter left behind as paddy stumps after harvest of paddy also added to the increased production. Selective stocking of prawn seed and supplementary feeding would augment production from perennial ponds. The author held the view that converting extensive systems to smaller semi intensive ones, would add to the economy of the system by increasing prawn production and providing employment opportunities, though initially it might prove to be costly.

Sebastian *et al.* (1992) conducted a preliminary study on intensive farming of fresh water prawn in Kerala and found that production of 3500kgs/ha/year of *Macrobrachium rosenbergii* could be achieved under the climatic conditions prevailing in Kerala, if proper management measures were followed. A phased harvesting was advisable due to high variation in the individual growth rates.

Thomas *et al.*, (1993) studied prawn culture in Ernakulam district of Kerala state to identify constraints in prawn production. It was found that about two per cent of farmers trained by KVK (Krishi Vigyan Kendra) continued traditional method of prawn culture. This was mainly because of the three months culture period associated with scientific farming. Even though they got only less amount of prawn they could go for frequent harvesting in the case of traditional prawn infiltration. Six per cent of the trainee farmers went for semi scientific prawn culture ie. prawn infiltration supplemented by stocking seeds of *P.indicus and P.monodon.* Lack of necessary finance was the major constraint for the adoption of the scientific method. Non-availability of prawn seed was yet another important constraint. The author suggested setting up of more number of government owned hatcheries to augment production. He also suggested that improved financial assistance should be extended to the prawn farmers extensively.

Sasidharan (1996) studied the cultivation practices of paddy in Pokkali lands and found that *Pokkali, Cheruviruppu, Chettiviruppu, Orkazhama* etc., were traditional varieties suitable for growing in Pokkali fields. Sprouted seedlings were planted in mounds in monsoon season. Fertilizers and pesticides were not generally used in these fields as they became toxic to fishes and prawns in the following season. The inundation of backwaters helped in the control of weeds by submergence. While harvesting, only the panicles were cut and the stumps were left behind in the field. These served as food and habitat for fish and prawn juveniles.

Gopinath (1997) noted that Pokkali cultivation system was free from the perils of chemicalisation. Still, high risk, huge losses and increasing labour problems loomed up as important issues threatening the systems. He also noted that, in this system rice

cultivation and prawn culture complement each other. Also, it was found that lack of recognition of the rice as a organic produce, provided only limited market access, though there was much scope for expansion. He had suggested setting up of Pokkali Organic Farming Agency (POFA) to popularize the system and make people more aware of it.

Mary (1998) studied the economics of Pokkali cultivation and concluded that integrated farming of paddy along with improved method of prawn culture was more remunerative than paddy cum traditional prawn culture. Labour cost was found to be dominant in paddy cum traditional prawn culture while in the latter case it was material cost.

Jose (1999) noted that most of the Pokkali cultivars were known for a very high degree of disease resistance. Also he found that after the paddy harvest in October, 80 to 90 per cent of the straw was left in the field itself. He noted that 55 to 60 per cent of the prawn harvest was constituted by Thelli, 30 to 35 per cent by Choodan and rest by Naran and Kara. Also, it was noted that in a high yielding natural infiltration field yield of about 500 to 750 kg per hectare prawn could be achieved. The system was also found to be highly ecologically suitable. The presence of excess weeds in the field was found to hamper the healthy growth of prawns in the field. The author opined that small scale fertilization of low yielding fields would enhance the yield of '*Kettu*' (prawn culture field). Application of cow dung at the rate of 1-1½ tonne/ha and Mossouriphos at 50-100 kg/ha was recommended. He also observed that a shift to monoculture of prawn due to huge losses involved in rice, or leaving the land fallow during the first season might not be ecologically advisable in the long run.

Peter and Karmachandran (1999) noted that Pokkali cultivation system of rice-prawn rotation was one of the most environmentally sustainable cultivation systems. They also observed that the farmers realised a net profit of Rs.35000-45000 per acre through prawn culture. But it was concluded that this was bound to change with season.

Purushan (2000) reported that with the increasing demand for prawns in the export market the lease amount for Pokkali lands had also increased upto Rs.40,000/- per hectare. He also noted that about 40 years back the farmers used to get about 1-1½ tonnes of prawn and about the same quantity of fish from one hectare of land. The rice cultivation used to yield 1½ -2 tonnes of paddy and an equivalent quantity of straw. But, the author noted that all this had noticeably dwindled in the 1980's with the high incidence of water pollution, Kayal land reclamation, bund construction etc. Also, the shift to monoculture to gain higher profits also proved costly to the ecological sustainability of the system.

DESIGN OF THE STUDY

CHAPTER III

DESIGN OF THE STUDY

The present chapter deals with the materials, sampling design, data and method of analysis of the Pokkali system of Rice-Prawn rotational cultivation. The study was conducted in the Pokkali lands of Ernakulam district. The data were collected by means of sample survey. A brief description of the procedures followed in sample selection, data collection and analysis made in this study are explained in this chapter.

Sampling Procedure

The Ernakulam district was purposively selected for the study as item accounted for 6000 hectares of area under Pokkali system out of the total 9000 hectares in the three districts. A two stage sampling procedure was adopted for the selection of farmers from the Pokkali Region of Ernakulam district. The list of Krishi Bhavans in the Pokkali region was secured from the Pokkali Development Agency located at Paravoor. Three Krishi Bhavans were selected at random from the given list of 20 Krishi Bhavans given in the Table 2.

The selected Krishi Bhavans were the Varappuzha Krishi Bhavan in Aluva Agricultural Development Block, Elamkunnathupuzha Krishi Bhavan in Njarrakkal Agricultural Development Block and Ezhikkara Krishi Bhavan in Paravoor Agricultural Development Block. The Krishi Bhavans were contacted and lists of individual farmers following the Pokkali system of Rice-Prawn rotational cultivation were collected from the respective Agricultural Officers. Thirty farmers were then selected at random from the areas under the jurisdiction of each of the three Krishi Bhavans.

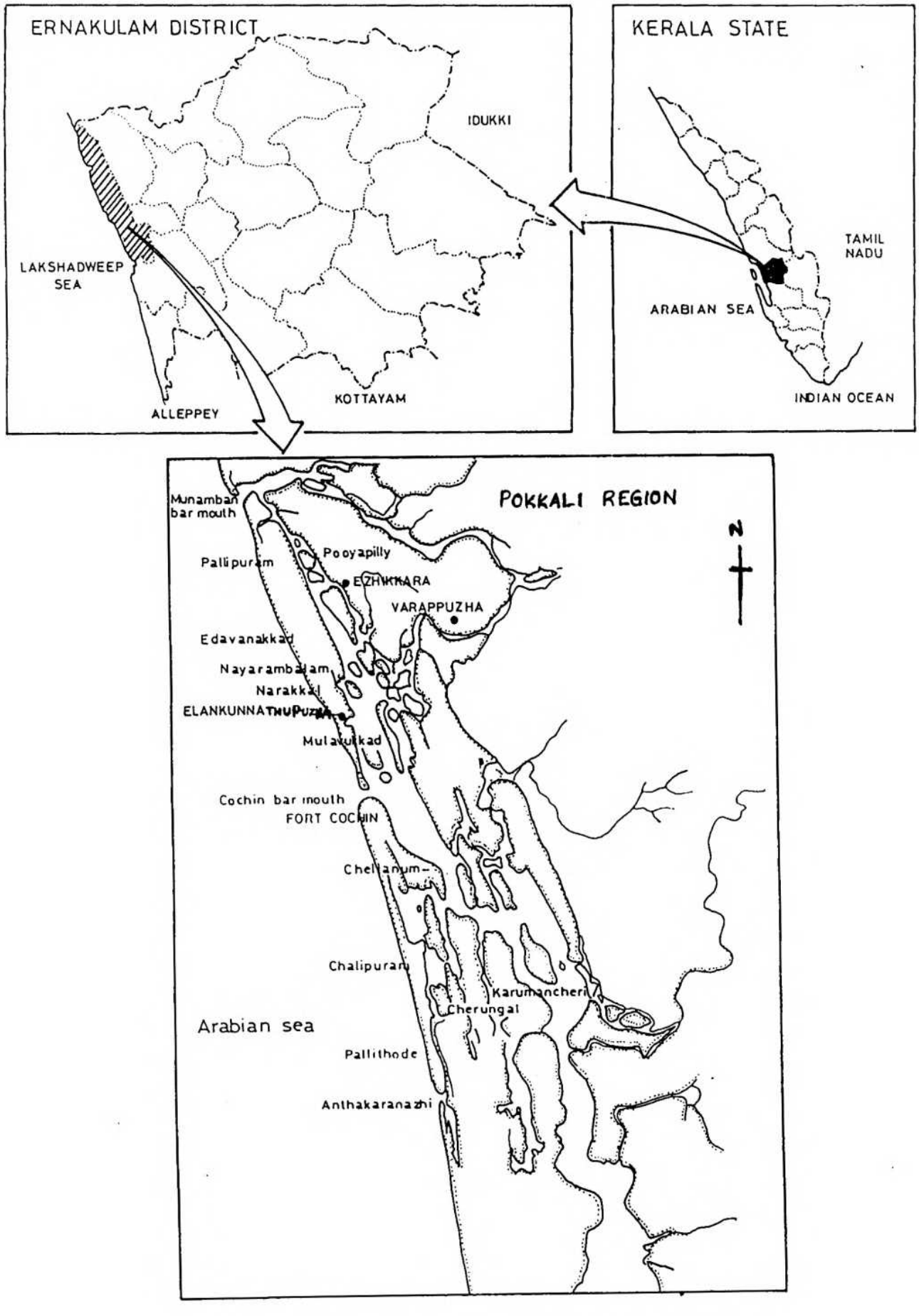

FIG.1 MAP SHOWING THE STUDY AREA

Table.2 List of Krishi Bhavans in Ernakulam District

Sl. No	Name of the Krishi Bhavans
1	Kumbalangi
2	Chellanam
3	Cochin Corporation
4	Kuzhippally
5	Edavanakkad
6	Elankunnathupuzha
7	Nayarambalam
8	Pallipuram
9	Mulavukadu
10	Varappuzha
11	Thrippunithara
12	Maradu
13	Kumbalam
14	Chittattukara
15	Ezhikkara
16	Kottuvally
17	Kadamakkudy
18	Cheranallur
19	Udayamperur
20	Njarakkal

The total sample size was fixed at 90. The farmers were post classified as given in Table 3.

Table.3 Classification of Pokkali Farmers into Different Classes

Krishi Bhavan	Class I	Class II	Class III	Class IV	Total
Varappuzha	12	5	6	7	30
Elankunnathupuzha	13	9	4	4	30
Ezhikkara	15	5	5	5	30
Total	40	19	15	16	90

Class I : Farmers going for culture of Naran (White Prawn) and Kara (Tiger Prawn)

Class II : Farmers going for culture of Naran (White Prawn) alone in the second season.

Class III : Farmers going for culture of local mixed type of seedlings collected from the sea (Koral)

Class IV : Farmers leasing out the land in the second season for prawn culture.

For the purpose of comparing the advantage of growing rice before prawn culture, the sample farmers have been grouped into two categories; (i) farmers doing prawn culture after rice (numbering 72) and (ii) farmers doing prawn culture after leaving the land fallow (numbering 18).

Period of the Study

Reference period of the study was the agricultural year 1999-2000. The data were collected in March - April 2001.

Collection of Data

Farm level data were collected with the help of a well-structured interview schedule through personal interview method. The farmers were requested to recall the details. The information about socio economic conditions of the farmers, cost and returns of paddy cultivation and prawn culture, factors influencing yield of prawn and paddy and problems encountered by the farmers in paddy as well prawn culture were collected. Secondary data on land holding pattern, land utilization pattern, population, occupation, climate and rainfall, land and soil, water resources and cropping pattern were obtained from various government publications and other records maintained by other institutions.

Tools of Analysis

The sample farmers were classified according to the type of prawn culture adopted. The farmers who rented out their lands after harvesting of Pokkali rice were treated separately.

Cost and Returns were worked out separately for each of the sub groups and also pertaining to the Krishi Bhavans, for rice and prawn culture.

Simple averages and Percentage analyses were employed to study the costs of paddy cultivation and prawn cultivation. The various costs computed in the present study are explained below.

Cost Concepts

Paddy Cultivation

1. Value of hired human labour

The human labour employed for various operations like land preparation, sprouting of seeds, sowing, weeding and harvesting were included. The hired labour and family labour were evaluated at the wage rate actually paid or market rate prevailing at that time.

2. Sluice maintenance charges

Permanent labour was engaged in rice cultivation for the initial two months, for maintenance of water level at the sluice. It was evaluated on the basis of the monthly wages paid to them.

3. Value of seeds

The farm-produced seeds were evaluated on the basis of the prevailing market price. Purchased seeds were accounted for at the actual price paid.

4. Cost of gunny bags

The gunny bags used for sprouting of seeds were evaluated at half their price, since these are used for two years.

5. Interest on Working Capital

Interest on working capital was charged at the rate of 12 per cent per annum. This was the rate of interest charged by State Bank of Travancore for short-term agricultural loans. The interest was charged only for the duration of crops.

6. Cost of transportation

It included the van charges for carrying the grain to the miller and also the cost of canoes used for transportation.

Prawn Culture

1. Value of hired human labour

In the case of prawn cultivation, hired human labour was used for removal of weeds, general field preparation, fixing sluice gates, maintenance of sluices, harvesting etc. These were evaluated on the basis of the wages paid to them. Permanent labour generally engaged for sluice management, application of eradicants and the field, shrimp care etc. were evaluated on the basis of monthly salary paid to them. The permanent labour was usually engaged for the entire duration of the crop.

2. Value of fingerlings (seedlings)

The different types of fingerlings (seedlings) bought for shrimp culture were evaluated at the market price actually paid.

3. Value of eradicants

In case of prawn culture, cost incurred for the purchase of eradicants was estimated at the prevailing market price actually paid.

4. Value of sluice gates

Value of the sluice gates in the present study was evaluated on the basis of the cost of the different types of woods used for the maintenance of sluices.

5. Value of lights

With regard to prawn culture cost of illumination included the cost of bulbs and other accessories and electricity charges. Half of the purchase prices of the bulbs, etc. were taken since they could be used for two years.

6. Value of feeds

The different types of feeds were valued at the purchase price of the feeds in the market.

7. Value of watchman's shed

This was estimated on the basis of the cost incurred for the maintenance of the watchman's shed every year.

8. Value of filtration nets and fishing nets

The full costs of the nets were taken for evaluation as the period of use varies in most cases upto one season and rarely upto two seasons.

9. Interest on working capital

Interest on working capital was charged at the rate of 12 per cent per annum. This was the rate of interest charged by State Bank of Travancore for short-term agricultural loans. The interest was charged only for the duration of prawn rearing.

10. Cost of transportation

The cost of transportation involves the rent for the canoes used for transportation of prawn and ice at the prevailing market rates.

11. Miscellaneous expenses

This include the processing charges for prawn, the harvesting charges if canoes were hired for harvesting etc. In the case of electric motors used for dewatering, their hiring charges were also included under the miscellaneous expenses.

Returns

Gross Returns

The total value of the paddy produced and the different types of prawn reared evaluated at the prevailing farm harvest price constituted the gross returns.

Net Returns

It was calculated by subtracting the total operating cost from the gross returns.

Case Study

A case study was also taken up on Sri Durga Aqua Farm in Varappuzha to examine the scientific prawn culture.

Production Function Analysis

The functional analysis was carried out using Cobb-Douglas type of production function separately for paddy cultivation and prawn culture. The Cobb-Douglas production function being logarithmically linear it assumes a constant rate of change in the dependent variable with respect to the independent variable. It also allows economic

use of degrees of freedom. This function has asymptotic isoquants, straight-line isoclines passing through the origin and the regression coefficients are the production elasticities and it allows constant, increasing or decreasing marginal productivity.

In the present study the Cobb-Douglas type of production function was fitted with following five explanatory variable such as amount of feed required per hectare, number of fingerlings per hectare, number of sluices per hectare and number of mandays required per hectare. Dummy variables were used to capture variation between the Krishi Bhavans, the use of eradicants and whether or not the farmers go in for rice cultivation in the first season. The functional form was specified as given below.

$$Y = a\, X_1^{b1}\ X_2^{b2}\ X_3^{b3}\ X_4^{b4}\ D_1^{b5}\ D_2^{b6}\ D_3^{b7} + u$$

Y - Yield of prawn in Kilograms per hectare

a - Constant term

X_1 - Feed used in Kilograms per hectare

X_2 - Number of sluices present per hectare

X_3 - Number of fingerlings used per hectare

X_4 - Number of labourers used per hectare

D_1 = { 1 for 1st Krishi Bhavan Varappuzha; 0 otherwise }

D_2 = { 1 for use of eradicants; 0 otherwise }

D_3 = { 1 for rice cultivation in first season; 0 otherwise }

u : Stochastic disturbance term

$b_1, b_2 \ldots\ldots b_7$ - Coefficients or production elasticities

The Cobb-Douglas production was again used to analyse the Resource Use Efficiency of rice cultivation system.

