DETERMINANTS AND IMPACT OF MODERN TECHNOLOGY ADOPTION IN AGRICULTURE – A CASE STUDY OF TRICHUR DISTRICT

By

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CERTIFICATE

*Certified that this written account on "**Determinants and Impact of Modern Technology Adoption in Agriculture-A case study of Trichur District**" is a bonafide record of research work done by Smt. Vimla M. Under my supervision. This thesis has not been submitted earlier for any other degree or diploma.*

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DECLARATION

*I, Vimala. M., do hereby declare that this written account entitled **"Determinants and Impact of Modern Technology Adoption in Agriculture - a case study of Trichur District"** is a bonafide record of research work done by me under the guidance of Dr. U.T. Damayanti, Reader in Economics, University of Calicut.*

I also declare that the thesis has not been submitted by me fully or partly for the award of any degree, diploma, title or recognition before.

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CHAPTER - 1

INTRODUCTION

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CHAPTER - I

INTRODUCTION

Technological changes are one of the most significant forces which have altered the structure of the agricultural production process. In the developing countries, the physical and value productivity of farm resources are changing continuously due to the adoption of modern innovations. With the introduction of new techniques of production, production functions have shifted upwards. Increased efficiency of resources has contributed to the social and economic development of the developing economies.

Technological transformations have helped to reduce the marginal cost of output. This change can occur either by the employment of the existing input but in different composition or by introducing new factors of production either by replacing the old ones or simply through additional inputs. Technological change in either case is associated with shift in the production functions representing the technical relations between input and output. Thus "technological change can be broadly defined as a change in the parameters of a production function resulting directly from the use of new knowledge." [1]

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1. Stout T.T. & Rutten.V.W., "Regional Patterns of Tecnological change in American Agriculture", American Journal of Farm Economics, Vol.XL, No.2, May 1958, pp 196-207.

Technological change in agriculture can be classified broadly as labour - augmenting changes and land-augmenting changes. The former refer to those which increase the marginal physical productivity of labour by the introduction of machines in farm operations and the latter consist of introduction of new or improved inputs which increase the marginal yield of cultivated areas. The adoption of these changes is not uniform at the farm level. It is a complex process which is governed by many socio-economic factors related with the adopters. Thus it refers to a change in practices with the adoption of improved farming technique and innovation over traditional farming. The essential ingredients of such techniques include use of improved variety of seeds, fertilisers, assured irrigation water, pesticides and improved implements. Mechanisation of agriculture is another technological revolution in the field of agriculture.

India has made considerable progress in the development of agriculture since the beginning of the era of five year plans. Between 1950-51 and 1992-93, the gross cropped area increased by 40.5 percent and gross irrigated area went up by 193 percent. Significant development took place from the fifth plan onwards in the agricultural sector because of the new strategy called "Green Revolution". In countries like India, the first feature of agricultural supply planning was postulated as a realistic estimate of land as a binding constraint. Alternative methods which introduce land as a binding constraint in an agricultural plan were advocated. Since the new technology on account of the photo-insensitive high yielding variety seeds permitted shorter duration crops, this factor permitted further increases in cropping intensity.

It is probably correct to argue that Indian agriculture is now moving on a growth path over 3 percent compound growth rate per annum in foodgrains.[2] Area growth is now less than one third percent of the planned level. Therefore almost the entire growth of output is explained by expansion of yield which had resulted by the adoption of new strategies in farming activities. The area covered under HYVs of foodgrain seeds has increased from 1.9 million hectares in 1966-67 to 75 million hectares in 1995-96. Also the consumption of ingredient factors like fertilisers, pesticides, insecticides, machineries etc. has increased over this period. Thus total foodgrain production has rose from 50.8 million tonnes in 1950-51 to 185 million tonnes in 1995-96, showing an increase of 270 percent during the period.

In Kerala Economy, primary sector had registered either very low growth rates or negative growth rates during the last three decades. As a result of the structural changes that had taken place in the economy, relative share of this

2. Economic Survey, 1996-97.

sector began to decline. With a period of thirty years from 1960-61 to 1990-91 relative share of primary sector in net domestic product of the state declined from 55 percent to 29 percent. Agricultural crop production which is the most important single activity accounts for nearly 94.31 percent of the SDP generated within the primary sector.

