ECONOMIC ANALYSIS OF RICE PRODUCTION IN KUTTANAD AND KOLE AREAS OF KERALA

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled **"Economic Analysis of Rice Production in Kuttanad and Kole Areas of Kerala"** is a bonafide record of research work done by me during the course of research work and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any University or Society.

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Certified that this thesis entitled **"Economic Analysis of Rice Production in Kuttanad and Kole Areas of Kerala"** is a record of research work done independently by **Mr. Mohandas, K.,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship or other similar titles to him.

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INTRODUCTION

INTRODUCTION

Rice is the staple food of the people of Kerala. This fact has given it a very important position in the state's agriculture. It has been and is the second most important crop in terms of area, occupying as much as 17.92 per cent of the gross cropped area in the state. Yet, the state is not self sufficient in rice. On the other hand, its dependence on the rest of the country has been increasing on account of the dwindling area cropped and rising population. The decline in area is mainly attributable to the relatively lower profitability of rice cultivation, resulting in rice lands being converted into garden lands. Though from the purely economic part of view, this appears unexceptional, it has serious ecological implications. Moreover, as is well known, the level of foodgrain consumption is generally better in areas where production is high and hence falling production will have adverse consequences on the nutritional levels of the population, and particularly of poorer sections. The current level of per capita consumption of rice is 274 gram of paddy at which level the requirement for the projected population of 3.50 crores by the turn of the century will be about four million tonnes per year. On the basis of the State Nutrition Bureau's recommendation a minimum of 400 gram per day per person is needed, making the total requirement 5.5 million tonne (Silas and Abraham, 1988). As against these, the current level of production within the state is 1.06 million tonnes only. Though it may not be possible to make the state self-sufficient in rice (it may not be desirable either considering the opportunity cost) there is need to increase rice production in the state. A collective areawise approach involving the co-operation of all farms in homogeneous rice field units and the application of a systems approach to rice farms based on HYV technology, integrated nutrition management and integrated pest and disease management are therefore indispensable for making a breakthrough in rice production.

1.1 The problem

The cultivation of rice in the state is seriously constrained as evidenced by the trends in area, production and productivity of this crop over the three decades ending 1990-91. The results show that the area was on an increasing trend upto 1974-75 reaching a peak level of 8.81 lakh hectare during that year. The peak production so far recorded in an year is 13.76 lakh tonnes during 1972-73. From mid seventies both area and production were on the decline and the negative

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Silas, E.G. and Abraham, C.C. 1988. Stepping up food production in Kerala. Problems, Prospectives and Strategies. Agricultural Situation in India **43** (5): p.435.

growth is still continuing unaltered. However productivity of rice was steadily on the increase reaching its peak level of 1942 kg/ha by 1990-91. The decline in area was so large that productivity gains could not prevent the decline in production. Till the early 1970's there was restriction on the inter-state movement of rice on trade account in the country which made the state insulated from the rest of the country, resulting in fairly high rice price. When this restriction was lifted partially, there came about substantial reduction in price. Whereas the average net realization from paddy cultivation without considering rental value of land in 1974-75 was Rs.4838/- per hectare it was estimated to have declined to an average of Rs.632/- for the two year period 1979-81 (Radhakrishnan, 1983).

Some of the initiatives taken by the government during the Seventh Five Year Plan such as decentralisation of production efforts through establishment of 'Krishi Bhavans' at the panchayat level, and promotion of 'Group Farming' as an instrument for revitalising rice production were expected to hold considerable promise for better performance. Group farming in rice introduced in 1989-90 was expected to instill

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* Radhakrishnan, V. (1983). 'Economics of paddy cultivation, and its impact on production'. Paper presented at the Seminar on stagnation of Rice production in Kerala, held from 1st-3rd, July, 1983 at College of Agriculture, Vellayani.

a new spirit and confidence among paddy growers. It was also decided that the HYV coverage and organisation of production at the farm levels would be improved strategically. Contrary to the expectation of the planners, the overall production performance has been persistently deteriorating.

As stated above the decline in rice area in Kerala is mainly the result of reduced profitability due to lower prices and escalating cost of cultivation, compounded by the problems arising out of fragmented holdings. Comparison of the real price of inputs in terms of the value of the output shows that the terms of trade, has turned unfavourable to the producer in respect of the major items of cost viz., labour and fertilizers*.

'Kuttanad' and 'Kole' represent two major rice growing tracts where the cultivation is a challenging task mainly due to natural constraints. Trends in area, production and productivity of rice in Kuttanad and kole from 1975-76 to 1986-87 showed that, the growth rate for area and production were -2.04 per cent per annum and -2.01 per cent per annum respectively for Kuttanad. The corresponding figures for Kole were -2.04 and 0.02. The growth rate for productivity was 0.01 for Kuttanad and 0.13 for Kole.

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* George, M.O. and Oommen, M.A. (1979). Kerala Economy since Independence. Oxford and IBH Publishers, New Delhi. 42.

Recognising the importance of Kuttanad and Kole in the rice economy of Kerala and due to their peculiar nature of farming, the present study on economics of rice production is undertaken in these two areas. This study is an attempt to understand the extent to which farmers are exploiting their resources in the production of rice. An attempt is also made to work out the economics of rice cultivation and its resource use efficiency. The specific objectives of the study are:

1. To compare the cost and returns
2. To measure the resource use and productivity of farm resources and to examine the possibility of increasing return by reallocating the existing resources.
3. To study the marketed surplus and factors contributing to it.
4. To identify the constraints in rice production.

1.2 Scope of the study

Comparative studies on the economics of rice cultivation in these two regions have not been attempted so far. A micro level study is relevant to get a realistic picture on rice cultivation and resource use efficiency. Information on the cost structure would be of use to the policy makers and planners in the formulation of plans. The study on marketed surplus is important for forecasting the supply of food grains and formulating agricultural price policy of the State.

1.3 Limitations

Results of the study are based on the farm level data relating to a particular cropping season (Punja), generated through sample survey. The responses were drawn from the farmer's memory. Moreover it is difficult to assess the level of efficiency of a farmer in his production process unless one is sure of the prevailing conditions in which he operates.

1.4 Plan of work

This thesis is divided into six chapters including the present introductory chapter. The second chapter deals with review of related studies in the light of present investigation. The third chapter deals with description of the study areas under study and the fourth chapter deals with methodology used in the process of investigation in areas under the study. This is followed by presentation of the results and discussion of the findings in the fifth chapter. Chapter sixth summarises the study followed by references and abstract.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

An attempt is made, in this chapter, to review the past studies on resource use efficiency and marketing aspects related to the present study. The first section deals with resource use efficiency and the second section emphasis on marketed surplus of rice.

2.1 Resource use efficiency

Samuel (1963) examined in detail the resource use efficiency of paddy farms in Kuttanad and Onattukara regions of Alleppey district. The efficiencies of the independent variables were evaluated and it was observed that farm size and human labour gave significant and positive coefficients. Bullock labour was found to have negative elasticity. Diminishing returns to scale was noticed in Kuttanad. The input-output ratio was 1.61. cost of production studies of paddy revealed that bulk of the cost spend on human labour.

Kaimal (1966) conducted a comparative study on the resource use efficiency of paddy farms in Palakkad district where package programme for paddy was introduced and non-package areas of other districts of Kerala and observed that the marginal value productivity of land was much more in package area, but that of labour and manures and fertilisers was more in non-package area farms. The elasticity coefficient for manures and fertilisers was as high as 1.041 in non-package area.

Radhakrishnan (1969) studied the optimum allocation of resources for maximising farm income in Coimbatore district and reported greater marginal value productivity of resources in large farms as compared to small farms. The result showed that farmers were not efficient in resource allocation and pointed out the scope for increasing farm income of the farmers by reorganising the existing resources.

Saini (1969) evaluated the efficiency with which the farmers in the states of Uttar Pradesh and Punjab use their resources to achieve highest returns in crop production. He observed that small farmers are quite rational in terms of their response to economic opportunities and make adjustments in resource use. This rationality however does not imply that farmers always succeed in operating their farm business at economically optimum level. The unexploited economic margins in the two states suggest that farmers are not always efficient for allocation of resources in exploiting fully the economic opportunities available to them.

Naidu and Nagarathnam (1971) conducted a study on optimum allocation of resources in selected farms of

Chandragiri block in Chittoor district of Andhra Pradesh. Efficiency analysis was conducted by estimating the intensity of cropping, farm business income, labour earnings per employed man-day, returns to capital invested and marginal value product of factors. Sub-optimal resource allocation was observed indicating possibilities for better farm incomes by re-organisation of the existing resources.

Prabhakaran and Venugopal (1971) conducted studies on the resource use efficiency of different size of paddy farms in Kerala. Stratified sampling technique was used for the selection of sample. Cobb Douglas production function was used and the results indicated a greater emphasis on the use of fertilisers and manures. In small farms labour was a significant ingredient which accelerated production. The gross output per acre was found to decrease as the size of the farm increased.

Singh (1975) in his article on "Resource use, farm size and returns to scale in a backward agriculture" estimated the resource use efficiency of the farmer in Eastern Uttar Pradesh on the basis of neo-classical criterion that each factor of production is paid equal to its marginal productivity. A significant difference between marginal value product and market price of individual inputs were noticed which would indicate that the farmers are using these factors inefficiently.

Mukundan and Dasgupta (1977) while studying the comparative economics of irrigated and unirrigated paddy lands in Palakkad, observed that seeds and manures gave significant negative elasticities in irrigated farms.

Sampath (1979) analysed the economic efficiency of farms in Deria district of Uttar Pradesh and identified the existence of considerable economic inefficiency. The major component of the economic inefficiency was observed to be technical inefficiency rather than allocative efficiency. A disaggregate analysis of the data, based on size of land revealed that the difference between the small farmer in terms of the level of economic efficiency achieved was insignificant.

Kalirajan and Flinn (1981) made a comparative study on the allocative efficiency of paddy farms of Coimbatore district, growing improved variety and traditional variety of paddy. Constant returns to scale was observed in both the farms. Inefficient resource use with respect to pest management was noticed in farms growing the improved variety.

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

Selvarajan and Subramonian (1981) identified sub-optimal resource use in farms of Parambikulam-Aliyar project area in Tamil Nadu. A reallocation of the resources in the optimal direction would increase the gross income of farms by 25.97 per cent, net income by 33.11 per cent and the farm business income by 45.13 per cent. The study also revealed that there exists considerable scope for increasing incomes in the study area through resource use optimisation. The non-awareness of the optimum plans coupled with factors like lack of awareness of the improved varieties and their technology, difficulties in procuring additional resources, lack of adequate infrastructure for sustaining the increased demand for modern inputs, etc. were acting as obstacles in fully realising the potentials of these optimal plans.

Joseph (1982) studied resource use efficiency of paddy farms of Kuttanad region in Kerala. The analysis showed that total cultivation expenses per hectare of paddy cultivation was Rs.4240 in lower Kuttanad and Rs.3011 in upper Kuttanad. Operation-wise break-up showed that gap filling and weed control formed the largest expenses followed by fertiliser and its application. Input-wise study of the cost of cultivation revealed that human labour use per hectare was the most important input cost amounting for about 45 per cent of the total cost. Regression analysis showed that none of the regression coefficient was found significant.

Radhakrishnan (1983) studied the economics of paddy cultivation and its impact on production in Palghat, Alleppey and Trichur districts of Kerala. The analysis showed that the relative as well as absolute profitability in paddy cultivation has declined considerably after 1974-75 and this seems to be only one of the reasons for the recent decline in paddy area and production. The low profitability in paddy cultivation appears to have had a depressing effect on paddy land prices and this may has also contributed to the shifting of land away from cultivation.

Muraleedharan (1987) conducted a study on resource use efficiency in Kole lands in Trichur. The study was based on primary data collected from a sample of 142 cultivators during the year 1978-79 using a two stage random sampling. Cobb-Douglas form of production function was used. Output of rice as dependent variable, farm size, human labour, bullock labour, fertilisers and manures as independent variables. The study revealed that cultivators have not been able to allocate their inputs efficiently and this seems to be considerable scope for augmenting profit for Kole cultivation by optimum use of inputs.

Ghosh (1990) examined the profit maximisation hypothesis in Indian Agriculture based on farm management survey data for 1972-73 in Hoogly District of West Bengal. The results reject the validity of the profit maximisation hypothesis. In a subsistence or semisubsistence peasant agriculture where most of the farmers are small, land productivity is low, production is highly dependent on nature, and there exists limited scope for alternative non-farm activities, the farm households are more concerned about security and survival than profit maximisation. The results of the study also contradict the findings of earlier research regarding the relative economic efficiency of small and large farms.

Randhir and Krishnamoorthy (1990) studied the productivity variation and water use in farms of Madurantakam Tankfed area of Chengalpattu District, Tamil Nadu using Cobb-Douglas form of production function. The results of the study showed a clear picture of the inter-farm variations in farm productivity. There was productivity variation due to farm size even under homogeneous irrigation situations.

Thomas _et al_. (1991) studied the decline in paddy land in Trichur district of Kerala and factors leading to it and was found that during a short span of three years (1987-88 to 1988-89) the decline in the area under paddy was to the extent of 31 per cent. The cost and returns from paddy cultivation showed a benefit-cost ratio of 1.51 over all paid out costs.

Babu (1992) in his study to assess the interseasonal and interfarm variations in the production credit needs based on the estimated cost of cultivation of paddy, and its gap on paddy farms in Puzhakkal Block revealed some of the peculiar features of paddy cultivation. According to him the differences in the cultivation practices due to seasonal factors affect the cost of production.

He also reported that the share of operational cost of cultivation was found to be very significant in all size of holdings. Hence the economics of scale operation is a determinant factor influencing the cost of production of paddy. This is evident by the fact that the cost of cultivation varies inversely with the size of holdings. The highest cost of cultivation was accounted on marginal farms in all the seasons. The per acre cost of cultivation estimates indicated that Punja cultivation was costly in all the farms compared to other seasons.

Bal *et al*. (1992) studied the variance of actual and recommended levels of fertilisers in Punjab. The samples were taken from the comprehensive scheme to study the cost of cultivation of principal crops in Punjab, pertaining to the year 1990-91. According to them, paddy cultivation was still at stage where fertiliser requirement were more than the recommended levels. A good number of farmers used excessive doses and as a result the pay-off turned out to be low.

Bandgopadhyay (1992) examined the fertiliser use efficiency in paddy cultivation in the Indo-British Fertiliser Education Project areas in the three states of Assam, Orissa and West Bengal during the period 1981-82 to 1984-85. The analysis showed that even the application of recommended doses of fertilisers and assured irrigation in high yielding varieties have no significant impact upon yield or fertiliser use efficiency in demonstrated villages in any state. Only the rational combination of vital production factors at optimum proportion and their effective utilisation can substantially contribute to the improvement in productivity and consequently in fertiliser use efficiency.

Chandrasekhar and Jayaram (1992) analysed the technical efficiency in rice cultivation in Mandya district of Karnataka state. The study indicate the existence of over-use of resources in the production of rice. The high output efficiency coupled with the high inefficient use of resources, is suggestive of improper pricing of resources which induces non-judicious use of resources such as fertiliser and irrigation, leading to wastage. The high subsidy accorded to these resources induces inefficiency in the resources which is likely to affect the sustainability of agriculture in the long run.

Chotan Sing (1992) estimated the input-output relationship and examined the efficiency and productivity of resource use in different size groups of farms in Salem district. In order to examine resource use efficiency, the marginal value product was compared with its acquisition cost. It was observed that farm returns were highly responsive to irrigation, fertilisers and bullock labour on all the farms. Production elasticity of expenditure on fertilisers and bullock labour days varied.

Giri (1992) studied the effect of different nutrient composition of fertiliser use on yield and found that relatively high dose of phosphatic and potassic fertiliser as compared to nitrogen was associated with higher yield in Kerala, Karnataka and Tamil Nadu.

Kushwaha and Singh (1992) examined the resource use efficiency of paddy and wheat crops in Kanpur district of Uttar Pradesh. The analysis showed that MVP of manure and fertilisers was found to be highest followed by irrigation and plant protection and lowest in human labour in both the crops. This trend was observed for all categories of farms and crops indicating that resources should be shifted from human labour to seed, manures and fertiliser, irrigation and plant protection.

Mahitha and Hemachandrudu (1992) made an attempt to probe into the resource use efficiency of factors of production on paddy farm in Andhra Pradesh using secondary data for 15 years obtained from the cost of cultivation scheme. The period of study has been divided into three distinct time periods of five years each, viz., period I: 1971-72 to 1975-76, period II: 1976-77 to 1980-81 and period IV 1982-83 to 1985-86. The analysis showed a high degree of resource use inefficiency on paddy farms in Andhra Pradesh. There is good scope to reorganise the farm resource since MVP/OC ratios for most of the resources deviated from unity.

Pawar *et al.* (1992) studied the resource use efficiency in crop production activity of farms in Solapur district in Maharashtra and reported that the inadequacy of capital and other resource input combined with their inefficient use is the prime cause of low crop productivity. The comparison of MVPs of individual resources with their unit costs indicated several inefficiencies in the use of resources on all types of farms. According to them the small and medium sized farms can take advantage of intensifying land and capital resources to enhance the returns from crop production activity.

Raja (1992) examined the factors influencing the productivity of high-yielding variety paddy (J.13) and the extent of inter-farm variation in the production of the crop in relation to various inputs used per unit of cultivated areas in Periyar district of Tamil Nadu. The results showed that the over use of chemical fertilisers and pesticides beyond the optional level not only leads a decline in productivity but also causes some unfavourable side effects and will create new pest infestation. The productivity of paddy could be increase with readjustment in the resource inputs.

Rao et al. (1992) made an attempt to study the factors influencing fertiliser use efficiency in rice cultivation in Nizamabad district of Andhra Pradesh. For the purpose of the study, data collected from a random sample of 90 farmers selected from three villages each representing rainfed, well and canal irrigated farms respectively during kharif 1986-87 season were used. The analysis showed that with soil condition, control over irrigation and investible capacity influence fertiliser use efficiency in paddy cultivation.

Rao and Rao (1992) studied the pattern of use of inputs and the efficiency of their use in the cultivation of kharif paddy in bela and non-bela lands in Srikakulam district of Andhra Pradesh. The bela lands are characterised by waterlogging during the cropping season of kharif paddy. MVP/OC ratio revealed that land was excessively utilized on bela paddy. In non bela kharif lands also excessive utilisation of land was noticed. The analysis indicated scope for readjustment of resources based on MVP/OC ratio. The human labour has to be reduced in both the types of land by the introduction of machine labour which may increase the efficiency of labour use, resulting in a reduction of total cost.

Shareef (1992) examined the water use efficiency in the cultivation of paddy under the K.C. canal ayacut in Andhra Pradesh. The area between Santajutur Anicut and Rajoli Anicut reach the K.C. canal irrigation system was purposively selected. The relationship between farm output and factors influencing it and the resource-use efficiency were studied by Cobb-Douglas production function. The MVP of fertiliser and labour indicated that the input was under used. The study revealed that potentialities existed for maximizing the level of crop output through resource real location.

Shise and Balakritaiah (1992) assessed the input use efficiency of energised farms in the cultivation of paddy and sugarcane in Nizamabad district of Andhra Pradesh. The marginal value productivity to opportunity cost ratios for all the input variables in both the crops clearly indicated a high degree of resource use efficiency since for none of the variables the MVP/OC rates was either equal to one or closer to unity. The analysis revealed good scope for reallocation of resources to improve the returns or productivity in both paddy and sugarcane crops.

Singh et al. (1992) examined the resource us efficiency in Haryana agriculture and the study revealed that in case of paddy, there was increasing returns to scale which means that all the inputs are increased by same proportion, the output would increase more than proportionately. The marginal value productivity (MVP) of capital in case of paddy was 1.76 which is sufficiently high. Hence the farmers could further increase the use of inputs to the point where $MVP_{xi} = P_{xi}$. The MVP of labour in case of paddy was 33.62 and are found significant. It shows that additional labour use in paddy crop is more paying.

Sunandini et al. (1992) studied the input use efficiency on paddy farms in west Godawari district of Andhra Pradesh. Cobb-Douglas production function was fitted to the data collected from a sample of 108 small and large farmers for rabi season during 1988-89. The marginal value product to factor cost ratio associated with each input factor under study was higher than unity indicating resource use inefficiency of these inputs to a great extent on both small and large farms in the rabi season.

Talathi (1992) examined the response of yield of rice to different inputs in Konkan region of Maharashtra and found that plot size and fertiliser use influenced the productivity high yielding variety of rice positively and significantly whereas in the production of local varieties of rice plot size, hired labour and family labour and seed influenced the productivity positively.

Thomas et al. (1992) analysed the cost structure of paddy cultivation in Kole lands. The analysis showed that labour input alone was the largest single item of the cost for both local (70.96 per cent) and high yielding varieties (66.41 per cent) followed by fertiliser. The total cost of cultivation worked out to Rs.10676 for local varieties and Rs.11380 for high yielding varieties and returns obtained from local and high yielding varieties were Rs.15,000 and Rs.17,000 respectively.

Upender (1992) examined the production elasticities with respect to factor inputs, returns to scale and nature of relationship between production per acre and farmsize on different farm size-groups in Hasanparthy mandal of Warangal district of Andhra Pradesh. The study revealed that the production elasticity is the highest with respect to land on small farms followed by medium and large farms. An increase in the area of paddy crop by one per cent on small and medium farms would increase the output of paddy by 4.79 per cent and 3.28 per cent respectively, keeping other factors constant. The output per acre and farm size relationship indicated that the hypothesis of direct relationship is true in the area under study.

Lakshmi (1993) studied the supply utilization and repayment performance of crop loans of commercial banks in Alapuzha district. Paid out costs alone were taken into consideration for estimating the cost of cultivation of paddy. Cost of cultivation estimates showed an inverse relationship between the cost of cultivation and size of holding. Total paid out cost estimated from paddy cultivation in this area was Rs.12,706. Input-output ratio was obtained for large farmer (1.87), followed by marginal farmer (1.70) and small farmer (1.64).

Sankar (1993) studied the prospects of dryland farming in West Bengal and observed that in all the four group of farmers use of labour per acre of cultivation was higher in paddy than in dryland crops. Material cost involved was 55 per cent of the total cost in paddy in all the size-groups. The marginal productivity of labour (MPL) in paddy cultivation in four groups were Rs.31, Rs.18, Rs.11 and Rs.22 respectively. The marginal productivity of material inputs (MPM) in paddy cultivation were Re. 0.58, Re. 0.78, Re. 0.09 and Re. 0.96 in four size-groups. The material inputs appear to be over used in the case of paddy especially in groups I and II. Thus there is scope for reducing the level of material inputs in paddy till the point of optimality is reached.

Santha (1993) studied the cost and returns of paddy cultivation for different seasons in Thrissur, Kerala and found that hired labour was the most important input invariably used for all the seasons inspite of the variation in the cost of cultivation for the different seasons. The average net income was lowest in Punja (Rs.1,095.19 per hectare). The returns per rupee invested was also lowest for 'punja' (1.24).

Shanmugam and Sureshkumar (1993) studied the output supply and inputs demand for Rice in Kaveripattinam block of

Dharmapuri District of Tamil Nadu and revealed a positive sign for the prizes of fertiliser. This implies the adjustment of farms towards price rise and there exists scope to increase the use of quantity of fertilisers. Among the inputs, the demand for labour and fertiliser had inelastic showing the importance of this factor for rice production.

Thomas et al. (1993) assessed the performance of rice production in the light of co-operative credit flow. A multi stage random sampling technique was adopted for selecting sample cultivators. The inputwise cost of cultivation had shown that human labour alone accounted for more than 40 per cent of the cost followed by manures and fertilisers. The benefit cost ratio was 1.42. Resource productivities were estimated with the help of Cobb-Douglas production function. The analysis leads to the prospects of restricting the use of fertilisers and plant protection chemicals both in view of economic reasons and environmental effects.

2.2 Marketed surplus

Balasubramanian (1960) in his article on "The problem of marketable surplus in Indian Agriculture" suggested certain concrete measures which could help in augmenting the marketed surplus. The measures proposed by him are mainly steps to raise the agricultural production and collection of land revenue, setting up of more regulated markets, persuit of a well defined price policy, fixing of floor prices for food grains assured and stable prices linked up with co-operative marketing, compulsory levy etc.

Bhattarcharjee (1960) studied the changing characteristics of the flow of food grains supplied from the farmers. His studies on the selected villages of Bengal, Bihar and Orissa have shown that with the growth in the modernisation of the economy and the pressure of population on land, the contribution of the small farmers to the total marketed surplus tends to decline and that of the large farmers to increase. His study also revealed a direct relationship of the marketed surplus as only 22.2 per cent while that of the medium class 68.6 per cent.

Majid (1960) conducted a study on the subject covering six selected villages in Punjab and Western Uttar Pradesh. He observed that the proportion of the marketed surplus to the total production of food crops tended to increase with an increase in the size of holding. The economy of the households in the highest size groups was highly market oriented. In poor and backward villages, the variation in the marketed surplus is different in different size groups because of distress sales. Sales were found to be more in the lowest size groups lesser in the next higher group and very much in the highest size group.

Bansil (1961) in his article on "Problems of marketable surplus" described that marketed surplus may be less, equal to or even more than marketable surplus depending upon the external factors operating on the market economy. Both these are equal only under ideal conditions. The process of economic development is accompanied by a faster rate of urbanisation or a reduction in the percentage of population engaged in agricultural production. The resultant rise in the standard of living both of producer and non-producer generates forces which results in larger retention on the farm and restricted flow to the market.

Dharam Narain (1961) studied the marketed surplus of agricultural produce by size of holding in India. He estimated the proportions in which holdings of different size groups contributed to the marketed surplus. He found that holdings on the lowest stratum of size upto 5 acres contributed as much as 25 per cent of marketed surplus and holdings of size upto 15 acres contributed as much as 50 per cent of marketed surplus.

Ramsaran (1961) in his article on "The problem of marketable surplus of food grains in India" suggested that the marketable surplus can be increased either by discouraging retention of the produce by the farmers for one purpose or the other or by encouraging production.

Rao (1961) in his study on "the marketed surplus of food grains with special reference to selected villages in South India" reported that, in distribution of area between different crops, say food grains and the rest, given the size of holding per family, has a bearing on marketed surplus, of food grains. A larger percentage of cash crop could result in a lesser percentage of marke d surplus is likely to be still lower if the proportion of cash crops to the total cropped area varies directly with size of holding, i.e., it has found that the area under cash crop appears to vary directly with the size of holdings. This has a significant influence on the percentage of produce of foodgrains marketed. He also stated that in case of small cultivators marketed surplus may be more than the marketable surplus because they may repurchase in the lean season, the quantity sold after harvest. With big farmers he pointed out, marketed surplus and marketable surplus tend to be equal with the size of holding and productivity of the land.