The function was specified as given below.

$$Y = a\ X_1^{b1}\ X_2^{b}\ X_3^{b3}\ X_4^{b4}\ X_5^{b5}\ D_1^{b6} + u$$

a - constant term

X_1 - seeds used in kgs per hectare

X_2 - Age of the farmer in years

X_3 - Experience of the farmers in years

X_4 - Labour used in mandays

X_5 - Number of members in the family

D_1 - { 1 for Krishi Bhavan one ie. Varappuzha
0 otherwise }

u - Stochastic disturbance term

$b_1, b_2 \ldots\ldots b_6$ - Coefficients or production elasticities

DESCRIPTION OF THE STUDY AREA

CHAPTER IV

DESCRIPTION OF THE STUDY AREA

The Pokkali Lands have a predominant place in the Agro-Ecological Problem Zone in Kerala. The peculiar name owes its origin to the unique system of paddy cultivation in the region, which is traditionally done using a local cultivar 'Pokkali' - It is a complex, organic, ecofriendly system of rotational paddy-cum prawn culture along the coastal belt of Arabian sea. The current study is based on existing Pokkali cultivation system in the regions under three randomly selected Krishni Bhavans in Ernakulam District. The District had been specifically selected since the Pokkali Region is largely confined to it.

Location

The District of Ernakulam often called the 'Commercial Capital of Kerala' is located between the 9° 42' 38" to 10° 18' 00" North latitude and 76° 12' 00" to 76° 46' 00" East longitude. The total area is 235319 hectares and accounts for 6.1 per cent of total area of the State. The district is bound by a 30 km long coastal belt of Arabian sea on the West, Kottayam and Allappuzha districts on the South, Thrissur in the North and Idukki in the East. The district was formed in 1958 carving out regions from the neighbouring Thrissur and Kottayam districts.

Administrative Units

The district is divided into two revenue subdivisions headquartered in Fort Cochin and Muvattupuzha. The district includes 122 revenue villages and seven taluks. It is also divided into 15 Community Development Blocks, eight Municipalities, one Corporation and 86 Panchayats. The Region also has 20 Krishi Bhavans.

Population

According to the 1991 census, the district supports a population of 28.18 lakhs of which 14.09 lakhs are males and 14.08 lakhs females. The density of population is 1170 per square kilometre. Effective literacy rate is 92.35.

Occupation

The occupational distribution of population in the district for the year 1991 shows that 92 percent of the workers are main workers and 7.3 per cent are marginal workers. Seventy seven percent of the total workers are male and 23 per cent are females. The work participation rate is worked out to be 33.44 per cent.

Agricultural labourers constitute 31.0 per cent of the total number of main workers and cultivators constitute 18.27 per cent. Other occupations are manufacturing, processing, servicing and repairs in household industry (50 to 73 per cent). The distribution of working class in Ernakulam district ie. furnished in the Table 4.

Table 4. Distribution of Working Class in Ernakulam District

1.	Total main workers	873408
2.	Cultivators	81198
3.	Agricultural labourers	137921
4.	House hold industry workers	13733
5.	Other workers	640556

Source: Panchayat Level Statistics-1995, Ernakulam, Department of Economics and Statistics, Trivandrum

Topography

Physiographic conditions divide the district into three natural divisions - Highland, the Middle land and Low land. The entire Paravur and Cochin Taluks and the western Part of Kanayannur Taluk falls under the Low land division. The Midland division comprises of Kanayannur Taluk (East) Aluva, Muvattupuzha and Kothamangalam. The major part of Kanathnadu Taluk is in the mid land region and the remaining portion is in the Highland region. The Pokkali Lands are mostly confined to the Low land region.

Climate

The district experiences a tropical humid climate with almost uniform temperature throughout the year. The total annual rainfall in the district is more or less same as the total average rainfall per year in the State. It is more than 3000mm, the major part of which is received in the months of June, July and August. The maximum day temperatures range from 21°C to 28°C. Humidity is often very high, recording more than 90 per cent. Heavy rains occurring continuously for 10-15 days result in flooding, which is usual during June, July and August. The month wise rain fall details in the district is furnished in the Table 5.

Soil

Laterite soil, sandy loam and alluvial soil are the three most commonly encountered types of soils in the district. In the Pokkali Region the soil is acid saline in nature. It is clayey mixed with sand and silt. It is fairly rich in organic carbon and other nutrients. The pH of the soil is as high as 3.5 when it is dry, but when inundated the soil pH ranges from 5 to 6.5. The soil is highly acidic and saline sulphidic when waterlogged with saline tidal water. The inherent acidity of soil regenerates when salinity is washed off in heavy monsoon rains.

Nutrient Status of Soil

With regard to nutrient status, the soil is very low in Phosphorus, medium in Nitrogen and high in Potash. The soil has water-soluble salts like Sulphates and Chlorides of Sodium and Magnesium in high proportions. In dry conditions white encrustation's of Aluminium Hydroxide also develop on soil surfaces. Electrical conductivity of the soil during summer months (January-May) varies from 12-24 mmhos/cm and average salt content reaches upto 18 ppt). During rainy season (June-August) water becomes almost fresh, salt content reduces to traces and electrical conductivity ranges from 6-8 mmhos/cm.

Water Temperature and Other Characteristics

The water pH ranges from 7 to 8.5 and the mean temperature 28°C to 31°C. The salinity of the surface water varies considerably depending on the tidal flow it receives. It is found to vary from 10 ppt to 25 ppt during December to April and 3 ppt to 8 ppt

Table. 5 Monthwise Rainfall in Ernakulam District

(in mm)

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	TOTAL
Normal Rainfall (based on data upto 1970	15.00	17.00	41.00	133.00	314.00	741.00	726.00	460.00	289.00	319.00	175.00	45.00	3275.00
Average Monthly Rainfall (1999)in Ernakulam district	0.00	18.10	20.70	125.80	605.90	648.50	645.40	170.60	81.90	643.00	76.00	15.50	3048.20
State Average	15.00	17.00	40.00	107.00	113.00	697.00	764.00	455.00	269.00	297.00	166.00	43.00	3228.00

Source : Pokkali Land Development Project Report, 2000

during May to November. It varies considerably from *Padasekharam* to *Padasekharam* depending on the distance from the sea. The tidal amplitude ranges from 0.6 to 0.75 mtrs.

Land Utilization Pattern

The district has a total geographical area of 235319 hectares. The data available regarding land utilization pattern of the district show that 3.45 per cent of the total geographical area comes under forests. Cultivable waste land account for 1.5 per cent of the total while land put to nonagricultural uses account for 14.67 per cent. The net area sown is 179529 hectares which accounts for 76.31 per cent of the total geographical area. Out of the total cropped area of 222459 ha, area cropped more than once account for 19.28 per cent. The details regarding the land utilization pattern in the district is furnished in the Table 6.

Table.6 Classification of Area in Ernakulam District

(Area in hectares)

1.	Geographical area	235319
2.	Forest	8123 (3.45)
3.	Land put to non agricultural uses	34510 (14.67)
4.	Barren & uncultivable land	905 (0.38)
5.	Permanent pastural & grazing land	26 (0.01)
6.	Land under tree crops	424 (0.18)
7.	Cultivable waste	3506 (1.50)
8.	Fallow other than current fallow	3726 (1.58)
9.	Current fallow	4527 (1.92)
10.	Net area sown	179572 (76.31)
11.	Area sown more than one	42887
12.	Total cropped area	222459

(Figures in parantheses indicate percentages to total geographic area)

Source : Records of Department of Economics and Statistics,Trivandrum

Land Holding Pattern in Ernakulam

The data regarding the size of holding in Ernakulam district is given in the Table 7. It could be seen that more than 88 per cent of total number of holdings are those of small holders having less than 0.5 hectare of agricultural land.

Table. 7 Land Holding Pattern in Ernakulam District

Holding Size (ha)	No. of holding (000's)	Per cent	Total area (000 ha)	Area in (Per cent)
Below 0.02	189.51	17.56	1.23	1.04
Bet 0.02-0.5	360.67	70.74	41.14	34.70
Bet 0.5-1.0	31.50	6.21	24.24	20.44
Bet 1.0-2.0	20.12	3.90	26.81	22.61
Bet 2.0-4.0	67.00	1.30	17.16	14.47
Bet 4.0 - 1.0	1.16	0.23	5.81	4.90
10 & above	0.09	0.01	2.18	1.84
Total	509.86	100.00	118.57	100.00

Source: Panchayat Level Statistics-1995, Ernakulam, Department of Economics and Statistics, Trivandrum.

Water Resources

Rivers : The district has many water sources such as rivers, canals, tanks, wells, etc. The most important rivers in the district are the Periyar and Muvattupuzha. The longest is Periyar with a length of 229 kms. Agricultural, industrial and commercial sector of the district is largely dependent on the state of these rivers. Kalyar, Thodupuzha and Kothamangalam rivers join together to form the Muvattupuzha river. Muvattupuzha, Idamalayar and Periyar valley constitute the major irrigation projects, which are currently functional.

Backwaters : The backwaters are very important in the Pokkali cultivation system. The Vembanad and Kodungallor Kayals stretch along the western and northeastern coasts of the district having many small river- lets opening into them. They ensure the presence of an attractive network of canals & backwaters. The large spacious lake of Vembanad extends to a total area of 205 km^2 having a length of 82 km and maximum breadth of 40 km.

Infrastructural Facilities

Transport

Roadways: The district has long been called the commercial and industrial capital of Kerala. The strategic location of Cochin Port and the proliferation of industrial units make the district ideal for investors and businessmen. A number of major industries including FACT are located in the district. Also the district is endowed with a fair share of the National & State highways. The district has about 138.74 kms of National highways passing through it and about 188.60 kms of state highways. There are in total 24 railway stations. A number of major trains start from the major Ernakulam South Railway Station. The details regarding the transport facilities is furnished in the Table 8.

Table.8 Transport Facilities available in Ernakulam District

Type of Road	Length in kms
National Highways	138.74
State highways	188.60
PWD Roads	1741.31
Black topped roads	2112.29
Panchayat Road (mettalled)	1094.58
Earthen roads	5926.95
TOTAL	**11202.46**
Railway track	55.00
No:of Railway stations	24

Source : Panchayat Level Statistics-1995, Ernakulam, Department of Economics and Statistics, Trivandrum.

Communication Facilities

The state is endowed with ample facilities for communication with a well-established post and telegraph system. The district has a total of 380 post offices and 784 public telephone booths as per 1994 statistics. The communication facilities available within the district are furnished in the Table 9.

Table.9 Communication Facilities available in Ernakulam District

Post	
Head Post office	6
Sub Post office (SO)	143
EDSO	43
Branch Post office (BO)	--
EDBO	188
Total	380
Letter Boxes Numbers	1479
Telegraph	
Telegraph office Numbers	72
Telephone exchange	76
Telephone connections	106215
Local calls only	186
Local & STD	47
STD & ISD	91
Total	784

Source: Panchayat Level Statistics-1995, Ernakulam, Department of Economics and Statistics, Trivandrum

Banking

The presence of a large number of well established banks increases the credibility of the district as a major commercial centre. A number of foreign banks also have offices in the District. The District has an all-encompassing network of Nationalised banks, other scheduled commercial banks, & agricultural societies. The details are furnished in Table 10.

Table.10 Bank & Co-Operative Societies in Ernakulam District

Institution	Numbers
Banks	269
Nationalised Bank Branches	
Other Scheduled Commercial Banks	174
Cooperatives	
Agricultural Societies numbers	3
Other numbers	178

Source : Panchayat Level Statistics-1995, Ernakulam, Department of Economics & Statistics, Trivandrum.

Hatchery Units

The major hatcheries in the region are mentioned in the Table 11. All The three are in good working condition. The infrastructure plans for two more hatcheries are currently now in the proposal stage.

Table. 11 Details of the hatcheries in Ernakulam District

Hatcheries	Location
Regional Shrimp hatchery (Govt.)	Azhikode
CMFRI'S Shrmip hatchery	Njarrackal
Shrimp Hatching complex of MPEDA	Vallarpadam

Source: ADAC Pamphlet 1995

Other facilities

The Krishi Bhavans act as coordinating centres for the agricultural activities in the region. Acquaculture Development Agency and CMFRI provide aid to the farmers to go for prawn culture. Many banks like to Federal Bank and the SBI extend loan assistance to the farmers. Harvesting bonus is also provided to the labourers in the harvesting season. The Pokkali Development Agency has provision for subsidies so as to support the system.

RESULTS AND DISCUSSION

CHAPTER V

RESULTS AND DISCUSSION

The current chapter deals with the results of the study and discussions thereon. The chapter is divided into different sections, so as to have a clear perception of the study as a whole. The chapter is organised as follows.

- General socio-economic characteristics of the sample farms
- Operation wise and input wise cost of cultivation in the case of paddy cultivation in the different classes of farms in the three Krishi Bhavans.
- Operation wise and input wise cost cost of production of prawns in the case of different classes of farms in the three Krishi Bhavans
- Total returns from paddy cultivation
- Total returns from prawn culture
- Comparative analysis of input use and returns in farms where prawn culture follows rice cultivation and where the land is left fallow before prawn culture.
- Employment potential of Pokkali rice prawn cultivation system.
- Production Function Analysis of prawn culture
- Production Function Analysis of rice cultivation
- Case study

General Socioeconomic Characteristics of the Sample Farms

A brief idea about the socio-economic conditions under which the farmers operate would be very much desirable to have a proper understanding of their farming activities. In this section an attempt is made to bring out a clear and lucid picture of social and economic conditions of the sample farmers viz. family size, age and sex, level of literacy and nature of occupation.

The study has been conducted in the areas under the jurisdiction of the three different Krishi Bhavans of Varappuzha, Elankunnathupuzha and Ezhikkara. The socioeconomic characters have been analyzed separately for the three Krishi Bhavans so as to get a clearer picture.

Family Size

The family size and distribution of the respondent farmers are given in the Table 12.

Table.12 Family Size of the Respondent Farmers

Krishi Bhavans	1-3	4-6	>6	Total	Average family size
Varappuzha	2 (6.67)	26 (86.67)	2 (6.67)	30 (100.00)	4.80
Elankunnathupuzha	-	24 (80.00)	6 (20.00)	30 (100.00)	5.90
Ezhikkara	2 (6.67)	17 (56.67)	11 (36.67)	30 (100.00)	5.97
Total	**4 (4.44)**	**67 (74.44)**	**19 (21.11)**	**90 (100.00)**	**5.36**

(Figures in parentheses indicate percentage to total)

Out of the total 90 farmers, the majority (74.44 per cent) had families with 4 to 6 members and 21.11 per cent had a family size of more than six members. Small families with 1 to 3 members were rather a minority constituting only 4.44 per cent of the total sample farms.

Among the Krishi Bhavans, also the same trend prevailed. Varappuzha had 86.67 per cent of the sample farmers with family size of 4 to 6 members closely followed by Elankunnathupuzha at 80.00 per cent and Ezhikkara with 56.67 per cent. Ezhikkara had 36.67 per cent of the sample farmers with family size of more than six members.

The average family size was 5.36 for the sample as a whole while it was 4.80, 5.90 and 5.97 members in Varappuzha, Elankunnathupuzha and Ezhikkara, respectively.

Age of the Heads of the Respondent Households

The details regarding the age of the heads of the respondent households are presented in Table 13.

Table.13 Age of the Heads of the Respondent Households (in years)

Krishi Bhavans	20-39	40-59	60 and above	Total	Average
Varappuzha	2 (6.67)	12 (40.00)	16 (53.33)	30 (100.00)	59.26
Elankunnathupuzha	-	18 (60.00)	12 (40.00)	30 (100.00)	58.08
Ezhikkara	-	17 (56.67)	13 (43.33)	30 (100.00)	57.43
Total	**2 (2.22)**	**47 (52.22)**	**41 (45.56)**	**90 (100.00)**	**58.26**

(Figures in parentheses indicate percentage to total)

The average age of the farmers for the sample as a whole was 58.26 years. It was slightly higher in Varappuzha at 59.26 years while it was the lowest in Ezhikkara at 57.43 years. In Elankunnathupuzha it was 58.08 years. Generally, the farmers were very old. It could be seen from the table that majority of the respondent farmers (52.22 per cent) belonged to the age group of 40 to 59 years closely followed by the farmers in the age group of 60 years and above. Only a minority (2.22 per cent) belonged to the age group of 20 to 39 years.

The same trend prevailed in the two Krishi Bhavans with the exception of Varappuzha which had 53.33 percent of the respondents in the age group of more than 60 years followed by 40.00 per cent of the farmers in the age group of 40 to 59 years and 6.67 percent of the farmers in the age group of 20 to 39 years.

Sex Composition of the Respondent Farmers

The details regarding the sex composition of the respondent farmers are furnished in Table 14.