Agricultural sector of the state economy had passed through three stages in terms of growth rates. During the first phase (1960-61 to 1975-76) agricultural production, area and productivity indices increased at the annual compound growth rates of 2.9 percent, 2.3 percent and 0.6 percent respectively. The second phase (1975-76 to 1985-86) is usually termed as the period of 'agricultural stagnation' because the annual compound growth rates in agricultural production, area and productivity were found to be -2.4 percent, -1.5 percent and -0.9 percent respectively. During the third phase (1985-86 to 1995-96) total cultivated area and agricultural productivity have shown positive growth rates.

With respect to the foodcrops, Rice has a significant role in the state agricultural economy since it accounts for more than 98 percent of the total foodgrain production. But the per capita daily availability of domestic rice in Kerala has been declined from 162 gms in 1961 to 97.15 gms in 1991. During the past two decades, the gap between internal production and requirement of rice in the state has been widening. At present more than 75 percent of the State's rice requirements are met through imports by private traders and through central allotments.

Several agricultural development programmes have been designed by the state Government during the last three decades. Most of them were for the development of paddy sector with a view to increasing the area under paddy and to augment its productivity by the adoption of modern strategies in farming practices. Intensive Agricultural development programme (IADP) of 1960-61, Intensive Paddy Development Programme of 1971-72, Group Farming Programme of 1989-90, Irrigated Programme for Rice Development of 1994-95 were meant for the development of paddy cultivation in the state. Inspite of the execution of these programmes, paddy sector of the state has been showing declining trends in area and production since seventies.

1.1 Importance of the Study

The new strategy adopted in mid-sixties has played an important role in the growth of foodgrain production in the Indian economy. But in the state economy, foodgrain production showed a marked negative growth rate due to the drastic decline in the area under rice since 1975-76. But the productivity of rice has been considerably increased during 1965-66 to 1990-91 (i.e. from 1243 Kg/Ha to 1942 Kg/Ha).

So it can be argued that the increase in productivity was the result of adoption of HYVs and other modern inputs.

The area under cash crops and plantations, particularly under coconut and rubber has been registering rapid growth against the sharp decline in rice area. So within the land constraint, agricultural growth must come primarily from more productive utilisation of the existing land area. This is possible only by the indigenous use of modern inputs and adoption of new farm practices. Thus the questions which naturally arise at this point are "whether the farmers have used a right composition of the complementary inputs with HYV seeds to utilise effectively the potentials of the new technology ?" and "if not, what are the factors that have been resticting farmers from doing so?". No such deep attempts have been made regarding these questions in state agriculture. So, to fill this gap in the agricultural research, an attempt is made to get an overall picture of the level of adoption of modern strategies in state agriculture. The intensity of adoption of modern farm practices and the problems faced by the farmers in the adoption of new methods have been analysed by taking a sample from Trichur District. The analysis is concentrated on the most important food crop 'paddy' and cash crop 'coconut'.

1.2 Objectives of the Study

The specific objectives of the present study are :

1. To discuss the extent and magnitude of HYV technology

that has been adopted in agriculture.

2. To measure the intensity of adoption of various improved farm practices and their combinations based on sample.

3. To analyse the impact of socio-economic factors on the level of technological adoption.

4. To examine the impact of modern technology on Resource-Use Efficiency.

1.3 Data & Methodology

1.3.1 Data

The present study is based on both primary and secondary data. Primary data is collected from Trichur District for the normal year extending from June 1997 to May 1998 using a specially prepared questionnaire which is given in Appendix (4). Detailed procedure of sample selection has been given in Section 4.2 and related organogram is presented in Appenxix (2). Also geographical map of Trichur District is given in Appendix (1).

Secondary data has been used to get an overall view of the magnitude and extent of HYV technology in agriculture. Main sources of secondary data are various issues of 'Statistics for Planning', 'Economic Review' (both published by Government of Kerala), Fertiliser Statistics (Ministry of Agriculture, New Delhi), Economic Survey (Government of India) etc. More secondary information has been collected from other publicatons like journals, Data Base and Statistical Compendium.

1.3.2 Concepts and Definitions

It is necessary to discuss briefly the concepts and definitions of the terms used in the study.

(i) HYV Technology :

We define 'HYV Technology' as one which uses high yielding varieties of seeds along with other inputs like fertilisers, irrigation, insecticides and machineries.