Saxena (1962) conducted a study on the marketed surplus of wheat in Punjab. He observed that the quantity marketed and the location of sales were very much influenced by prices. When the prices remain high the marketed surplus tended to increase.

Sinha (1962) in his article on "Marketable surplus in agriculture in under-developed countries" discussed the important role of marketable surplus in promoting economic development and examined the various factors influencing the farmer's attitude towards increasing farm production and marketable surplus under different economic conditions. He was of the view that in order to promote marketable surplus, the prices of agricultural commodities must be kept relatively lower than industrial commodities must be kept relatively lower than industrial prices, or in other words, the terms of trade should be slightly adverse to the farmers. He has also suggested the need of certain complimentary measures like improving transport facilities, standardisation of weights and measures etc. for augmenting the marketed surplus.

Kalhon and Dwivedi (1963) examined the behaviour of marketed surplus in terms of different farm factors like size of the holding and tennurial status, size of the family, consumer habits and relative prices of farm-products. They found that the marketed surplus was directly associated with production and size of the holding. The size of the family showed a negative relationship.

Shastri (1963) studied the inter-relationship between production, prices and marketable surplus in Bihar with respect to four crops rice, gram, arhar and potato. The study revealed that production exercises a considerable influence on marketed surplus.

Dandaker (1964) studied the effect of change in relative prices of agricultural produce with that of the marketed surplus. According to him, a relative rise in agricultural prices is not necessarily be an incentive to production and marketed surplus in a large segment of agricultural activity or thus a fall in prices necessarily become a deterrent to production.

In the poor and uncertain economy of underdeveloped countries, the farmers sell that amount of the product which will give them that amount of money needed to satisfy their cash requirement and retain the balance of their output for their own consumption. In this case, if prices rises, a small amount of food grains provides the necessary cash and vice versa. Thus, prices and marketed surplus tended to more in opposite direction.

Muthiah (1964) studied marketed surplus of foodgrains by size, level of holding and income. He examined the quantity of marketed surplus contributed by holdings of different size groups in selected districts of Madhya Pradesh and Rajastan. Holdings of size below 25 acres according to him contributed nearly 1/6th of the total while more than 50 per cent of the marketed surplus was contributed by big sized holdings.

Parthasarathy (1964) conducted a study on the production and marketed surplus of rice in the Delta of South. According to the study cultivators having more than fifteen acres accounted for the bulk of the marketed surplus. They felt that since the bulk of the produce and marketed surplus were in the hands of medium and big cultivators whose bargaining power is relatively strong a marginal shortfall in supplied may lead to a big rise in prices.

Raj (1965) investigated into the behaviour of marketable surplus for a subsistence crop. After an analysis with Indian data he observed a strong linear and in some cases even non linear relationship between output and marketed surplus. In his view, for a subsistence crop, output is the best predictor of marketed surplus with income as the second. Acreage or size of the holding according to him is the most unsatisfactory predictor of marketable surplus.

Shah (1965) made some cross-sectional studies in the regions of Gujarat and Uttar Pradesh. The analysis was carried out considering the independent factors such as non-land farm assets, size of the family, size of holding, distance from market, net sown area, debt area under tenancy, value of production technology. The study showed that the size of family and retention for home consumption were found to be closely correlated. Further, production and marketed surplus were found to be closely associated. Other variables such as value of farm assets, debts, tenancy, level of fragmentation and technological improvements also influenced marketed surplus.

Vyas and Maharaja (1966) studied the behaviour of marketed surplus in two regions of Gujarat and Rajastan in terms of different farm factors. In their studies they assumed marketable surplus as a function of production of crop, area sown, size of the family and other disposals in kind. They found that in higher size groups, the total marketed surplus increased with increase in production. Similarly the marginal increase in marketed surplus in relation to increase in production of fine as well as coarse grains, were found to be positive and significant.

Sharma (1967) studied the effect of farm factors on marketed surplus of Bajra in Jaipur district by considering two main factors namely size of family and total production. It was found that the marketed surplus and size of the family were negatively correlated. Total production was found to be directly associated with marketed surplus.

Nair (1975) studied the behaviour of marketed surplus in terms of the different farm factors namely size of the family, gross cropped area, total production, gross income and total consumption at Kannadi village in Palakkad District, as the village occupied the first position in the area and production of paddy in the district. The study revealed that the vital factors affecting marketed surplus of paddy were size of family, gross cropped area total production and total consumption. The relationship between marketed surplus and size of the family was found to be negative. The same type of negative relationship was obtained with respect to total consumption also. The total production and marketed surplus was found to be positively correlated. This means that marketed surplus can be very well augmented by increasing production.

Cyril (1984) conducted a study with a view to evaluate the changes in the village level paddy marketing system in Polonnaruna district of Srilanka as consequence of change in government policies. As per the study the total production of paddy increased by 64 per cent meha and 37 per cent yala. The changes in the marketable surplus of paddy produced did not undergo such a change on the two periods.

Tuteja (1992) studied the marketed surplus in Tribal villages of Assam based on data collected from micro level studies conducted by Agro-economic Research Centre, Assam. The study reveals that marketed surplus of commercial crops has shown an increase in the tribal villages but it is relatively very low for paddy as it is a subsistence crop.

Rai et al. (1994) studied the marketed and marketable surplus of wheat and paddy in Kurukshetra district of Haryana. The study revealed that production, consumption marketed and marketable surplus of wheat and rice increased with farm size. The volume of total production and wages in kind to farm labourers had a positive and significant relationship with marketed surplus for both crops.

AREA OF STUDY

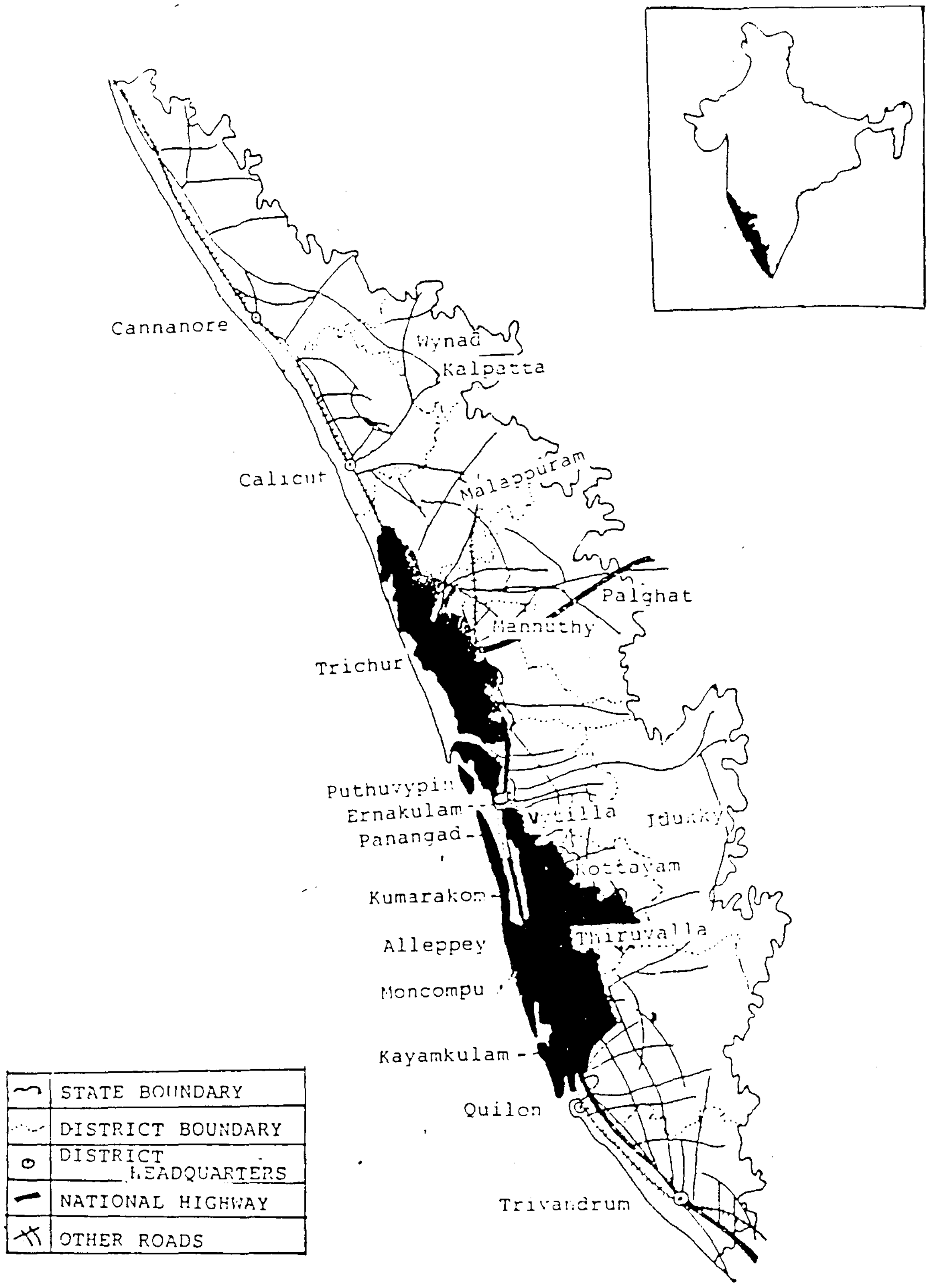

FIG.1. MAP OF KERALA SHOWING KUTTANAD AND KOLE AREAS

AREA OF STUDY

3.1 Kuttanad

Kuttanad, often referred as the 'Holland of Kerala' is a sedimentary formation unique among the rice growing regions in the state.

3.1.1 Location and geographic distribution

Kuttanad encompasses the low lying lands measuring approximately 25 kilometres east-west and 60 kilometres north-south on the west coast of the state. Situated between 9°8' and 9°52' north latitude and 76°19' and 76°44' east longitude. Major part of this land area lies below the mean sea level. On the western side, it is separated from the Arabian sea by a narrow strip of land. The port town of Alappuzha is on its west and the taluks Kottayam and Changanacherry are on the east.

It extends over 54 villages spread over Kottayam, Changanacherry and Vaikom taluks of Kottayam district and Thiruvalla, Chengannur, Ambalappuzha, Mavelikkara, Karthigappalli and Shertallai taluks of Alappuzha district.

Of this about 304 square kilometres lie approximately one metre above mean sea level (MSL) and 500 square kilometres is submerged (0.6 to 2.2 metre below MSL). Kuttanad is a sedimentary formation shaped by the confluence of 4 major rivers of Kerala - the Meenachil, Manimala, Pampa and Achankoil, which drain into Vembanad lake which is the largest lake in Kerala covers an area of about 80 square kilometres and open into the Arabian sea at Kochi.

3.1.2 Physiography

The Kayal lands represent the deeper portions of Kuttanad very close to the back waters called Vembanad lake which is situated parallel to the Arabian sea. These areas represent a "recent sedimentary formation". It has been established that Arabian sea was once extended as far as the eastern border of Kuttanad region. With the upheaval of the "Varkala formation" the tract got elevated forming an extensive bay into which were discharged the waters of Pampa, Achencoil, Meenachil and Manimala rivers. The silt carried by these rivers was deposited at the mouth of the rivers and converted the shallow bay into an extensive water tract. These lagoons gradually silted up and gave rise to wet paddy lands referred to Kuttanad.

3.1.3 Geological features

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

During the south-west monsoon period the flow of water through Achankoil, Pamba, Manimala and Meenachil rivers is estimated at 1,89,000 m^2/sec. As a result the area is prove to flooding during the south-west monsoon period. The north-east monsoon also causes floods, though on a lesser scale.

3.1.4 Climate

A uniform climate prevails in this zone. The minimum temperature of the zone varies from 23.3°C to 26.6°C with an average of 25.2°C. The maximum temperature varies from 30.0°C to 34.6°C with an average of 32.2°C. Relative humidity shows a range of 63.5 to 84.9 with and average of 70.1. The mean rainfall is 2844 mm. The rainiest months are June and July (South-west monsoon) receiving 40.3 per cent of the total annual rainfall. The rainfall during the north-east monsoon (October-November) is only 15.8 per cent of the total. The driest months of the year are January and February.

3.1.5 Soil

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

3.16 Irrigation

As the land is below sea level (about 2m), irrigation is done by gravitational flow of water from the innumerable crisscross channels of the rivers Meenachil, Pampa, Manimala and Achencoil, which enter into this situation (Kayal lands). The total length of water courses is about 82.4 km.

3.1.7 Cropping pattern

Almost all areas in Kuttanad are reclaimed lands of Vembanad lake. Of the total cropped area in the districts of

Alappuzha and Kottayam, the situation forms only 1.9 per cent Rice is grown as the main crop during 'punja' season (September-October to January-February). The area of kayal lands under 'punja' crop in Kuttanad goes upto 26.36 per cent when the percentage is worked out on the total area under 'puncha' crop in the two districts. In about 1/3rd of the kayal lands an additional crop of rice is taken during the 'virippu' season (April-May to August-September). The cropping pattern in Kuttanad is summarised below.

Low lands	-	Rice (Additional crop) April-May to September-October
	-	Virippu
	-	Rice (Normal punja crop) September-October to February-March
	-	Flood fallow
'R' Block	-	Mixed crops of coconut, sugarcane, cocoa, banana, fodder etc.

On the earthern buds strengthened by bricks around the padasekharams, coconuts are raised. In about 620 ha of land in the R-Block padasekharam, permanent non-submersible bunds have been constructed at a height of 2 metres and more profitable cash crops, like coconut, sugarcane, banana etc. are raised. The total length of bunds comes to 10.4 km.

Three vast padasekharams mainly chithira, Marchandam and Rani having a total extent of 600 ha also exist in this situation. They are taken as excess land by the Government and have been distributed to Agricultural labourers. The cultivation in these padasekharams are done by a Farming Co-operative Society.

3.1.8 Demographic features

3.1.8.1 Land holding pattern

There are no separate statistics for the land holding pattern for Kuttanad. Hence the statistics for the different situations which together constitute Kuttanad is considered and is given in Table 3.1.

Out of the 46543 cultivators of Kuttanad, nearly 86 per cent have holdings less than 2 ha.

3.1.8.2 Population

Kuttanad is a very densely populated area. The estimated population of Kuttanad is 20.24 lakhs which forms 7.95 per cent of the population in the state. The density of population in the kayal lands is 1314 per km^2. It is very high when compared to the state average of 556 per km^2. The literacy rate in Kuttanad is about 78.5 per cent.

3.1.8.3 Occupation

The labour force participation in Kuttanad works out

Table 3.1 Land holding pattern in the districts which constitute Kuttanad area

Patter of holdings (ha)	Alleppey district		Kottayam district	
	No. of culti-vators	Extent of holdings (ha)	No. of culti-vators	Extent of holdings (ha)
Below 0.42	10112	4166	6464	2556
Between 0.41-1	7723	6667	4460	3981
Between 1.00-2	6203	9841	4957	7182
Between 2.00-4	3816	8696	1215	3503
Between 4.00-6	1013	4612	283	1072
Above 6	201	4333	141	1323

Source: Status Report, NARP, 1989.

to 27.6 per cent as against the state figure of 28.9 per cent. Out of the total labour force, 20 per cent are cultivators and 44 per cent are agricultural labourers. Male agricultural labourers get only 100-120 days of work in an year and women labourers 80-100 days of work. The reason for this is that the bulk of the paddy area in Kuttanad is single cropped.

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

3.2 Kole lands

The Kole lands extending an area of 13.632 ha is an important rice growing tract of Kerala. In olden days the Kole lands were reclaimed from Kayal area by putting up temporary earthen bunds and cultivation of rice was done by enterprising farmers during summer period from December to May.

3.2.1 Location and geographic distribution

The Kole lands are spread over Thrissur and Malappuram districts extending from the northern bank of Chalakudy river in the south to the southern bank of Bharathapuzha river in the north. The area lies between 10°20' and 10°40' north latitudes and 75°58' and 76°11' east longitudes. The fields are geographically distributed in Mukundapuram, Chavakkad and Thrissur taluks of Thrissur district and Ponnani taluk of Malappuram district.

3.2.2 Physiography

Physiographically the entire tract is a product of fluvial extuarine agencies modified by human activities. The area is devoid of any significant relief features and consists of extensive flat land surface interspersed with uplands. The area is saucer shaped with low lands at the centre with elevation gradually increasing towards the fringes. The land around rice fields have steep slopes which are terraced and put under perennials like arecanut and coconut and annuals like banana, yams etc. The slopes merge with fairly level plateau lands. The dry lands of the Kole region adjoining the coastal belt have level topography and are under coconut.

The Kole fields are low lying tracts located 0.5 to 1 m below the mean sea level. A major portion of the area is flat and it remains submerged for about six months in an year. The area extends from the low lands is the bank of Chalakudy river in the south to Thavanur in the north, lying parallel to the sea. These lands were formally shallow lagoons which gradually got silted up. The flood waters in the Kole areas are mainly brought by two rivers Kechery and Karuvannur which finally drain into the sea.

3.2.3 Geological features

Geologically the Kole area is a low lying plain running parallel to the sea representing piedmont type deposits silted up in flood plains with alluvium brought down by Kechery and Karuvannur rivers. At present the region appears as a saucer shaped basin flanked by laterite hills in the western and eastern margins.

The vally-fill material is mainly of fine to coarser elastics formed of gravel and sand of laterite composition mainly brought down from the laterite hills. These are evidences of the major role of fluvio-esturine deposition in the development of this area. The presence of deep sandy layers also leads to the conclusion that part of these areas were under sea in the recent geological past. The western margin of the Kole lands have expanses of sedimentary rocks including sandstone and clay of Varkala formation. The coastal alluvium seen in the western extremities probably represent a sand bar extending north south parallel to the coast. This is indicated by the sandy flats, the hills and lows observed in the area.

The eastern border of the Kole area is characterised by lowlying hills which represent erosional valleys. The area is essentially a crystalline terrain. The laterite is under crystalline rock and biotite gneiss under different stages of weathering. The main exposures are seen in the south-east of Mala, in the vicinity of Irinjalakuda.

3.2.4 Climate

The climate of the area is moderate. Extremes of heat or cold are not felt, the minimum temperature goes down to 21°C and the maximum may go upto 38°C. Atmosphere is always dump along the coastal belt due to high humidity. The crop growth is generally not inhibited by temperature but governed by rainfall alone. The rainfall distribution in the area is bimodal. The two well defined rainy seasons are south-west monsoon and north-east monsoon. The south-west monsoon extends from June to September with the mean date of onset varying from 25th May to 1st June. The north-east monsoon starts during the middle of October, and extends upto November. There is practically no rain from December to April. The mean annual rainfall of the situation is 2757 mm, out of which 67.3 per cent is received during south-west monsoon and 18 per cent during north east monsoon. The mean monthly humidity varies from 85 to 95 per cent during June-September and is about 70 per cent in January.

3.2.5 Soil

The average level of Kole field is slightly higher than of Kuttanad fields. The highly acidic peaty soils are practically absent in Kole area.

Since the Kole area is a deposition basin, the laterite soil from the eastern hills are eroded, brought down and deposited in this basin during the rainy season. As the area remains submerged for a considerable time, the clay and other finer particles get deposited in course of time. Very often this component of sediments will include organic matter also. Thus the soils of Kole land include secondary laterite and clay. The western extremities of the Kole lands are characterised by the presence of sandy soil. The main soil series in the Kole lands are Anthikad series, Kochira series and Perimpuzha series.

3.2.6 Irrigation

The sources of irrigation water for the Kole area are (1) Peechi Irrigation Project (2) Vazhani Irrigation Project (3) Chalakudy Project and (4) Chimoni Project.

Peechi dam is a straight masonry dam built across the Manali river (one of the tributaries of Karuvannur river) at Peechi. Out of the total storage capacity of 110 Mm^3

(3883 M cuft.) only 37 Mm^3 (130 M cuft.) of water is set apart for Kole cultivation. The Vazhani Irrigation Project across the river Kechery. It consists of an earthen dam with a 61 km canal system. This project serves only the ayacut above the Kole areas. Further the temporary bunds (chiras) put across the natural water course down stream of the Vazhani dam reduces the dry weather flow to the Kole areas.

Chalakudy Irrigation Project is a diversion scheme from Chalakudy river. The river water is sometimes used for Kole lands by diversion through circuitions routes but it does not effectively serve the purpose.

Chimoni project was started with the aim of converting the entire Kole area into double crop fields, one from September to December (the additional crop) and the other from January to May ('punja'). During September-December there will be sufficient water for irrigation both due to rainfall and riverflow. From January to May there will be dearth of water for the summer crop. With the construction of a dam across the Chimoni river, the necessary storage of water for this purpose has become possible.

The other source of irrigation for the Kole areas is the stored water in the canal system inside the Kole areas.

The canals are very narrow and hence no appreciable quantity of water can be stored in them.

3.2.7 Cropping pattern

In the Kole land proper, two rice crops are taken viz., 'Kadumkrishi' (additional crop) and 'punja'. In the upper region of Kole areas 'Virippu', 'mundakan' and 'punja' crops are cultivated. The field level of a particular locality decides the period of cultivation. The general seasons of rice cultivation are as follows:

	Season	Period
Single crop	Virippu	April-August
	Kadumkarishi/Mundakan	September/October - January/February
	Puncha	December/January - March/April
Double crop	Additional crop	August/September - December/January
	Puncha	January/February - April/May

'Virippu'

In higher rice fields around the Kole lands which are flooded during heavy rains, the floods may last for four or five days only. Varieties capable of withstanding floods for a few days are used for this crop. The fields will be prepared dry and the seeds sown with the onset of first monsoon rain. By the time floods come, the crop will be 30-40 days old. In the main Kole lands 'virippu' is not feasible since the entire area would be flooded during this period.

'Mundakan'

Rice fields of medium elevation come out of water when the floods subside by August. 'Mundakan' crop can be raised in these fields. Irrigation has to be provided throughout the crop period.

'Kadumkrishi'

This crop cultivated in September-January period, is possible only in areas protected by bunds. Towards the end of south west monsoon i.e., by September, the flood waters in the fields subside considerably. Water from the protected area will be pumped out in 10 to 15 days. When the water level falls, the bunds around the 'padavus' are raised and strengthened to a height of 1 to 1.5 m above the field level.

When there is only 10 to 15 cm water in the fields, the crop is direct sown or transplanted. Continuous pumping out of the water is necessary for the major portion of the crop period. Towards the end of the crop period, irrigation water has to be supplied.

'Punja'

'Punja' crop is raised over the entire Kole area. Temporary earthen bunds are put up around groups of rice fields in December-January wherever bunds have not been taken for additional crop and the excess water is pumped out into the canals. The crop period is from December-January to April-May. In the early stages of the crop, water needs are met from the summer flow in the rivers and the storage in canals and at later stages. Water from dams are used for irrigation.

3.2.8 Demographic features

3.2.8.1 Land holding pattern

Size of holding of the Kole area is not known separately. Hence the size of holdings of Thrissur district is considered to represent the Kole region and is presented in the Table 3.2.

Table 3.2 Land holding pattern in Thrissur district

Size	Number of holding (000)	(%)	Total 000 ha	Area in (%)
Less than 1 ha	199.1	75.4	33.1	19.1
Between 1 and 2 ha	22.0	11.9	31.3	18.7
Between 2 and 4 ha	15.3	8.3	40.9	24.4
Between 4 and 6 ha	3.6	2.0	16.2	9.7
Between 6 and 8 ha	1.7	0.9	11.5	6.9
Between 8 and 10 ha	1.5	0.8	14.0	8.3
Above 10 ha	1.2	0.7	20.7	12.3
Total	184.4	100.0	167.7	100.0

Source: Status Report, NARP, 1989.

It can be seen that 75 per cent of the total number of holdings are owned by small holders having less than one hectare of agricultural land.

3.2.8.2 Population

The estimated population of Kole is 23.471 lakhs. The density of population in the Kole lands is 1044 per km^2 and this is fairly high when compared to the state average of 556 per km^2. Literacy rate in Kole is 63.77 per cent.

3.2.8.3 Occupation

Agriculture is the main occupation of the people and about 90 per cent of the population depends on it. Due to the vagaries of nature and other handicaps in cultivation the returns from the fields are low which result in underemployment and unemployment. Industries engage only 50,000 people. Tile making is the major industry. Other industries are coir, matches, tentiles, oil mills, timber and toddy tapping.

METHODOLOGY

METHODOLOGY

The study was conducted in the areas of Kuttanad in Alappuzha district and Kole lands in Thrissur district. Kuttanad and Kole areas are the most important rice tracts among the problem areas which are almost similar in topography, soil type and problems encountered during cultivation operations.

4.1 Sampling procedure and collection of data

The present study is based on data collected from a sample of 160 farmers in the area of Kuttanad and Kole. Two stage random sampling was employed with 'Krishi Bhavans' (Panchayat level Agricultural offices) as parimary unit and individual farmers as secondary unit, for generating primary data. Lists of 'Krishi Bhavans' coming under Kuttanad and Kole areas were first prepared. From these lists, four 'Krishi Bhavans' each were selected randomly. From each selected 'Krishi Bhavan', twenty paddy growers were selected at random thus making a total sample of 160. The sample was post-stratified based on the area under rice cultivation and analysis was carried out separately for different strata. The size classification adopted is given below.

Size of holding	Area (ha)
Marginal	0-1
Small	1-2
Large	Above 2

Farm level data were collected from the respondents by personal interview method using a well structured and pretested schedule. Information about the family composition, educational status of the family members, occupation, income and all aspects of rice cultivation including disposal of produce for the season were obtained. Secondary data were collected from various published and unpublished sources.

The season covered in the study was summer/'punja' crop season as this is the main rice crop season in the area. Reference period was the agricultural year 1992-'93. The data were collected from May 1993 to July 1993.

4.2 Analytical framework

4.2.1 Costs and returns

The relationship between the costs incurred and returns obtained from the crop production help the individual farm enterprise in taking decisions. For economy in general, data afford basis for the formulation of policies relating to the agricultural sector. Cost of cultivation per hectare, both operation-wise and input-wise, was worked out for both the regions separately and for various size classes.

The following 'ABC' cost concepts were also used to estimate various income measures* for both the regions separately and for various size classes.

Cost A_1 - All actual expenses in cash and kind incurred in production.

Cost A_2 - Cost A_1 + rent paid for leased-in land.

Cost B_1 - Cost A_1 + interest on value of own fixed capital assets.

Cost B_2 - Cost B_1 + rental value of own land and rent paid for leased-in land

Cost C_1 - Cost B_1 + imputed value of family labour

Cost C_2 - Cost B_2 + imputed value of family labour

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* Kahlon, A.S. and Tyagi, D.S. (1983). Agricultural Price Policy in India. Allied publishers Pvt. Ltd., New Delhi. 104.