Table.14 Sex Composition of the Respondent Farmers

Krishi Bhavans	FEMALE	MALE	Total
Varappuzha	3 (10.00)	27 (90.00)	30 (100.00)
Elankunnathupuzha	2 (6.00)	28 (94.00)	30 (100.00)
Ezhikkara	2 (6.00)	28 (94.00)	30 (100.00)
Total	**7 (7.8)**	**83 (92.2)**	**90 (100.00)**

(Figures in parentheses indicate percentage to total)

The details presented in the table would show that majority of the respondents (92.20 per cent) were male and only 7.8 per cent were females. Among the Krishi Bhavans, also the same trend existed.

Educational Status of the Respondents

The details regarding the educational status of the respondents are furnished in Table 15.

Table. 15 Educational Qualification of the Respondent Farmers

Krishi Bhavans	Below SSLC	SSLC	Pre degree	Graduate	Post graduate	Total
Varappuzha	14 (46.66)	3 (10.00)	6 (20.00)	5 (16.67)	2 (6.67)	30 (100.00)
Elankunnathupuzha	13 (43.33)	5 (16.67)	6 (20.00)	4 (13.33)	2 (6.67)	30 (100.00)
Ezhikkara	17 (56.66)	3 (10.00)	5 (16.67)	2 (6.67)	3 (10.00)	30 (100.00)
Total	**44 (48.89)**	**11 (12.22)**	**17 (18.89)**	**11 (12.22)**	**7 (7.78)**	**90 (100.00)**

(Figures in parentheses indicate percentage to total)

The results presented in the table would reveal that 48.89 per cent of the respondent farmers were having an educational level below SSLC, followed by 18.89 per cent of the farmers who had attained pre-degree and 12.22 percent who had attained SSLC. Only 12.22 per cent of the total farmers were graduates while 7.78 percent were postgraduates. The Krishi Bhavans also exhibited the same trend.

Experience of the Farmers in Pokkali Rice Prawn Cultivation

The experience of the farmers in Pokkali Rice Prawn Cultivation is given in Table 16.

Table. 16 Experience of the Respondent Farmers in Pokkali Rice Prawn Cultivation

Krishi Bhavans	<10	10-20	20-30	30-40	40-50	Total	Average
Varappuzha	1 (3.33)	3 (10.00)	13 (43.33)	8 (26.67)	5 (16.67)	30 (100.00)	28.25
Elankunnathupuzha	-	4 (13.33)	15 (50.00)	11 (36.67)	-	30 (100.00)	23.17
Ezhikkara	-	2 (6.67)	16 (53.33)	8 (26.67)	4 (13.33)	30 (100.00)	26.83
Total	**1 (1.11)**	**9 (10.00)**	**44 (48.89)**	**27 (30.00)**	**9 (10.00)**	**90 (100.00)**	**26.08**

(Figures in parentheses indicate percentage to total)

The majority (48.89 per cent) of the total respondent farmers had 20 to 30 years of experience in farming followed by 30.00 per cent of the farmers having a farming experience of 30 to 40 years, 10.00 per cent with 40 to 50 years and 10 to 20 years and 1.11 per cent with less than 10 years. The same trend was observed in the case of Krishi Bhavans also.

The average farming experience in years in the case of the sample as a whole was 26.08 years. It was 28.25 years, 23.17 years and 26.83 years in Varappuzha, Elankunnathupuzha and Ezhikkara respectively.

Occupational Structure

Classification of the respondents based on occupation is given in Table 17.

Table. 17 Occupational Structure of the Respondent Farmers

Krishi Bhavans	Agriculture as main occupation	Agriculture as sub occupation	Total
Varappuzha	20 (66.67)	10 (33.33)	30 (100)
Elankunnathupuzha	15 (50.00)	15 (50.00)	30 (100)
Ezhikkara	20 (66.67)	10 (33.33)	30 (100)
Total	**55 (61.11)**	**35 (38.89)**	**90 (100)**

(Figures in parentheses indicate percentage to total)

The results presented in the table would indicate that 61.11 per cent of the sample respondent had agriculture as the primary occupation. Agriculture happened to be the secondary occupation for 38.89 per cent of the farmers. Among the Krishi Bhavans, with the exception of Elankunnathupuzha, the same trend prevailed, whereas in Elankunnathupuzha 50.00 per cent of the respondents had agriculture as primary occupation and 50.00 per cent had agriculture as secondary occupation.

Details of Paddy Cultivation in Pokkali Lands

The Pokkali farmers generally go for paddy cultivation in the first season from April-May to September-October when the fields receive the South West Monsoon at *Edavappathi*. Sowing begins by the end of May though land preparation starts from April end onwards. Harvesting is usually done by the end of September whereupon, the field is left exposed for one month or so for the paddy straw to decay.

Input use in Pokkali Paddy Cultivation

Paddy cultivation under the Pokkali system required only two major inputs namely labour and seed. The details of inputs used are given in the Table 18.

Table. 18 Major Inputs Required for Pokkali Paddy Cultivation

Classes	Krishi Bhavans	No.	Seed required in kgs/ha	Labour required in mandays / ha
Class I	Varappuzha	12	107.21	132.09
	Elankunnathupuzha	8	102.32	142.71
	Ezhikkara	11	104.74	144.23
	Total	31	105.07	139.14
Class II	Varappuzha	5	102.03	121.27
	Elankunnathupuzha	5	100.92	135.24
	Ezhikkara	2	103.71	139.35
	Total	12	101.85	130.10
Class III	Varappuzha	6	99.72	122.23
	Elankunnathupuzha	3	101.23	133.74
	Ezhikkara	4	102.21	135.25
	Total	13	100.83	128.89
Class IV	Varappuzha	7	98.25	117.18
	Elankunnathupuzha	4	97.31	122.91
	Ezhikkara	5	99.24	127.54
	Total	16	98.32	121.85
Sample as a whole		72	102.26	131.94

(Note:Eighteen farmers did not raise paddy)

Use of Seed : It could be seen from the Table that average quantity of seed used for the sample as a whole was 102.26 kgs per hectare. In Class I farms it was 105.07 kgs per hectare. It varied between 102.32 kgs in Elankunnathupuzha and 107.21 kgs in Ezhikkara.

For Class II farms, the seed used was slightly lower at 101.85 kgs per hectare. It ranged between 100.92 kgs in Elankunnathupuzha and 103.71 kgs in Ezhikkara. In Varappuzha it was 102.03 kgs per hectare.

For Class III farms however, the amount of seed used per hectare was 100.83 kgs. It varied between 99.72 kgs in Varappuzha and 102.21 kgs in Ezhikkara. It was 101.23 kgs in Elankunnathupuzha.

For all the sample farms, the average seed used was 102.26 kg per hectare and it generally ranged between 97.31 kgs and 107.21 kgs per hectare.

The amount of seed used per hectare was lowest in Class IV farms at 98.32 kgs per hectare. It ranged between 97.31 kgs in Elankunnathupuzha and 99.24 kgs in Ezhikkara. In Varappuzha, it was 97.31 kgs per hectare.

Use of Labour : The Pokkali paddy cultivation was labour intensive. It was assumed that two women days were equivalent to one manday. The average amount of labour used for the sample, as a whole was 131.94 mandays per hectare. The labour used varied considerably across the different classes.

Among the different Classes, Class I farms had the highest amount of labour used at 139.14 mandays per hectare. Among the Krishi Bhavans it varied between 132.09 mandays in Varappuzha and 144.23 mandays in Ezhikkara.

Class II farms recorded an average labour use of 130.10 mandays per hectare. The labour use in the different Krishi Bhavans ranged from 121.27 mandays in Varappuzha and 139.35 mandays in Ezhikkara.

In the Class III farms, average labour use per hectare was 128.89 mandays. Among the Krishi Bhavans, it ranged between 122.23 mandays in Varappuzha and 135.25 mandays in Ezhikkara.

The Class IV farms recorded the lowest amount of labour use per hectare at 121.85 mandays. It varied between 117.18 mandays per hectare in Varappuzha and 127.54 mandays per hectare in Ezhikkara.

It could be observed that in Varappuzha, the number of mandays required per hectare was less as compared to other Krishi Bhavans in all the four classes. This was because women labourers constituted majority of the labour force in the region.

Operation Wise Cost of Pokkali Paddy Cultivation

Cost and returns are two elements of any business enterprise. The costs represent the values of inputs used in the production process, while returns represent the value of output achieved by cultivation operations. The relative magnitude of costs and returns from the enterprise indicate the success of any business venture.

The operation wise cost of cultivation of Pokkali paddy was computed in aggregate for all the farmers and the separately for those under each of the Krishi Bhavans. The major operations included were land preparation, *vettieru*, inter cultural operations and other miscellaneous expenses. Interest on working capital was estimated at the rate of 12 per cent for six months.

Knowledge of the operation wise cost will be helpful in understanding the importance of the operation, which combines both labour and material cost. It will also give better idea for managing funds efficiently, at different points of time in the duration of crop growth or prawn culture.

The details regarding operation wise expenses for Pokkali paddy cultivation is furnished in Table 19.

Table.19 Comparison of Operation wise Costs of Pokkali Paddy Cultivation across the different Classes

(Rs per hectare)

Operation	Class I	Class II	Class III	Class IV
Land preparation	4909.49 (28.72)	4690.08 (28.75)	4850.94 (29.64)	4280.48 (28.73)
Seeds and sowing	2972.18 (17.39)	2752.74 (16.87)	3039.71 (18.57)	2725.98 (18.29)
Vettieru	3991.64 (23.35)	4118.34 (25.25)	4404.58 (26.91)	4270.73 (28.66)
Intercultural operations	989.86 (5.79)	421.46 (2.58)	285.77 (1.74)	208.62 (1.40)
Harvesting	2353.21 (13.77)	2683.80 (16.45)	2566.13 (15.67)	2374.35 (15.94)
Transportation cost	92.52 (0.54)	114.76 (0.70)	97.48 (0.59)	90.92 (0.61)
Interest on Working Capital	381.22 (2.23)	280.99 (1.72)	236.53 (1.44)	230.65 (1.55)
Other costs	1403.45 (8.21)	1250.40 (7.68)	884.66 (5.44)	718.41 (4.82)
Total cost	**17093.59 (100.00)**	**16312.57 (100.00)**	**16365.80 (100.00)**	**14900.14 (100.00)**

(Figures in parentheses indicate percentage to total)

Information presented in Table 19 would clearly indicate that the total cost was recorded to be maximum in Class I farms at Rs.17093.59 per hectare while it was minimum in Class IV farms at Rs.14900.14 per hectare. Class II farms recorded a total cost of Rs.16312.57 per hectare while the same was Rs.16365.80 in Class III farms.

The details presented in the Table would clearly show that in all the classes land preparation constituted the majority of total cost at 28.72 per cent in Class I farms, 28.75 per cent in Class II farms, 29.64 per cent in Class III farms and 28.73 per cent in Class IV

farms. The same trend was observed in various Krishi Bhavans also in the different classes except for Varappuzha where *Vettieru* was the major operation.

The next major operation was *Vettieru* which constituted 23.35 per cent, 25.25per cent, 26.91 per cent and 28.66 per cent of the total cost in Class I, Class II, Class III, and Class IV farms, respectively. Harvesting was yet another major component constituting 13.77 per cent, 16.50 per cent, 15.67 per cent and 15.94 per cent of the total cost in Class I, Class II, Class III and Class IV farms respectively.

Seeds and sowing constituted 17.29 per cent, 16.87 per cent, 18.57 per cent and 18.29 per cent of the total cost in Class I, Class II, Class III and Class IV farms, respectively. Other costs constituted about 8.21 per cent of total cost in Class I farms. The same was 7.68 per cent, 5.44 per cent and 4.82 per cent of the total cost in Class II, Class III and Class IV farms respectively.

Intercultural operations, transportation costs and interest on working capital were very minor as compared to others. Together they constitute 8.56 per cent, 5.00 per cent, 3.77 per cent and 6.83 per cent of the total cost in Class I, Class II, Class III and Class IV farms respectively.

It could be seen that the percentage composition of the total cost was almost similar in the different classes.

The results presented in the Tables 20,21,22 and 23 indicate the operation wise cost of cultivation of Pokkali paddy in different classes across the Krishi Bhavans. In Class I farms, the total cost varied between Rs.16120.22 per hectare in Varappuzha and Rs.18939.93 hectare in Ezhikkara. Elankunnathupuzha recorded a total cost of Rs.17018.07 in this class.

The same trend was followed in the case of all the three classes with the exception of Class IV. In Class IV, the total cost varied from Rs.15256.15 per hectare in

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Elankunnathupuzha and to Rs.14610.78 per hectare in Varappuzha. Ezhikkara recorded a total cost of Rs.14996.48 per hectare.

In Class II farms, the total cost was observed to be Rs.15586.90, Rs.16295.74, Rs.18193.82 per hectare in Varappuzha, Elankunnathupuzha and Ezhikkara respectively. The same was Rs.15462.82, Rs.16783.14 and Rs.17284.84 per hectare respectively in the different Krishi Bhavans in the case of Class IV.

Table. 20 Operation wise Costs of Pokkali Paddy Cultivation -Class I Farms

(Rs per hectare)

Operation	**Varappuzha**	**Elankunnathupuzha**	**Ezhikkara**	**Total**
Land preparation	3839.74 (23.82)	5361.80 (31.51)	5762.56 (30.43)	4909.49 (28.72)
Seeds and sowing	2968.63 (18.42)	2622.76 (15.41)	3294.03 (17.39)	2972.18 (17.39)
Vettieru	4025.18 (24.97)	4290.03 (25.21)	3680.73 (19.44)	3991.64 (23.35)
Intercultural operations	441.81 (2.74)	634.89 (3.73)	1960.24 (10.35)	989.86 (5.79)
Harvesting	2625.45 (16.29)	2360.34 (13.87)	2643.19 (13.96)	2353.21 (13.77)
Transportation cost	94.56 (0.59)	95.84 (0.56)	87.89 (0.46)	92.52 (0.54)
Interest on Working Capital	382.71 (2.37)	384.47 (2.26)	377.22 (1.99)	381.22 (2.23)
Other costs	1742.14 (10.81)	1267.94 (7.45)	1132.57 (5.98)	1403.45 (8.21)
Total cost	**16120.22 (100.00)**	**17018.07 (100.00)**	**18938.43 (100.00)**	**17093.59 (100.00)**

(Figures in parentheses indicate percentage to total)

Table. 21 Operation wise costs of Pokkali Paddy Cultivation -Class II Farms

(Rs per hectare)

Operation	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Land preparation	3847.38 (24.69)	5323.03 (32.67)	5214.44 (28.66)	4690.08 (28.75)
Seeds and sowing	2815.57 (18.08)	2432.79 (14.93)	3395.56 (18.66)	2752.74 (16.87)
Vettieru	4537.56 (29.13)	3957.05 (24.28)	3473.49 (19.09)	4118.34 (25.25)
Intercultural operations	204.24 (1.31)	471.35 (2.89)	839.80 (4.62)	421.46 (2.58)
Harvesting	2578.83 (16.56)	2395.55 (14.72)	3666.82 (20.15)	2683.80 (16.45)
Transportation cost	108.86 (0.70)	122.52 (0.75)	110.12 (0.61)	114.76 (0.70)
Interest on Working Capital	289.24 (1.86)	272.28 (1.67)	282.14 (1.55)	280.99 (1.72)
Other costs	1195.22 (7.67)	1321.17 (8.1)	1211.45 (6.66)	1250.40 (7.68)
Total cost	**15576.9 (100.00)**	**16295.74 (100.00)**	**18193.82 (100.00)**	**16312.57 (100.00)**

(Figures in parentheses indicate percentage to total)

Table. 22 Operation wise costs of Pokkali Paddy Cultivation -Class III Farms

(Rs per hectare)

Operation	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Land preparation	3810.49 (24.64)	5536.47 (32.99)	5852.27 (33.70)	4850.94 (29.64)
Seeds and sowing	2928.49 (18.94)	2340.22 (13.94)	3455.36 (19.99)	3039.71 (18.57)
Vettieru	4516.09 (29.21)	5184.71 (30.89)	3958.71 (22.90)	4404.58 (26.91)
Intercultural operations	346.71 (2.24)	0 (0.00)	326.95 (1.89)	285.77 (1.74)
Harvesting	2604.09 (16.84)	2461.75 (14.66)	2562.34 (14.82)	2566.13 (15.67)
Transportation cost	99.95 (0.65)	97.28 (0.58)	94.59 (0.55)	97.48 (0.59)
Interest on Working Capital	228.78 (1.48)	232.91 (1.39)	247.28 (1.43)	236.53 (1.44)
Other costs	928.22 (6.00)	929.80 (5.54)	814.34 (4.71)	884.66 (5.44)
Total cost	**15462.82 (100.00)**	**16783.14 (100.00)**	**17284.84 (100.00)**	**16365.80 (100.00)**

(Figures in parentheses indicate percentage to total)

Table. 23 Operation wise costs of Pokkali Paddy Cultivation -Class IV Farms

(Rs per hectare)

Operation	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Land preparation	3640.49 (24.92)	4723.24 (30.96)	4822.27 (32.16)	4280.48 (28.73)
Seeds and sowing	2732.93 (18.70)	2212.12 (14.50)	3127.35 (20.85)	2725.95 (18.29)
Vettieru	4423.92 (30.28)	4627.81 (30.33)	3746.61 (24.98)	4270.73 (28.66)
Intercultural operations	326.64 (2.24)	262.84 (1.72)	0 (0.00)	208.62 (1.40)
Harvesting	2402.07 (16.44)	2354.62 (15.43)	2351.34 (15.68)	2374.35 (15.94)
Transportation cost	89.72 (0.61)	92.54 (0.61)	91.31 (0.61)	90.92 (0.61)
Interest on Working Capital	224.72 (1.54)	232.74 (1.53)	237.28 (1.58)	230.65 (1.55)
Other costs	770.29 (5.27)	750.24 (4.92)	620.32 (4.14)	718.41 (4.02)
Total cost	**14610.78 (100.00)**	**15256.15 (100.00)**	**14996.48 (100.00)**	**14900.14 (100.00)**

(Figures in parentheses indicate percentage to total)

It could be inferred from the results on operation wise cost of Pokkali rice that among the four classes of farms the operations namely land preparation, seeds and sowing and *vettieru* constituted between 69.46 per cent of the total cost in Class I and 75.68 per cent in Class IV.It was 70.87 per cent in Class II farms and 75.12 per cent in Class III farms. These operations constituted between 67.21 per cent and 72.13 per cent of the total cost among the three Krishi Bhavans in Class I farms, between 66.41 per cent and 72.07 per cent in Class II farms, between 72.79 per cent and 77.82 per cent in Class III farms and between 73.90 per cent and 77.99 per cent in Class IV farms.

It may be mentioned that in Class III farms and Class IV farms, the proportion of cost incurred for these operations was relatively higher at around 75 per cent as compared to Class I and Class II farms were the cost was around 70 per cent.

It could be inferred from the analysis, that these three operations, which accounted for little over 70.00 per cent of the cost, were taken up in the first one and a half to two months of the crop growth period indicating a heavy initial investment in Pokkali rice cultivation.

Input wise costs involved in Paddy cultivation

The details of input wise cost in the different Classes of farmers are presented in Table 24.It could be seen from the Table that the major inputs used in Pokkali paddy cultivation were labour and seeds.

Table. 24 Comparison of Input Wise Costs across the different Classes in Pokkali Paddy Cultivation

(Rs per hectare)

Input	Class I	Class II	Class III	Class IV
Labour	15289.94 (89.45)	14552.76 (89.21)	14634.46 (89.42)	13115.67 (88.02)
Seed	1010.47 (5.91)	989.22 (6.07)	999.71 (6.12)	946.44 (6.35)
Transportation cost	92.52 (0.54)	114.76 (0.70)	97.48 (0.59)	90.92 (0.61)
Interest on Working Capital	381.22 (2.23)	280.99 (1.72)	236.53 (1.44)	230.65 (1.55)
Other costs	319.44 (1.87)	374.58 (2.25)	397.62 (2.43)	516.46 (3.47)
Total cost	**17093.57 (100.00)**	**16312.57 (100.00)**	**16365.80 (100.00)**	**14900.14 (100.00)**

(Figures in parentheses indicate percentage to total)

The labour cost constituted 89.45 per cent, 89.21 per cent, 89.42 per cent and 88.02 per cent out of the total cost in Class I, Class II, Class III and Class IV farms respectively. The seed cost constituted 5.91 per cent, 5.95 per cent, 6.12 per cent and 6.35 per cent of the total cost respectively, in the four classes. Other costs constituted 1.87 per cent, 2.25 per cent, 2.43 per cent and 3.47 of the total cost in Class I, Class II, Class III and Class IV farms. Transportation costs and interest on working capital constituted 2.77 per cent, 2.42 per cent, 2.03 per cent and 2.16 per cent of total cost respectively in the four classes.

The input wise cost exhibited the same trend across the Krishi Bhavans in the different classes. The details are furnished in Tables 25, 26, 27and 28.

Table. 25 Input wise Costs involved in Pokkali Paddy Cultivation -Class I Farms

(Rs per hectare)

Input	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Labour	13905.55 (86.26)	15474.24 (90.93)	16758.50 (88.49)	15289.94 (89.45)
Seed	1072.07 (6.65)	946.35 (5.56)	995.97 (5.26)	1010.47 (5.91)
Transportation cost	94.56 (0.59)	95.84 (0.56)	87.89 (0.46)	92.52 (0.54)
Interest on Working Capital	382.71 (2.37)	384.47 (2.26)	377.22 (1.99)	381.22 (2.23)
Other costs	665.33 (4.13)	117.17 (0.69)	718.85 (3.80)	319.44 (1.87)
Total cost	**16120.22 (100.00)**	**17018.07 (100.00)**	**18938.43 (100.00)**	**17093.57 (100.00)**

(Figures in parentheses indicate percentage to total)

Table.26 Input wise Costs involved in Pokkali Paddy Cultivation - Class II Farms

(Rs per hectare)

Input	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Labour	13722.50 (88.09)	14658.64 (89.95)	16243.71 (89.28)	14552.86 (89.21)
Seed	1020.38 (6.55)	959.76 (5.89)	1014.46 (5.58)	989.38 (6.07)
Transportation cost	108.86 (0.70)	122.52 (0.75)	110.12 (0.61)	114.76 (0.70)
Interest on Working Capital	289.24 (1.86)	272.28 (1.67)	282.14 (1.54)	280.99 (1.72)
Other costs	435.92 (2.80)	282.54 (1.74)	543.39 (2.99)	374.58 (2.30)
Total cost	**15576.90 (100.00)**	**16295.74 (100.00)**	**18193.82 (100.00)**	**16312.57 (100.00)**

(Figures in parentheses indicate percentage to total)

Table.27 Input wise Costs involved in Pokkali Paddy Cultivation -Class III Farms

(Rs per hectare)

Input	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Labour	13852.75 (89.58)	15140.11 (90.21)	15370.25 (88.92)	14634.46 (89.42)
Seed	955.37 (6.18)	939.3 (5.60)	1079.48 (6.24)	999.71 (6.12)
Transportation cost	99.95 (0.65)	97.28 (0.58)	94.59 (0.56)	97.48 (0.59)
Interest on Working Capital	228.78 (1.48)	232.91 (1.39)	247.28 (1.43)	236.53 (1.44)
Other costs	325.97 (2.11)	373.54 (2.22)	493.24 (2.85)	397.62 (2.43)
Total cost	**15462.82 (100.00)**	**16783.14 (100.00)**	**17284.84 (100.00)**	**16365.80 (100.00)**

(Figures in parentheses indicate percentage to total)

Table. 28 Input wise Costs involved in Pokkali Paddy Cultivation - Class IV Farms

(Rs per hectare)

Input	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Labour	13052.77 (89.33)	13220.12 (86.65)	13120.23 (87.49)	13115.67 (88.02)
Seed	944.23 (6.46)	975.21 (6.20)	949.71 (6.33)	946.44 (6.35)
Transportation cost	89.72 (0.61)	92.54 (0.61)	91.31 (0.61)	90.92 (0.61)
Interest on Working Capital	224.72 (1.54)	232.74 (1.53)	237.28 (1.58)	230.65 (1.55)
Other costs	299.34 (2.05)	764.54 (5.01)	597.95 (3.99)	516.46 (3.47)
Total cost	**14610.78 (100.00)**	**15256.15 (100.00)**	**14996.48 (100.00)**	**14900.14 (100.00)**

(Figures in parentheses indicate percentage to total)

Among different Krishi Bhavans under the different classes, the proportion of expenditure to meet the labour cost ranged between 86.26 per cent and 91.92 per cent of total cost. The seed cost constituted only between 5.26 per cent and 6.65 per cent. Other components such as transportation, interest on working capital and other costs constituted only 1.5 per cent to close to 3.00 per cent. The analysis would reveal that the Pokkali paddy cultivation happens to be labour intensive.

Yield in Pokkali Paddy Cultivation

The details regarding the average yield per hectare of Pokkali Paddy are furnished in the Table 29.

Table. 29 Average yield per hectare of Pokkali Paddy

Classes	Krishi Bhavans	No.	Yield in Kgs/ha
Class I	Varappuzha	12	1272.84
	Elankunnathupuzha	8	1279.64
	Ezhikkara	11	1382.38
	Total	31	1306.08
Class II	Varappuzha	5	1241.81
	Elankunnathupuzha	5	1213.12
	Ezhikkara	2	1456.03
	Total	12	1258.07
Class III	Varappuzha	6	1233.91
	Elankunnathupuzha	3	1376.06
	Ezhikkara	4	1344.42
	Total	13	1298.28
Class IV	Varappuzha	7	1062.47
	Elankunnathupuzha	4	1174.88
	Ezhikkara	5	1216.79
	Total	16	1138.80
Sample as a whole	Varappuzha	30	1210.80
	Elankunnathupuzha	20	1256.52
	Ezhikkara	22	1344.54
	Total	72	1259.50

An examination of Table 29 would show that the average yield per hectare of the sample as a whole was 1259.50 kgs per hectare. Ezhikkara recorded the highest yield of 1344.54 kgs per hectare, closely followed by Elankunnathupuzha with 1256.52 kgs per hectare and Varappuzha with 1210.80 kgs per hectare.

Among the different classes, Class I farms recorded the highest average yield at 1306.08 kgs per hectare. It was closely followed by Class III farms with 1298.28 kgs per hectare. Class II farms had an average yield of 1258.07 kgs per hectare. Class IV farms, however, had the lowest average yield of 1138.80 kgs per hectare.

In Class I farms, the yield ranged from 1382.38 kgs per hectare in Ezhikkara to 1272.84 kgs per hectare in Varappuzha. In Class II farms, yield varied between 1456.03 kgs per hectare in Ezhikkara and 1213.12 kgs per hectare in Elankunnathupuzha. In Varappuzha it was 1241.81 kgs per hectare. In Class III farms, the yield ranged from 1376.06 kgs per hectare at Elankunnathupuzha to 1233.91 kgs per hectare at Varappuzha. In Class IV farms, the yield ranged from 1216.79 kgs per hectare in Ezhikkara to 1062.47 kgs per hectare in Varappuzha.

Overall, the yield ranged between 1062.47 kgs and 1456.03 kgs per hectare indicating the scope to improve the average yield by better management practices though the scope for use of external inputs like fertilisers and pesticides are only remote.

Returns from Pokkali Paddy Cultivation

The details regarding the cost and returns from Pokkali Paddy Cultivation are furnished in Table 30.

Table. 30 Returns from Pokkali Paddy Cultivation

(Rs per hectare)

Classes	Krishi Bhavans	Total returns / ha,	Total Cost / ha,	Net Returns / ha.
Class I	Varappuzha	8909.86	16120.22	-7210.36
	Elankunnathupuzha	8957.50	17018.07	-8060.57
	Ezhikkara	9676.64	18938.43	-9261.79
	Total	9142.54	17093.59	-7951.05
Class II	Varappuzha	8692.65	15576.9	-6884.25
	Elankunnathupuzha	8491.84	16295.74	-7803.90
	Ezhikkara	10192.18	18193.82	-8001.64
	Total	8806.46	16625.11	-7818.65
Class III	Varappuzha	8637.37	15462.82	-6825.45
	Elankunnathupuzha	9632.43	16783.14	-7150.71
	Ezhikkara	9410.95	17284.84	-7873.89
	Total	9087.99	16365.80	-7277.81
Class IV	Varappuzha	7437.32	14610.78	-7173.46
	Elankunnathupuzha	8224.17	15256.15	-7031.98
	Ezhikkara	8517.54	14996.48	-6478.94
	Total	7971.60	14900.14	-6928.54
Sample as a whole	Varappuzha	8475.60	16105.54	-7629.94
	Elankunnathupuzha	8795.64	16551.30	-7755.66
	Ezhikkara	9411.78	17444.15	-8032.37
	Total	8816.5	16638.38	-7821.88

An examination of the results presented in the Table would show that the total returns per hectare for the sample, as a whole was Rs.8816.5. The net returns was always negative in all the cases, which indicated a loss. It was Rs.7821.88 for the sample as a whole.

The maximum returns was recorded in the case of Class I farms at Rs.9142.54 per hectare. It was closely followed by Class III farms with Rs.9087.99 per hectare. In Class II farms it was Rs.8806.46 per hectare while in Class IV farms it was the least at Rs.7971.60 per hectare.

The loss per hectare was maximum in the case of Class I farms at Rs.7951.05. In Class II farms it was marginally lower at Rs.7818.65 per hectare. In Class III it was Rs.7277.81 per hectare while the loss was minimum Class IV at Rs.6928.54.

In Class I farms, the total returns ranged from Rs.8957.50 per hectare in Elankunnathupuzha to Rs.9676.64 per hectare in Ezhikkara. The loss ranged from Rs.9261.79 per hectare in Ezhikkara to Rs.7210.36 per hectare in Varappuzha.

In Class II farms, the total returns ranged from Rs.8692.65 per hectare in Varappuzha to Rs.10192.18 per hectare in Ezhikkara. The loss ranged from Rs.8001.64 per hectare in Ezhikkara to Rs.6884.25 per hectare in Varappuzha.

In Class III farms, the returns varied from Rs.8637.37 per hectare in Varappuzha to Rs.9632.43 per hectare in Elankunnathupuzha. The loss varied from Rs.7873.89 per hectare in Ezhikkara to Rs.6825.45 per hectare in Varappuzha.

In Class IV farms, the returns varied from Rs.8517.54 per hectare to Ezhikkara to Rs.7437.32 per hectare in Varappuzha. The loss ranged from Rs.6478.94 per hectare in Ezhikkara to Rs.7173.46 per hectare Varappuzha.

One could infer the following from the analysis of costs and returns, which clearly showed that the rice cultivation always resulted in a loss to all the farmers. This could be attributed to many factors. Non adoption of high yielding varieties like Vyttila 1 and Vyttila 2 was noted in almost all the farmers. They had a feeling that it was not suited to the region. Also, the millers, the sole source of market for the Pokkali rice, did not prefer these high yielding varieties saying that they had poor milling quality. Some farmers even commented that original natural taste of Pokkali rice was only obtained in the case of local cultivars. The failure of pre monsoon showers also often lead to the failure of the crop. However, one important inference is that the scope to increase returns is very limited in the case of Pokkali paddy cultivation.

The Krishi Bhavans, the major co-ordinating centres for the local farmers do not have sufficient infrastructural facilities to facilitate the various requirements of the farmers. This coupled with unnecessary political intervention make their functioning highly difficult. The lack of strong farmers' organisations also makes it difficult for the farmers to have sufficient bargaining power over the labour organisations existing in the region. Labour costs are also very high thereby adding to the net loss. Still, the farmers go for rice cultivation with the hope of compensating the loss through the returns from prawn culture.

Prawn Culture

Pokkali cultivation signifies the typical rice prawn rotational cultivation in the Pokkali lands. The prawn culture is usually takenup in the second season and it usually starts in the beginning of November and ends in the middle of April, next year.

There are two major methods of prawn culture now prevalent in the Pokkali lands.

- Traditional Prawn Culture
- Improved Traditional Prawn Culture

Traditional Prawn Culture

After the harvest of paddy by the end of October, the fields are allowed to have free exchange of water. The fields are then cleaned by removing weeds and other undesirable species of organisms. The outer bunds are strengthened, the sluice gates are fixed in place where there is medium flow of water from canals or backwaters to the fields. After these preliminary operations, water is let into the fields during high tides at night, through the sluice, where the lights are arranged for luring in prawns. During low tide, water is let out through a bamboo screen, which prevents escape of fingerlings of prawn, and fish that had already entered the field and brings down the water level, so that water can again be taken in during high tide. The actual fishing operations start by the middle of January coinciding with the lunar phase. When the water is let out of the fields, during low tide, the prawns and fishes carried along with water are collected in prawn filtration net fitted to the sluice gate. The harvesting of prawns some times starts

in November itself but it becomes intensive from January. The filtration is carried out for about a week around every full moon and new moon, the period being locally called as *'thakkam'*. The process of filtration is continued for a period of 2 to 3 hours, depending on the force of out flow. The bulk of the prawns are caught during the initial hours. When the filtration is over the sluice gates are closed. By the middle of April, when the season terminates, a complete harvesting of entire stock of prawns and fishes is made by cast nets and drag nets and even hand picking after draining out the water to the extent possible. This process is called *'Kettukalakkal'*.