In the present study cost A_1 includes,

1. Value of hired human labour

Human labour employed for various cultural operations like land preparation, sowing, interculture, weeding, application of manures and fertilisers, plant protection measures and harvesting were included in determining the value of hired human labour. The actual wages paid for labour was considered as value of hired labour.

2. Value of animal labour

Animal labour is used for initial land preparation and mostly obtained on hire. The hire charges paid or payable for this labour was taken as cost of animal labour.

3. Value of machine use

In addition to animal labour, machines are also being used by all the farmers for the preparation of land. These were predominantly on hire. As such hire charges paid/payable were reckoned as cost of machinery.

4. Value of seeds

Purchased seeds were evaluated on the basis of their purchase price. The same price was used for evaluating farm produced seeds.

5. Value of manures and fertilisers

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

6. Value of plant protection chemicals

Value of plant protection chemicals viz. insecticides and fungicides were calculated at their market price.

7. Interest on working capital

The rate of interest charged by the commercial banks for short term agricultural loans which was 11.00 per cent per annum was charged for 3 months duration of the crop.

8. Miscellaneous expenses

Expenses incurred for electricity, dewatering, irrigation, land revenue etc. were included in this item. The actual rate of land tax paid to the revenue department at Rs.10/- per acre was taken.

In both the areas under study leasing in of land by the respondents was not found. Hence cost A_2 is same as Cost A_1. Rental value of land was calculated as equal to one fifth of the value of total produce. Cost of family labour was imputed based on the prevailing wages for hired labour in these areas during the period. It was Rs.45/- per day for men and Rs.30/- per day for women.

4.2.2 Income measures

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

1. Gross income

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

2. Farm business income

It was calculated by taking the difference between gross income and Cost A_1. This represents income to the farmer when only production expenses are considered as costs.

3. Family labour income

It was calculated by adding the imputed wages for family labour to the net income or the difference between gross income and Cost B_2.

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* Sandhya, V. (1992). Economics of production and marketing of vegetables in Ollukkara Block in Thrissur district. Unpublished M.Sc. (Ag.) thesis, Department of Agricultural Economics, KAU.

4. Net income

This is the difference between the gross income and Cost C_2.

5. Input output ratio

Input out ratio reveals the physical production efficiency. It was calculated by dividing the total benefits by total costs.

4.2.3 Bulk line cost

Bulk line cost, computed for rice, covers cost of production of majority of farmers, production or area on cost C_2 basis. Generally it is calculated to cover 85 per cent of farmers, production or area.*

4.2.4 Resource-use efficiency

To estimate the resource use efficiency, Cobb-Douglas production function was used which is logrithemically linear. This log linear function is simple and very easy to compute, and it assumes a constant rate of change in the dependent variable with respect to the independent variable. It also

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* Kahlon, A.S. and Tyagi, D.S. (1983). Agricultural Price Policy in India. Allied publishers Pvt. Ltd., New Delhi. p.16.

allows economic use of degrees of freedom. This function has asymptotic isoquants, straight line isoclines passing through the origin, the regression coefficient is same as production elasticity and allows only constant, increasing or decreasing marginal productivity. This function had a major limitation in the sense that it has a constant unitary elasticity of substitution between any set of two imput variables*.

The model as given below was fitted for both the regions separately:

$$Y_1 = a_1 \; X_{1.1}^{b_{1.1}} \; X_{2.1}^{b_{2.1}} \; X_{3.1}^{b_{3.1}} \; X_{4.1}^{b_{4.1}} \quad \ldots\ldots \text{(Kuttanad)}$$

$$Y_2 = a_2 \; X_{1.2}^{b_{1.2}} \; X_{2.2}^{b_{2.2}} \; X_{3.2}^{b_{3.2}} \; X_{4.2}^{b_{4.2}} \quad \ldots\ldots \text{(Kole)}$$

where, Y_1 represents the average per hectare gross income from rice in Kuttanad area.

a_1 - is the intercept

$X_{1.1}$, $X_{2.1}$, $X_{3.1}$ and $X_{4.1}$ are cost on machine use, human labour, fertiliser and plant protection respectively, whereas $b_{1.1}$, $b_{2.1}$, $b_{3.1}$ and $b_{4.1}$ are the corresponding regression coefficients.

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* Sankhayam, P.L. 1988. Introduction to the Economics of Agricultural Production. Prentice Hall of India Private Limited, New Delhi. 64.

In the second model,

Y_2 represents the average per hectare gross income of rice in Kole area.

a_2 - is the intercept

$X_{1.2}$, $X_{2.2}$, $X_{3.2}$ and $X_{4.2}$ are cost on machine use, human labour, fertiliser and plant protection respectively, whereas $b_{1.2}$, $b_{2.2}$, $b_{3.2}$ and $b_{4.2}$ are the corresponding regression coefficients.

4.2.4.1 Units of measurement of variables

The choice of units for measuring the inputs and output is crucial as the selection of the variable and mathematical model for analysis. Ideally inputs and output should be measured in physical unit of a homogeneous nature. Measurement of inputs and output in physical units is possible in experimental studies. But in actual farming situation this differ from farm to farm. Moreover heterogeneous capital forms have no common physical measurement. Consequently monetary units are commonly used to measure inputs categories of considerable heterogeneity. Similarly, there are various qualities of physical output which can be aggregated feasibly only in the value terms. Hence all the inputs and output included in the present study are measured in value terms.

All the four explanatory variables have been retained in the first run and the regression coefficients have been estimated by the method of least square. After the coefficient have been estimated, the variable having standard error of its coefficient greater than the coefficient itself (i.e. t-value of the regression coefficient is less than unity) has been dropped and the model was rerun with the remaining variables.* The production functions selected on the basis of the criterion laid down above for the further economic analysis are the following:

$$Y_1 = a_1 \; X_{1.1}^{b_{1.1}} \; X_{2.1}^{b_{2.1}} \; X_{3.1}^{b_{3.1}} \qquad \text{..... (Kuttanad)}$$

$$Y_2 = a_2 \; X_{1.2}^{b_{1.2}} \; X_{2.2}^{b_{2.2}} \; X_{3.2}^{b_{3.2}} \qquad \text{..... (Kole)}$$

4.2.4.2 Returns to scale

The sum of the regression coefficient, Σb_i, of all inputs included in the function indicates returns to scale. These regression coefficients (elasticities) are constant over all ranges of inputs.

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* Maji, C.C. (1968) productivity and allocation of resources in jute and paddy. A farm level study in Mondalh at (Burdwan) and Naricha (Hoogly). M.Sc. Ag. thesis, I.A.R.I.

4.2.4.3 Marginal value product (MVP)

Marginal value product denotes the additional return from an additional rupee invested in the relevant inputs. These have been estimated at geometric mean level of inputs and output. The most reliable estimate of marginal productivity is obtained by taking X_i at the geometric mean level.* In general, given the Cobb-Douglas type of production function, the Marginal Value Product at the geometric mean level of inputs and output can be worked out as follows:

$$MVP_{X_i} \text{ at geometric mean} = \frac{dY}{dX_i} = \frac{b_i \bar{Y}}{\bar{X}_i}$$

Where MVP_{X_i} is the marginal value products of input X_i.

(i = 1,2 .... n refers to input)

$$\text{Thus, } MVP_{X_{1.1}} \text{ at geometric mean} = \frac{b_{1.1} \bar{Y}_1}{\bar{X}_{1.1}}$$

$$MVP_{X_{2.1}} \text{ at geometric mean} = \frac{b_{2.1} \bar{Y}_1}{\bar{X}_{2.1}}$$

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* Heady, E.O. and Dillon, J.L. 1961. Agricultural Production Function. Kalyani Publishers, Ludhiana. 231.

$$MVP_{X_{3.1}} \text{ at geometric mean} = \frac{b_{3.1}\,\bar{Y}_1}{\bar{X}_{3.1}}$$

$$MVP_{X_{1.2}} \text{ at geometric mean} = \frac{b_{1.2}\,\bar{Y}_2}{\bar{X}_{1.2}}$$

$$MVP_{X_{2.2}} \text{ at geometric mean} = \frac{b_{2.2}\,\bar{Y}_2}{\bar{X}_{2.2}}$$

$$MVP_{X_{3.2}} \text{ at geometric mean} = \frac{b_{3.2}\,\bar{Y}_2}{\bar{X}_{3.2}}$$

Where Y_1 and Y_2 are average per hectare gross income from rice production in Kuttanad and Kole areas respectively.

4.2.4.4 Optimum allocation of resources

The next step in the present study is to find out the optimum combinations of resources under limited resource situation.

$$Y_1 = a_1 \quad X_{1.1}^{b_{1.1}} \quad X_{2.1}^{b_{2.1}} \quad X_{3.1}^{b_{3.1}} \qquad \ldots\ldots\ldots \text{(I)}$$

$$X_{1.1} + X_{2.1} + X_{3.1} = C_1 \qquad \text{........(II)}$$

Where $X_{1.1}$ + $X_{2.1}$ + $X_{3.1}$ are per hectare investment in machine labour, fertiliser and human labour and C_1 is the total available funds for the above inputs that can be used in one hectare of paddy in Kuttanad.

From production function

$$\frac{dY_1}{dX_{1.1}} = \frac{b_{1.1}\ Y_1}{X_{1.1}} \qquad \text{......(III)}$$

$$\frac{dY_1}{dX_{2.1}} = \frac{b_{2.1}\ Y_1}{X_{2.1}} \qquad \text{.......(IV)}$$

$$\frac{dY_1}{dX_{3.1}} = \frac{b_{3.1}\ Y_1}{X_{3.1}} \qquad \text{....... (V)}$$

For optimisation

$$\frac{dY_1/dX_{1.1}}{dY_1/dX_{2.1}} = \frac{b_{1.1}\ Y_1/X_{1.1}}{b_{2.1}\ Y_1/X_{2.1}} = \frac{PX_{1.1}}{PX_{2.1}} \qquad \text{...... (VI)}$$

$$\frac{dY_1/dX_{2.1}}{dY_1/dX_{3.1}} = \frac{b_{2.1}\ Y_1/X_{2.1}}{b_{3.1}\ Y_1/X_{3.1}} = \frac{PX_{2.1}}{PX_{3.1}} \qquad \text{......(VII)}$$

Where $PX_{1.1}$, $PX_{2.1}$ and $PX_{3.1}$ are the price of inputs X_1, X_2 and X_3 respectively.

From equation (VI)

$$\frac{dX_{2.1}}{dX_{1.1}} = \frac{b_{1.1}}{b_{2.1}} \frac{X_{2.1}}{X_{1.1}} = 1$$

(as production function is a value function)

Therefore $b_{1.1} X_{2.1} - b_{2.1} X_{1.1} = 0$ .....(VIII)

Similarly from equation (VII)

$$b_{2.1} X_{3.1} - b_{3.1} X_{2.1} = 0 \qquad ..... \quad (IX)$$

From equation (VIII)

$$X_{2.1} = \frac{b_{2.1}X_{1.1}}{b_{1.1}} \qquad ..... \quad (X)$$

and in substituting the value $X_{2.1}$ in equation (IX) we get

$$X_{3.1} = \frac{b_{3.1}X_{1.1}}{b_{1.1}} \qquad ..... \quad (XI)$$

Substituting these values of $X_{2.1}$ and $X_{3.1}$ in terms of $X_{1.1}$ in the constant equation (II) to obtain

$$X_{1.1} + \frac{b_{2.1}X_{1.1}}{b_{1.1}} + \frac{b_{3.1}X_{1.1}}{b_{1.1}} = C_1 \qquad ..... \quad (XII)$$

So that

$$X_{1.1} = \frac{b_{1.1}\ C_1}{b_{1.1} + b_{2.1} + b_{3.1}} \qquad .....(XIII)$$

Similarly

$$X_{2.1} = \frac{b_{2.1}\ C_1}{b_{1.1} + b_{2.1} + b_{3.1}} \qquad .....(XIV)$$

and

$$X_{3.1} = \frac{b_{3.1}\ C_1}{b_{1.1} + b_{2.1} + b_{3.1}} \qquad .....(XV)$$

These X_i give the optimum input level and thus depend on the fixed amount of C_1 at the disposal of the farmer and the production coefficient. Thus the optimum level of these inputs can be estimated for every farmer by multiplying the capital constraint of the farm for the crop by the elasticity of coefficient of the corresponding input and dividing the product by the sum of the coefficients of all inputs since the input X_i are in rupee unit.

4.2.5 Factors contributing to marketed surplus

Farm retentions of the respondents in both the areas under study were worked out. Farm retentions refers to the total produce in quintal minus, quantity marketed, kept for seed, home consumption and for giving wages as kind. These were also estimated for the whole sample consisting of both the areas under study. This is due to the reason that the consumption behaviour of these two areas is identical.

Multiple regression analysis was used to determine the factors contributing to the marketed surplus. The model was fitted for both the areas together. The model is:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + e$$

where a is the intercept

X_1 the family size

X_2 productivity in quintal

X_3 the area under paddy in hectare and

e the error term

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

This chapter is divided into six sections which deals with the results of the study and discussion thereon. The first section is about the general socio-economic characteristics of the sample holdings in Kuttanad and Kole areas and section two deals with methods of rice cultivation. Section three includes the operationwise, inputwise cost of cultivation, cost of cultivation of rice according to different cost concepts, income measures in relation to different cost concepts, yield and returns from rice (per hectare) and bulk line cost of rice in Kuttanad and Kole areas. Section four includes the resource use efficiency of rice cultivation and optimum allocation for these two areas. Section five is about the marketed surplus and farm retention of sample farmers in Kuttanad and Kole and also the factors contributing marketed surplus in the study area. Finally section six deals with the important constraints of rice production in Kuttanad and Kole areas.

5.1 General economic and social conditions of the sample

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

5.1.1 Kuttanad

5.1.1.1 Family size

The respondent farmers were classified based on their family size and their distribution is given in Table 5.1. As much as 60 per cent (48 numbers) of the sample families came under the size group of 3 to 5 members and the remaining 40 per cent had 6 to 8 members. In the case of marginal farmers 54.35 per cent came under the size group of 3 to 5 members and 45.65 per cent came under the size group of 6 to 8 members. Out of the twenty nine small farmers 65.52 per cent had 3 to 5 members and the rest 34.48 per cent had 6 to 8 members. Whereas 80.00 per cent of the large farmers belong to the size class of 3 to 5 members and the remaining 20.00 per cent had 6 to 8 members. Out of the 48 sample farmers having the size group of 3 to 5 members, 52.08 per cent were marginal farmers, 39.58 per cent were small farmers and the rest were large farmers. The average family size of the respondent farmers was 5.05.

Table 5.1 Classification of the respondents according to family size (Kuttanad)

Class of farmer	Family size and number of families			Average size of the family
	3-5	6-8	Total	
Marginal	25 (54.35)	21 (45.65)	46 (100.00)	5.02
Small	19 (65.52)	10 (34.48)	29 (100.00)	5.17
Large	4 (80.00)	1 (20.00)	5 (100.00)	4.60
Total	48 (60.00)	32 (40.00)	80 (100.00)	5.05

(Figures in parentheses show percentages to total)

5.1.1.2 Age and sex

Classification of the members of respondents families on the basis of age and sex is given in Table 5.2. As much as 33.33 per cent of the total members came under the age group of 40 to 59 and 25 per cent came under the age group of 18 to 39. About 14.95 per cent was in the age group of 60 and above. Out of the total family members 26.72 per cent was below eighteen years of age. Males accounted for 51.96 per cent of the total members and females accounted the rest 48.04 per cent. The number of females per thousand male was only 925. This is in contrast to the general situation in the state. This seem to be on account of the extremely adverse sex ratio in the age group of 60 and above which is found among all the three land holding categories.

5.1.1.3 Literacy

Classification of respondents according to their educational status is given in Table 5.3. Analysis showed that none of the farmer was illiterate. Out of the total respondents 27.50 per cent (22 numbers) was educated below S.S.L.C., 53.75 per cent upto S.S.L.C., 5 per cent upto Pre-degree level and 13.75 per cent at degree level.

Table 5.2 Distribution of respondent family members according to age and sex (Kuttanad)

Class of farmer	Age group (Years)										Grand total
	0-17		18-39		40-59		60 and above		Total		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
Marginal	29 (12.29)	31 (13.14)	36 (15.25)	27 (11.44)	33 (13.98)	43 (18.22)	27 (11.44)	10 (4.24)	125 (52.97)	111 (47.03)	236 (100.00)
Small	18 (12.08)	26 (17.45)	16 (10.74)	15 (10.07)	24 (16.11)	29 (19.46)	15 (10.07)	6 (4.03)	73 (48.99)	76 (51.01)	149 (100.00)
Large	4 (17.39)	1 (4.35)	5 (21.74)	3 (13.04)	2 (8.70)	5 (21.74)	3 (13.04)	-	14 (60.87)	9 (39.13)	23 (100.00)
Total	51 (12.50)	58 (14.22)	57 (13.97)	45 (11.03)	59 (14.46)	77 (18.87)	45 (11.03)	16 (3.92)	212 (51.96)	196 (48.04)	408 (100.00)

(Figures in parentheses show percentages to total)

Table 5.3 Classification of respondents according to education level (Kuttanad)

Class of farmer	Below S.S.L.C	S.S.L.C.	Pre-Degree	Degree	Total
Marginal	14 (30.43)	24 (52.17)	1 (2.17)	7 (15.22)	46 (100.00)
Small	7 (24.14)	16 (55.17)	2 (6.90)	4 (13.79)	29 (100.00)
Large	1 (20.00)	3 (60.00)	1 (20.00)	-	5 (100.00)
Total	22 (27.50)	43 (53.75)	4 (5.00)	11 (13.75)	80 (100.00)

(Figures in parentheses show percentages to total)

5.1.1.4 Occupation

Distribution of respondents according to their occupation is shown in Table 5.4. Agriculture is the sole occupation of 57.50 per cent of the sample farmers in Kuttanad area. As much as 91.30 per cent of the marginal farmers, agriculture as the sole occupation while it was 13.79 per cent in the case of small farmers. It was also found that agriculture is the main occupation of 36.25 per cent of all the farmers. In this group there are 8.70 per cent of the marginal farmers and 86.21 per cent of small farmers. Agriculture also served as a sub-occupation for another 6.25 per cent of the total respondents. In fact for all the large farmers agriculture is a subsidiary occupation.

5.1.1.5 Ownership holding

The respondents were classified based on their holding size and are given in Table 5.5. It was found that marginal farmers who formed 57.5 per cent of the total respondents have only 32.26 per cent of the total area. Small farmers who constituted 36.25 per cent of the total have 47.06 per cent of the total area and large farmers who formed 6.25 per cent of the total have 20.68 per cent of the total area. Average size of holding was 1.34 hectares.

Table 5.4 Classification of respondents according to to occupation (Kuttanad)

Class of farmer	Agriculture as the only occupation	Agriculture as main occupation	Agriculture as sub occupation	Total
Marginal	42 (91.30)	4 (8.70)	-	46 (100.00)
Small	4 (13.79)	25 (86.21)	-	29 (100.00)
Large	-	-	5 (100.00)	5 (100.00)
Total	46 (57.50)	29 (36.25)	5 (6.25)	80 (100.00)

(Figures in parentheses show percentages to total)

Table 5.5 Distribution of respondents according to ownership holding (Kuttanad)

Class of farmer	No. of farmers in each class	Area (in hectares)	
		Area	Average size of holding
Marginal	46 (57.50)	34.62 (32.26)	0.75
Small	29 (36.25)	50.51 (47.06)	1.74
Large	5 (6.25)	22.20 (20.68)	4.44
Total	80 (100.00)	107.33 (100.00)	1.34

(Figures in parentheses show percentages to total)

5.1.1.6 Cropping pattern

Cropping pattern of the respondent farmers is given in Table 5.6. The major crops grown in the area were rice, coconut, banana and vegetables. Rice was grown in 86.35 per cent of the gross cropped area and is the important food grain crop in the area. Coconut occupied 8.56 per cent of the gross cropped area. Banana and vegetables were grown in 2.14 and 0.43 per cent respectively of the gross cropped area.

5.1.1.7 Area under rice

Classification of the respondents based on their area under rice cultivation is given in Table 5.7. Out of the total respondents 57.5 per cent of the respondents were marginal farmers having an area below one hectare and they had only 32.73 per cent of the total rice area of all the respondents. Small farmers who owned an area between one and two hectares came to 36.25 per cent of the total respondents and they owned an area of 48.06 per cent of the total area. The percentage of respondents who were having more than two hectares of land under rice cultivation was 6.25 and they accounted 19.21 per cent of the total area of all respondents. For the sample as a whole the average size of rice area was only 1.16 hectares.

Table 5.6 Cropping pattern of respondent farmers (Kuttanad)

Crops	Area (in hectares)	Percentage of gross cropped area
Rice	92.66	86.35
Coconut	9.18	8.56
Other perennials	2.70	2.52
Banana	2.30	2.14
Vegetables	0.46	0.43
Gross cropped area	107.30	100.00

Table 5.7 Distribution of respondents according area under rice (Kuttanad)

Class of farmer	Number of farmers	Area (in hectares)	
		Total area	Average size of farm
Marginal	46 (57.50)	30.33 (32.73)	0.66
Small	29 (36.25)	44.53 (48.06)	1.54
Large	5 (6.25)	17.80 (19.21)	3.56
Total	80 (100.00)	92.66 (100.00)	1.16

(Figures in parentheses show percentages to total)

5.1.2 Kole

5.1.2.1 Family size

Respondents in Kole area were classified based on their family size and their distribution according to it is given in Table 5.8. analysis showed that 60 per cent of the total sample farmers came under the family size group having 3 to 5 members and the remaining 40.00 per cent had 6 to 8 members. In the case of marginal farmers 62.90 per cent came under the size group of 3 to 5 and the rest 37.10 per cent came under the size group of 6 to 8. Out of the fifteen small farmers 46.67 per cent had 3 to 5 members and 53.33 per cent had 6 to 8 members. In the case of large farmers 66.67 per cent belong to the size class of 3 to 5 and the rest 33.33 per cent belong to the size class of 6 to 8 members. Out of the 48 sample farmers having the size class of 3 to 5 members 79.00 per cent were marginal farmers. The average family size of the respondent farmers was 5.19.

5.1.2.2 Age and sex

Classification of all the members of respondent families on the basis of age and sex is given in Table 5.9. As much as 35.67 per cent of the total members came under the age group of 18 to 39 and 33.5 per cent came under the age group of 40 to 59. About 10.84 per cent was in the age group

Table 5.8 Classification of respondents according to family size (Kole)

Class of farmer	Family size and number of families			Average size of the family
	3-5	6-8	Total	
Marginal	39 (62.90)	23 (37.10)	62 (100.00)	5.13
Small	7 (46.67)	8 (53.33)	15 (100.00)	5.53
Large	2 (66.67)	1 (33.33)	3 (100.00)	4.67
Total	48 (60.00)	32 (40.00)	80 (100.00)	5.19

(Figures in parentheses show percentages to total)

Table 5.9 Distribution of respondent family members according to age and sex (Kole)

Class of farmer	Age group (Years)										Grant total
	0-17		18-39		40-59		60 and above		Total		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
Marginal	29 (9.[illegible])	27 (8.48)	55 (17.30)	64 (20.13)	54 (16.98)	55 (17.30)	20 (6.29)	14 (4.40)	158 (49.69)	160 (50.31)	318 (100.00)
Small	8 (9.64)	15 (18.07)	11 (13.25)	15 (18.07)	13 (15.66)	11 (13.25)	5 (6.03)	5 (6.03)	37 (44.58)	46 (65.42)	83 (100.00)
Large	2 (14.29)	2 (14.29)	3 (21.43)	-	3 (21.43)	3 (21.43)	-	1 (7.14)	8 (57.14)	6 (42.86)	14 (100.00)
Total	39 (9.40)	44 (10.60)	69 (16.63)	79 (19.04)	70 (16.87)	69 (16.63)	25 (6.02)	20 (4.82)	203 (48.92)	212 (51.08)	415 (100.00)

(Figures in parentheses show percentages to total)

of 60 and above. Out of the total family members 20.00 per cent was below 18 years of age. Males constituted 48.92 per cent of the total members and the remaining 51.08 per cent females. Sex ratio (number of females per thousand males) was 1054. It is interesting to note that in the age groups of 40 years and above sex ratio reversed and the reversal was more.

5.1.2.3 Literacy

Classification of the respondents according to their educational status is given in the Table 5.10. Analysis showed that all the sample farmers were literate. Out of the total respondents 15 per cent was educated below secondary school level, 58.75 per cent attained secondary school level, 12.50 per cent attained pre-degree (higher secondary) level and the rest 13.75 per cent was degree holders. All the respondents whose educational level was below the secondary school level, belonged to the category of marginal farmers.

5.1.2.4 Occupation

Distribution of respondents according to their occupation is shown in Table 5.11. Though the respondents were all farmers, agriculture was not the sole occupation nor was main occupation in many cases. Agriculture was the sole occupation of 52.5 per cent of the sample farmers. Surprisingly more than 95 per cent of those farmers whose sole

Table 5.10 Classification of respondents according to education level (Kole)

Class of farmer	Below S.S.L.C	S.S.L.C.	Pre-Degree	Degree	Total
Marginal	12 (19.35)	40 (64.52)	6 (9.68)	4 (6.45)	62 (100.00)
Small	-	5 (33.33)	3 (20.00)	7 (46.67)	15 (100.00)
Large	-	2 (66.67)	1 (33.33)	-	3 (100.00)
Total	12 (15.00)	47 (58.75)	10 (12.50)	11 (13.75)	80 (100.00)

(Figures in parentheses show percentages to total)

Table 5.11 Classification of respondents according to occupation (Kole)

Class of farmer	Agriculture as the only occupation	Agriculture as main occupation	Agriculture as sub occupation	Total
Marginal	40 (64.52)	16 (25.81)	6 (9.67)	62 (100.00)
Small	2 (13.30)	13 (86.67)	-	15 (100.00)
Large	-	-	3 (100.00)	3 (100.00)
Total	42 (52.50)	29 (36.25)	9 (11.25)	80 (100.00)

(Figures in parentheses show percentages to total)

occupation was agriculture, belonged to the category of marginal farmers. For as much as 64.52 per cent of the marginal farmers and 13.33 per cent of small farmers, agriculture was the sole occupation. This was the main occupation of 36.25 per cent of the respondents and as much as 86.67 per cent of small farmers and 25.81 per cent of marginal farmers reported agriculture as the main occupation. Agriculture served as a sub-occupation for another 11.25 per cent of total respondents. None of the large farmers reported agriculture either as the sole occupation or the main occupation. For all of them (through small in number) agriculture was a subsidiary occupation. Though the large farmers were educationally not superior to others, they were able to find other major occupations, not out of economic compulsions. It would appear that the relatively higher resource base enabled them to venture into other avocations which give better incomes.