The catch mainly consists of *Metapenaeus dobsoni, Penaeus indicus,* crabs, and fishes like Etroplus, Tilapia and Mugil. Advantage of traditional method of prawn culture is that it requires only low investment and low level of input. The quality of yield obtained in traditional method is poor because the catches mainly constitute lower quality prawns, fishes and metapenaeids and majority of the prawns may be of smaller size. Many undesirable species of fishes of predatory behaviour enter the field along with incoming tidal water and is one of the reasons for low yield in such fields. Since the quantity and quality of prawn the farmers get from traditional prawn culture is low, the average price they get per kg of prawn is as low as Rs.35.37. Selective stocking of desirable species of commercially important prawns may enhance the yield from these farms.

Improved Traditional Prawn Culture

The traditional practice can be improved by the introduction of prawn fingerlings, provision for supplementary feeding, etc. The use of eradicants like Mahua cake can also be seen in many fields. The two major type of prawn fingerlings used for the Improved Traditional Prawn Culture are White Prawn (*Penaeus indicus*) locally known as Naran and the bigger Tiger Prawn (*P.monodon*) locally known as Kara. They grow fast in inpoundments, fetch higher price and are in great demand.

Farmers obtain prawn seed from local hatcheries as well as commercial hatcheries of other states. Those who cannot afford these high priced seeds, also go for local seed

collected from the sea and introduced into the field. Locally, the process of collecting such seeds from the sea is called *Koral*. A number of varieties may be available in this seed mixture and the quality may not be very high.

All the farmers surveyed for the present study go for introduction of prawn fingerlings in the field and therefore follow the improved traditional method of prawn culture. There are cases where the individual farmers do not go for prawn culture on their own but let out the field for lease to contractors. In some cases, the whole *Padasekharam* is auctioned and given for lease by *Padasekharam* Committee during the Prawn culturing. *Padasekharam* refers to a compact paddy area registered under one body known as "*Padasekharam* Committee".

Input Use in Prawn Culture in Pokkali Paddy Fields

The details regarding the inputs used in Prawn culture in Pokkali paddy fields are furnished in the Table 31.The Class IV farmers contract out their field and therefore, the cost-returns analysis could not be made for them.

Table.31 Inputs Required for Prawn Culture

Classes	Krishi Bhavans	No.	Feed (Kgs/ha)	Seed (Nos. /ha)	Labour (mandays/ha)
Class I	Varappuzha	12	318.75	32405.30	255.23
	Elankunnathupuzha	13	285.25	30204.28	232.19
	Ezhikkara	15	342.76	31384.17	270.14
	Total	40	316.86	31847.04	253.33
Class II	Varappuzha	5	196.58	22897.40	224.12
	Elankunnathupuzha	9	113.18	21925.25	212.35
	Ezhikkara	5	231.78	23402.35	231.49
	Total	19	166.34	22569.79	220.48
Class III	Varappuzha	6	89.08	15547.19	198.12
	Elankunnathupuzha	4	77.31	10430.82	172.35
	Ezhikkara	5	50.21	16324.94	189.37
	Total	15	72.98	14442.07	188.33

Rearing of prawn under the Pokkali system required the following major inputs namely, seed (fingerlings) feed and labour.

The fingerlings used per hectare varied very widely among the three classes of operations. In Class I farms, an average of 31847.04 fingerlings were used. It varied between 30204.28 fingerlings in Elankunnathupuzha and 32405.30 fingerlings in Varappuzha. It was 31384.17 fingerlings in Ezhikkara. In Class II farms, the average number of fingerlings used was 22569.79 which was only close to $3/4^{th}$ of the fingerlings used in Class I farms. Among the Krishi Bhavans it varied between 21925.25 in Elankunnathupuzha and 23402.35 in Ezhikkara. It was 22897.40 fingerlings in Varappuzha. In Class III farms, the average number of fingerlings used was 14442.07. It ranged between 10430.82 in Elankunnathupuzha and 16324.94 in Ezhikkara. It was 15547.19 in Varappuzha Krishi Bhavan. The fingerlings used were only little more than half of the quantity of fingerlings used in Class I farms.

It could be seen that under Class I, the average quantity of feed used was 316.86 kg per hectare. It varied between 285.25 kg in Elankunnathupuzha and 342.76 kg in Ezhikkara. It was 318.75 kg per hectare in Varappuzha. In Class II farms, the feed used was much lower at only 166.34 kg per hectare and it ranged between 113.18 kg in Elankunnathupuzha and 231.78 kg in Ezhikkara. It was 196.58 kg per hectare in Varappuzha. In the Class III farms, where only a local mixture of fingerlings were used, the quantity was still lesser at 72.98 kgs per hectare. It varied between 50.21 kg in Ezhikkara and 89.08 kg in Varappuzha Krishi Bhavans. It was 77.31 kg per hectare in Elankunnathupuzha.

Labour used in prawn culture in the three classes of farms also varied considerably. In Class I farms 253.33 mandays were used per hectare. Among the Krishi Bhavans, it ranged from 232.19 mandays in Elankunnathupuzha to 255.23 mandays in Varappuzha and 270.14 mandays in Ezhikkara. The average mandays used in Class II farms were 220.48 and it ranged between 212.35 mandays in Elankunnathupuzha and 231.49 mandays Ezhikkara. In Varappuzha, it was 224.12 mandays. The difference in

labour use between Class I and Class II farms was 32.85 mandays. In Class III farms the average mandays used was 188.33 and it ranged between 172.35 in Elankunnathupuzha and 198.37 mandays in Varappuzha. It was 189.37 mandays in Ezhikkara.

The analysis of input use would clearly reveal the larger variations that exist among the three classes of prawn rearing.

Operation wise Cost of Prawn Culture in Pokkali Fields

The major operations in the case of prawn culture happen to be the sluice management and general shrimp care including introduction of seedlings, application of feed, preparatory works of strengthening the outer bunds and sluices, application of eradicants if any etc. The next important operation is the harvesting which is done using small country canoes. Transportation also plays a major role.

The operation wise cost of prawn culture for different classes of prawn culture are furnished in the Table 32.

Table.32 Operation wise Cost of Prawn Culture in Sample Farms

(Rs per hectare)

Operations	Class I	Class II	Class III
Preparatory works	4359.77	3798.25	3441.57
	(9.30)	(11.88)	(14.36)
Sluice management and	31944.63	19608.85	13030.81
general shrimp care	(68.13)	(61.36)	(54.38)
Harvesting	2747.26	1898.48	1368.60
	(5.85)	(5.94)	(5.71)
Transport	555.35	633.35	515.37
	(1.18)	(1.98)	(2.15)
Interest on Working	443.43	402.32	388.20
Capital	(0.95)	(1.26)	(1.62)
Rental value	4000.00	4000.00	4000.00
	(8.53)	(12.52)	(16.69)
Other costs	2840.20	1617.73	1219.47
	(6.06)	(5.06)	(5.09)
Total cost	46890.64	31958.98	23964.02
	(100.00)	(100.00)	(100.00)

(Figures in parentheses indicate percentage to total)

An analysis of results presented in the table would indicate that the total cost of prawn rearing varied widely among the three classes. It was Rs.46890.64, Rs.31958.98 and Rs.23964.02 in Class I, Class II and Class III farms, respectively.

Among different operations, the sluice management and shrimp care constituted the major share. These were 68.13 per cent, 61.36 per cent and 54.38 per cent, respectively in Class I, Class II and Class III farms. Since, the Tiger Prawn required more care, it accounted for the relatively larger share of the cost in sluice management and general shrimp care in the case of Class I. Apart from the rental value, the next important operation was preparatory works. It constituted 9.30 per cent, 11.88 per cent and 14.36 per cent of total cost in Class I, Class II and Class III farms respectively. Cost of harvesting constituted 5.85 per cent, 5.94 per cent and 5.71 per cent, respectively. Transport constituted 1.18 per cent, 1.98 per cent and 2.15 per cent, respectively, in Class I, Class II and Class III farms. Other costs constituted between 5.06 per cent in Class II farms and 6.06 per cent in Class I farms. In Class III farms it was 5.09 per cent of the total cost.

It could be inferred from the results that though the total cost varied widely, the percentage composition was more or less similar. The trend regarding the percentage composition of cost was almost the same across the various Krishi Bhavans too, as could be seen from the Tables 33, 34 and 35.

It could be seen from these tables that in Class I farms, the total cost was maximum in Ezhikkara at Rs. 50948.94 while it was minimum in Elankunnathupuzha at Rs.40926.66. In Varappuzha the total cost was Rs.48363.32.Class II farms also exhibited the same trend with the cost varying from Rs.36487.33 in Ezhikkara to Rs.27561.21 in Elankunnathupuzha. At Varappuzha it was Rs.34946.60. In the case of Class III farms also the trend was slightly different with the cost ranging from Rs.22049.19 in Elankunnathupuzha to Rs.25191.44 in Varappuzha. In Ezhikkara, it was Rs.24123.05 per hectare.

Table. 33 Operation wise Cost of Prawn Culture-Class I farms

(Amount in Rs per hectare)

Operations	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Preparatory works	4477.22 (9.26)	4359.03 (10.65)	4266.06 (8.37)	4359.77 (9.30)
Sluice management and general shrimp care	33513.10 (69.29)	26097.78 (63.77)	35757.12 (70.18)	31944.63 (68.13)
Harvesting	2204.48 (4.56)	3604.66 (8.81)	2438.39 (4.79)	2747.26 (5.86)
Transport	593.81 (1.23)	617.71 (1.51)	470.54 (0.92)	555.35 (1.18)
Interest on Working Capital	474.23 (0.98)	423.31 (1.03)	436.24 (0.86)	443.43 (0.95)
Rental value	4000 (8.27)	3500 (8.55)	4500 (8.83)	4000 (8.53)
Other costs	3099.98 (6.41)	2324.17 (5.68)	3080.59 (6.05)	2840.20 (6.06)
Total cost	**48363.32 (100.00)**	**40926.66 (100.00)**	**50948.94 (100.00)**	**46890.64 (100.00)**

(Figures in parenthesis indicate percentage to total)

Table. 34 Operation wise Cost of Prawn Culture - Class II farms

(Amount in Rs per hectare)

Operations	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Preparatory works	2934.28 (8.4)	4112.92 (14.92)	4095.84 (11.22)	3798.25 (11.88)
Sluice management and general shrimp care	22429.74 (64.18)	16156.11 (58.62)	23002.88 (63.04)	19608.85 (61.36)
Harvesting	2772.22 (7.93)	1295.63 (4.8)	2109.89 (5.77)	1898.48 (5.94)
Transport	883.34 (2.53)	483.36 (1.75)	653.31 (1.80)	633.35 (1.98)
Interest on Working Capital	402.26 (1.15)	391.24 (1.42)	422.32 (1.16)	402.32 (1.26)
Rental value	4000 (11.45)	3500 (12.7)	4500 (12.33)	4000 (12.52)
Other costs	1524.76 (4.36)	1621.95 (5.88)	1703.09 (4.67)	1617.73 (5.06)
Total cost	**34946.6 (100.00)**	**27561.21 (100.00)**	**36487.23 (100.00)**	**31958.98 (100.00)**

(Figures in parenthesis indicate percentage to total)

Table.35 Operation wise Cost of Prawn Culture -Class III farms

(Amount in Rs per hectare)

Operations	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Preparatory works	3639.90 (14.45)	3266.97 (14.82)	3343.27 (13.86)	3441.57 (14.36)
Sluice management and general shrimp case	13961.52 (55.42)	11941.89 (54.16)	12785.12 (53.0)	13030.81 (54.38)
Harvesting	1482.44 (5.89)	1352.32 (6.13)	1244.99 (5.17)	1368.60 (5.71)
Transport	565.31 (2.24)	522.19 (2.37)	450.00 (1.86)	515.37 (2.15)
Interest on Working Capital	392.27 (1.56)	378.32 (1.72)	391.26 (1.62)	388.20 (1.62)
Rental Value	4000 (15.88)	3500 (15.87)	4500 (18.65)	4000 (16.69)
Other costs	1150.00 (4.56)	1087.50 (4.93)	1408.41 (5.84)	1219.47 (5.09)
Total cost	**25191.44 (100.00)**	**22049.19 (100.00)**	**24123.05 (100.00)**	**23964.02 (100.00)**

(Figures in parenthesis indicate percentage to total)

Analysis of operation wise cost structure among the different Krishi Bhavans under the three Classes would also reveal more or less the same pattern with only marginal differences.

Input Wise Cost of Prawn Culture in Pokkali Fields

The results of input wise cost of Prawn culture across the three different classes are furnished in Table 36.

Table.36 Input Wise Cost of Prawn Culture in Pokkali Fields

(Amount in Rs per hectare)

Inputs	Class I	Class II	Class III
Labour	13578.64 (28.96)	12810.57 (40.08)	11257.68 (46.97)
Seed	8148.08 (17.38)	2709.32 (8.48)	1701.66 (7.10)
Feed	12706.00 (27.09)	5821.76 (18.22)	1253.08 (5.23)
Sluice charge	2948.88 (6.29)	3332.59 (10.44)	3172.20 (13.24)
Eradicants	1669.46 (3.56)	631.64 (1.97)	456.36 (1.90)
Transport cost	555.35 (1.18)	633.35 (1.98)	515.37 (2.15)
Interest on Working Capital	443.43 (0.95)	402.32 (1.25)	388.2 (1.62)
Rental Value	4000 (8.53)	4000 (12.52)	4000 (16.69)
Other cost	2840.20 (6.06)	1617.75 (5.06)	1219.47 (5.1)
Total cost	**46890.64 (100.00)**	**31958.98 (100.00)**	**23964.02 (100.00)**

(Figures in parentheses indicate percentage to total)

It could be clearly observed from the table that labour was the major input in all the three Classes irrespective of the difference in cost composition. Labour cost constituted 28.96 per cent of the total cost in Class I farms while it was 40.08 per cent in Class II farms. It constituted 46.97 percent of the total cost in Class III farms.

Apart from the rental value, the next important input constituting a major portion of the total cost was the feed for prawn juveniles. It also varied widely across the different Classes. It constituted 27.09 per cent of the total cost in Class I farms, 18.22 per cent in Class II farms and 5.23 per cent in Class III farms. This wide difference could be basically attributed to the fact that the quantity and the quality of the feed, which had been provided to the prawn juveniles across the different classes, were widely different.

Other costs constituted 6.06 per cent of the total cost in Class I farms while it was 5.09 per cent of the total cost in Class III farms. It was 5.06 per cent of the total cost in Class II farms.

Transportation costs came next in the order of importance. In Class III farms it constituted 2.15 per cent of the total cost followed by Class II farms constituting 1.98 per cent and Class I farms constituting only 1.18 per cent.

Interest on working capital was maximum in Class III farms constituting 1.62 per cent of the total cost. While it was 1.16 per cent in the case of Class II farms it was 0.95 per cent in the case of Class I farms.

The same trend in cost composition could be observed in the case of the three Krishi Bhavans also across the three classes. The details of input wise costs in the three different classes across the Krishi Bhavans are furnished in the Tables 37, 38 and 39.

Table. 37 Input wise Cost in Prawn Culture - Class I farms

(Rs per hectare)

Inputs	**Varappuzha**	**Elankunnathupuzha**	**Ezhikkara**	**Total**
Labour	15026.15	12134.14	13672.52	13578.64
	(31.07)	(29.65)	(26.83)	(28.96)
Seed	8828.36	4632.67	10651.07	8148.08
	(18.25)	(11.32)	(20.91)	(17.38)
Feed	11430.66	12726.08	13710.46	12706.60
	(23.64	(31.10)	(26.91)	(27.09)
Sluice charges	3462.32	2968.00	2521.56	2948.88
	(7.17)	(7.26)	(4.95)	(6.29)
Eradicants	1447.81	1601.18	1905.96	1669.46
	(2.99)	(3.91)	(3.74)	(3.56)
Transport cost	593.81	617.71	470.54	555.35
	(1.22)	(1.51)	(0.92)	(1.18)
Interest on Working	474.23	423.31	436.24	443.43
Capital	(0.98)	(1.03)	(0.86)	(0.95)
Rental value of	4000	3500	4500	4000
ownland	(8.27)	(8.55)	(8.83)	(8.53)
Other cost	3099.98	2324.17	3080.59	2840.20
	(6.41)	(5.67)	(6.05)	(6.06)
Total cost	**48363.32**	**40927.66**	**50948.94**	**46890.64**
	(100.00)	**(100.00)**	**(100.00)**	**(100.00)**

(Figures in parentheses indicate percentage to total)

Table. 38 Input wise Cost of Prawn Culture - Class II farms

(Rs per hectare)

Input	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Labour	14856.91 (42.51)	11551.49 (41.91)	13030.58 (35.71)	12810.57 (40.08)
Seed	3289.33 (9.41)	1750.02 (6.36)	3856.05 (10.58)	2709.32 (8.48)
Feed	6880.17 (19.69)	3961.32 (14.38)	8112.14 (22.24)	5821.76 (18.22)
Sluice charges	3109.83 (8.90)	3733.94 (13.55)	2832.95 (7.76)	3332.59 (10.44)
Eradicants	0 (0.00)	567.89 (2.06)	1376.91 (3.77)	631.64 (1.97)
Transport cost	883.34 (2.53)	483.36 (1.75)	653.31 (1.79)	633.35 (1.98)
Interest on Working Capital	402.26 (1.15)	391.24 (1.42)	422.32 (1.16)	402.32 (1.25)
Other cost	1524.76 (4.36)	1621.95 (5.88)	1703.09 (4.66)	1617.73 (5.06)
Rental Value	4000 (11.45)	3500 (12.69)	4500 (12.33)	4000 (12.52)
Total cost	**34946.6** **(100.00)**	**27561.21** **(100.00)**	**36487.35** **(100.00)**	**31958.98** **(100.00)**

(Figures in parentheses indicate percentage to total)

In Class I farms, high quality and costly feeds like 'Higashi maru', were administered to promote the most suitable living conditions to the Tiger Prawn to achieve considerable size, so that it would fetch a good price in the market. In Class II farms, the quality of feed was comparatively poor with only few farmers resorting to high quality feeds and others using a unique traditional combination of wheat flour, shell meat, intestine waste, etc. In Class III farms most farmers seldom bothered about feeding especially if it was a field with rice cultivation in the first season. If feed was still administered it was the traditional one (traditional combination of wheat flour, shell meat, intestine waste, etc) which was comparatively cheaper. This accounted for the wide variation in feed cost across the classes.