5.1.2.5 Ownership holding

Distribution of respondents according to their land holding is given in Table 5.12. It was found that 77.50 per cent of the total respondents were having 52.80 per cent of the total area. small and large farmers were having 35.09 and 12.11 per cent of the total area respectively. Average size of holding was 0.96 hectare.

Table 5.12 Distribution of respondents according to ownership holding (Kole)

Class of farmer	Number of farmers in each class	Area (in hectares)	
		Area	Average size of holding
Marginal	62 (77.50)	40.59 (52.80)	0.65
Small	15 (18.75)	26.98 (35.09)	1.80
Large	3 (3.75)	9.31 (12.11)	3.10
Total	80 (100.00)	76.88 (100.00)	0.96

(Figures in parentheses show percentages to total)

5.1.2.6 Cropping pattern

Cropping pattern of the respondent farmers is given in Table 5.13. The major crops grown in the area are rice, coconut, banana and vegetables. Total gross cropped area of all the respondent farmers was 76.88 hectares. Rice was grown in 79.77 per cent of the gross cropped area and though it is the important food crop in the area its cultivation is commercially oriented. Coconut occupied 10.73 per cent of the gross cropped area. Banana and vegetables were grown in 2.99 and 1.04 per cent respectively of the gross cropped area. The area under other perennials came to 5.47 per cent of the gross cropped area.

5.1.2.7 Area under rice

The respondents were classified according to their area under rice cultivation and their distribution is given in Table 5.14. Out of the total respondents, 77.50 per cent was marginal farmers having an area below one hectare and 18.75 per cent was having an area between one and two hectares (small farmers). The percentage of respondents who were having more than two hectares of land under paddy cultivation was 3.75 per cent. As much as 52.03 per cent of the rice area belonged to 77.50 per cent of farmers. Another 18.75 per

Table 5.13 Cropping pattern of respondent farmers (Kole)

Crops	Area (in hectares)	Percentage of gross cropped area
Rice	61.33	79.77
Coconut	8.25	10.73
Other perennials	4.20	5.47
Banana	2.30	2.99
Vegetables	0.80	1.04
Gross cropped area	76.88	100.00

Table 5.14 Distribution of respondents according to area under rice (Kole)

Class of farmer	Number of farmers	Area (in hectares)	
		Total area	Average size of farm
Marginal	62 (77.50)	31.91 (52.03)	0.51
Small	15 (18.75)	21.02 (34.27)	1.40
Large	3 (3.75)	8.40 (13.70)	2.80
Total	80 (100.00)	61.33 (100.00)	0.77

(Figures in parentheses show percentages to total)

cent of farmers had 34.27 per cent of area and the rest 3.75 per cent had 13.70 per cent of area.

5.2 Methods of rice cultivation

5.2.1 General practices of rice cultivation in Kuttanad

Rice cultivation in Kuttanad is popularly known as 'puncha' cultivation. The paddy fields of Kuttanad are separated into blocks of contiguous area, separated by canals. Such blocks are known as 'Padasekharams'. A 'padasekharam' is a viable cultivable unit having an extent varying from 10 to 800 ha. The 'padasekharam' will be under 1 to 2 m deep water during the south-west monsoon period before the commencement of the cultivation season. Flooding prevents the capillary rise of salts in soil.

5.2.1.1 Dewatering

At the time of cultivation the water from the fields is bailed out with the help of a special pumping device called 'petti' and 'para'. This is an axial flow pump with low head and high discharge. After completely draining out water, the outer bunds of the 'padasekharam' are strengthened and the fields made ready for cultivation.

The fields are then ploughed, often, in waist deep water. This helps to stir up the soil and allow fresh water to percolate into the soil. Ploughing would also help in removing acidity and other toxicants from the soil through the flush of water.

5.2.1.2 Repair to the inner bunds

Bunds, which are made to demark individual plots are also strengthened and this operation is known as 'Varambukuttal'. Along with this small channels are made to facilitate irrigation and drainage.

5.2.1.3 Levelling

After breaking the clods, then removing weeds, stabbles etc. the field is levelled so that the soil obtain a fine tilth. This is carried out by women labourers. Levelling is also done with hands. This practice is scrupulously followed by farmers. Then fresh water is let into the fields.

5.2.1.4 Sowing

Seeds, packed in screw-pine baskets and soaked for about 8 to 12 hours and drained to induce sprouting. Sprouted seeds are broadcast in the prepared field in ankle-deep water. The seed rate recommended is 100 kg per hectare, but cultivators in general adopt a higher seed rate of 100-125 kg per hectare on the presumption that thick stand will reduce weed growth and will look after the losses due to bird picking etc. Three to four days after sowing, the fields are completely drained and kept for about a week with the soil moist and not dry completely. Transplanting is also practiced rarely in certain parts.

5.2.1.5 Gap filling

This is the removal of overcrowded portions in the field by thinning out the excess seedlings and filling the gaps. This is done 25 to 30 days after sowing. First weeding as well as top dressing is carried out soon after gap filling.

5.2.1.6 Liming

In areas where pH of the soil is below 5.5 liming is essential. In areas where pH ranges between 5.5 and 6.5 liming improves the soil. Calcium carbonate, lime, dolomite etc. are used based on soil testing results.

5.2.1.7 Weeding

First weeding is done along with gap filling. Usually weeding is done thrice in a season. Weed infestation in the wet direct-sown rice fields is usually severe. Hence apart from manual weeding, chemical weeding is also resorted to.

5.2.1.8 Manuring

Farm yard manure or green leaves or both are applied to the field while levelling is done. Now-a-days it is not a common practice because of the high material and transportation cost.

5.2.1.9 Fertiliser application

Fertilisers acts as the major source of nutrients for paddy in Kuttanad. The Kerala Agricultural University fertiliser recommendations of NPK (kg per hectare) for short duration varieties is 70:35:35. Usually fertilisers are applied in 2 to 3 doses. Half the quantity of phosphatic fertilisers is added while preparing the land. Second application is made after 10 days from sowing when the plants are at two leaves stage. Half the quantities of nitrogenous, potassic and phosphatic fertilisers are given as the second dose. Remaining quantities of nitrogen and potash are given about 5 to 10 days after gap filling. The fields are drained before the application of fertilisers and kept moist for about two days after.

5.2.1.10 Plant protection

The high yielding varieties necessitate the intensive use of plant protection chemicals. A regular pattern of plant protection is not seen adopted. However, need based plant protection operations are being followed by farmers.

5.2.1.11 Water management

Water is let in and drained occasionally (every 10 to 15 days) so as to maintain a continuous water level of about 5 cm in the field. Field is completely drained about 10 days before harvest.

5.2.1.12 Harvest

The earheads are cut and collected while harvesting. These re tied to bundles ('katta'). Later threshing and winnowing were done. Winnowing machines are widely used. The cleaned grains are often sold at the threshing floor. the wages for harvesting is paid in kind as 18 to 20 per cent of the total grain harvested and threshed by a labour (known as 'patham' and 'theerpu').

5.2.2 General practice of rice cultivation in Kole

In olden days the Kole lands were reclaimed from 'kayal' area by putting temporary earthen buds and cultivation of rice has done by enterprising farmers during the summer period from December to May. This water and timely showers used to produce bumper crops if other conditions are favourable. 'Kole' a malayalam word indicated bumper yield or high returns in case of floods did not damage the crop.

With the onset of pre-monsoon showers after harvest, the fields are given two or three ploughings after which they are allowed to get submerged under the monsoon floods. At the time of cultivation dewatering is done by electric motors with 'Petti' and 'Para', a device for lifting large volumes of water to a height of about 1.5 to 2.5 m and rarely with country 'water sheels' ('chakram'). Each one is given a specific time limit for starting dewatering and sowing operations. This system enables to conserve the water available within the 'Kole' area to be utilized in this area itself. When one zone is completely dewatered, the other zone will be in a position to let in water. With the completion of dewatering the field is ploughed. Generally shallow ploughing or harrowing is followed in most of the areas.

5.2.2.1 Dewatering

Dewatering is done with cessation of the north east monsoon showers in November-December.

5.2.2.2 Repair to inner bunds

Inner buds boardering individual plots are strengthened and small channels were made to facilitate irrigation and drainage.

5.2.2.3 Levelling

After dewatering 3 to 4 mounds of ploughing are given incorporating cattle manure. then levelling is done with a local implement called 'Pallimutti'. This is carried out by women labourers. The soil attain a fine tilth.

5.2.2.4 Sowing

Broadcasting sprouted seed is the general practice followed. Seeds are prepared at a rate of 100kg per hectare and are sown early in January. Now-a-days transplanting is also adopted. Only short duration varieties are used. Medium duration varieties are used in a limited area. After germination the field is allowed to dry till racks are developed. This aids in leaching of the injurious salts and better aeration of roots once fresh water is let into the fields.

5.2.2.5 Gap filling

This refers to the removal of over crowded portions in the field by thinning out the excess seedlings and filling the gaps.

5.2.2.6 Liming

Area having a soil pH below 5.5, liming is essential. Calcium carbonate, lime, dolomite etc. are used in this area. Usually 350 kg/ha of lime was applied at the time of last ploughing.

5.2.2.7 Weeding

First weeding is carried out along with gap filling. It is usually done thrice in a season. Weed problem is severe in this area and hence a lot of manual weeding is necessary. Chemical weeding is also in practice.

5.2.2.8 Manuring

Farm yard manure or green leaves are applied at a rate of 5 t/ha to the field after the levelling is conducted. It is not resorted to because of the high cost involved in its application.

5.2.2.9 Fertiliser application

Fertiliser are the major suppliers of nutrients in Kole area. The fertiliser recommendation for the regular crop 'puncha' is NPK per hectare 47:35:17.5 kg of NPK per hectare is the basal. Twenty three kilogram of N and 17.5 kg of K per hectare is applied at the panicle initiation stage.

5.2.2.10 Plant protection

The incidence of pests and diseases often necessitate prophylactic measures. Most of the farmers use combination of insecticides and fungicides to economise the cost of plant protection. Use of high yielding varieties demands intensive use of plant protection chemicals. On an average, 5-6 pesticide sprayings are common in Kole lands.

5.2.2.11 Water management

Water is occasionally let in and drained in order to maintain a continuous water level of 5 cm in the field. Field is completely drained one week before harvest.

5.2.2.12 Harvest

The crop is harvested in May. The harvested earheads were tied together to form 'kattas' and they are then threshed. Winnowing machines are used for winnowing the grains. Farmers often sell their produce after cleaning in the threshing floor itself. Wages for harvesting are given in kind usually 18 to 20 per cent of the total grain harvested and threshed by each labourer. This is known as 'patham' and 'theerpu'.

5.3 Cost of cultivation of rice

5.3.1 Kuttanad

5.3.1.1 Operation-wise cost of cultivation of rice

Operation-wise cost of cultivation per hectare of rice for different size groups and the sample as a whole were computed and is presented in the Table 5.15. The operation-wise cost include land preparation, seed and sowing, fertiliser and application, plant protection, liming, weeding and cost on miscellaneous items. Rental value of own land and interest on working capital were worked out.

Harvesting and postharvest costs were not included as operational costs. The common practice in the study area is to pay the harvesting charges as kind. Hence the kind portion of the produce is not included for the estimation of gross income. The yield and returns of rice including and excluding the kind portion (harvesting charges) were also worked out and are presented in the Table 5.22. Neither depreciation charges nor interest on fixed capital have been included in the cost. This is because farmers generally do not using any own fixed capital in rice cultivation. The labourers generally bring their own implements to the field and the wages they get included the rent for implements too. The farmers are not using their own fixed assets since the operations like dewatering, irrigation etc. were done for the 'padasekharam'

Table 5.15 Operationwise cost of cultivation of rice in Kuttanad for different size groups (Rs./ha)

Sl. No.	Operations	Class I (marginal)	Class II (small)	Class III (large)	Aggregate
1.	Land preparation	1718.35 (13.11)	1790.90 (13.46)	2197.05 (15.85)	1790.29 (13.52)
2.	Seed and sowing	866.27 (6.61)	869.47 (6.53)	910.38 (6.57)	870.40 (6.58)
3.	Fertilizer and application	3012.33 (22.98)	3065.97 (23.04)	3100.75 (22.37)	3185.39 (24.06)
4.	Plant protection	772.84 (5.90)	713.25 (5.36)	715.00 (5.16)	748.68 (5.66)
5.	Liming	281.62 (2.15)	308.53 (2.32)	408.00 (2.95)	144.36 (1.09)
6.	Weeding	1631.73 (12.45)	1795.92 (13.49)	1767.75 (12.76)	1706.12 (12.89)
7.	Rental value of own land	3171.40 (24.19)	3112.00 (23.38)	3077.50 (22.21)	3137.66 (23.70)
8.	Interest on working capital	263.51 (2.01)	263.68 (1.98)	291.70 (2.10)	264.58 (2.00)
9.	Miscellaneous	1390.00 (10.60)	1390.00 (10.44)	1390.00 (10.03)	1390.00 (10.50)
	Total	13108.05 (100.00)	13309.72 (100.00)	13858.13 (100.00)	13237.48 (100.00)

(Figures in parentheses show percentages to total)

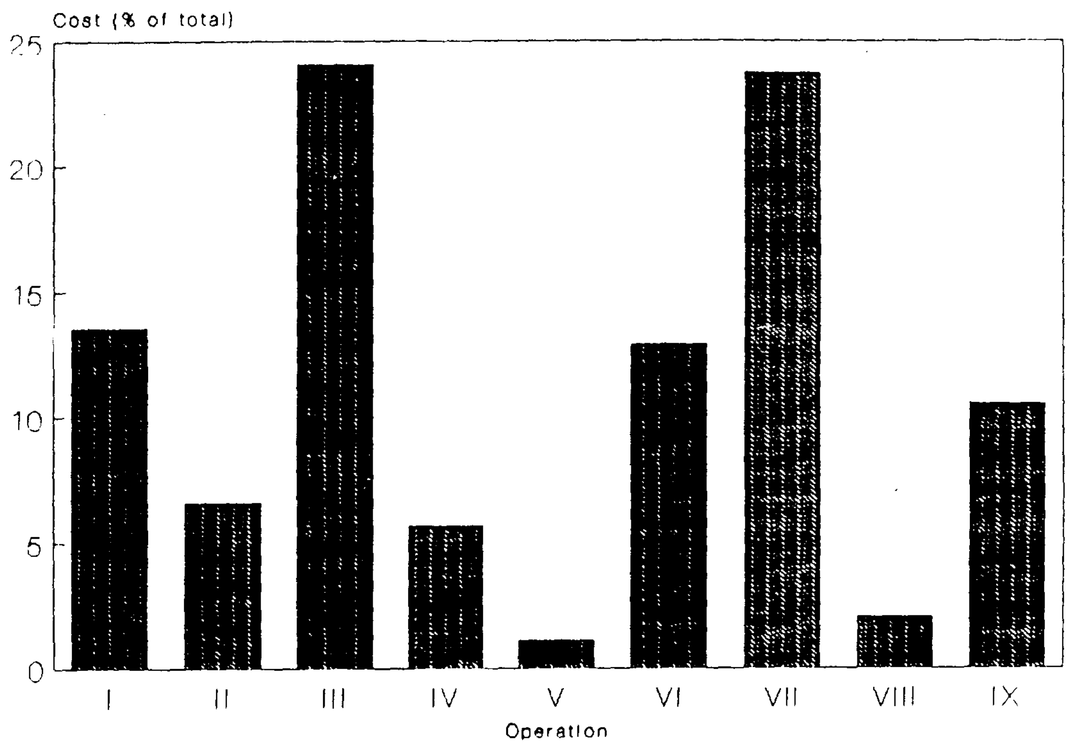

FIG.2. OPERATION-WISE COST OF CULTIVATION OF RICE (KUTTANAD)

I	Land preparation
II	Seed and sowing
III	Fertilizer and application
IV	Plant protection
V	Liming
VI	Weeding
VII	Rental value of own land
VIII	Interest on working capital
IX	Miscellaneous

as a whole by the 'padasekharam' committee. Similarly for land preparation, tractors and work animals are hired.

The cost of fertilisers including its application cost was the most important item at the aggregate level. It accounted for 24.06 per cent of the total cost (Rs.3185.39). Rental value of own land came to 23.70 per cent of the total cost (Rs.3137.66). The next major item of operation was preparation of land which accounted for 13.52 per cent (Rs.1790.29) of the total cost. Land preparation include ploughing, levelling and preparation of inner and outer bunds. This was followed by weeding, with 12.89 per cent (Rs.1706.12) of the total cost. Expenditure on miscellaneous item came next with 10.50 per cent (Rs.1390.00). Miscellaneous items include common expenses for dewatering, irrigation, transportation of inputs undertaken by the 'padasekharam' committee, land taxes, electricity charges etc.

Class-wise analysis showed that the total cost of cultivation in Class I (marginal farmers) was Rs.13108.05, Rs.13309.72 for Class II (small) and Rs.13858.13 for Class III (large). Rental value of own land recorded the highest expenditure in Class I and II which accounted for 24.19 per cent (Rs.3171.40) and 23.38 per cent (Rs.3112.00) respectively. Fertiliser and its application cost was the next important item of expenditure in Class I and II. It

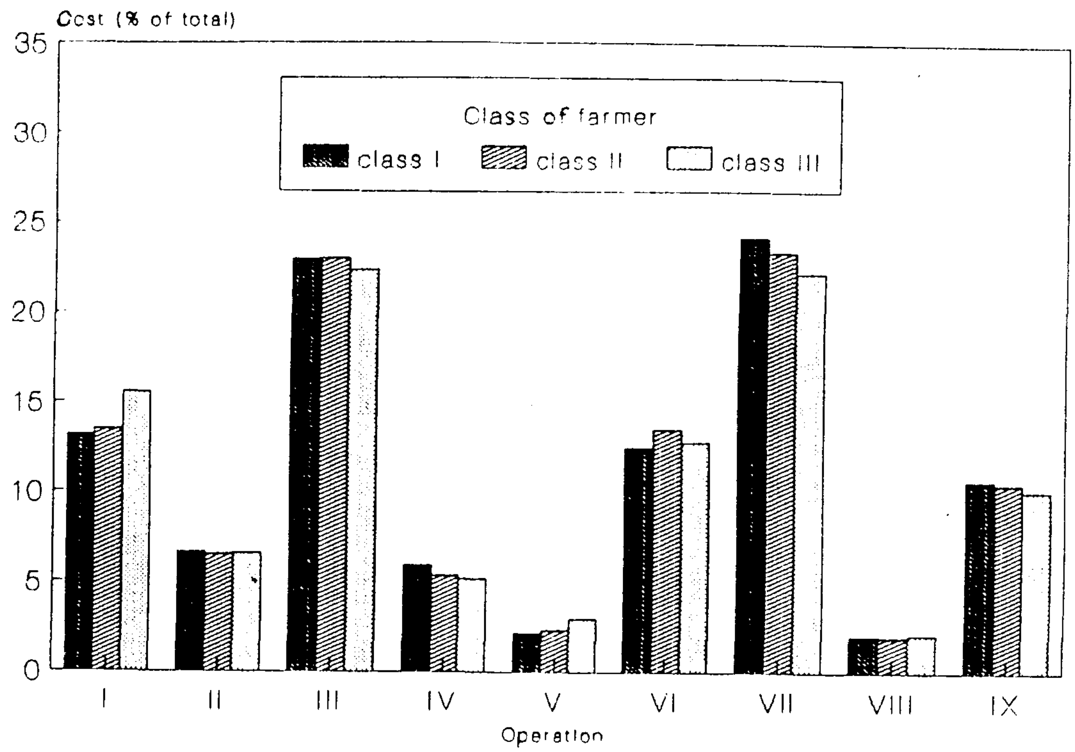

FIG.3. OPERATION-WISE COST OF CULTIVATION OF RICE FOR DIFFERENT CLASSES OF FARMERS (KUTTANAD)

I	Land preparation	VI	Weeding
II	Seed and sowing	VII	Rental value of own land
III	Fertilizer and application	VIII	Interest on working capital
IV	Plant protection	IX	Miscellaneous
V	Liming		

accounted for 22.98 per cent (Rs.3012.33) in Class I and 23.04 per cent (Rs.3065.97) in Class II respectively.

The highest item of expenditure was fertiliser and application in Class III which came to 22.37 per cent (Rs.3100.75) of the total cost.

Rental value of land recorded the second item of expenditure in Class III which came to 22.21 per cent (Rs.3077.50) of the total cost. Land preparation was the third major item in Class I and III. The expenditure on this item was 13.11 per cent (Rs.1718.35) in Class I, and 15.85 per cent (Rs.2197.05) in Class III. Weeding was the third major item in Class II with 13.49 per cent (Rs.1795.92) of the total cost. Expenditure on miscellaneous items formed the next important cost and this accounted for 10.60 per cent in Class I, 10.44 per cent in Class II and 10.03 in Class III respectively. The expenditure on this item was Rs.1390 for all the classes and at the aggregate level. This is because various expenses under miscellaneous items viz., dewatering, irrigation, transportation of input, electricity charges etc. were calculated by the 'padasekharam' committee, for the whole area on per hectare basis. This was followed by seed and sowing in all the three classes. It accounted for 6.61 per cent (Rs.866.27) in Class I, 6.53 per cent (Rs.869.47) in Class II and 6.57 per cent (Rs.910.38) in Class III. Plant protection came as the seventh major item which accounted 5.90 per cent of the total cost in Class I, 5.36 per cent in Class II and 5.16 in Class III. Liming came as the next important item. Interest on working capital came as the last and it accounted for only 2.01 per cent of the total cost in Class I, 1.98 per cent in Class II and 2.1 per cent in Class III.

5.3.1.2 Input-wise cost of cultivation of rice

Input-wise cost of cultivation was also worked out for the area under study. It has also been worked out for different size groups and the results are given in Table 5.16. This will help to have an idea about the relative importance of various inputs in general and among different size groups.

The inputs involved in the cultivation of paddy crop were grouped into three, viz., the labour input, materials and other items. The labour input classified into human labour, bullock labour and machine labour. The human labour included both hired and family labour. The material costs include the cost on seed, fertiliser and plant protection chemicals. Other items consisted of rental value of owne land, interest on working capital and miscellaneous expenses. The farmers were not using the farm yard manure because of its high cost including the cost of transportation. At the aggregate level, the sub-group (other items) accounted for the share in total

Table 5.16. Inputwise cost of cultivation of rice in Kuttanad for different size groups (Rs./ha)

Sl. No.	Inputs	Class I (Marginal)	Class II (Small)	Class III (Large)	Aggregate
A.	**Labour**				
1.	Animal labour	726.28 (5.54)	732.81 (5.50)	734.38 (5.29)	729.74 (5.51)
2.	Machine labour	333.95 (2.55)	332.87 (2.50)	290.63 (2.09)	331.90 (2.51)
3.	Human labour	3152.34 (24.05)	3583.43 (26.92)	4014.73 (28.97)	3371.01 (25.47)
	Sub total	4212.57 (32.14)	4649.11 (34.92)	5039.74 (36.36)	4432.65 (33.49)
B.	**Materials**				
4.	Seed	786.55 (6.00)	800.39 (6.01)	815.00 (5.88)	791.30 (5.98)
5.	Chemical fertilizer	2357.47 (17.98)	2265.63 (17.02)	2454.69 (17.71)	2329.95 (17.60)
6.	Soil rectifier	313.75 (2.39)	315.82 (2.37)	285.00 (2.05)	317.01 (2.39)
7.	Weedicides	67.64 (0.52)	60.26 (0.45)	66.00 (0.47)	63.54 (0.48)
8.	Pesticides	545.16 (4.16)	452.83 (3.40)	438.50 (3.16)	510.79 (3.86)
	Sub total	4070.57 (31.05)	3894.93 (29.25)	4059.19 (29.29)	4012.59 (30.31)
C.	**Others**				
9.	Rental value of own land	3171.40 (24.19)	3112.00 (23.38)	3077.50 (22.20)	3137.66 (23.70)
10.	Interest on working capital	263.51 (2.01)	263.68 (1.98)	291.70 (2.10)	264.58 (2.00)
11.	Miscellaneous	1390.00 (10.60)	1390.00 (10.44)	1390.00 (10.03)	1390.00 (10.50)
	Sub total	4824.91 (36.80)	4765.68 (35.80)	4759.20 (34.34)	4792.24 (36.20)
	Total	13108.05 (100.00)	13309.72 (100.00)	13858.13 (100.00)	13237.48 (100.00)

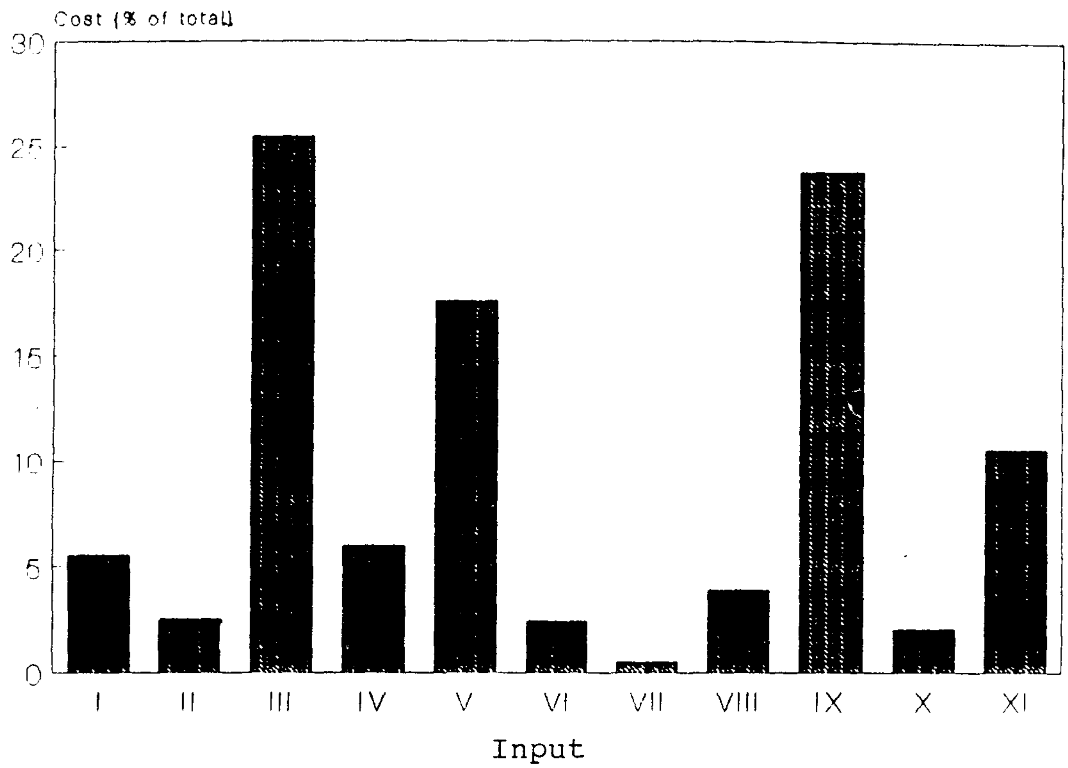

FIG.4. INPUT-WISE COST OF CULTIVATION OF RICE (KUTTANAD)

I	Animal labour	VII	Weedicides
II	Machine labour	VIII	Pesticides
III	Human labour	IX	Rental value of own land
IV	Seed	X	Interest on working capital
V	Chemical fertilizer		
VI	Soil rectifier	XI	Miscellaneous

cost as highest and it acccunted for 36.20 per cent (Rs.4792.24) of the total cost. Within this sub-group, rental value of own land formed the major share (23.70 per cent of total) followed by miscellaneous expenses (10.5 per cent) which was the only explicit cost in this category. The sub-group labour cost was the second major group, accounting for 33.49 per cent (Rs.4432.65) of the total cost followed by material inputs (30.31 per cent). Lakshmi (1993) reported that material cost alone accounted for 21.58 per cent of the total cost of rice in Alapuzha district. In the case of labour input human labour was the largest component (25.47 per cent). Joseph (1992) reported that about 45 per cent of the total cost of cultivation was spent as wages for human labour in Kuttanad. This was followed by animal labour (5.51 per cent) and machine labour (2.51 per cent). Out of the material inputs chemical fertilisers accounted the highest, with 17.60 per cent (Rs.2329.95) of the total cost. This was succeeded by seed, pesticides, soil rectifier, and weedicides. Expenditures on these items were Rs.791.30, Rs.510.79, Rs.317.01 and Rs.63.54 respectively.