The sluice charges constituted 10.44per cent of total cost in Class II farms while it was 13.24 per cent in the case of Class III farms. In Class I farms it constituted only 6.29 per cent of the total cost.

Seed cost came as another important constituent of total cost in Class I farms with it constituting 17.36 per cent of it. But it was only 8.48 per cent in Class II farms and 7.10 per cent in Class III farms.

This wide difference in seed cost could be attributed to the wide difference, which existed in seed prices. In Class I farms, White Prawn and Tiger Prawn fingerlings were used. A white prawn fingerling costs only upto 10 ps while in the case of Tiger prawn it could vary from 50ps to80 ps per fingerling. The total mixed type from sea used in Class III farms was priced as low as 4 to 5 ps per fingerling. This attributed to the wide range in seed costs across the three classes.

Another input of considerable weightage was the eradicants. Eradicant cost constituted 3.56 per cent of the total cost in Class I farms, 1.97 per cent in Class II farms and 1.90 per cent in Class III farms. The use of eradicants was subject to many constraints. The fisher folk in the region were vehemently against it since they believed that it would affect the fish population in the main water bodies once the out flowing water with eradicants reaches them. This had prevented the farmers from using it in many regions, particularly so in Varappuzha.

Table. 39 Input Wise Cost Of Prawn Culture - Class III farms

(Amount in Rs per hectare)

Input	Varappuzha	Elankunnathupuzha	Ezhikkara	Total
Labour	11764.63 (46.71)	10563.02 (47.91)	11205.08 (46.45)	11257.68 (46.97)
Seed	1672.71 (6.61)	962.43 (4.36)	2327.79 (9.65)	1701.66 (7.10)
Feed	1781.60 (7.11)	1546.39 (7.01)	384.28 (1.59)	1253.08 (5.22)
Sluice charge	3300.35 (13.10)	2624.84 (11.91)	3456.29 (14.33)	3172.20 (13.24)
Eradicants	564.57 (2.24)	864.5 (3.92)	0 (0.00)	456.36 (1.90)
Transport cost	565.31 (2.24)	522.19 (2.37)	450.00 (1.87)	515.37 (2.15)
Interest on Working Capital	392.27 (1.55)	378.32 (1.72)	391.26 (1.62)	388.2 (1.62)
Rental Value	4000 (15.87)	3500 (15.87)	4500 (18.65)	4000 (16.69)
Other cost	1150.00 (4.57)	1087.50 (4.93)	1408.41 (5.84)	1219.47 (5.1)
Total cost	**25191.44 (100.00)**	**22049.19 (100.00)**	**24123.11 (100.00)**	**23964.02 (100.00)**

(Figures in parentheses indicate percentage to total)

Prawn Yield in Different Classes of Farms across the Krishi Bhavans

The details of yield of prawns in the different classes of prawns are given in Table 40.

Kara or Tiger prawn was cultured only in the case of Class I. The average yield per hectare was 240.93 kgs for Class I as a whole, while it was 314.63 kgs per hectare for Varappuzha, 171.19 kgs per.hectare for Elankunnathupuzha and 242.42 kgs per hectare for Ezhikkara.

Table.40 Yield in kgs per hectare of Different Prawn Varieties Across the Different Classes

Classes	Krishi Bhavans	Naran (White Prawn)	Kara (Tiger Prawn)	Thelli
Class I	Varappuzha	151.25	314.63	286.84
	Elankunnathupuzha	113.13	171.19	202.31
	Ezhikkara	133.65	242.42	257.50
	Total	132.26	240.93	248.36
Class II	Varappuzha	222.26	0	368.53
	Elankunnathupuzha	138.66	0	272.63
	Ezhikkara	245.64	0	344.26
	Total	188.81	0	316.72
Class III	Varappuzha	156.88	0	319.10
	Elankunnathupuzha	106.54	0	229.66
	Ezhikkara	140.30	0	237.81
	Total	137.93	0	268.15

The comparatively lower yield in Elankunnathupuzha could be mainly attributed to the virus infection prevalent in the region.

Naran or White Prawn was present in the case of all the three classes. The highest average yield was 188.81 kgs per hectare in the case of Class II farms while it was 132.26 kgs per hectare in Class I farms and 137.93 kgs per hectare in Class III farms.

The differences was mainly because of the fact that since in Class II only Naran seeds are introduced they face comparatively less competition and grow upto a bigger size.

In Class I farms, Varappuzha had the highest average yield of Naran at 151.25 kgs per hectare followed by Ezhikkara at 133.65 kgs per hectare and Elankunnathupuzha at 113.13 kgs per hectare.

In Class II farms, Ezhikkara had the highest average yield of Naran at 245.64 kgs per hectare followed by Varappuzha at 222.26 kgs per hectare Elankunnathupuzha had the least at 138.66 kgs per hectare.

In Class III farms again, Varappuzha had the highest average yield of Naran at 156.88 kgs per hectare followed by Ezhikkara at 140.30 kgs per hectare. In the case of Elankunnathupuzha it was only 106.54 kgs per hectare.

Naran was also susceptible to virus attack. Hence, the reduced yield in Elankunnathupuzha could be attributed to the same, coupled with the reduced investment in inputs and operations.

The yield of Thelli was basically a gamble because it depends on how much fingerlings (seed) come in by infiltration. With the Thelli having very little export value the farmers were not interested in introducing them as fingerlings. The amount of infiltration largely depends on proximity to sea or backwaters and other conditions.

The highest average yield of Thelli was in Class II farms at 316.72 kgs per hectare while it was 248.36 kgs per hectare for Class I farms and 268.15 kgs per hectare for class III farms.

In Class II farms Varappuzha had the highest average yield of 368.53 kgs per hectare followed by Ezhikkara at 344.26 kgs per hectare. Elankunnathupuzha had an average yield of 272.63 kgs per hectare.

In Class I farms, Varappuzha again had the highest average yield at 286.84 kgs per hectare while Ezhikkara and Elankunnathupuzha had 257.50 kgs per hectare and 202.31 kgs per hectare respectively.

In Class III farms also Varappuzha had the highest average yield at 319.10 kgs per hectare followed by Ezhikkara having an average yield of 237.81 kgs per hectare. In the case of Elankunnathupuzha the average yield was 229.66 kgs per hectare.

Returns from Prawn Culture in Pokkali Fields

The details on the returns from various classes of prawn culture are furnished in Table 41.

Table.41 Returns from Prawn Culture in Pokkali Fields across the different Classes

Classes	Krishi Bhavans	Total Returns	Total cost	Net Returns
Class I	Varappuzha	160602.82	48363.32	112249.50
	Elankunnathupuzha	93964.32	40926.66	53037.66
	Ezhikkara	127794.68	50948.94	76845.74
	Total	126642.25	46890.64	79751.61
Class II	Varappuzha	48561.81	34946.60	13615.21
	Elankunnathupuzha	32156.45	27561.21	4595.24
	Ezhikkara	51123.32	36487.35	14635.97
	Total	41464.93	31958.98	9505.95
Class III	Varappuzha	36783.86	25191.44	11592.42
	Elankunnathupuzha	29621.82	22049.19	7572.73
	Ezhikkara	31183.70	24123.05	7060.75
	Total	33007.26	23964.02	9043.24

The results presented in the table would reveal that Class I farms registered the highest total returns of Rs.1,26,642.25 with a net return of Rs.79,751.61. In Class II farms, with the total returns was Rs.41464.93 with net returns at Rs.9505.98. Class III farms had the least total returns of Rs.33007.26 with net returns of Rs.9043.24.

The same trend could be seen in the case of all the Krishi Bhavans too.

In Class I farms the maximum total returns was noticed in Varappuzha with Rs.160602.80. It was Rs.127794.68 in the case of Ezhikkara and Rs.93964.32 in the case of Elankunnathupuzha. The net returns was also the highest in Class I farms in the case of Varappuzha at Rs.112249.50 followed by Ezhikkara where Rs.76845.74 and it was

least in the case of Elankunnathupuzha with Rs.53037.66. This was so because of the prevalent virus infection in Elankunnathupuzha which killed a lot of Tiger prawns and White prawns since they were particularly prone to it.

In Class II farms the maximum total returns was in the case of Ezhikkara at Rs.51123.32. It was minimum in Elankunnathupuzha at Rs.32156.45. In Varappuzha it was Rs.48561.81. The net returns were maximum in the case in Ezhikkara at Rs.14635.99 while it was minimum in Elankunnathupuzha at Rs.4595.24 and in Varappuzha it was Rs.13615.21.

In Class III farms however the total returns were maximum in Varappuzha at Rs.36783.86, while it was minimum in Elankunnathupuzha at Rs.29621.82. Ezhikkara had a total return of Rs.31183.70. The net returns were the highest in the case of Varappuzha at Rs.11592.42. It was Rs.7572.73 in Elankunnathupuzha while Ezhikkara had a net return of Rs.7060.75.

Returns Gained by the Farmers who lease out the Land

The returns obtained by the farmers who leased out the land after cultivation of paddy for prawn culture is furnished in the Table 42.

Table. 42 Average Lease Value of Land in the different Classes

Class	Krishi Bhavans	Rs./ha
Class IV	Varappuzha	3705.45
	Elankunnathupuzha	3625.27
	Ezhikkara	4675.32
	All Krishi Bhavans	3988.49

The average lease value for the farms as a whole was Rs.3988.49 per hectare. Among the Krishi Bhavans it was highest in Ezhikkara at Rs.4675.32. In Varappuha the lease value was Rs.3705.45 per hectare. In Elankunnathupuzha the average lease value per hectare was marginally less compared to others due to prevalence of virus infection in

certain fields and an increased susceptibility to it in others. The lease value varied from region to region. The information furnished above could indicate the fact that individual leasing out would not help the farmers economically. The farmers stood to gain by going for cultivation on their own.

Savings in Feed Cost and Value of Yield Difference in the case of Rice Prawn and Fallow Prawn Sequence

Discussions in earlier sections would indicate that rice cultivation ended in loss in all the cases. However, literature indicate that in rice prawn sequence, the paddy stubbles and straw decay and create an unique ecological environment suited for prawn culture. The stubbles would form a hiding place for the prawn fingerlings .It was also a source of food to them. It might probably save some cost of food. In the fallow prawn sequence, the ecological adaptability would be reduced and more amount of feed would be required. The yield is also high in the rice prawn situation. Therefore a comparison was made to find out the net effect of savings in feed and changes in yield if any and consequent changes in the value of additional yield or otherwise.

Table. 43 Feed Used and Yield in the case of Rice Prawn and Fallow Prawn Conditions

Classes	Type	Feed (Kgs /ha.)	Yield (kgs/ha)		
			Naran	Kara	Thelli
Class I	Rice prawn	305.31	131.39	247.46	263.37
	Fallow prawn	447.91	120.97	212.10	238.31
Class II	Rice prawn	236.68	189.88	0	360.95
	Fallow prawn	516.23	169.22	0	296.30
Class III	Rice prawn	71.84	145.21	0	185.36
	Fallow prawn	159.58	90.59	0	156.28

The results furnished in Table 43 showed that in all the three Classes of prawn culture in the rice prawn sequence the Quantity of feed used was relatively less. In Class I farms the difference was 142.61 kgs per hectatre.In Class II farms the difference was 279.55 kgs per hectare,wheras the difference was 87.74 kgs per hectare in Class III farms. However the yield of prawn was always higher in the case of rice prawn sequence.

In Class I farms the additional yield of Naran was 10.42 kgs, the additional yield of Kara was 35.36 kg and that of Thelli was 25.06 kgs per hectare.

In Class II farms the additional yield of Naran was 20.66 kgs and that of Thelli was 64.65 kgs. In Class III farms the additional yield of Naran was 54.62 kgs and that of Thelli was 29.08 kgs per hectare.

The analysis would clearly reveal that there was savings in feed, while the yield was always high in the rice-prawn sequence. The net savings of the farmers who would go for rice cultivation in the first season followed by prawn culture is furnished in Table 44.

Table. 44 Net Savings of the Farmers who go for Rice Cultivation in the First Season

Classes	Saving in seed cost	Increase in the value of output	Total benefit	Loss incurred in paddy cultivation	The Net Value
(1)	(2)	(3)	(4)	(5)	(4)-(5)
Class I	4641.44	16324.1	20965.54	7951.05	13014.49
Class II	5193.24	4845.0	10038.24	7818.65	2220.59
Class III	1316.13	2929.5	4245.63	7277.81	-3032.18

The details furnished in the table would clearly show that by going for rice in the first season, the farmers clearly benefit by savings in feed and obtaining additional yield in all the Classes .In Class I farms, the difference between the additional gain even after accounting for loss incurred in paddy cultivation was Rs. 13014.94 per hectare. In Class

II farms the additional gain was Rs.2220.59.However in Class III farms the farmers could only reduce the loss from Rs.7277.80to Rs.3032.18.In any case , the rice prawn sequence proved to be advantageous as compared to fallow prawn sequence.

The information furnished in the table 44 also helped to conclude clearly that the farmers did not stand to gain by going for culture with the local seedlings (Koral) though the cost involved was less.

Employment generated by Pokkali Rice Prawn Culture

The employment generated by Pokkali rice prawn culture is given in the Table 45. It could be seen from the table that the mandays requirement for paddy cultivation in the classes of farms ranged from 128.89 mandays in ClassIII farms to 139.14 mandays in Class I farms. It was 130.10 mandays in Class II farms .The mandays requirement for prawn culture ranged between 188.33 mandays in Class III farms and 253.33mandays in Class I farms.It was 220.48 man days in Class II farms.The total mandays required for paddy prawn sequence ranged between 317.22 mandays in Class III farms and 392.47 mandays in Class I farms.It was 350.58 mandays in Class II farms.

Table.45 Employment generated by Pokkali Rice Prawn Culture

Class	Krishi Bhavans	Paddy	Prawn	Total
Class I	Varappuzha	132.09	255.23	387.32
	Elankunnathupuzha	142.17	232.19	374.36
	Ezhikkara	144.23	270.14	414.37
	Total	**139.14**	**253.33**	**392.47**
Class II	Varappuzha	121.27	224.12	345.59
	Elankunnathupuzha	135.24	212.35	347.59
	Ezhikkara	139.35	231.49	370.84
	Total	**130.10**	**220.48**	**370.84**
Class III	Varappuzha	122.23	198.12	320.35
	Elankunnathupuzha	133.74	172.35	306.09
	Ezhikkara	135.25	189.37	324.62
	Total	**128.89**	**188.33**	**317.22**

In the different Krishi Bhavans across the different Classes, the total mandays used varied between 306.09 mandays and 414.37 mandays. It could very clearly indicate the enormous employment potential of the Pokkali system. This would rather serve as a livelihood system of the farmers in the area.

Another important fact is that preliminary operations for paddy cultivation starts in the month of May and extends upto September end. After leaving the land fallow for a month in October, the preliminary operations for prawn culture will begin in November and extend to April in the next year. This would mean that employment is spread all through the year with intensity varying in different periods of crop growth and prawn culture.It is observed to be an excellent livelihood system.

Resource Use Efficiency

In the present study resource use efficiency has been estimated using Cobb-Douglas production function. A production function has been fitted here for the Prawn culture as a whole.

Prawn Culture

The variables used in the model as explanatory variables included Feed (X_1) in kilograms/hectare; sluices (X_2) in Number / hectare; seed (X_3) in number of seedlings / ha and Labour (X_4) in number of mandays / hectare. The dummy variable (D_1) to represent the variations among the Krishi Bhavans, the dummy variable(D_2) to capture the effect of use of eradicants and the dummy variable (D_3) to account for the variation due to raising paddy in the first season.