Class-wise analysis showed that cost of other items was the highest in Class I and II with 36.80 per cent (Rs.4824.91) in Class I and 35.80 per cent (Rs.4765.68) in Class II respectively. among the other items rental value of

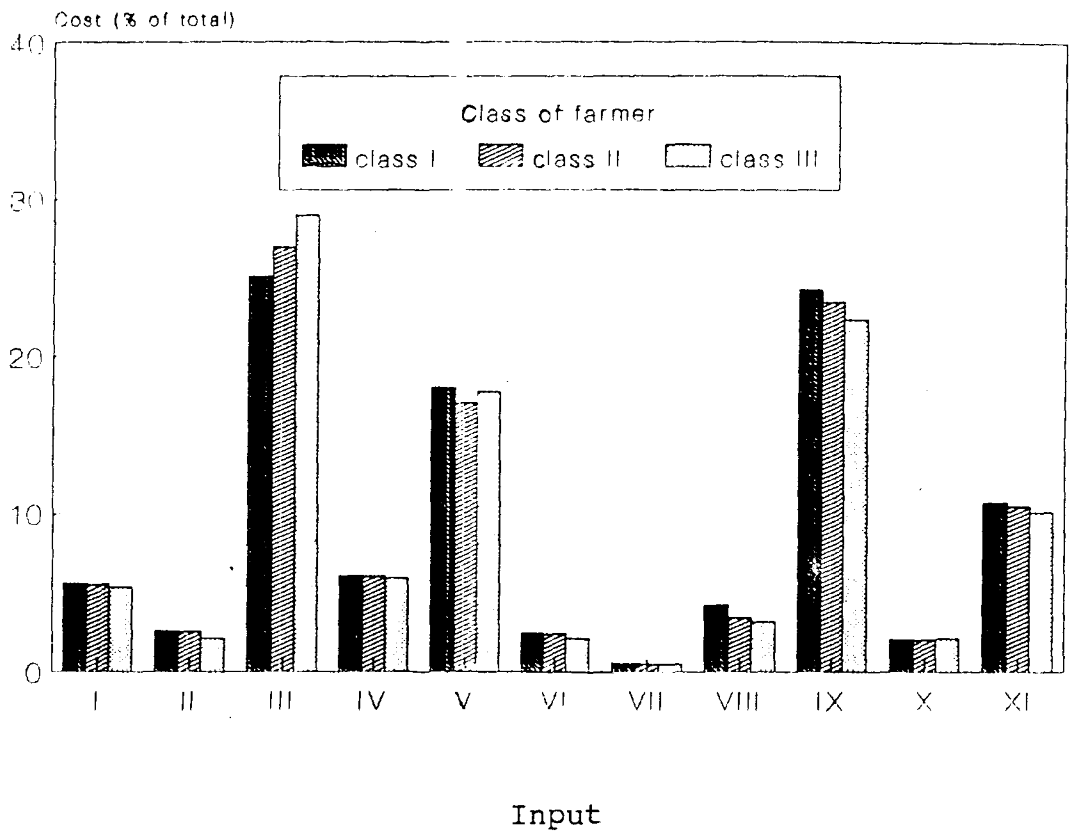

FIG.5. INPUT-WISE COST OF CULTIVATION OF RICE FOR DIFFERENT CLASSES OF FARMERS (KUTTANAD)

I	Animal labour	VII	Weedicides
II	Machine labour	VIII	Pesticides
III	Human labour	IX	Rental value of own land
IV	Seed	X	Interest on working capital
V	Chemical fertilizer		
VI	Soil rectifier	XI	Miscellaneous

own land was highest in Class I and II which accounted 24.19 per cent (Rs.3171.40) of the total cost in class I and 23.38 per cent (Rs.3112.00) of the total cost in Class II. In both these classes the next major item of expenditure was miscellaneous costs which accounted for 10.6 per cent in Class I and 10.44 per cent in Class II. Interest on working capital came last with only 2.01 per cent in Class I and 1.98 per cent in Class II.

Labour cost was the highest for Class III which accounted 36.36 per cent (Rs.5039.74) of the total cost. Labour cost formed the second highest expenditure in both Class I and II. Expenditure on this item are 32.14 per cent (Rs.4212.57) in Class I and 34.92 per cent (Rs.4649.11) in Class II. Among the labour inputs human labour was the highest in all the three classes. This accounted for 24.05 per cent (Rs.3152.34) in Class I, 26.92 per cent (Rs.3583.43) in Class II and 28.97 per cent (Rs.4014.73) in Class III. This was followed by animal labour in all the classes. Expenditure on this item was 5.54 per cent in Class I, 5.50 per cent in class II and 5.29 per cent in Class III. Machine labour came as the last among labour inputs in all the three classes and contributed 2.55 per cent in Class I, 2.50 per cent in Class II and 2.09 per cent in Class III.

Material cost came as the third major item in all the three classes with 31.05 per cent (Rs.4070.57) of the total cost in Class I, 29.25 per cent (Rs.3894.93) in Class II and 29.29 per cent (Rs.4059.19) in Class III. Chemical fertilisers were the most important among material inputs in all cases. The relative share of this item was the highest in Class I which accounted for 17.98 per cent (Rs.2357.47) of the total cost, closely followed by Class III with 17.71 per cent (Rs.2454.69 and Class II with 17.02 per cent (Rs.2265.63) of the total cost. In absolute terms Class III accounted highest cost of this item followed by Class I and II.

Majority of the farmers used straight fertilisers, viz., urea, single super phosphate and muriate of potash for production. None of the respondents applied these fertilisers at the recommended dose (Table 5.17). While some applied at higher doses, others applied at lower doses. Out of the total respondents 71.25 per cent applied urea (N) at doses below the recommended dose while the rest (28.75 per cent) applied it at higher doses. In the case of phosphatic fertilisers viz. single super phosphate (P) 21.25 per cent of the respondents applied it at lower doses and the rest 78.75 per cent applied this at a higher dose. In the case of potassic fertilisers each and every respondent has applied muriate of potash which was the supplier of K, at doses above the recommendation.

Table 5.17 Frequency distribution of farmers according to level of fertiliser use (Kuttanad)

Dose of nutrients	No. of farmers using the nutrients		
	N	P	K
Below recommendation	57 (71.25)	17 (21.25)	-
Above recommendation	23 (28.75)	63 (78.75)	80
Total	80 (100.00)	80 (100.00)	80 (100.00)

(Figures in parentheses show percentages to total)

Out of the total respondents twenty farmers applied all the three nutrients above the recommended level. Chemical fertilisers were usually applied in three splits and its cost and application charges together accounts for a major share in the cost of cultivation.

The next important item among material inputs was seed in all the three classes. Class II accounted the highest percentage of 6.01 of total cost, followed by Class I with 6 per cent and Class III with 5.88 per cent for this item. It was found that as much as 62.5 per cent of the total respondents used own seed and the rest 37.5 per cent purchased seeds for meeting their seed requirement (Table 5.18). all the respondents used high yielding variety seeds. None of the farmers adopted the recommended seed rate. As much as 95 per cent used seed rate above the recommended dose while the remaining 5 per cent followed a lesser seed rate (Table 5.19).

It was also seen that 50 per cent of the respondents used Red Thriveni for cultivation and this included 23 marginal farmers, 14 small farmers and 3 large farmers. The rest 50 per cent of the respondents cultivated White Thriveni and they include 23 marginal farmers, 15 small farmers and two large farmers respectively (Table 5.20).

Table 5.18 Frequency distribution of farmers using owned and purchased seed (Kuttanad)

Seed	Class I	Class II	Class III	Total
Owned	20 (43.48)	25 (86.21)	5	50 (62.50)
Purchased	26 (56.52)	4 (13.79)	-	30 (37.50)
Total	46 (100.00)	29 (100.00)	5 (100.00)	80 (100.00)

(Figures in parentheses show percentages to total)

Table 5.19 Frequency distribution of farmers based on the seed rate adopted (Kuttanad)

Seed rate	Class I (marginal)	Class II (small)	Class III (large)	Total
Above recommended dose	43 (93.48)	29 (100.00)	4 (80.00)	76 (95.00)
Below recommended dose	3 (6.52)	-	1 (20.00)	4 (5.00)
Total	46 (100.00)	29 (100.00)	5 (100.00)	80 (100.00

(Figures in parentheses show percentages to total)

Table 5.20 Number of farmers each class using a particular variety of seed (Kuttanad)

Variety used	Class I (marginal)	Class II (small)	Class III (large)	Total
Red Thriveni	23 (50.00)	14 (48.28)	3 (60.00)	40 (50.00)
White Thriveni	23 (50.00)	15 (51.72)	2 (40.00)	40 (50.00)
Total	46 (100.00)	29 (100.00)	5 (100.00)	80 (100.00)

(Figures in parentheses show percentages to total)

Pesticides came next to seed and expenditure on this was highest in case of Class I farmers accounting 4.16 per cent of the total cost, followed by Class II and Class III farmers with 3.40 per cent and 3.16 per cent respectively. Farmers generally applied pesticides even in the absence of any pest or disease incidence but as a prophylactic measure. The major insecticides in use were phosphamidon, quinalphos and monocrotophos. Phosphamidon and Quinalphos were used against the attack of stem borer. The fungicide prevalent in use was Hinosan, particularly against sheath blight. The farmers were less alert in applying these pesticides in correct doses as per recommendations since the cost of application was very high. The application charges often varied with the chemical depending upon its toxicity.

Almost all the respondents resorted to chemical weeding in addition to manual weeding. Weedicides formed the least costlier item among the material inputs. Expenditure on this was the highest in Class I (Rs.67.64) followed by Class III and Class II with an amount of Rs.66.00 and Rs.60.26 respectively. The major weedicide used by the farmers was 2,4-D sodium salt. The dosage of the weedicide applied was below the recommended level in all the cases. Farmers often apply pesticides and weedicides together in order to reduce the cost of application. As a result, the purpose of spraying is not served adequately.

The analysis showed that the total cost of cultivation of rice (both operation-wise and input-wise) was Rs.13237.48 at the aggregate level. Joseph (1982) and Lakshmi (1993) reported that the total cost of cultivation per hectare of rice in Kuttanad was Rs.3607.33 and Rs.12705 respectively. It was found that as the size of holding increases the cost of cultivation also increases. This was highest for large farmers (Rs.13858.13) followed by small farmers (Rs.13309.72) and marginal farmers (Rs.13108.05).

5.3.1.3 Cost of cultivation of rice under different cost concepts

Cost concepts refers to the classification of cost which regroups the components so as to distinguish between constituents that are price determining from those that are price-determined. This classification gives some idea of the element of elasticity obtaining in agricultural costs and may be helpful to the price fixing authority.*

The cost concepts used in this study are Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1 and Cost C_2. The different

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* Kahlon, A.S. and Tyagi, D.S. (1983). Agricultural Price Policy in India. Allied Publishers Private Ltd., New Delhi: 104.

Table 5.21 Cost of cultivation of rice under different cost concepts (Kuttanad)

Cost	Class I (Marginal)	Class II (Small)	Class III (Large)	Aggregate
Cost A_1 (All actual expenses incurred in production)	9763.50	100081.34	10660.63	9953.02
Cost A_2 (Cost A_1 + rent for leased in land)	9763.50	100081.34	10660.63	9953.02
Cost B_1 (Cost A_1 + interest on own fixed capital)	9763.50	100081.34	10660.63	9953.02
Cost B_2 (Cost B_1 + rental value of own land and rent paid for leased in land)	12934.90	13193.34	13738.13	13090.68
Cost C_1 (Cost B_1 + imputed value of family labour)	9936.65	10197.72	10780.63	10099.82
Cost C_2 (Cost B_2 + imputed value of family labour)	13108.05	13309.72	13858.13	13237.48

costs based on these concepts were worked out for the sample as a whole as well as for the three size classes and is given in Table 5.21. For the sample as a whole costs A_1, A_2, B_1, B_2, C_1 and C_2 per hectare were Rs.9953.02, Rs.9953.02, Rs.9953.02, Rs.13090.68, Rs.10099.82 and Rs.13237.48 respectively. For Class I the costs were Rs.9763.5, Rs.9763.5, Rs.9763.5, Rs.12934.9, Rs.9936.65 and Rs.13108.05. for Class II the costs were Rs.10081.34, Rs.10081.34, Rs.10081.34, Rs.13193.34, Rs.10197.72 and Rs.13309.72. For Class III the costs were Rs.10660.63, Rs.10660.63, Rs.10660.63, Rs.13738.13, Rs.10780.63 and Rs.13858.13. Cost A_1, Cost A_2 and Cost B_1 are same because in this area leasing of land by the respondents were not observed and also the farmers do not have their own fixed assets for rice cultivation. Class-wise analysis showed that all the costs were highest in Class III followed by Class II and Class I. Thus, there is a clear cut direct relationship between size of farm and per hectare cost of production of rice.

5.3.1.4 Income measures in relation to different cost concepts

Gross income consists of value of the main product and byproduct. This was estimated at Rs.15688.30 at the aggregate level. Gross income was highest in Class I which came to

Table 5.22 Income measures in relation to different cost concepts in rice cultivation (Kuttanad)

Particulars	Category			
	Class I (Marginal)	Class II (Small)	Class III (Large)	Aggregate
Gross income	15857.00	15560.00	15387.50	15688.30
Farm business income (G.I.-Cost A_1)	6093.50	5478.66	4726.87	5735.28
Family labour income (G.I.-Cost B_2)	2922.10	2366.66	649.37	2597.62
Net income at Cost C_1 (G.I.-Cost C_1)	5920.35	4642.28	4606.87	5588.48
Net income at Cost C_2 (G.I.-Cost C_2)	2748.95	2250.28	1529.37	2450.82
Input-output ratio at Cost C_2	1.21	1.17	1.11	1.19
Input-output ratio at Cost C_1	1.60	1.53	1.43	1.55

GI - Gross Income

Rs.15857.00, followed by Class II with Rs.15560.00 and then Class III with Rs.15387.50.

Farm business income of farmers in Kuttanad area was estimated. This was also worked out for different classes of farmers. The farm business income at the aggregate level was Rs.5735.28. Class-wise analysis showed that Class I farmers accounted the highest farm business income of Rs.6093.50 followed by Class II with Rs.5,478.66 and then Class III with Rs.4726.87.

Family labour income was also worked out at the aggregate level as well as for different classes. At the aggregate level it was estimated to be Rs.2597.62. Class-wise analysis revealed that this was highest for Class I (Rs.2922.10) followed by Class II (Rs.2366.66) and Class III with Rs.1649.37. Family labour income was least for Class III since it utilises minimum family labour in the production process.

At the aggregate level net income was Rs.2450.82. This was also worked out at Cost C_1 as Rs.5588.48 at the aggregate level without accounting the rental value of land. Net income was the highest for Class I with Rs.2748.95 followed by Class II with Rs.2250.28. Net income was the least for Class III with Rs.1529.37. Santha (1993) estimated the average net income from 'Punja' rice as Rs.1095.19 per hectare.

Input-output ratio was estimated for Kuttanad as 1.19 on Cost C_2 basis and as 1.55 at Cost C_1. Class-wise analysis showed that the B.C. ratio was the maximum for marginal farmers (1.21) followed by small and large farmers which came to 1.17 and 1.11 respectively. Samuel (1963), Radhakrishnan (1981) and Joseph (1982) conducted similar studies in rice and estimated the benefit cost ratio as 1.61, 1.32 and 1.43 respectively.

5.3.1.5 Yield and returns of rice

The average yield, income from the main product, byproduct, total explicit cost, input-output ratio and cost of production per quintal were worked out both by excluding and including the kind portion of the produce, at the aggregate level as well as for different classes of farmers. The results are presented in Table 5.23.

The average yield per hectare of rice excluding the kind portion as wages was worked out as 37.72 quintals at the aggregate level. This was the highest for marginal farmers which accounted 38.14 quintals followed by small farmers with 37.4 quintals and large farmers with 36.97 quintals.

Table 5.23 Yield and returns of rice in Kuttanad (per hectare)

	Excluding wage in kind for harvest			
	Class I (Marginal)	Class II (Small)	Class III (Large)	Aggregate
Average yield (in quintal)	38.14	37.40	36.97	37.72
Gross income	15857.00	15560.00	15387.50	15688.30
Income from main product	15257.00	14960.00	14787.50	15088.30
Income from byproduct	600.00	600.00	600.00	600.00
Total explicit cost	9499.99	9817.66	10368.93	9688.44
Gross expenditure	13108.05	13309.72	13858.13	13237.48
Net income	2748.95	2250.28	1529.37	2450.82
Input-output ratio	1.21	1.17	1.11	1.19
Cost of production per quintal	343.68	355.87	374.85	350.94
Cost of production per quintal as explicit cost	249.08	262.50	280.47	256.85
Including wages in kind for harvest				
Average yield (in quintal)	47.68	46.75	46.21	47.15
Gross income	19672.00	19300.00	19084.00	19460.00
Income from main product	19072.00	18700.00	18484.00	18860.00
Income from byproduct	600.00	600.00	600.00	600.00
Total explicit cost	13314.99	13557.66	14065.43	13460.14
Gross expenditure	16923.05	17049.72	17554.63	17009.18
Net income	2748.95	2250.28	1529.37	2450.82
Input-output ratio	1.16	1.13	1.08	1.14
Cost of production per quintal	354.92	364.70	379.89	360.75
Cost of production per quintal as explicit cost	279.26	290.00	304.38	285.47

The income from the main product was Rs.15088.30 at the aggregate level. Class-wise analysis showed that income from main product was the highest for marginal farmers, which accounted for Rs.15257 followed by small and large farmers with Rs.15560 and Rs.15387 respectively. Income derived from the byproduct was estimated as follows. The average yield per hectare of byproduct is 1500 kg for high yielding rice varieties. The price per kg was Rs.0.40 and thus the income from the byproduct was estimated as Rs.600 per hectare for different size classes and for the aggregate in both the areas under study. Hence this is the same for all.

Total explicit cost was estimated as Rs.9688.44 at the aggregate level and was highest for large farmers (Rs.10368.93). The input-output ratio was 1.19 for Kuttanad. This ratio showed a declining trend with the increase in size of holding.

Cost of production per quintal was estimated as Rs.350.94 at the aggregate level. The cost of production per quintal increased with increase in size of holding. Cost of production was also worked out s the explicit cost and was Rs.256.85 for Kuttanad. This was highest for large farmers with Rs.280.47 followed by marginal and small farmers.

When the kind portion of the produce was also considered, the average yield per hectare was worked out as 47.15 quintals at the aggregate level. Income from the main product was Rs.18860 at the aggregate level and this was found to decrease with the increase in the size of holding.

Total explicit cost was Rs.13460.14 for Kuttanad and this was the highest for large farmers accounting for Rs.14065.43. The input-output ratio was 1.14 at the aggregate level. Cost of production per quintal was estimated as Rs.360.75. This increased as the size of holding increases. Cost of production per quintal (as explicit cost) was worked out as Rs.285.47 at the aggregate level. This was found to increase with the increase in holding size.

5.3.1.6 Bulk line cost of rice

Bulk line cost have been worked out for rice in Kuttanad and the results are presented in the Table 5.22. From this table, it is evident that bulk line cost is Rs.4000 per tonne covers 86.13 per cent of the total output supplied by 85 per cent of the cultivators.

Marshall gave the name of bulk line cost curve to a curve which represents the array of actual average costs of the different producers in an industry when the total output of an industry was a given amount and the individual costs

Table 5.24 Bulk line cost of rice (Kuttanad)

Average cost per tonne (Rs.)	Percentage of total output supplied	Percentage of cultivators producing at cost indicated under 1 and 2	
Upto 2400	2.76	2.50	
2500	4.34	3.75	
2600	8.00	7.50	
2700	12.50	11.25	
2800	18.25	16.25	
2900	21.05	18.75	
3000	22.36	20.00	
3100	31.82	28.75	
3200	39.08	36.25	
3300	47.81	45.00	
3400	55.15	52.50	
3500	58.56	56.25	
3600	68.31	66.25	
3700	73.51	71.25	
3800	76.90	75.00	
3900	81.51	80.00	
4000	86.13	85.00	BULK LINE
4100	87.47	86.25	
4200	89.54	88.75	
4300	91.83	91.25	
4400	93.09	92.50	
4500	97.52	97.50	
4600	98.97	98.75	
4700	100.00	100.00	

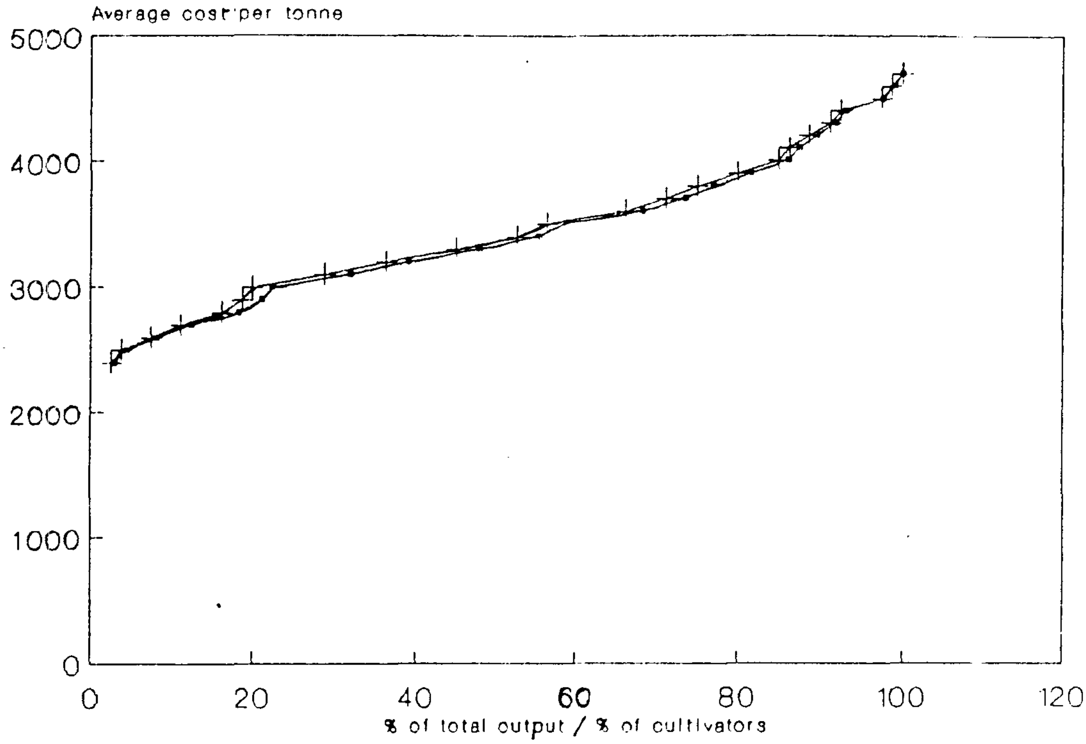

FIG.6. BULK LINE COST OF RICE (KUTTANAD)

being arranged in increasing order of size from left to right. Figure represents the bulk line cost curve of rice in Kuttanad.

5.3.2 Kole

5.3.2.1 Operation-wise cost of cultivation of rice

Operation-wise cost of cultivation per hectare of rice for different size groups and the sample as a whole were computed and presented in the Table 5.25.

Rental value of own land was the most important item at the aggregate level which accounted for 21.70 per cent (Rs.2690.18) of the total cost. Cost of fertiliser and its application came next (18.76 per cent). Expenditure on this item was Rs.2325.51. This was followed by weeding which came to 15.13 per cent (Rs.1875.07) of the total cost, closely followed by land preparation which accounted 14.78 per cent (Rs.1831.98) of the total cost. The next item of expenditure was miscellaneous item (12.68 per cent) which accounted Rs.1571.76. In Kole area also the various items under miscellaneous expenses viz., dewatering, irrigation, transportation of inputs, electricity charges etc. were calculated by the 'padasekharam' committee for the whole area on per hectare basis. The sixth major item was the cost on seed and sowing. Expenditure on this item was 7.45 per cent

Table 5.25 Operationwise cost of cultivation of rice in Kole for different size groups (Rs./ha)

Sl. No.	Operations	Class I (marginal)	Class II (small)	Class III (large)	Aggregate
1.	Land preparation	1754.73 (14.45)	2113.50 (15.90)	2020.83 (13.87)	1831.98 (14.78)
2.	Seed and sowing	917.73 (7.56)	942.63 (7.09)	958.21 (6.57)	923.92 (7.45)
3.	Fertilizer and application	2324.62 (19.15	2230.54 (16.78)	2818.75 (19.34)	2325.51 (18.76)
4.	Plant protection	586.90 (4.83)	672.03 (5.06)	493.67 (3.39)	599.48 (4.84)
5.	Liming	259.21 (2.13)	292.08 (2.20)	248.28 (1.70)	319.04 (2.57)
6.	Weeding	1744.71 (14.37)	2298.95 (17.30)	3108.00 (21.33)	1875.07 (15.13)
7.	Rental value of own land	2729.06 (22.48)	2892.51 (21.76)	3046.39 (20.90)	2690.18 (21.70)
8.	Interest on working capital	252.55 (2.08)	278.01 (2.09)	308.25 (2.12)	259.41 (2.09)
9.	Miscellaneous	1571.76 (12.95)	1571.76 (11.82)	1571.76 (10.78)	1571.76 (12.68)
	Total	12141.27 (100.00)	13292.01 (100.00)	14574.14 (100.00)	12396.35 (100.00)

(Figures in parentheses show percentages to total)

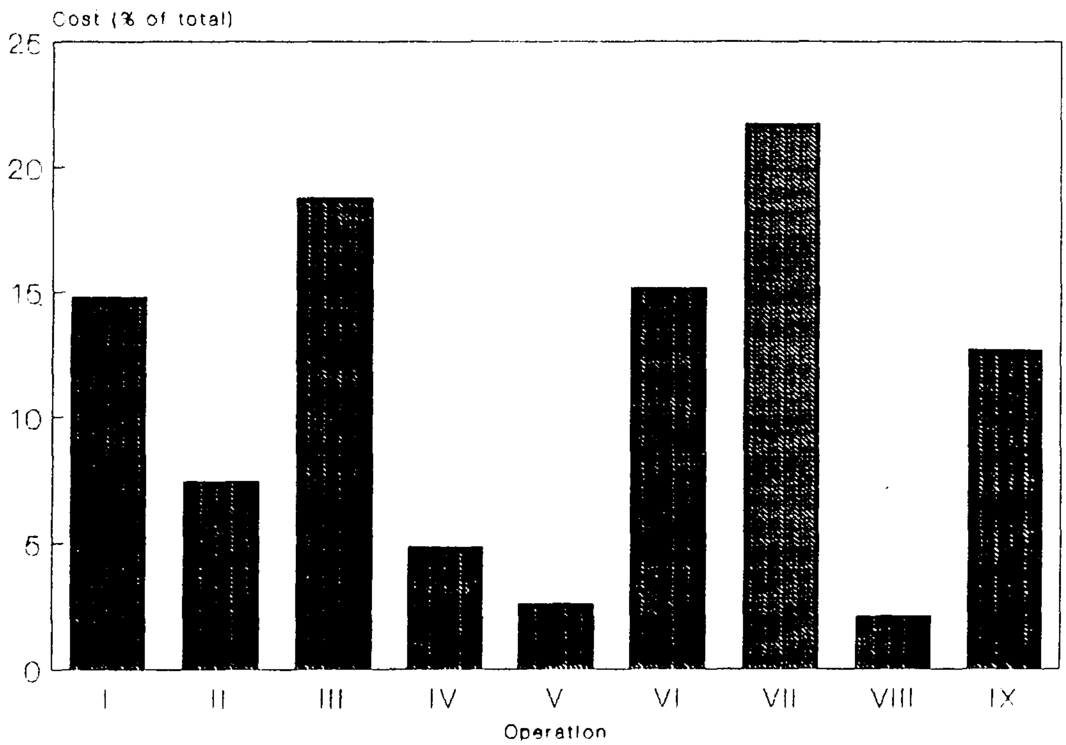

FIG.7. OPERATION-WISE COST OF CULTIVATION OF RICE (KOLE)

I Land preparation

II Seed and sowing

III Fertilizer and application

IV Plant protection

V Liming

VI Weeding

VII Rental value of own land

VIII Interest on working capital

IX Miscellaneous

(Rs.923.92) of the total cost. Liming came as the next which accounted 2.57 per cent of the total cost while interest on working capital came last which accounted for only 2.09 per cent of the total cost.

Class-wise analysis showed direct relationship of cost with size of holding. total cost was highest in Class III with Rs.14574.14. This was followed by Class II (Rs.13292.01) and Class I with Rs.12141.27. Babu (1992) also reported that farm size differences in paddy cultivation are influencing the cost of production in Thrissur district. Rental value of own land accounted the highest cost in groups I and II. This accounted for 22.48 per cent (Rs.2729.06) of the total cost in Class I and 21.76 per cent (Rs.2892.51) of the total cost in Class II. While this item came next to weeding in Class III (20.90 per cent; Rs.3046.39). Expenditure on weeding was 21.33 per cent (Rs.3108.00) of the total cost. Weeding was the second item of expenditure in Class II which came to 17.30 per cent (Rs.2298.95) of the total cost. Fertiliser and application came as the third important item in Class II at 16.78 per cent (Rs.2230.54) of the total cost. Land preparation was the third major item in Class I and III which came to 14.45 per cent (Rs.1754.73) and 13.87 per cent (Rs.2020.83) of the total cost in Class I and III respectively. Weeding was the next important item in Class I

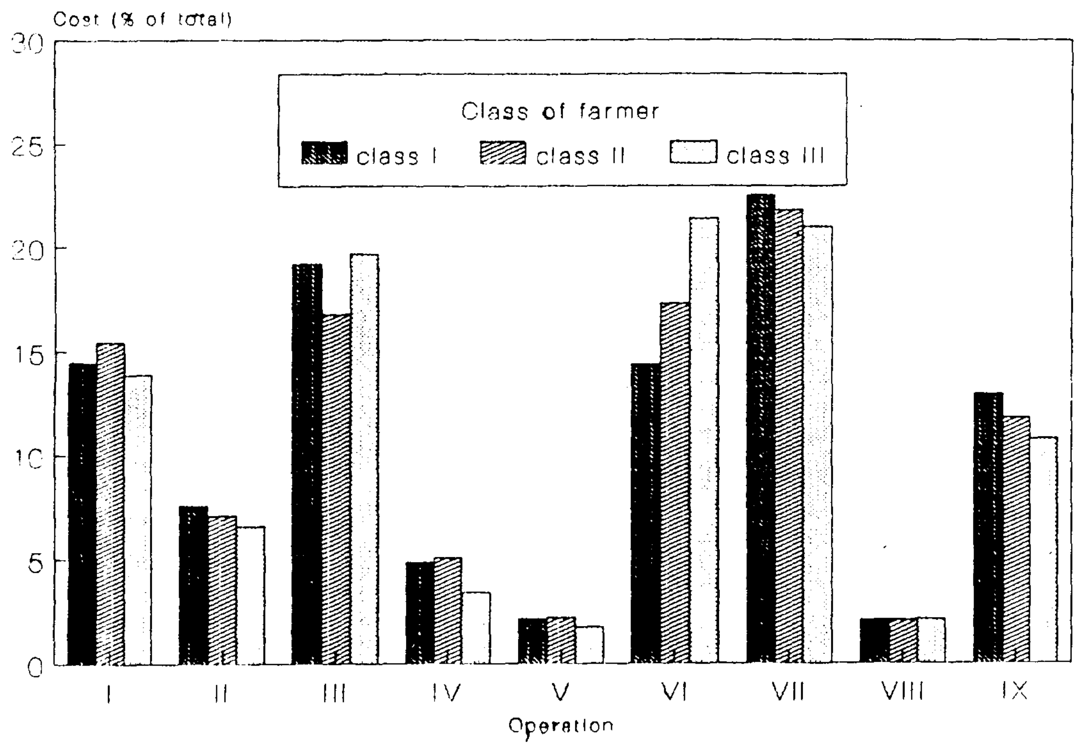

FIG.8. OPERATION-WISE COST OF CULTIVATION OF RICE FOR DIFFERENT CLASSES OF FARMERS (KOLE)

I	Land preparation	VI	Weeding
II	Seed and sowing	VII	Rental value of own land
III	Fertilizer and application	VIII	Interest on working capital
IV	Plant protection	IX	Miscellaneous
V	Liming		

with 14.37 per cent (Rs.1744.71). The fifth item of importance was miscellaneous cost in all the three classes which came to 12.95 per cent in Class I, 11.82 per cent in Class II and 10.78 per cent in Class III respectively. Seed and sowing was the next major item. Expenditure on this item was maximum in Class I (7.56 per cent) followed by Class II and III with 7.09 per cent and 6.57 per cent respectively. Plant protection was the next important item which was the highest in Class II with 5.06 per cent followed by Class I with 4.83 per cent and then Class III with 3.39 per cent. Liming came as the penultimate item in all the three classes with 2.13 per cent in Class I, 2.20 per cent in Class II and 1.70 per cent in Class III. Interest on working capital came as the last with 2.08 per cent in class I, 2.09 per cent in Class II and 2.12 per cent in Class III.

5.3.2.2 Input-wise cost of cultivation of rice

Input-wise cost of cultivation was worked out grouping the total into three sub-groups viz., labour, materials and others. The results are presented in the Table 5.26.

At the aggregate level, cost of other items was the highest. This accounted 36.47 per cent (Rs.4520.53) of the total cost. This was followed by labour cost and material cost. Expenditures on these items are 34 per cent

Table 5.26. Inputwise cost of cultivation of rice in Kole for different size groups (Rs./ha)

Sl. No.	Inputs	Class I (Marginal)	Class II (Small)	Class III (Large)	Aggregate
A.	**Labour**				
1.	Animal labour	591.64 (4.87)	727.67 (5.47)	730.00 (5.01)	623.09 (5.03)
2.	Machine labour	387.32 (3.19)	427.50 (3.22)	416.00 (2.85)	396.27 (3.20)
3.	Human labour	2963.37 (24.41)	3754.49 (28.25)	4326.00 (29.68)	3194.62 (25.97)
	Sub total	3942.33 (32.47)	4909.66 (36.94)	5472.00 (37.54)	4213.98 (33.99)
B.	**Materials**				
4.	Seed	819.59 (6.75)	828.98 (6.24)	917.33 (6.29)	825.00 (6.66)
5.	Chemical fertilizer	2118.76 (17.45)	2130.34 (16.03)	2646.25 (18.16)	2141.08 (17.27)
6.	Soil rectifier	204.60 (1.69)	216.75 (1.63)	257.08 (1.76)	205.84 (1.66)
7.	Weedicides	62.19 (0.51)	74.40 (0.56)	68.00 (0.47)	64.70 (0.52)
8.	Pesticides	440.43 (3.63)	389.60 (2.93)	287.08 (1.97)	425.22 (3.43)
	Sub total	3645.57 (30.03)	3640.07 (27.39)	4175.74 (28.65)	3661.84 (29.54)
C.	**Others**				
9.	Rental value of own land	2729.06 (22.48)	2892.51 (21.76)	3046.39 (20.91)	2690.18 (21.70)
10.	Interest on working capital	252.55 (2.08)	278.01 (2.09)	308.25 (2.12)	258.59 (2.09)
11.	Miscellaneous	1571.76 (12.94)	1571.76 (11.82)	1571.76 (10.78)	1571.76 (12.68)
	Sub total	4553.37 (37.51)	4742.28 (35.67)	4926.40 (33.81)	4520.53 (36.47)
	Total	12141.27 (100.00)	13292.01 (100.00)	14574.14 (100.00)	12396.35 (100.00)

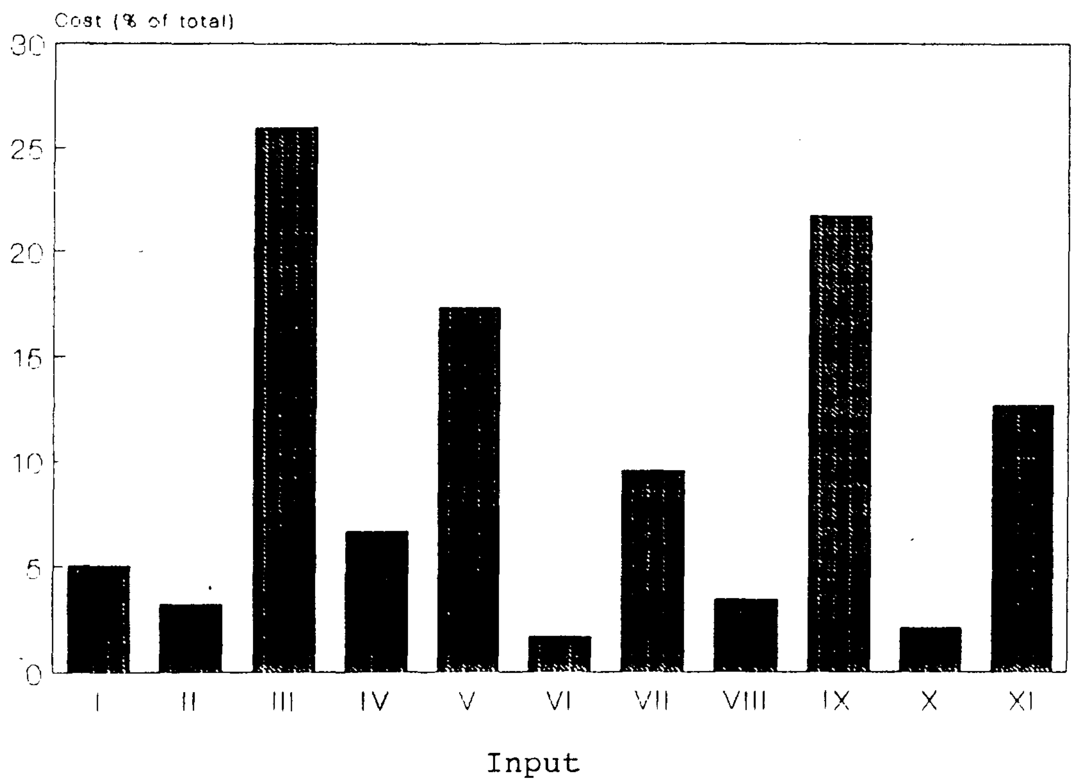

FIG.9. INPUT-WISE COST OF CULTIVATION OF RICE (KOLE)

I	Animal labour
II	Machine labour
III	Human labour
IV	Seed
V	Chemical fertilizer
VI	Soil rectifier
VII	Weedicides
VIII	Pesticides
IX	Rental value of own land
X	Interest on working capital
XI	Miscellaneous

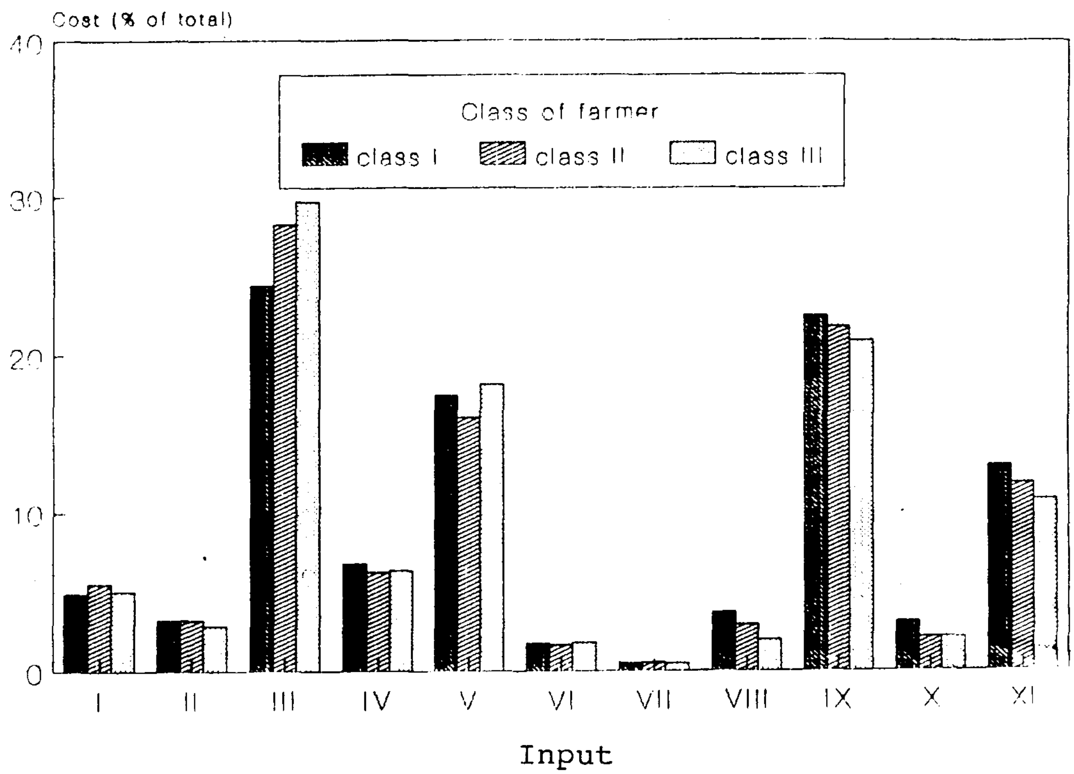

FIG.10. INPUT-WISE COST OF CULTIVATION OF RICE FOR DIFFERENT CLASSES OF FARMERS (KOLE)

I	Animal labour	VII	Weedicides
II	Machine labour	VIII	Pesticides
III	Human labour	IX	Rental value of own land
IV	Seed	X	Interest on working capital
V	Chemical fertilizer		
VI	Soil rectifier	XI	Miscellaneous

(Rs.4213.98) and 29.54 per cent (Rs.3661.84) respectively. Among the other items rental value of own land constituted the largest and accounted for 21.70 per cent of the total cost followed by miscellaneous items (12.68 per cent) and interest on working capital which came to only 2.09 per cent of the total cost. Human labour contributed 25.97 per cent (Rs.3194.62) of the total cost at the aggregate level followed by animal labour which came to 5.03 per cent (Rs.623.09) of the total cost. Machine labour came last among labour inputs and it accounted for only 3.20 per cent (Rs.396.27) of the total cost.

Cost of labour inputs was the highest for Class II and Class III. This accounted for 36.94 per cent (Rs.4909.66) for Class II and 37.53 per cent (Rs.5472.00) for Class III respectively. among the labour inputs human labour was the most important input in both the Class III and II with 29.68 per cent (Rs.4326.00) and 28.25 per cent (Rs.3754.49) of the total cost respectively. The next important items was animal labour in these classes which came to 5.47 per cent (Rs.727.67) for Class II and 5 per cent (Rs.730.00) for Class III. Machine labour came as least among the labour inputs in all the groups. This contributed only 3.19 per cent in Class I, 3.22 per cent in Class II and 2.85 per cent in Class III respectively. Labour input was the second largest item

(32.47 per cent) in Class I next to the other items of cost. Expenditure on others came to 37.51 per cent (Rs.4553.37 in Class I).

Expenses on other items was the second important cost for Class II and III. This accounted for 35.67 per cent (Rs.4742.28) for Class II and 33.8 per cent (Rs.4926.40) for Class III. Among these items, rental value of land was the highest for all groups. This accounted 22.48 per cent for Class I, 21.76 per cent for Class II and 20.90 per cent of the total cost for Class III. Miscellaneous costs came next in all the three classes contributing 12.95 per cent, 11.82 per cent and 10.78 per cent for Class I, II and III respectively. Interest on working capital came as the lowest item for all the three classes which accounted for only 2.08 per cent in Class I, 2.09 per cent in Class II and 2.12 per cent in Class III. Expenses on other items was the highest for Class I, accounting for 37.51 per cent (Rs.4553.37) of the total cost. Material cost was the third important item in all size of classes. Expenditure on this item was 30.03 (Rs.3645.57), 27.39 per cent (Rs.3640.07) and 28.64 per cent (Rs.4175.74) respectively of total cost in classes I, II and III. Among the material inputs chemical fertilisers was the most important item in all the classes. At the aggregate level it accounted for 17.27 per cent of the total cost. Radhakrishnan

(1981) estimated the cost of fertiliser as 20.29 per cent of the total cost of paddy cultivation in Thrissur district. In Kole lands this cost accounted for 12.64 per cent of the total cost as reported by Thomas *et al*. (1992).

Majority of the farmers used straight fertilisers, viz., urea monophos and muriate of potash. The highest expenditure on this item was for Class III with 18.16 per cent (Rs.2646.25) duly followed by Class I with 17.45 per cent (Rs.2118.76) and Class II with 16.03 per cent (Rs.2130.34). Out of the total respondents, only 7.5 per cent (six farmers) used all the three fertilisers above the recommended dose while 3.75 per cent (three farmers) used these at a rate below the recommended dose. The rest 88.75 per cent of the total sample farmers cannot be classified into the above mentioned groups since they have applied some of the nutrients in excess while the others in deficient. The farmers were of opinion that the high yielding varieties require higher amounts of fertilisers for better performance of the crop. Seventy seven point five per cent of the total respondents applied urea at a rate below the recommended dose (Table 5.27). While the rest 22.5 per cent applied urea at a rate above the recommended dose. Mussoriephos was the supplier of phosphorus. While 26.58 per cent of the total sample applied it at a rate lower than the recommended dose, the rest 73.42

Table 5.27 Frequency distribution of farmers according to level of fertiliser use (Kole)

Dose of nutrients	Number of farmers using the nutrients		
	N	P	K
Below recommended dose	62 (77.50)	22 (27.50)	30 (37.50)
Above recommended dose	18 (22.50)	58 (72.50)	50 (62.50)
Total	80 (100.00)	80 (100.00)	80 (100.00)

(Figures in parentheses show percentages to total)

per cent applied this at a higher dose. In the case of potassic fertilisers muriate of potash was applied by the respondents. Among them 37.5 per cent applied this at a lower rate and the rest 62.5 per cent applied at a higher dose. It was interesting to note that there was not even a single respondent who followed the correct recommendation. We can observe a higher utilization in the case of muriate of potash eventhough the prices were much higher.

Seed was the second important item of material input which accounted 6.75 per cent (Rs.819.59) of total cost in Class I, 6.29 per cent (Rs.917.33) in Class III, 6.24 per cent (Rs.828.98) in Class II and 6.66 per cent (Rs.825.00) at the aggregate level. The study revealed that out of the total respondents 33 farmers used own seed and the remaining 47 farmers used purchased seed (Table 5.28). the percentage of farmers using own seeds was the least among marginal farmers while all the large farmers used own seeds. Seventy six point twenty five per cent of the total respondents adopted a seed rate below the recommended dose while the rest 23.75 per cent adopted a seed rate above the recommended dose (Table 5.29). The study also revealed that out of the 50 per cent farmers using Red Thriveni for cultivation 32 were marginal farmers, 5 were small farmers and the rest three were large farmers (Table 5.30). The 50 per cent farmers who were using White

Table 5.28 Frequency distribution of farmers using own and purchased seed (Kole)

Seed	Class I (marginal)	Class II (small)	Class III (large)	Total
Own	18 (29.03)	12 (80.00)	3 (100.00)	33 (41.25)
Purchased	44 (70.97)	3 (20.00)	-	47 (58.75)
Total	62 (100.00)	15 (100.00)	3 (100.00)	80 (100.00)

(Figures in parentheses show percentages to total)

Table 5.29 Frequency distribution of farmers based on the seed rate adopted (Kole)

Seed rate	Class I (marginal)	Class II (small)	Class III (large)	Total
Above recommendation	15 (24.19)	4 (26.67)	-	19 (23.75)
Below recommendation	47 (75.81)	11 (73.33)	3 (100.00)	61 (76.25)
Total	62 (100.00)	15 (100.00)	3 (100.00)	80 (100.00)

Table 5.30 Number of farmers each class using a particular variety of seed (Kole)

Variety used	Class I (marginal)	Class II (small)	Class III (large)	Total
Red Thriveni	32 (51.61)	5 (33.33)	3 (100.00)	40 (50.00)
White Thriveni	30 (48.39)	10 (66.67)	-	40 (50.00)
Total	62 (100.00)	15 (100.00)	3 (100.00)	80 (100.00)

(Figures in parentheses show percentages to total)

Triveni for production included 30 marginal farmers and 10 small farmers.

Pesticide was the third major material input for all classes of farmers. Expenditure on this item was 3.63 per cent in Class I, 2.93 per cent in Class II and 1.97 per cent in Class III respectively. In this study area all the farmers were using pesticides regularly. A large percentage of the respondents were applying pesticides as a precautionary measure based on their experience.

The most widely used insecticides were phosphamidon (Dimecron), Quinalphos (Ekalux) and Monocrotophos (Nuvacron). Phosphamidon was used against the attack of stem borer while Ekalux was used against brown plant hopper. The doses were not kept accurate while applying these chemicals. They apply both the fungicides and insecticides even when one malady is seen, resulting in the excess usage and wastage of chemicals. The prevalent fungicides used were Bavistin and Hinosan against diseases like Blast and Sheath blight.

The fourth important item among material cost was soil rectifier. This accounted for 1.59 per cent in Class I, 1.63 per cent in Class II and 1.76 per cent in Class III respectively. At the aggregate level cost of this item was 1.66 per cent of the total cost.

Weedicides came as last which contributed only 0.51 per cent of the total cost in Class I, 0.56 per cent in Class II and 0.47 per cent in Class III. Vast majority of the farmers also resorted to chemical weeding in addition to manual weeding. The major weedicides used were Fernoxone against broad leaved weeds and propanil (Stam F,34) against karada. Farmers often apply pesticides and weedicides together in order to reduce the cost of application. As a result the purpose of spraying is not served.

5.3.2.3 Cost of cultivation of rice under different cost concepts

The different cost concepts were also worked out for Kole area and is given in the Table 5.31. All the items of cost were found to increase with holding size. Cost A_1, A_2, B_1, B_2, C_1 and C_2 per hectare were Rs.9566.17, Rs.9566.17, Rs.9566.17, Rs.12256.35, Rs.9706.17 and Rs.12396.35 at the aggregate level. For Class I the costs were Rs.9252.21, Rs.9252.21, Rs.9252.21, Rs.11981.27, Rs.9412.21 and Rs.12141.27. For Class II these costs were Rs.10278.17, Rs.10278.17, Rs.10278.17, Rs.13170.68, Rs.10399.50 and Rs.13292.01. For Class III the costs were Rs.11417.75, Rs.11417.75, Rs.11417.75, Rs.14464.14, Rs.11527.75 and Rs.14574.14.