The production function fitted for prawn culture had an R^2 value of 0.692 which would indicate that 69.2 per cent of the variation in Prawn yield could be explained by the explanatory variables (independent variables) included in the function. The results of the functional analysis are furnished in the following Table 46.

Table. 46 Estimates of Parameters of the Cobb-Douglas Production Function for Prawn Culture

Variables	Production elasticities (Coefficients)	Standard error	't' value
Intercept	2.82	0.785	3.592
Feed in kgs/ha	0.187**	0.075	2.505
Sluices in Number / ha	0.098	0.092	1.064
Seed in Number /ha	0.260*	0.078	3.341
Labour in mandays / ha	-0.035	0.140	-0.25
D_1	0.236*	0.068	3.472
D_2	0.039	0.062	0.628
D_3	0.029	0.104	0.278

N : 40

R^2 : 0.692

$\overline{R^2}$:0.624

F Value : 10.25*

Returns to Scale : 0.81

* Significant at one per cent level of probability

** Significant at five per cent level of probability

The estimated regression coefficients of the independent variables represent the production elasticities of the respective factors. It could be seen that *ceteris paribus*, one per cent increase in the use of feed would help in increasing the yield of prawn by 0.19 per cent. This variable would significantly influence the yield at 5 per cent probability level. Letting of seed material (prawn finger lings) would influence yield significantly at one per cent probability level. One per cent increase in the use of seed material would increase the yield by 0.26 per cent. Similarly, the dummy variable to capture the regional variation was also significant at one per cent probability level.

The analysis would indicate the scope to considerably increase the yield of prawn by proper management of prawn population and also through increasing the use of feed material.

Positive sign for the explanatory variables; feed, number of sluices and seed clearly indicated that greater yield could be achieved if farmers use more of these inputs. The negative sign for labour indicated that it would be worth while for the cultivator if the use of this input was reduced. The regression coefficients of the variables, feed and seed and the Dummy D_1 to capture the regional effect were found to be significant. This showed that seed and feed had significant influence on the production process.

Rice cultivation

Rice cultivation in the Pokkali region is basically a gamble with the elements of nature. Whatever be the level of inputs one use (only seed and labour), a slight variation in the climatic parameters like failure of pre monsoon showers could result in the loss of an entire crop. A Cobb-Douglas type of production function was conceptualised to capture the effect of the following variables, namely, seed labour, age of the farmer, experience of the farmer in the Pokkali system of paddy prawn culture, the family size and the dummy variable to capture the effect of regional variations.

The results of the functional analysis for rice cultivation are furnished in Table 47.

Table. 47 Estimates of Parameters of the Cobb-Douglas Production Function for Rice Cultivation

Variables	Coefficient	Standard error	T.Statistics
Intercept	17.701	2.501	7.075
Seed	-0.204	0.181	-1.131
Age	-0.061	0.039	-1.560
Experience	+0.076	0.053	1.427
Labour	-0.011	0.025	-0.426
Family Size	0.015	0.016	0.896
D_1	-0.170	0.050	-3.372

N	:	72	R^2	:	0.26
$\bar{R}^2$	:	0.19	F	:	3.727

The functional analysis revealed a very low R^2 value of 0.26. However, the F value of 3.727, significant at one per cent level would indicate the appropriateness of the fit. This showed that only 26.0 per cent of the total, variation in the dependent variable could be explained by the independent variables. The results would show that only the intercept was significant and none of the explanatory variables exerted any significant effect on yield. Also the variables with the exception of experience and family size carried negative signs as against the *apriori* assumptions. The nature of the results that the functional fit being significant, only the intercept being significant would reveal the fact that the paddy yield is largely influenced by the random effects inspite of the use of labour and seed to a considerable extent. The results would further emphasise the need for better management which may be a real problem as the average age of Pokkali farmers which was greater than 58 , which is the age where accepting new ideas will be a strenuous process. However, the results would indicate the need for better attention to be bestowed upon paddy cultivation in this system which would support very effectively the prawn culture in the succeeding season by way of reducing the feed cost and providing a congenial environment to the growing prawn and fish which would ultimately result in a relatively higher yield.

Case Study

Pokkali cultivation system, or rice prawn rotational cultivation system is unique in its own way. Being a purely organic form of cultivation the ecological environment in the rice fields is highly amenable to form a suitable habitat for the prawns in the second season. The rice being a highly risky venture, the farmers incur heavy losses and therefore completely depend on the second crop of prawn to cover the losses and reap profits. The prawn farming in the second season, mostly an export oriented venture prevent the farmers from going bankrupt.

The farmers generally depended on natural infiltration of Prawns fingerlings during low tide in the second season (November - April). However in the recent years, the farmers have resorted to a semi-scientific way of prawn farming, ie the improved traditional method of prawn culture, where artificial seedlings from the hatcheries are

introduced into the fields. This method has shown an increasing trend in the recent years with the reduced infiltration in to the fields. Improved traditional prawn farming, if meticulously planned and judiciously carried out can bring out excellent results making it an attractive, economicaly viable option for the prawn farmers of the Pokkali region. Inspite of the initial high investment involved in the improved method it brings out good returns if carefully managed. However, those farmers who follow the scientific method down to each and every meticulous detail are very few. In this case study, a unique case of successful integration of the traditional and scientific method of cultivation is presented.

Established in 1995, Sri Durga Arquafarm Varappuzha has completed 6 successful years. Scrupulously maintained and effectively monitored, the success story of the farm shows a case of unique integration of traditional and scientific method of prawn farming.

The farm is run by Mr.Krishna kumar, an Engineer by profession who is now completely dedicated to the farming enterprise. The total farm area itself is about 12.15 hectares. Out of this he has exclusively allocated in 4.9 hectares is dedicated to scientific prawn culture. This area was divided into four ponds of almost equal dimension each coming upto 1.03 hectares including the area of the outer bunds. The rest of the area ie. 7.25 hectares were more or less used for traditional prawn farming where majorities of the prawn fingerlings (Seedlings) come in by infiltration.

The farm has a quite big labour force who are hired for the period of prawn culture. They are generally treated as permanent labourers.

The operation wise and input wise costs of cultivation of rice, when computed were almost comparable to those of respondents in the study. The details on the operation wise and input wise cost of paddy are furnished in Tables 48 and 49.

Table.48 Operation Wise Cost and Returns of Rice Cultivation in the Case Study Farm

(Rs. per hectare)

Operation	Cost
Land preparation	3780.02 (23.59)
Seeds and Sowing	2970.55 (18.54)
Vettieru	4082.82 (25.48)
Intercultural operations	527.34 (3.29)
Harvesting	2755.72 (17.20)
Transportation Cost	127.65 (0.79)
Other Costs	1781.32 (11.11)
Total cost	**16025.42 (100.00)**
Total returns	**8823.69**
Loss	**7201.73**

(Figures in parentheses indicate percentage to total)

Table.49 Input Wise Cost and Returns of Rice Cultivation in the Case Study Farm

(Rs. per hectare)

Input	Cost
Labour cost	14061.48 (87.74)
Seed cost	1246.97 (7.78)
Transportation Cost	127.65 (0.79)
Other Costs	589.32 (3.69)
Total cost	**16025.42 (100.00)**
Total returns	**8823.69**
Net loss	**7201.73**

(Figures in parentheses indicate percentage to total)

Similar to that of the sample farmers, 67.61 per cent was incurred in the initial stages of cultivation. The total cost (Rs.16025.45 per hectare), returns (Rs.8823.69 per hectare) and loss (Rs.7201.73 per hectare) were similar in magnitude when compared to the sample farmers. The input wise cost also exhibited to similar trend.

Here also, though the farmer was aware of the high yielding varieties and the advantages of cultivating it, but could not do so because the millers, the sole buyers of Pokkali rice preferred the local varieties to it.

Though the rice cultivation was a total loss for this farmer too, he made up the loss through the subsequent prawn crop.

The farm, especially the scientific part of it was meticulously maintained. The farmer was well aware of the new innovations in prawn culture and was interested in adopting them for increasing the yield. In the region where scientific prawn culture was practiced, mostly Tiger Prawn (Kara), the most sought after in the export market was cultured. Each of the four ponds, had two cement sluices each, well protected by nets of fine mesh size to prevent the introduced prawn juveniles from moving out. The initial installation cost of the sluices was Rs.15000/-. The most important advantage of these small cement sluices was that they did not require yearly maintenance. Aerators each costing about Rs.12000/- were installed at the rate of 2 each in three of the ponds. This ensured adequate air circulation. Natural infiltration was reduced to the minimum in these parts. A narrow canal strip separated the scientific area from the region subjected to natural infiltration. A high discharge pump was also used to facilitate adequate water exchange. An average rate of 30,000 prawn juveniles per hectare was maintained.

The farmer believed in the application of probiotics like Epizin, which could maintain the ecological environment by promoting the growth of beneficial bacteria and other micro organisms in the ponds making it more suitable for the prawn juveniles. Initially, after the application of eradicant ie., Mahuacake, to destroy the predatory fishes,

water was let in. The prawn juveniles were introduced into the field only then. Epizin was introduced at the rate of 100g/ha about one week after the introduction of prawn juveniles. This helped in promoting the growth of beneficial bacteria, which could promote healthier growth of the introduced fingerlings.

The farmer also used an instrument called Refractometer for periodic monitoring of water quality, by checking whether the water is turbid by the accumulation of food materials, and other waste products. If ever there was a slight variation in pH, the farmer went for the application of lime prior to introduction of prawn juveniles.

Water exchange at mandatory levels was done every day using the pump. This also facilitated increased aeration and prevented the water from becoming stagnant. Application of Pottassium Permanaganate formulations like Stayphor at the rate of 1 litre/hectare ,once in 10 days or 15 days helped in annihilating the growth of any other microorganisms which could inhibit its growth. The feed used was Higashimaru since it did not accumulate and the juvenile prawns were able to assimilate them quickly.

The initial investment in this case was very high and meticulous care should be taken for maintenance. Therefore, though it brought about rich dividends in the long run, it was taxing or both time and capital.

The operational and input cost structure of the farm is furnished in the Tables 50 and 51. The cost on the farm infrastructure like sluices, instruments etc. and to the increased expenditure by the farmer since the number of sluices are more. The application of probiotics also proved to be costly.

Table.50 Operation Wise Cost and Total Returns of Prawn Culture in the Case Study Farm

(Rs. per hectare)

Operation	**Cost**
Preparatory works	4897.22 (9.38)
Sluice management and general shrimp care	39813.10 (76.27)
Harvesting	2604.48 (4.99)
Transport	583.81 (1.12)
Other costs	4299.98 (8.24)
Total cost	**52198.59 (100.00)**
Total returns	**180202.95**
Net returns	**128004.36**

(Figures in parentheses indicate percentage to total)

Table.51 Input Wise Cost and Total Returns of Prawn Culture in the Case Study Farm

(Rs. per hectare)

Input	**Cost**
Labour cost	17526.15 (33.58)
Seed	9938.36 (19.03)
Feed	13430.66 (25.73)
Sluice	4362.32 (8.36)
Eradicant	2057.31 (3.94)
Transportation cost	583.81 (1.12)
Other cost	4299.98 (8.24)
Total cost	**52198.59 (100.00)**
Total returns	**180202.95**
Net returns	**128004.36**

(Figures in parentheses indicate percentage to total)

Sluice management and general shrimpcare dominated the operation wise cost constituting 76.27 per cent of the total cost, which was definitely higher then, the sample farmers surveryed. Preparatory works constituted 9.38 per cent and harvesting and other costs were also noted to be important. In the case of inputs too, labour cost dominated at 33.58 per cent of the total cost followed by feed cost at 25.73 per cent. Eradicants were used in the field. The total returns were Rs.180202.95 while net returns was Rs.128004.36.

The average yield of Tiger prawn was noted to be 330.27 kgs per hectare as against 240.93 kgs per hectare for sample farms in Class I. While that of Naran (White Prawn) was 196.77 kgs per hectare as against 137.93 kgs per hectare in Class III farms, Thelli yield came upto 285.22 kgs per hectare as against 268.15 kgs per hectare in Class III farms.

On comparison of the yield with the general trend one could see that in the case of scientific farming, yields are comparatively higher. Though the costs were also higher because of meticulous care required, it paid rich dividends in the end.

The farmer got an ample crop of fish also from the field after the harvest of prawn. He was also of the opinion that rice cultivation in the first season helped in the initial establishment of prawn juveniles. The farmer also opined that majority of the farmers, preferred improved traditional method because of the reduced risk attached to it. Also, the initial high investment was not a problem in this case. However, he pointed out availability of adequate credit as a problem.

SUMMARY AND CONCLUSION

CHAPTER VI

SUMMARY AND CONCLUSIONS

Pokkali cultivation is a unique rice prawn rotational system, indigenously maintained in the Pokkali tract of Ernakulam, Thrissur and Alleppey. This study was intended as the economic analysis of the system based on the data collected from the areas under the three sample Krishi Bhavans in Ernakulam i.e., Varappuzha, Elankunnathupuzha and Ezhikkara.

The objectives of the study are as follows

i) to analyse the cost and returns of rice cultivation in the Pokkali cultivation.
ii) to analyse the cost and returns in prawn culture in Pokkali system.
iii) to analyse the Resource Use Efficiency in rice cultivation and prawn culture.
iv) to evaluate the additional cost and returns in the prawn culture when followed after rice.
v) to assess the additional employment created by the system of rice followed by prawn culture, and
vi) to suggest suitable policy measures to improve the Pokkali System as a whole

The results of the study are summarised as given below.

General Socio economic Characteristics of the Sample

Family Size

The majority of the farmers i.e., 74.44 per cent belonged to the family size of 4 to 6 members. Small families having 1 to 3 members constituted only 4.44 per cent of the total population. In the case of the areas under the three Krishi Bhavans also, the majority of the sample farmers had families with 4 to 6 members. Small families were a minority in Varappuzha and Ezhikkara while in Elankunnathupuzha none belonged to this class.

Age and Sex

Majority ie. 52.22 per cent belonged to the age group of 40 to 59 years. Only a minority ie. 2.22 per cent belonged to the age group of 20 to 39 years while 45.56 per cent of the total respondents belonged to the age group of 60 years and above. Varappuzha had majority of its farmers in the age group of 60 years and above while the majority of the farmers in Ezhikkara and Elankunnathupuzha belonged to the age group of 40 to 59 years.

Pokkali farming was largely a male dominated vocation since 92.2 per cent of the respondent farmers were males. Only 7.8 per cent were females. The same trend was followed in the case of different Krishi Bhavans too. Varappuzha had 10 per cent of its respondents as females while Elankunnathupuzha and Ezhikkara had 6 per cent of its respondents as females.

Educational Status of the respondents

Majority of the respondent farmers ie. 48.89 per cent had education below SSLC. Only a minority ie. 7.78 per cent were postgraduates. The same trend was followed in the Krishi Bhavans too. In Varappuzha, Ezhikkara and Elankunnathupuzha also the same trend was followed with the majority ie. 46.66 per cent, 43.33 per cent and 56.6 per cent of the total farmers below SSLC. None of the farmers were illiterates and 12.22 per cent of the total were graduates. 18.89 per cent of the total farmers had attained pre-degree while 12.22 per cent attained SSLC.

Experience of the farmers

Most of the farmers in the Pokkali region were highly experienced having atleast 20 to 30 years of experience. Thirty per cent of the total respondents had 30 to 40 years of experience while 9 per cent had about 40 to 50 years of experience. Farmers having less than ten years of experience were very few constituting only 1.11 per cent. The same trend reflected in the case of the three Krishi Bhavans too. In all the three Krishi

Bhavans majority of the farmers had 20 to 30 years of experience closely followed by those having 30 to 40 years of experience. Varappuzha and Ezhikkara had farmers having even upto 40 to 50 years of experience in Pokkali cultivation while in Ezhikkara there were none belonging to this group.

Occupation

Agriculture was the main occupation for 61.11 per cent of the respondent farmers. It was the secondary occupation for about 38.89 per cent of the respondents. In all the three Krishi Bhavans of Varappuzha, Ezhikkara and Elankunnathupuzha farmers having agriculture as the main occupation dominated constituting 66.67 per cent of the total respondents in each of the Krishi Bhavans respectively.

Inputs used in Paddy Cultivation

The quantity of seed used was highest in Class I farms, at 105.07 kgs per hectare. In Class II farms it was slightly lower at 101.85 kgs per hectare. For Class III farms, the amount of seed used was 100.83 kgs per hectare. Class IV farms recorded an average use of 98.32 kgs per hectare.

Class I farms had the highest amount of labour used at 139.14 mandays per ha. Class II farms recorded an average labour use of 130.10 mandays per ha. In Class III farms, average labour use per ha was slightly less. In Class IV farms, the lowest amount of labour use per ha was recorded at 121.85 mandays per ha.

Operation Wise Costs involved in Pokkali Paddy Cultivation

The total cost was recorded to be maximum in Class I farms at Rs.17093.59 per hectare while it was minimum in Class IV farms at Rs.14900.14 per hectare. Class II farms recorded a total cost of Rs.16312.57 per hectare while the same was Rs.16365.80 per hectare in Class III farms.