Table 5.31 Cost of cultivation of rice under different cost concepts (Kole)

Cost	Class I (Marginal)	Class II (Small)	Class III (Large)	Aggregate
Cost A_1 (All actual expenses incurred in production)	9252.21	10278.17	11417.75	9566.17
Cost A_2 (Cost A_1 + rent for leased in land)	9252.21	10278.17	11417.75	9566.17
Cost B_1 (Cost A_1 + interest on own fixed capital)	9252.21	10278.17	11417.75	9566.17
Cost B_2 (Cost B_1 + rental value of own land and rent paid for leased in land)	11981.27	13170.68	14464.14	12256.35
Cost C_1 (Cost B_1 + imputed value of family labour)	9412.21	10399.50	11527.75	9706.17
Cost C_2 (Cost B_2 + imputed value of family labour)	12141.27	13292.01	14574.14	12396.35

5.3.2.4 Income measures in relation to different cost concepts

At the aggregate level gross income was estimated as Rs.13450.91. This was also estimated for different classes. The Class I farmers had the least gross income of 13645.30. The next higher amount was accounted by Class II with Rs.14462.56 and the Class III recorded the highest gross income of Rs.15231.93. Thus, gross income per hectare was found to increase with holding size.

Farm business income of the farmers as a whole and for different classes was estimated. At the aggregate level this was 3884.74. Class I has the highest farm business income of Rs.4393.09 followed by Class II with Rs.4184.39 and then Class III with only 3814.18 rupees. Thus, farm business income was inversely related to holding size.

Family labour income was worked out for Kole area and this accounted for Rs.1194.56. Family labour income worked out for different class of farmers revealed that this also was inversely related to holding size. It was highest in Class I (Rs.1664.03), then in Class II (Rs.1291.88) followed by Class III (Rs.767.79).

The net income, at the aggregate level was Rs.1054.56. This was also worked out at Cost C_1 as Rs.3744.74 at the

Table 5.32 Income measures in relation to different cost concepts in rice cultivation (Kole)

Particulars	Category			
	Class I (Marginal)	Class II (Small)	Class III (Large)	Aggregate
Gross income	13645.30	14462.56	15231.93	13450.91
Farm business income (G.I.-Cost A_1)	4393.09	4184.39	3814.18	3884.74
Family labour income (G.I.-Cost B_2)	1664.03	1291.88	767.79	1194.56
Net income at cost C_1 (G.I.-Cost C_1)	4233.09	4063.06	3704.18	3744.74
Net income at Cost C_2 (G.I.-Cost C_2)	1504.03	1170.55	657.79	1054.56
Input-output ratio at Cost C_2	1.12	1.09	1.05	1.09
Input-output ratio at Cost C_1	1.45	1.39	1.32	1.38

GI - Gross Income

aggregate level without accounting the rented value of land. This was also worked out for different classes. Net income was highest for Class I (Rs.1504.03) followed by Class II (Rs.1170.55) and then Class III (Rs.657.79). Thus, this measure of income was also inversely related to holding size.

Input-output ratio was worked out at the aggregate level as well as for different size groups. Input-output ratio is 1.09 at the aggregate level and this is the highest for marginal farmers which came to 1.12 on Cost C_2 basis and 1.38 cm Cost C_1 level. Radhakrishnan (1981) and Thomas et al. (1991) have worked out the benefit-cost ratio for rice cultivation in Thrissur district as 1.64 and 1.51 respectively.

5.3.2.5 Yield and returns of rice

The average yield, income from main product, byproduct, total explicit cost, input-output ratio and cost of production per quintal cost were also worked out for Kole area and are presented in Table 5.33. These were worked out for different classes of farmers both by including and excluding the kind portion of the produce which was given as wages.

The average per hectare yield of rice excluding the kind portion as wages in Kole was estimated as 32.53 quintals. This was the highest for large farmers which accounted 37.04

Table 5.33 Yield and returns of rice in Kole (per hectare)

	Excluding wage in kind for harvest			
	Class I (Marginal)	Class II (Small)	Class III (Large)	Aggregate
Average yield (in quintal)	33.03	35.10	37.04	32.53
Gross income	13645.30	14462.56	15231.93	13450.91
Income from main product	13045.30	13862.56	14631.93	12850.91
Income from byproduct	600.00	600.00	600.00	600.00
Total explicit cost	8999.66	10000.16	11084.94	9306.76
Gross expenditure	12141.27	13292.01	14574.14	12396.35
Net income	1504.03	1170.55	657.79	1054.56
Input-output ratio	1.12	1.09	1.05	1.09
Cost of production per quintal	367.58	378.69	393.47	381.07
Cost of production per quintal as explicit cost	272.47	284.90	299.26	286.10
	Including wages in kind for harvest			
Average yield (in quintal)	41.29	43.88	46.30	40.66
Gross income	16514.55	17932.60	18888.50	16660.70
Income from main product	15914.55	17332.60	18288.50	16060.70
Income from byproduct	600.00	600.00	600.00	600.00
Total explicit cost	11868.91	13470.20	14766.07	12516.55
Gross expenditure	15010.52	16762.05	18230.71	15606.14
Net income	1504.03	1170.55	657.79	1054.56
Input-output ratio	1.10	1.07	1.04	1.07
Cost of production per quintal	363.54	382.00	393.75	383.82
Cost of production per quintal as explicit cost	287.45	306.98	318.92	307.83

quintals followed by small farmers (35.10 quintals) and then marginal farmers with 33.03 quintals. Thus it was found that average yield increased with increase size of holding.

The income derived from the main product was Rs.12850.91 at the aggregate level. This was also found to increase with increase in the size of holding. Income from the byproduct was estimated as Rs.600 per hectare for all the classes and as well as for the aggregate.

Total explicit cost for Kole area was estimated as Rs.9306.76. This was the least for marginal farmers (Rs.8999.66) and was the highest for large farmers (Rs.11084.94) thus showing an increasing trend along with increase in the size of holding. The input output ratio was 1.09 at the aggregate level. Marginal farmers accounted for the highest input-output ratio.

Cost of production per quintal was estimated as Rs.381.07 for Kole and this was found to increase as the holding size increases. Cost of production per quintal as explicit cost was also worked out and was Rs.286.10 at the aggregate level. This was the highest for large farmers with Rs.299.26, followed by small and marginal farmers accounting for Rs.284.90 and Rs.272.47 respectively.

While considering the kind portion of the produce that was given as wages for harvest, the average yield was found to be 40.66 quintals. The large farmers had the highest average yield of 46.3 quintals followed by small and marginal farmers accounting for 43.88 and 41.29 quintals respectively.

Income from the main product was Rs.16060.70 for Kole and this was found to increase as the holding size increases. The input-output ratio was estimated as 1.07 at the aggregate level. This showed a decline with the increase in the size of holding. The total explicit cost was worked out as Rs.12516.55 at the aggregate level. Cost of production per quintal was Rs.383.82 at the aggregate level and was found to increase with the increase in the holding size. Cost of production per quintal (as explicit) cost also showed an increase with the increase in the holding size. This was estimated as Rs.307.83 at the aggregate level.

5.3.2.6 Bulk line cost of rice

Bulk line cost have been worked out for rice in Kole area and the results are presented in Table 5.34. From the table it is evident that bulk line cost is Rs.4600 per tonne and it covers 86.17 per cent of the total output supplied by 83.75 per cent of the cultivators.

Table 5.34 Bulk line cost of rice (Kole)

Average cost per tonne (Rs.)	Percentage of total output supplied	Percentage of cultivators producing at cost indicated under (1)	
Upto 2600	2.83	2.50	
2800	8.94	7.50	
3000	21.97	18.75	
3200	29.92	26.25	
3400	42.08	37.50	
3600	46.91	42.50	
3800	60.96	56.25	
4000	67.15	62.50	
4200	73.90	70.00	
4400	80.95	77.50	
4600	86.17	83.75	BULK LINE
4800	88.66	86.25	
5000	93.27	91.25	
5200	96.24	95.00	
5400	-	-	
5600	-	-	
5800	97.46	96.25	
6000	99.21	97.50	
6200	100.00	100.00	

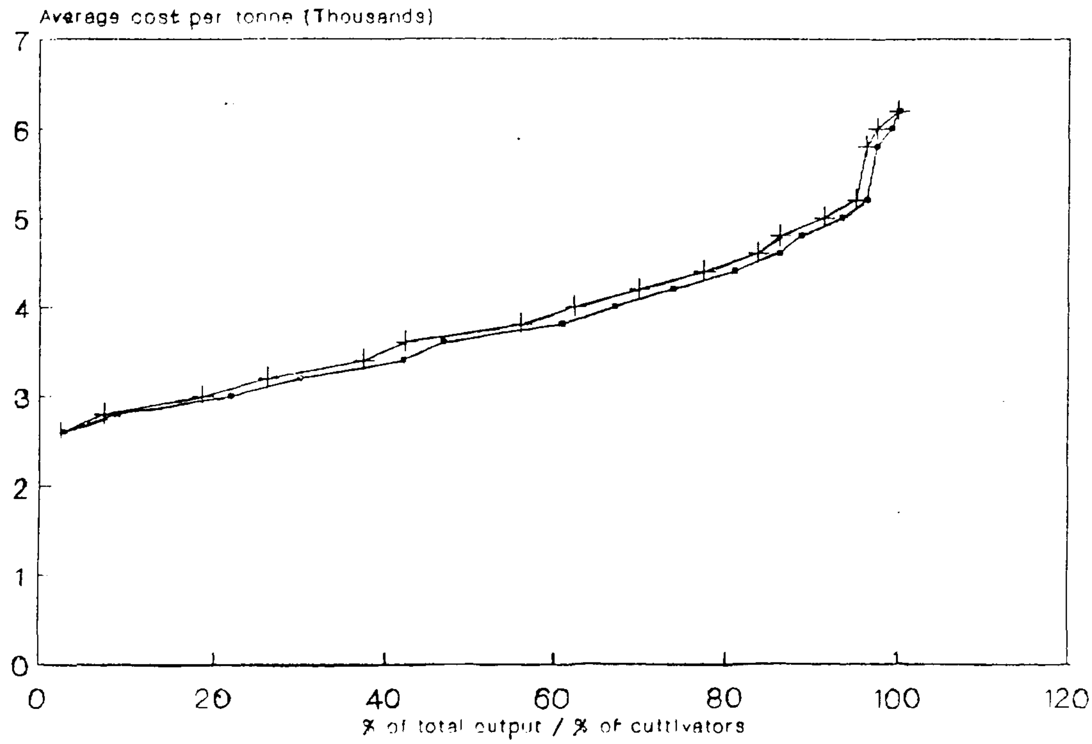

FIG.11. BULK LINE COST OF RICE (KOLE)

5.4 Resource use efficiency

Resource allocation is referred to the distribution of a given amount of factor among alternatives in production in order to maximize the relevant end of the economic unit in question. The end may be maximum physical product from given resources or it may be maximum profit for a farm-firm. The problem is how resources should be allocated among or between different products or production methods at a certain point of time and at different periods of time. The efficiency with which the limited resources are used depends upon the selection of enterprises and combination and allocation of resources. Mal allocation leads to the wastage of resources and inefficient production.

Efficiency in production is attained when resources are organised to give maximum profit. In order to achieve this resources should be combined in such a manner that they cannot be rearranged to give a greater physical product with the same amount of resources or the same physical product with less of one or more resources.

In the present study resource use efficiency has been estimated using Cobb-Douglas production function. When resource supply is unlimited for one product and one factor relationship, the return from the factor per technical unit of production is minimized by adding the resources until its marginal value product (MVP) is equal to the acquisition cost of the unit. In such case, problem of allocation does not arise. But in agriculture resource supply is limited. Under limited resource condition, the efficient use and allocation of same resources can be estimated by multiplying the capital constraint of the farm for the crop by the elasticity of coefficient of the corresponding input and dividing the product by the sum of the coefficient of all inputs since the inputs are in money unit.

For facilitating discussions, the results of the estimated parameters of the regression equations in rice cultivation of Kuttanad and Kole area are given below:

Rice in Kuttanad

$$\text{Log } Y_1 = \text{Log } 1.0032 + \underset{(0.0645)}{0.1130} \text{ Log } X_{1.1} + \underset{(0.0768)}{0.4631} \text{ Log } X_{2.1} + \underset{(0.0525)}{0.3901} \text{ Log } X_{3.1} - \underset{(0.0528)}{0.0516} \text{ Log } X_{4.1}$$

$$R^2 = 0.741$$

Rice in Kole

$$\text{Log } Y_2 = \text{Log } 0.9535 + \underset{(0.0614)}{0.0969} \text{ Log } X_{1.2} + \underset{(0.0749)}{0.5110} \text{ Log } X_{2.2} + \underset{(0.0444)}{0.2824} \text{ Log } X_{3.2} + \underset{(0.0316)}{0.0231} \text{ Log } X_{4.2}$$

$$R^2 = 0.58$$

(Figures in parenthesis are standard errors)

The function fitted for Kuttanad has an R^2 value of 0.741 indicating that 74 per cent of the variation in rice production in Kuttanad is explained by the function. The regression coefficient (b_i) indicates the rate at which the output 'Y' would change if input X_i changes by one unit while all other factors remain constant at their geometric mean levels. The estimated regression coefficients (b_i) of independent variables are the production elasticities of the respective factors (X_i).

The production elasticities of inputs for rice production in Kuttanad were 0.1130 for machine labour ($X_{1.1}$), 0.4631 for human labour ($X_{2.1}$), 0.3901 for fertiliser ($X_{3.1}$) and -0.0516 for plant protection chemicals ($X_{4.1}$). The negative production elasticity associated with plant protection indicated an excess use of this resource though it is not significant statistically.

The sum of regression coefficients (Σb_i) of all the input variables indicate the returns to scale. By returns to scale is meant the behaviour of production of returns when all the productive factors are increased or decreased simultaneously and in the same ratio. In the case of rice in Kuttanad the sum of the regression coefficients is less than one (0.9146) and indicated decreasing returns to scale.

Among the four explanatory variables, plant protection ($X_{4.1}$) has its standard error greater than the regression coefficient itself and hence this particular variable has been dropped for the final run analysis as was done by Maji (1968)* and Sankhayan and Sirohi (1971)**.

Similarly, the production elasticities of various inputs for rice production in Kole were 0.0969 for machine labour ($X_{1.2}$), 0.5110 for human labour ($X_{2.2}$), 0.2824 for fertiliser ($X_{3.2}$) and 0.0231 ($X_{4.2}$) for plant protection respectively. the sum of regression coefficients was less than unit (0.9134) indicating decreasing return to scale. The variable plant protection ($X_{4.2}$) has been eliminated from the final model since standard error of this particular variable is greater than the value of its coefficient.

The production functions selected for further economic analysis are the following:

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* Maji, C.C. (1968). Productivity and allocation of resources in jute and paddy. A farm level study in Mondalhat (Burdwan) and Naricha (Hoogly). M.Sc. unpublished thesis, I.A.R.I.

** Sankhayan, P.L. and Sirohi, A.H. (1971). Resource productivity and allocation efficiency on sweet potato farms in Himachal Pradesh. Indian J. agric. Econ. **26** (3): 247-250.

Rice in Kuttanad

$$\text{Log } Y_1 = \text{Log } 0.8371 + \underset{(0.0641)}{0.1195^{**}} \text{ Log } X_{1.1} +$$

$$\underset{(0.0769)}{0.4635^{*}} \text{ Log } (X_{2.1}) + \underset{(0.0525)}{0.3918^{*}} \text{ Log } (X_{3.1})$$

$$R^2 = 0.738$$

Rice in Kole

$$\text{Log } Y_2 = \text{Log } 0.9976 + \underset{(0.0509)}{0.0930} \text{ Log } X_{1.2} +$$

$$\underset{(0.0750)}{0.5156} \text{ Log } X_{2.2}^{*} + \underset{(0.0316)}{0.2850} \text{ Log } X_{3.2}^{*}$$

$$R^2 = 0.57$$

(Figures in parentheses are standard errors)

* Significant at 0.01 per cent probability level

** Significant at 0.10 per cent probability level

5.4.1 Kuttanad

The results of the estimated parameters of the Cobb-Douglas production function for rice cultivation in Kuttanad area is given in Table 5.35. From the analysis it can be observed that the value of R^2 was 0.738. The elimination of the variable (plant protection) from the functional analysis has not affected the $R.^2$ value substantially. The value of R^2 was found quite satisfactory that the independent variable

Table 5.35 Estimates of parameters of the Cobb-Douglas production function for Kuttanad

Estimates	Variables		
	Machine labour $X_{1.1}$	Human labour $X_{2.1}$	Fertilizer $X_{3.1}$
Regression coefficients	0.1195	0.4635	0.3918
t-value	1.86	6.03	7.47
Standard error	0.0641**	0.0769*	0.0525*

Intercept	6.87
R^2	0.738
Adjusted R^2	0.728
F-value	71.33
Returns to scale	0.9748

* Significant at 0.01 probability level

** Significant at 0.10 probability level chosen in the equation have explained 73.8 per cent of the variation in dependent variable. As the number of explanatory variables increases, R^2 almost invariably increases and never decreases. To correct the above defect, R^2 is adjusted by taking into account the degrees of freedom which get decreased with the inclusion of additional explanatory variable in the model. In the present analysis the adjusted R^2 was 0.728.

The standard error of estimates has indicated the error in estimating gross income from the independent factors for the period under study. The analysis showed that variables viz. human labour ($X_{2.1}$), and fertilisers ($X_{3.1}$) were significant at 1 per cent level while machine labour $X_{1.1}$ was significant at 10 per cent level.

Elasticity of production and returns to scale

In Cobb-Douglas production function the regression coefficients give elasticities of production. The elasticity of production of each input was less than one, thus showing a diminishing return to each input i.e., the gross income declined when increasing only one input and holding other inputs constant. The elasticity of production of 0.1195 for machine labour ($X_{1.1}$) implies that if one per cent additional investment in this input will result in 0.1195 per cent addition to the gross return per hectare of rice. Similarly the elasticities of other inputs in rice cultivation revealed that holding remaining variables fixed, one per cent increase in the investment in human labour ($X_{2.1}$) is associated with 0.46 per cent increase in the per hectare gross income and an increase in investment in fertiliser ($X_{3.1}$) by one per cent will increase the per hectare gross income by 0.39 per cent.

All the variables in function have the expected sign for their coefficients. Positive signs for machine labour and human labour show a high gross income of a farm if it offers high quantities of these inputs. Positive sign of fertilisers confirm the obvious expectation that more gross income is generated in a farm if more of this input is being used.

The sum of the elasticities of the production function for Kuttanad area is 0.9748 which indicate decreasing return to scale, i.e., a simultaneous and proportionate increase in investment in all of the above inputs ($X_{1.1}$, $X_{2.1}$ and $X_{3.1}$) by one per cent, an increase in gross income per hectare of paddy by only 0.97 per cent. Samuel (1963) reported diminishing returns in Kuttanad. Singh (1992) found increasing returns to scale in case of rice in Haryana.

Marginal value product

Marginal value products (MVP) denotes the additional returns from an additional rupee invested in in the relevant input. These have been estimated at geometric mean level of inputs and output (Gross return per hectare). Therefore MVP and marginal value productivity ratios at factor cost have the same value. The Table 5.36 gives a clear indication that all the three resources are really restricted resources since the MVP of a rupee invested in each has appeared much higher than unity. This suggests that if the farmer has unlimited amount of money then the per hectare gross income from rice cultivation can be increased by expanding investment in these inputs. Thus a rupee of additional investment in machine labour ($X_{1.1}$), human labour ($X_{2.1}$) and fertiliser ($X_{3.1}$) will add Rs.5.25, Rs.1.47 and Rs.2.33 respectively to the per hectare gross income of rice in Kuttanad. The MVP factor cost ratios indicate that an investment of additional rupee in each input will yield an additional return worth Rs.5.25 from input machine labour, Rs.1.47 from human labour and Rs.2.33 in fertiliser. Marginal value product of machine labour was highest in large farmers to an extent of 5.55, followed by small and marginal farmers. In the case of human labour, the productivity was almost similar for all the size groups and for fertiliser it was found maximum among large farmers (2.44) followed by marginal and small farmers. Radhakrishnan (1969) reported greater marginal value productivity of resources in large farms as compared to small farms. Marginal value productivity of human labour (1.47) was lower than that of

Table 5.36 Marginal value products and factor cost ratio of various inputs in the production of rice (Kuttanad)

Class of farmer	Machine labour		Human labour		Fertilizer	
	MVP	FC ratio	MVP	FC ratio	MVP	FC ratio
Marginal	5.10	5.10	1.49	1.49	2.39	2.39
Small	5.12	5.12	1.49	1.49	2.18	2.18
Large	5.55	5.55	1.44	1.44	2.44	2.44
Aggregate	5.25	5.25	1.47	1.47	2.33	2.33

machine labour and fertiliser at the aggregate level as well as for different size groups.

5.4.1.1 Optimum allocation of resources

Under limited resource condition the optimum level of these inputs viz. machine labour, human labour and fertiliser were also estimated for different size groups of farmers by multiplying the capital constraint of the farm for the crop by the elasticity coefficient of the corresponding input and dividing the product by the sum of the regression coefficients of all inputs. The optimum values of resources were substituted in the original model and the gross income was worked out.

Existing and optimum levels of inputs such as machine labour, human labour and fertiliser are presented in the Table 5.37. A significant difference between the existing and optimum levels of machine labour were found in all the three classes and as well at the aggregate level. In Class I, farmers should increase their expenditure on machine labour from an existing level of Rs.334.00 to an optimum level of Rs.968.83. For Class II this is to be enhanced from the existing level of Rs.332.87 to the optimum level of Rs.955.40 and for class III the same is to be increased from Rs.307.00 to Rs.956.04.

Table 5.37 Average existing and optimum levels of investments and per hectare gross returns in rice cultivation (Kuttanad)

Class	Inputs							
	Machine labour $X_{1.1}$		Human labour $X_{2.1}$		Fertilizer $X_{3.1}$		Gross income	
	Existing	Optimum	Existing	Optimum	Existing	Optimum	Existing	Optimum
Marginal	334.00	968.93	4437.28	3759.73	2344.52	3199.01	14105.87	16757.14
Small	332.87	955.40	4438.13	3707.62	2568.02	3134.14	14615.04	16489.23
Large	307.00	956.04	4605.77	3710.12	2290.71	3215.57	14177.51	16657.12
Aggregate	324.62	960.09	4493.73	3725.82	2401.08	3182.91	14272.50	16634.13

As in the case of machine labour, the expenditure on fertilisers should also be enhanced from the existing level for all the three classes as well as for the aggregate. The marginal farmers should increase their expenditure on fertiliser from the existing level of Rs.2344.52 to the optimum level of Rs.3199.01. Expenditure on the same should be increased from the existing level of Rs.2568.02 to the optimum level of Rs.3134.14 in the case of small farmers. For large farmers enhancement to be made in this item of expenditure is from the existing level of Rs.2290.71 to the optimum level of Rs.3215.57.

In order to achieve maximum production, the expenditure on human labour should be reduced from the existing level for all the three groups under limited resource condition. For marginal farmers this should be reduced from an existing level of Rs.4437.28 to an optimum level of Rs.3759.73. The expenditure should be decreased from Rs.4438.13 to Rs.3707.62 for small farmers. For large farmers the expenditure on the same should be decreased from an existing level of Rs.4605.77 to an optimum level of Rs.3710.12.

The analysis showed that by reallocating the existing resources, the farmer may get 16.61 per cent of additional income at the aggregate level. The percentage increase in gross income per hectare from rice cultivation were highest among marginal farmers (to an extent of 18.8 per cent) followed by large farmers (17.5 per cent) and small farmers (12.8 per cent). Selvarajan and Subramanian (1981) reported that a reallocation of the resources in the optimal direction would increase the gross income of farms by 25.97 per cent.

5.4.2 Kole

The results of the functional analysis regarding resource productivity in rice cultivation of Kole area is given in Table 5.38. It is observed that the value of R^2 was only 0.59 which shows that about only 59 per cent of the variation in gross income was explained by explanatory variables chosen in the equation viz. machine labour ($X_{1.2}$), human labour ($X_{2.2}$) and fertiliser ($X_{3.2}$). The remaining 41 per cent unexplained variations may be due to those input factors which have been leftout. The value of adjusted R^2 was found to be 0.57. The elasticity of production of each input was less than unity thus showing diminishing return to each input. The estimated percentage increase in gross income came to 0.51 with one per cent change in human labour ($X_{2.2}$). While other inputs are held constant and it was significant at one per cent level. Similarly the estimated percentage increase in gross income with one per cent increase in machine labour ($X_{1.2}$) and fertilisers ($X_{3.2}$) came to 0.09 per cent and

Table 5.38 Estimates of parameters of the Cobb-Douglas production function for Kole

Estimates	Variables		
	Machine labour $X_{1.2}$	Human labour $X_{2.2}$	Fertilizer $X_{3.2}$
Regression coefficients	0.0930**	0.5156*	0.2850*
t-value	1.82	9.61	9.02
Standard error	0.0509	0.0750	0.0316
Intercept	9.94		
R^2	0.59		
Adjusted R^2	0.57		
F-value	36.08		
Returns to scale	0.8936		

* Significant at 0.01 probability level

** Significant at 0.10 probability level

0.28 per cent respectively. These coefficients are positive but statistically significant at 10 per cent and 5 per cent level respectively.

The sum of the elasticities of the production function for kole area indicate decreasing return to scale (0.8936), i.e., a simultaneous increase in investment in all of the above inputs ($X_{1.2}$, $X_{2.2}$ and $X_{3.2}$) by one per cent, would result in an increase in gross income per hectare of rice by only 0.89 per cent.

Marginal value product

Marginal value products have been estimated at geometric mean level of inputs and output and the results are presented in Table 5.39. The results indicate that if farmers have unlimited amount of money then the per hectare gross income from rice cultivation can be increased by expanding investment in machine labour, human labour and fertiliser. Thus a rupee of additional investment in machine labour ($X_{1.2}$), human labour ($X_{2.2}$) and fertiliser ($X_{3.2}$) will add Rs.2.78, 1.42 and 1.42 respectively to the per hectare gross income of rice in Kole. The marginal value products of all the variables were highest among marginal farmers, followed by small farmers and large farmer except for machine labour ($X_{1.2}$).

Table 5.39 Marginal value products and factor cost ratio of various inputs in the production of rice (Kole)

Class of farmer	Machine labour		Human labour		Fertilizer	
	MVP	FC ratio	MVP	FC ratio	MVP	FC ratio
Marginal	2.97	2.97	1.51	1.51	1.54	1.54
Small	2.69	2.69	1.37	1.37	1.50	1.50
Large	2.71	2.71	1.37	1.37	1.25	1.25
Aggregate	2.78	2.78	1.42	1.42	1.42	1.42

5.4.2.1 Optimum allocation of resources

Existing and optimum levels of inputs for rice cultivation in Kole area such as machine labour, human labour and fertiliser for different classes are presented in Table 5.40. Considerable differences between the existing and optimum levels of expenditure on machine labour were found in all the three classes and as well as at the aggregate level. Marginal farmers should increase their expenditure on machine labour from the existing level of Rs.387.32 to the optimum level of Rs.716.24. For small farmers, this is to be enhanced from the existing level of Rs.427.47 to the optimum level of Rs.774.00. The increase to be made for large farmers is from Rs.425.00 to Rs.821.84.