In Class I farms, the total cost varied between Rs.16120.22 per hectare in Varappuzha and Rs.18939.93 per hectare in Ezhikkara. Elankunnathupuzha recorded a total cost of Rs.17018.07 per hectare.

The same trend was observed in the case of all the three classes with the exception of Class IV farms. In Class IV farms, the total cost varied from Rs.15256.15 per hectare in Elankunnathupuzha to Rs.14610.78 per hectare in Varappuzha.

Land preparation constituted the majority of total cost at 28.72 per cent in Class I farms, 29.06 per cent in Class II farms, 29.64 per cent in Class III and 28.73 per cent in Class IV farms. The various Krishi Bhavans in the different classes also exhibited the same trend, except for Varappuzha where Vettieru was the major operation.

The next major operation was Vettieru which constituted 23.35 per cent, 25.23 per cent, 26.91 per cent and 28.66 per cent of the total cost in Class I, Class II, Class III, and Class IV farms respectively. Harvesting was yet another major component constituting 13.77 per cent, 16.50 per cent, 15.67 per cent and 15.94 per cent of the total cost in Class I, Class II, Class III and Class IV farms respectively. Seeds and sowing, harvesting, intercultural operations, interest on working capital and transport costs formed the other important cost components. The Krishi Bhavans also exhibited almost the same compositional pattern of cost.

It could be seen that among the four classes of farms the operations namely land preparation, seeds and sowing and *vettieru* constituted between 69.46 per cent of the total cost in Class I farms and 75.68 per cent in Class IV farms. It was 70.87 per cent in Class II farms and 75.12 per cent in Class III farms. These operations constituted between 67.21 per cent and 72.13 per cent of the total cost among the three Krishi Bhavans in Class I farms, between 66.41 per cent and 72.07 per cent in Class II farms, between 72.79 per cent and 77.82 per cent in Class III farms and between 73.90 per cent and 77.99 per cent in Class IV farms.

Input Wise Costs Involved in Paddy Cultivation

The major inputs used in Pokkali paddy cultivation were labour and seeds. Labour constituted 89.45 per cent, 89.21per cent, 89.42 per cent and 88.02 per cent of the total cost in Class I, Class II, Class III and Class IV farms. Seed costs constituted 5.91 per cent, 6.07 per cent, 6.12 per cent and 6.35 per cent of the total cost respectively, in the four classes. Other costs constituted 1.87 per cent, 2.25 per cent, 2.43 per cent and 3.47 per cent of the total cost in Class I, Class II, Class III and Class IV farms. Transportation costs and interest on working capital together constituted 2.77 per cent, 2.42 per cent, 2.03 per cent and 2.16 per cent of total cost respectively in the four classes of farms.

The pattern of cost composition followed the same trend across the Krishi Bhavans in the different classes.

In Class I labour cost constituted 86.26 per cent, 90.93 per cent and 88.49 per cent of the total cost in Varappuzha, Elankunnathupuzha and Ezhikkara, respectively. Seed cost constituted 6.65 per cent, 5.56 per cent and 5.26 per cent of the total cost in Varappuzha, Elankunnathupuzha and Ezhikkara, respectively.

Class II farms also exhibited the same trend with labour cost constituting 88.09 per cent, 89.95 per cent and 89.28 per cent of total cost in Varappuzha, Elankunnathupuzha and Ezhikkara, respectively.

Class III farms also did not show much deviation from the exhibited trend. Labour cost constituted 89.58 per cent, 90.21 per cent and 88.92 per cent of the total cost in Varappuzha, Elankunnathupuzha and Ezhikkara, respectively.

In Class IV farms again the labour cost constituted 89.33 per cent, 86.65 per cent and 87.49 per cent of the total cost in Varappuzha, Elankunnathupuzha and Ezhikkara respectively.

Yield of Pokkali Paddy Cultivation in the Sample Farms

The average yield per ha of the sample as a whole was 1259.50 kgs per hectare. It was highest in Ezhikkara at 1344.54 kgs, followed by Elankunnathupuzha at 1256.52 kgs per hectare and Varappuzha at 1210.80 kgs per hectare.

Class I farms exhibited the highest average yield of 1306.08 kgs per hectare. It was closely followed by Class III farms with 1298.28 kgs per hectare. Class II farms had an average yield of 1258.07 kgs per hectare. Class IV farms, had the lowest average yield of 1138.80 kgs per hectare.

Returns from Pokkali Paddy Cultivation

The maximum returns was recorded in the case of Class I farms at Rs.9142.54 per hectare. It was closely followed by Class III farms with Rs.9087.99 per hectare. In Class II farms it was Rs.8806.46 per hectare while in Class IV farms it was Rs.7971.60 per hectare.

The loss per hectare was maximum in the case of Class I farms at Rs.7951.05. In Class II farms it was marginally lower at Rs.7818.65 per ha.

In Class I farms, the total returns ranged from Rs.9676.64 per hectare in Ezhikkara to Rs.8957.50 per hectare in Elankunnathupuzha. In Class II farms, the total returns ranged from Rs.10192.18 per hectare in Ezhikkara to Rs.8692.65 per hectare in Varappuzha. In Class III farms, the returns varied from 9632.43 per hectare in Elankunnathupuzha to Rs.8637.37 per hectare in Varappuzha. In Class IV farms, the returns varied from Rs.8517.54 per hectare in Ezhikkara to Rs.7437.32 per hectare in Varappuzha. The returns were observed to be marginally higher in the case of Class I farms though the loss was also high in this case.

Prawn Culture

Input Use in Prawn Culture in Pokkali Paddy Fields

Rearing of prawn under the Pokkali system required, seed (fingerlings), feed and labour as major inputs. In Class I, the average quantity of feed used was 316.86 kg per ha. It varied between 285.25 kg in Elankunnathupuzha and 342.76 kg in Ezhikkara. In ClassII farms, the feed used was much lower at only 166.34 kg per ha and it ranged between 113.18 kg in Elankunnathupuzha and 231.78 kg in Ezhikkara. In the Class III farms, the quantity was still lesser at 72.98 per ha.

The fingerlings used per hectare again varied very widely among the three classes of farms. In Class I farms, an average of 31847.04 fingerlings were used. In Class II farms, the average number of fingerlings used was 22569.79 which was only close to $3/4^{th}$ of the fingerlings used in Class I farms. In Class III farms, the average number of fingerlings used was 14442.07. The fingerlings used were only little more than half of the quantity of fingerlings used in Class I farms.

Labour used in prawn culture in the three classes of farms also varied considerably. In Class I farms 253.33 mandays were used per ha. The average mandays used in Class II farms were 220.48 and it ranged between 212.35 mandays in Elankunnathupuzha and 231.49 mandays Ezhikkara. In Class III farms, the average mandays used was 188.33 and it ranged between 172.35 in Elankunnathupuzha and 198.37 mandays in Varappuzha.

Operation Wise Cost involved in Prawn Culture

The total cost was maximum in the case of Class I farms at Rs.46890.64 while it was minimum in the case of Class III farms at Rs.23964.02. In Class II farms it was Rs.31958.98. In Class I farms the cost was maximum in Ezhikkara while it was minimum in Elankunnathupuzha. In Class II farms the cost was maximum again in Ezhikkara while it was minimum in Elankunnathupuzha. In Class III farms, farms the cost was maximum in Varappuzha while it was minimum in Elankunnathupuzha.

Sluice management and shrimp care dominated the operational cost in all the three classes and across the Krishi Bhavans. Rental value on land constituted yet another dominant component of total cost. Preparatory works, harvesting and transportation cost came next in the order of importance.

Sluice management and shrimp care constituted 68.13 per cent of total cost in Class I farms, 61.36 per cent total cost in Class II farms and 54.38 per cent of total cost in Class III farms. Almost the same pattern was observed for the costs across the Krishi Bhavans in the three different classes too.

Input Wise Cost involved in Prawn Culture

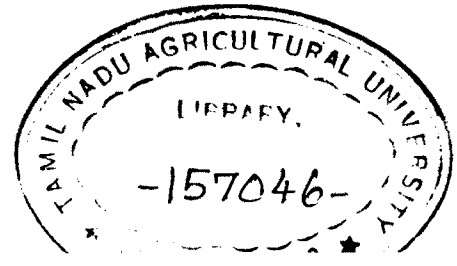
The major input across all the three classes was labour constituting 28.96 per cent of total cost in Class I farms while it constituted 40.08 per cent of total cost in Class II farms and 46.97 per cent of total cost in Class III farms. The same trend was followed in the case of the different Krishi Bhavans across the different classes.

The next important input was feed and it was 18.22 per cent in the Class II farms and 27.09 per cent of total cost in Class I farms But in Class III farms it was only 5.22 per cent of total cost.

Other important input costs included seed costs, sluice charges, eradicant costs, transport costs and interest on working capital.

Yield of Prawn in Different Classes of Farms across the Krishi Bhavans

Kara or Tiger prawn was cultured only in the case of Class I farms. Here the average yield per ha was 240.93 kgs per hectare, while it was 314.63 kgs per hectare for Varappuzha.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Naran or White Prawn was present in the case of all the three classes. The highest average yield was 188.81 kgs per hectare in the case of Class II farms while it was 132.26 kgs per hectare in Class I farms and 137.93 kgs per hectare in Class III farms.

The highest average yield of Thelli was in Class II farms at 316.72 kgs per hectare while it was 248.36 kgs per hectare in Class I farms and 268.15 kgs per hectare in Class III farms.

Returns obtained from Prawn Culture in Pokkali Fields

In the case of total returns also it could be clearly noticed that Class I farms registered the highest total returns of Rs.126642.25 per hectare with a net return of Rs.79751.61 per hectare. Next in the order was Class II farms, with a total return of Rs.41464.93 per hectare and net returns of Rs.9505.98 per hectare. Class III farms had the least total return of Rs.31940.6 per hectare with net return of Rs.7976.58 per hectare.

The same trend could be seen in the case of all the Krishi Bhavans too.

In Class I farms the maximum total returns was observed in the case of Varappuzha with Rs.160602.80 per hectare. It was Rs.127794.68 per hectare in the case of Ezhikkara and Rs.93964.32 per hectare in the case of Elankunnathupuzha. However the net return was also highest in Class I farms in the case of Varappuzha at Rs.112249.50 per hectare. In the case of Ezhikkara it was Rs.76845.74 per hectare and it was least in the case of Elankunnathupuzha with Rs.53036.66 per hectare.

In Class II farms the maximum total returns was in the case of Ezhikkara at Rs.51123.32 per hectare. It was minimum in Elankunnathupuzha at Rs.32156.45. In Varappuzha it was Rs.48561.81 per hectare. The net returns were maximum in the case in Ezhikkara at Rs.14635.99 per hectare while it was minimum in Elankunnathupuzha at Rs.4595.24 per hectare in Varappuzha it was Rs.13615.21 per hectare.

In Class III farms however the total returns were maximum in Varappuzha at Rs.36783.86 per hectare while it was minimum in Elankunnathupuzha at Rs.25621.82 per hectare. Ezhikkara had a total return of Rs.31183.70 per hectare. The net returns were the highest in the case of Varappuzha at Rs.11592.42 per hectare. It was the least in Elankunnathupuzha at Rs.3572.63 per hectare. Ezhikkara had a net return of Rs.7060.65 per hectare.

Returns realised by the Farmers who Leased out the Land after Paddy.

The average lease value for the farms as a whole was Rs.3988.49 per hectare. Among the Krishi Bhavans it was highest in Ezhikkara at Rs.4675.32 per hectare. In Varappuha the lease value was Rs.3705.45 per hectare. In Elankunnathupuzha the average lease value per ha was marginally less compared to others due to prevalence of virus infection in certain fields and an increased susceptibility to it in others. The lease value varied from region to region based on such regional preferences.

Comparisons of Input Use in the case of Feed Used and Yield in Rice-Prawn and Fallow Prawn Conditions

It was found that feed requirement was relatively higher in the case of fallow-prawn system. The yield was also significantly low in this case as compared to the rice prawn system.

In Class I farms the difference was 142.61 kgs per hectare. In Class II farms the difference was 279.55 kgs per hectare, whereas the difference was 87.74 kgs per hectare in Class III farms. However the yield of prawn was always higher in the case of rice prawn sequence.

In Class I farms the additional yield of Naran was 10.42 kgs, the additional yield of Kara was 35.36 kg and that of Thelli was 25.06 kgs per hectare.

In Class II farms the additional yield of Naran was 20.66 kgs and that of Thelli was 64.65 kgs. In Class III farms the additional yield of Naran was 54.62 kgs and that of Thelli was 29.08 kgs per hectare.

Employment Potential of the Pokkali System

The mandays requirement for paddy cultivation in the classes of farms ranged from 128.89 mandays in Class III farms to 139.14 mandays in Class I farms. It was 130.10 mandays in Class II farms .The mandays requirement for prawn culture ranged between 188.33 mandays in Class III farms and 253.33mandays in Class I farms. It was 220.48 mandays in Class II farms. The total mandays required for paddy prawn sequence ranged between 317.22 mandays in Class III farms and 392.47 mandays in Class I farms. It was 350.58 mandays in Class II farms. In the different Krishi Bhavans across the different Classes, the total mandays used varied between 306.09 mandays and 414.37 mandays.

Resource Use Efficiency

Production function analysis was undertaken to study the resource use efficiency in Prawn culture and Pokkali rice cultivation.

In the case of prawn culture function fitted had an R^2 value of 0.692 which indicated that 69.2 per cent of the variation in prawn yield could be explained by the independent variables included in the function. Feed and Seed were found to have significant influence on the yield. All the independent variables except labour had positive coefficients.

The function fitted for rice cultivation had an R^2 value of 0.26. This showed that only 26.0 per cent of the total variation in the dependent variable could be explained by the independent variables. None of the variables were significant and signs of variables, namely seed ,age and labour use against the *apriori* assumptions. This coupled with the highly significant intercept value would only show the influence of factors not under the control of the farmers. It also shows the need to improve the management in Pokkali paddy cultivation.

Case Study

The case study clearly revealed that scientific prawn culture if taken up appropriately could compliment any loss incurred in the initial rice cultivation. But it was initially capital intensive and required meticulous care. The yield showed was significantly more when compare to the three classes of prawn farmers at 330.27 kgs per hectare.

Conclusions

The following conclusions could be drawn from the discussion of the results.

- It could be concluded that Pokkali rice cultivation was highly risky and always ended in heavy losses.
- The rice cultivation and prawn culture was highly labour intensive and therefore provided ample employment avenues for the local agricultural labourers and provides an effective livelihood support.
- Labour cost constituted the major portion of the total cost. In paddy cultivation it was around 90 per cent. In prawn culture it ranged between 28.96 and 46.97 per cent.
- Prawn culture in Class I, farms which included the culture of tiger prawn, was very highly profitable compared to other classes.
- Rice cultivation in the first season was more preferable than leaving the land fallow. The paddy farmers actually gained in terms of saving in feed cost and in terms of relatively higher yield. Thus continuing with the rice prawn rotation inspite of the risk and losses involved in rice cultivation would help in the long-term sustainability of the system.
- The production function analysis revealed the significant contribution of seed material and feed in prawn culture.
- The production function analysis for rice revealed the dominance of factors not under the control of the farmers and the need for better management.

Policy Suggestions

- Adequate and timely financial support in terms of credit should be extended to the Pokkali farmers especially for paddy cultivation.
- The Government should come up with appropriate policy measures like provision for insurance to tide over the risk involved in the system. Designing an insurance programme duly considering the overall returns to bring in confidence in the minds of the farmers will help them to continuously go for paddy cultivation.
- The setting up of the earlier suggested Pokkali Organic Farming Agency (Gopinath, 1997) should be seriously considered since it may be instrumental in providing the much needed impetus for the system by providing technical advice and to take up and promotional measures aggressively.
- The farmers have to made aware of the dire necessity to go for rice cultivation in the first season since it complements the prawn culture and helps in the long term sustainability of the system. It is necessary to educate the farmers about the benefit of growing rice as it reduces the cost of feed and helps in enhancing the yield and in the process, would help to off-set the losses in paddy cultivation in Class-I and Class-II farmers.
- Adequate infrastructural facilities should be provided for the Krishi Bhavans and Pokkali Land Development Agency so as to ensure the better coordination of their activities in helping the farmers to operate efficiently.
- The experience of the case study farmer further reinforced the fact that improved traditional prawn culture would only be affordable to majority of the farmers and therefore the need for financial support to go for prawn culture is highly necessary. The Government has to take timely measures to facilitate this.

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APPENDICES

APPENDIX I

The local terms used in the study are,

Edavapathi	-	South West Monsoon
Kara	-	Tiger Prawn
Naran	-	White Prawn
Pokkali	-	The particular rice prawn rotational cultivation system as a whole. It also refers to the local cultivar cultivated in the region.
Thakkam	-	Prawn harvesting time
Thelli	-	Local Small Prawn