The existing levels of expenditure on human labour is to be decreased in all the three classes. The difference between the existing and optimum level of expenditure for human labour was Rs.237.22 for marginal farmers, Rs.360.55 for small farmers and Rs.96.62 for large farmers. In the case of expenditure on fertiliser the existing levels are more than optimum for marginal and large farmers. The existing level of expenditure on this input should be reduced in the case of these two classes. For marginal farmers, this should be reduced from an existing level of Rs.2286.63 to an optimum level of Rs.2194.93. For large farmers this should be reduced

Table 5.40 Average existing and optimum levels of investments and per hectare gross returns in rice cultivation (Kole)

Class	Inputs							
	Machine labour $X_{1.2}$		Human labour $X_{2.2}$		Fertilizer $X_{3.2}$		Gross income	
	Existing	Optimum	Existing	Optimum	Existing	Optimum	Existing	Optimum
Marginal	387.32	716.24	4208.11	3970.89	2286.63	2194.93	11595.78	11776.06
Small	427.47	774.00	4651.67	4291.12	2357.92	2371.94	12368.02	12624.09
Large	425.00	821.84	4652.96	4556.34	2818.75	2518.53	13073.75	13316.80
Aggregate	413.26	770.69	4504.25	4272.79	2487.77	2361.80	12373.71	12574.77

from Rs.2818.75 to Rs.2518.53. The small farmers should enhance their expenditure on fertilisers from Rs.2357.92 to Rs.2371.94 in order to achieve maximum efficiency in production.

The analysis showed that through reallocation of the resources farmers may get additional income of Rs.201.06 per hectare from the rice cultivation at the aggregate level. The increase will be Rs.180.28 in case of marginal farmers, Rs.256.07 for small farmers and Rs.243.05 for large farmers.

5.5 Marketed surplus

The term 'marketed surplus' of an agricultural produce represents that part of an year's production which the farmer disposes of directly or through intermediaries. It is very important to examine the pattern of marketed surplus of agricultural produce and the factors which determine its extent and flow. A reliable estimate on the quantum of marketed surplus available with the cultivators is essential for shaping out policies, relating to procurement and public distribution.

Marketed surplus does not depend not only on production but also on the farmer's behaviour regarding retention on the farms. Retention by the farmers for various needs include retention for home consumption, seed requirements, and payment of wages in kind.*

5.5.1 Kuttanad

5.5.1.1 Marketed surplus and other retentions by the farmers

Farm retentions of farmers in Kuttanad area are presented in Table 5.41. The marketed surplus accounted for 69.17 per cent of the total produce in this area. Farm retentions include 18.06 per cent of the total produce given as wages in kind, 10.28 per cent kept for family consumption and the rest 2.49 per cent kept for the purpose of seed.

Classwise analysis showed that marketed surplus increased as the holding size increases. Kalhon and Dwivedi (1963) found that marketed surplus was directly associated with size of holding. Thus large farmers accounted for 125.72 quintals. This was followed by small farmers with 51.97 quintals and marginal farmers with 19.55 quintals respectively. The quantity of produce given as kind expressed in percentage to total produce was almost the same in all the classes. Quantity kept for consumption was more in class II

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* Desai, M.B. (1960). Problems of marketable surplus in agriculture, Rapporteur's report on the 20th Annual Conference of the Indian Society of Agricultural Economics held during 21st to 25th December 1960 at Chandigarh.

Table 5.41 Marketed surplus and other retentions as percentages of total production in Kuttanad

(In quintals)

Size group	Seed	Home consumption	Kind wages	Marketed surplus	Total production
Marginal	0.85 (2.69)	5.41 (17.19)	5.66 (17.99)	19.55 (62.13)	31.47 (100.00)
Small	1.57 (2.18)	5.50 (7.64)	12.96 (18.00)	51.97 (72.18)	72.00 (100.00)
Large	4.13 (2.51)	5.05 (3.07)	29.61 (18.00)	125.72 (76.42)	164.51 (100.00)
Aggregate	1.36 (2.49)	5.62 (10.28)	9.87 (18.06)	37.81 (67.17)	54.66 (100.00)

(Figures in parentheses show percentages to total)

with 5.50 quintals followed by class I and then class III which accounted for 5.41 and 5.05 quintals respectively. Quantity kept for seed purpose was the highest among class I farmers and this accounted for 2.69 per cent of the total produce. Moreover the farmers of this class were found to adopt a seed rate higher than the recommended dose.

5.5.2 Kole

5.5.2.1 Marketed surplus and other retentions by the farmers

Farm retention analysis was also conducted in Kole area and the results are presented in Table 5.42. It was observed that 67.89 per cent of the total produce formed the marketed surplus in this area. Around 14.89 per cent of the produce was utilized for giving wages in kind. The quantity kept for consumption was 14.93 per cent of the produce and 2.29 per cent was utilized for seed purpose.

Classwise analysis showed that marketed surplus increased as the size of holding increases. Marketed surplus was highest among class III farmers with 97.94 quintals, followed by class II and class I with 44.54 and 12.07 quintals respectively. Around 18.00 per cent of the total produce was utilized for giving wages in all the classes of farmers. The quantity of the produce kept for consumption was highest in class II with 5.12 quintals, followed by class III

Table 5.42 Marketed surplus and other retentions as percentages of total production in Kole

(In quintals)

Size group	Seed	Home consumption	Kind wages	Marketed surplus	Total production
Marginal	0.62 (2.94)	4.58 (21.75)	3.79 (18.00)	12.07 (57.31)	21.06 (100.00)
Small	0.60 (0.98)	5.12 (8.33)	11.17 (18.18)	44.54 (72.51)	61.43 (100.00)
Large	3.36 (2.59)	5.02 (3.87)	23.32 (17.99)	97.94 (75.55)	129.64 (100.00)
Aggregate	0.70 (2.29)	4.70 (14.93)	4.69 (14.89)	21.38 (67.89)	31.49 (100.00)

(Figures in parentheses show percentages to total)

and class I with 5.02 and 4.58 quintals respectively. The quantity earmarked for seed purpose was the highest among large farmers (3.36 quintals). This was followed by marginal farmers and then by small farmers with 0.62 and 0.60 quintals respectively set apart for seed.

5.5.3 Marketed surplus and other retentions by the farmers representing the whole sample

Farm retentions for the sample as a whole was also worked out and is presented in Table 5.43. At the aggregate level 68.92 per cent of the production was marketed. Around 16.92 per cent was utilized for giving wages in kind. The quantity used for consumption purpose was 11.76 per cent of the total produce. An average of 2.40 per cent was used for seed purpose. Class-wise analysis showed that marketed surplus was the highest among large farmers (115.30 quintals) followed by small and marginal farmers with 49.44 and 15.25 quintals respectively. Bhattacharjee (1960), Majid (1960), Dharam Narain (1961), Muthiah (1964), Parthasarathy (1964), Raj (1965) and Rai et al. (1992) reported that proportion of food crops tended to increase with an increase in the size of holding. In contrary to this Raj (1965) found the acreage of size of holding was the most unsatisfactory predictor of marketable surplus.

Table 5.43 Marketed surplus and other retentions as percentages of total production for the whole sample (Kuttanad and Kole)

(In quintals)

Size group	Seed	Home consumption	Kind wages	Marketed surplus	Total production
Marginal	0.71 (2.79)	4.93 (19.35)	4.59 (18.01)	15.25 (59.85)	25.48 (100.00)
Small	1.09 (1.60)	5.37 (7.86)	12.37 (18.12)	49.44 (72.42)	68.27 (100.00)
Large	3.85 (2.54)	5.04 (3.33)	27.26 (18.00)	115.30 (76.13)	151.45 (100.00)
Aggregate	1.03 (2.40)	5.06 (11.76)	7.28 (16.92)	29.65 (68.92)	43.02 (100.00)

(Figures in parentheses show percentages to total)

As much as 18.00 per cent of the total produce was utilized for giving wages as kind by the three class of farmers. The quantity for consumption purpose was highest among class I farmers with 19.35 per cent of the total produce followed by class II and class III with 7.86 and 3.33 per cent respectively. The quantity of the produce was 2.79 per cent in class I, 2.54 per cent in class III and 1.60 per cent in class II.

5.5.3.1 Factors contributing marketed surplus

Multiple regression analysis was carried out to estimate the factors determining the marketed surplus of rice. Due to the similarity in the consumption behaviour of farmers in the study areas, the model was fitted for the whole sample and the estimated model is

$$Y = -0.9581 + \underset{(0.2048)}{0.3392}\, X_1^{NS} + \underset{(0.0074)}{0.3743}\, X_2 + \underset{(0.3033)}{0.4474}\, X_3^{NS}$$

X_1 the family size

X_2 the productivity and

X_3 the area under paddy

* Significant at 0.01 probability level

NS - Non-significant

R^2 - 0.946

It is evident that out of the three variables, productivity was found to be significant at 0.01 per cent level. For every unit increase in productivity, the marketed surplus increases by 37 per cent. The study conducted by Kalhon and Dwivedi (1963), Shastri (1963), Raj (1965), Sharma (1967) and Nair (1975) have reported that production exercises considerable influence on marketed surplus. The other two variables viz., family size and area under paddy were not found to be statistically significant. Sharma (1967) and Narayanan (1975) reported that marketed surplus and size of family were negatively correlated.

5.6 Major constraints to rice production

The last objective of the present study is to identify the constraints in rice production in Kuttanad and Kole areas. The major constraints identified while conducting pilot survey were submergence, weed infestation, input price, labour cost, acidity and salinity and incidence of pests and diseases which were similar in both the areas. These constraints were included in the questionnaire and the response of the farmers regarding these constraints were collected. Each constraint was ranked and the percentages have been worked out and are given in Table 5.44 and 5.45.

5.6.1 Kuttanad

5.6.1.1 Major constraints to rice production

All the farmers considered high the labour cost as the major problem of rice cultivation in Kuttanad (Table 5.44). The non-availability of labour during the peak agricultural operations and the resultant increase in their cost make the cultivation of rice a difficult task.

Weed infestation was the second important constraint according to 75.00 per cent of the respondents. The same was identified as the third and fourth important problem by another 18.75 per cent and 6.25 per cent of the farmers respectively. Weed problem in this area is severe and these are often removed manually before starting the cultivation in spite of the increased labour cost. Chemical weeding is also resorted to.

Incidence of pests and diseases was remarked as the third important problem by 56.25 per cent and as the second important problem by 6.25 per cent of the respondents. This also formed the fifth important problem to 12.50 per cent of the farmers while another 25.00 per cent identified this as the sixth major constraint in rice production.

High price of various inputs was recognised as the next important problem of rice cultivation. This was

Table 5.44 Constraints to rice production in Kuttanad

Constraints	Ranking of constraints					
	I	II	III	IV	V	VI
Flood/ submergence	-	15 (18.75)	-	5 (6.25)	-	60 (75.00)
Weed infestation	-	60 (75.00)	15 (18.75)	5 (6.25)	-	-
Acidity and salinity	-	-	-	20 (25.00)	60 (75.00)	-
Incidence of pests and diseases	-	5 (6.25)	45 (56.25)	-	10 (12.50)	20 (25.00)
High input price	-	-	20 (25.00)	50 (62.50)	10 (12.50)	-
High labour cost	80 (100.00)	-	-	-	-	-

(Figures in parentheses show percentages to total)

explained as the third important constraint by 25.00 per cent of the farmers and also as the fourth major constraint by another 62.50 per cent. Adoption of the recommended doses of fertilisers, lime etc. depends primarily on the price of their inputs.

Due to the proximity to the sea, salt water enters into the canals in Kuttanad when the water level in backwater goes down due to tidal action. Soil of Kuttanad is highly acidic and this was reported as the fifth important constraint by 75.00 per cent and as the fourth important constraint by 25.00 per cent of the farmers respectively.

Flood caused by rains during the monsoon will result in the submergence of rice fields in Kuttanad and hence, is a severe threat. Timely dewatering is a problem resulting from the submergence. Fifteen per cent of the farmers identified this as their second important constraint in production. While this was the fourth major constraint to 6.25 per cent of the farmers and this was also remarked as the sixth constraint by 75.00 per cent of the farmers.

5.6.2 Kole

5.6.2.1 Major constraints to rice production production

A vast majority of the farmers were of the view that

Table 5.45 Constraints to rice production in Kole

Constraints	Ranking of constraints					
	I	II	III	IV	V	VI
Flood/ submergence	-	10 (12.50)	21 (26.25)	29 (36.25)	20 (25.00)	-
Weed infestation	-	64 (80.00)	9 (11.25)	7 (8.75)	-	-
Acidity and salinity	-	-	2 (2.50)	12 (15.00)	44 (55.00)	26 (32.50)
Incidence of pests and diseases	-	6 (7.50)	30 (37.50)	-	16 (20.00)	28 (35.00)
High input price	-	-	18 (22.50)	32 (40.00)	-	26 (32.50)
High labour cost	80 (100.00)	-	-	-	-	-

(Figures in parentheses show percentages to total)

higher labour cost due to non-availability during the season is the major constraint in rice cultivation in Kole area.

Weed infestation was identified as the second important constraint by 80.00 per cent of the farmers. The cost of weeding is fairly high due to its severe infestation and high labour cost. Chemical weeding was also practiced. This was the third major constraint for 11.25 per cent and was the fourth major constraint for another 8.75 per cent of the respondents.

Incidence of pests and diseases was explained as the second important constraint by 7.50 per cent and as the third important constraint by 37.5 per cent of the farmers. They often follow prophylactic measures against pests and diseases. This was also identified as the fifth and sixth important constraint by 20 per cent and 35 per cent of the farmers respectively.

Higher cost of the inputs was the fourth major constraint in this area (40 per cent of the respondents). This was explained as the third important problem by 22.50 per cent and as the sixth by 32.5 per cent of the respondents.

Kole lands are confronted with the problem of floods during the monsoon months and acts as a flood moderation reservoir and are completely submerged. Hence this create problems with regard to dewatering as explained by 36.25 per cent of the farmers as their fourth important problem. Twenty six point twenty five per cent of the farmers identified this as the third important constraint. This was also formed the second major constraint to 12.50 per cent and as the fifth constraint by another 25 per cent of the respondents.

Soil of Kole land is acidic and toxic salts of iron and aluminium are produced in the soil which hamper agricultural production. There is ingression of saline water during summer months through the channel connecting Kole lands to backwaters of Enamakkal. Thus salinity is also a limiting factor to production. this formed the fifth important constraint as identified by 55 per cent of the farmers. This also remarked as their fourth major constraint by 15 per cent and also as the sixth important constraint by 32.5 per cent of the respondents.

SUMMARY

SUMMARY

The present study on economic analysis of rice production in Kuttanad and Kole areas of Kerala was undertaken on the basis of data pertaining to the agricultural year 1992-93. The data were collected from May 1993 to July 1993. The study aimed at comparing the cost and returns, measure the resource use productivity of farm resources, examine the possibility of increasing returns by reallocating the existing resources, study the marketed surplus and factors contributing to it and identify the constraints in rice production.

The study is based on a sample of 160 farmers, eighty each from Kuttanad and Kole areas. Two stage random sampling was employed with 'Krishi Bhavans' as primary units and individual farmers as secondary unit. Lists of 'Krishi Bhavans' coming under Kuttanad and Kole areas were first prepared. From these lists, four 'Krishi Bhavans' each were selected randomly as the primary sampling units. From each 'Krishi Bhavan', 20 paddy growers were selected at random thus making a total sample of 160. Post stratification of the samples based on the area under paddy cultivation was done and analysis was carried out for the different strata.

Tabular analysis was used to estimate the per hectare cost of cultivation of rice both inputwise and operationwise, the farm retentions and in the identification of constraints in rice production. Cobb-Douglas production function was used to estimate the factor productivity of important input variables on rice production. Linear type of production function was also used to identify the factors contributing to the marketed surplus of rice.

Total cost incurred for rice cultivation in Kuttanad was Rs.13237.48 and for Kole area it was Rs.12396.35. Classwise analysis showed that cost of cultivation was the highest for large farmers in both the areas. The total cost, analysed operationwise, indicated that fertiliser and its application cost was the most important item of expenditure and it accounted for 24.06 per cent of the total cost (Rs.3185.39) in Kuttanad and 18.76 per cent of the total cost (Rs.2325.51) in Kole area. The next important operations in Kuttanad area were land preparation and weeding which accounted for 13.52 per cent (Rs.1790.29) and 12.89 per cent (Rs.1706.12) of the total cost respectively. These two operations accounted for 14.78 per cent (Rs.1831.98) and 15.13 per cent (Rs.1875.07) of the total cost in Kole area.

Inputwise analysis of total cost revealed that the major input in Kuttanad was labour input followed by materials which accounted for 33.49 per cent (Rs.4432.65) and 30.31 per cent (Rs.4012.59) respectively of the total cost. In Kole area labour input accounted for 33.99 per cent (Rs.4213.98) and material input accounted for 29.54 per cent (Rs.3661.84) of the total cost. In both the areas human labour constituted the highest percentage of the labour input. Percentage of this input total cost was 25.47 in Kuttanad and 25.97 per cent in Kole area.

A, B and C cost concepts were also used to estimate the cost of cultivation of rice. Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1 and Cost C_2 per hectare were Rs.9953.02, Rs.9953.02, Rs.9953.02, Rs.13090.68, Rs.10099.82 and Rs.13237.48 respectively for Kuttanad and Rs.9566.17, Rs.9566.17, Rs.9566.17, Rs.12256.35, Rs.9706.17 and Rs.12396.35 respectively for Kole area. These different costs were the highest for large farmers in both the areas.

The income measures in relation to different cost concepts in rice cultivation such as gross income, farm business income, family labour income, net income and benefit-cost ratio were Rs.15688.30, Rs.5735.28, Rs.2597.62, Rs.2450.82 and 1.19 respectively for Kuttanad and Rs.13450.91, Rs.3884.74, Rs.1194.56, Rs.1054.56 and 1.09 respectively for Kole area. The different income measures except gross income were the highest for marginal farmers in Kole. The gross income was the highest for large farmers in this area. All the income measures including gross income was highest for marginal farmers in Kuttanad.

The average per hectare yield in quintals of rice in Kuttanad was 37.72, excluding harvesting charges paid in kind and 47.15, including kind portion. Corresponding values for Kole area were 32.53 quintals and 40.66 quintals respectively. Net income was Rs.2450.82 for Kuttanad and Rs.1054.56 for Kole area. The input-out ratio calculated both by excluding and including kind portion were 1.19 and 1.14 respectively for Kuttanad. The corresponding input-output ratios for Kole area were 1.09 and 1.07 respectively. Cost of production, per quintal was Rs.350.94 for Kuttanad and Rs.381.07 for Kole. Bulk line cost on Cost C_2 basis was Rs.4000 per tonne for Kuttanad and Rs.4600 per tonne for Kole area.

Production function analysis was also done for rice in Kuttanad and Kole areas separately. Cost per hectare of machine labour, human labour and fertiliser were the independent variables for analysis. The independent variables in the function could explain 74 per cent of the variation in output in Kuttanad area and 59 per cent of the variation in output in Kole area. Regression analysis has revealed that the contribution of these variable inputs namely machine labour, human labour and fertiliser towards gross income were found to be significant and positive for both the areas. The estimated percentage increase in gross income with one per cent increase in these three inputs came to 0.12 per cent, 0.46 per cent and 0.39 per cent respectively for Kuttanad area. As far as the Kole area is considered, the corresponding values are 0.09, 0.51, and 0.28 per cent respectively.

The sum of the elasticities of the production function for Kuttanad and Kole were less than one (0.9748 and 0.8936 respectively) and indicated diminishing returns to scale.

Marginal value productivity to factor cost ratios revealed that a rupee invested in the machine labour, human labour and fertiliser will add Rs.5.25, Rs.1.47 and Rs.2.33 respectively to returns in Kuttanad and Rs.2.78, Rs.1.42 and Rs.1.42 respectively for Kole area assuming the farmer has unlimited access to money to buy these resources.

Under limited resource condition also optimum levels of inputs such as machine labour, human labour and fertiliser were worked out for both the areas. For Kuttanad to achieve optimum production, the expenditure on machine labour and fertiliser should be enhanced from the existing level whereas expenditure on human labour should be reduced. In the case of Kole area, the expenditure on machine labour should be enhanced whereas the expenditure on human labour and fertiliser should be reduced.

The analysis also showed that by reallocating the existing resources, farmers could increase his income by 16.61 per cent at the aggregate level in Kuttanad. No substantial increase in additional income would come about in the case of Kole area as a result of reallocation.

Marketing analysis revealed that marketed surplus accounted for 69.17 per cent of the total produce in Kuttanad and 67.89 per cent of the total produce in Kole area. For the sample as a whole the marketed surplus accounted for 68.92 per cent of the total produce. As mush as 18.06 per cent and 14.89 per cent of the total produce was utilised for giving wages in kind in Kuttanad and Kole respectively. For the whole sample, percentage of produce given as wages was 16.92 per cent of the total produce. Around 10.28 and 14.93 percentage of the total produce was used for home consumption in Kuttanad and Kole areas. Analysis for the whole sample revealed that marketed surplus increased as size of holding increase. For the sample as a whole 11.76 per cent and 2.40 per cent of the total produce was used for the purpose of home consumption and seed respectively. The quantity used for seed purpose was 2.49 per cent of the total produce in Kuttanad and 2.29 of the total produce in Kole.

Multiple regression analysis to estimate the factors determining the marketed surplus has revealed that productivity is the only significant variable contributing to marketed surplus of rice.

Non-availability of labour during the peak agricultural season and their increased costs were reported to be the most important constraints in rice cultivation in both the areas under the study. Weed infestation was the second important constraint as explained by 75.00 per cent of the farmers in Kuttanad and 80.00 per cent of the farmers in Kole area. Incidence of pests and diseases and higher prices of inputs were the third and fourth important constraints in both the areas. Salinity and acidity was the fifth important constraint followed by the problem of submergence in Kuttanad, while submergence formed the fifth constraint in Kole, followed by the problem of acidity and salinity.

Policy implications

The results of the present study bring to surface some major issues for consideration.

Cost escalation is the most important factor which makes rice cultivation a relatively less remuneration enterprise. Hence the ways and means to reduce the costs of production to the maximum extent possible is the prime concern. Mechanisation should be allowed wherever possible and thus reduce the cost on human labour. The practice of chemical weeding should also be strengthened. The cost structure should be well studied before fixing support prices, cost studies should be conducted either by the Kerala Agricultural University or by the Department itself.

The risks arising out of infestation of pests and diseases can be minimised through integrated pest management activities. Excessive use of plant protection chemicals and fertilisers should be restricted both for economic and ecological considerations. The use of organic manure in rice fields is not practised now a days. This may create problems in maintaining soil fertility. The production and application of organic manures and bio-fertilisers have to be emphasised.

The co-operative sector should be streamlined and proper storage facilities should be made available at villages through co-operatives or group farming samithies.

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ABSTRACT

The present investigation on economic analysis of rice production in Kuttanad and Kole areas of Kerala was undertaken during the agricultural year 1992-93. The study aimed at comparing costs and returns, measure productivity of farm resources, examine the possibility of increasing incomes by reallocating the existing resources and examining the marketed surplus and factors contributing to it and to identify the constraints in rice production.

Data for the study was generated through a sample survey of farmers. Two stage random sampling was adopted for the study.

The largest single item of cost of operation was fertiliser and its application cost for both Kuttanad and Kole. The largest single item of input was labour in both the areas.

Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1 and Cost C_2 per hectare were Rs.9953.03, Rs.9953.02, Rs.9953.02, Rs.13090.68, Rs.10099.82 and Rs.13237.48 respectively for Kuttanad and Rs.9566.17, Rs.9566.17, Rs.9566.17, Rs.12256.35, Rs.9706.17 and Rs.12396.35 respectively for Kole area.

The income measures in relation to different cost concepts, in rice cultivation such as gross income, farm business income, family labour income, net income and benefit cost ratio were Rs.15688.30, Rs.5735.28, Rs.2597.62, Rs.2450.82 and 1.19 respectively for Kuttanad and Rs.13450.91, Rs.3884.74, Rs.1194.56, Rs.1054.56 and 1.09 respectively for Kole area.

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Production function analysis done separately for the two areas revealed that contribution of independent variables namely machine labour, human labour and fertiliser towards gross income was found to be significant and positive for both the areas. The estimated percentage increase in gross income with one per cent increase in these three inputs came to 0.12 per cent, 0.46 per cent and 0.39 per cent respectively for

Kuttanad area. For Kole area, the corresponding values are 0.09 per cent, 0.51 per cent and 0.28 per cent respectively.

The sum of the elasticities of production function for Kuttanad and Kole were 0.9748 and 0.8936 respectively, and indicated diminishing returns to scale.

Marginal value productivity to factor-cost ratios showed that a rupee invested in the three inputs, viz., machine labour, human labour and fertiliser will add Rs.5.25, Rs.1.47 and Rs.2.33 respectively in Kuttanad and Rs.2.78, Rs.1.42 and Rs.1.42 respectively for Kole area, if the farmer has unlimited amount of money.

Under limited resource conditions, optimum levels of inputs such as machine labour, human labour and fertiliser were worked out for both the areas. For Kuttanad to achieve maximum production, the expenditure on machine labour, and fertiliser should be enhanced from the existing level whereas the expenditure on human labour should be reduced. In the case of Kole area, the expenditure on machine labour should be enhanced while the same on human labour should be reduced.

The analysis also showed that by re-allocating the existing resources farmers could increase their income by 16.61 pr cent at the aggregate level in Kuttanad.

Marketing analysis revealed that the marketed surplus amounted for 69.17 per cent of the total produce in Kuttanad and 67.89 per cent of the total produce in Kole area. For the sample as a whole marketed surplus accounted for 68.92 per cent of the total produce. The quantity given as wages came to 18.06 per cent and 14.89 per cent of the total produce in Kuttanad and Kole areas respectively. Around 10.28 and 14.93 per cent of the total produce was used for farm household consumption in Kuttanad and Kole areas. The quantity used for seed purpose was 2.49 and 2.29 per cent of the total produce in Kuttanad and Kole areas respectively.

Multiple regression analysis to estimate the factors determining the marketed surplus for the sample as a whole revealed that productivity is the only significant variable.

Non-availability of labour and their increased costs, weed infestation and incidence of pests and diseases were perceived by the farmers as the important constraints to rice production in both the areas. Salinity and acidity followed by the problem of submergence formed the fifth and sixth major constraints in Kuttanad. In Kole submergence formed the fifth constraint followed by the problem of acidity and salinity.