(ii) Adoption

Adoption means acceptance of a single improved practice or a package of such practices.

(iii) Gross Output

'Gross Output' includes the output from the crops including their by-products.

(iv) Bio-Chemical Inputs :

Bio-chemical inputs consist of seeds, fertilisers & Manures, irrigation and insecticides. The value of these inputs has been computed at the respective prices that prevailed in the study area during the period of survey.

1.3.3 Methodology

Various methods to measure the level of technological adoption are available in the literature. Use of these different measures depends largely on the problem of enquiry and availability of data. In the case of time series data, the level of adoption can be assessed by using logistic growth function.[1] But to make a cross-section analysis on the level of adoption, simple and complex methods can be used. In most of the studies, adoption index has been treated as the simple percentage of HYV crop area to total crop area.[2]

In this study, simple analytical tools like percentage, ratio, index and compound growth rate have been used to discuss the magnitude and extent of HYV technology in agriculture.

Adoption Index

The intensity of adoption of various improved farm practices is measured by calculating the Adopton Index (AI) of

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1. Mahadev.G.Bhat, K.C. Hiremath and H.Basavaraja, 'An Economic Enquiry in to the adoption of High Yielding Cereal Varieties in Karnataka', Prajnan, Vol.XXII, No.1, April-June 1993, pp 37-48.

2. Kalyath Mal Choudhary and Madhukar Maharaja, 'Acceptance of Improved Practices and their Diffusion among Wheat-growers in the Pali District of Rajasthan, Indian Journal of Agriculture Economics Vol.XXI, January- March 1966, No.1.

area and acceptance using the formulae,

$$\text{AI area} = \frac{\text{Area under a particular practice} \times 100}{\text{Total farm area}}$$

$$\text{AI acceptance} = \frac{\text{Number of farms under a particular practice} \times 100}{\text{Total number of farms}}$$

Linear Probability Model (LPM)

Impact of socio-economic factors on the level of adoption has been analysed using Linear Probability model. As HYV seeds are widely accepted in paddy cultivation, the present study concentrates on the socio-economic factors which determine the adoption of HYV seeds of paddy by the farmers. Since the whole paddy area possessed by a farmer is cultivated either by high yielding variety or by local variety, we assign the values 1 or 0 for the adoption level of HYV. Thus the level of adopton is treated as a qualitative variable in the LP model.

Models which express the dichotomous Yi as a linear function of the explanatory variables Xi, are called linear prbability models (LPM). The conditional expectation of the model can be interpretted as the conditional probability of Yi. The stochastic form of LPM used in the study is :

$$Y_i = b_0 + b_1 X_{1i} + b_2 X_{2i} + b_3 X_{3i} + b_4 X_{4i} + b_5 X_{5i} + U_i .$$

Where

Y_i = 1 if the farmer adopts HYV

0 if the farmer doesn't adopt HYV.

X_{1i} = Educational status of ith farmer which is quantified by giving scores ranging from 1 to 5. (Illiterate - 1, Primary - 2, High School - 3, Under Graduate - 4, Graduate and above 5.)

X_{2i} = age of ith farmer which is also quantified by giving scores ranging from 1 to 5. (Below 30 years = 1, 30-40 years = 2, 40-50 years = 3, 50-60 years = 4, above 60 years = 5).

X_{3i} = Size of ith farm in acres.

X_{4i} = Percapita income of ith farm family.

X_{5i} = Net Income from paddy per acre.

U_i = Random disturbance term.

b_o = Intercept term.

Although ordinary Least Square (OLS) does not require the disturbances (Ui) to be normally distributed, we assume them to be so distributed for the purpose of statistical inference. But the assumption of normality for Ui is no longer tenable for the LPMs because like Yi, Ui takes on only two values.

But the nonfulfillment of the normality assumption may not be so critical as it appears because we know that the OLS point estimates still remain unbiased. Furthermore, as sample size increases indefinitely, it can be shown that the OLS estimators tend to be normally distributed generally. Therefore, in large samples the statistical inference of the LPM will follow the usual OLS procedure under the normality assumption.

Another problem related to the LPM is 'heteroscedastic variance of the disturbance'. Since the variance of Ui depends on the expected value of Y conditional upon the X value, one way of resolving the hetcroscedasticity problem is to transform the data by dividing both sides of the model by the square root of Wi where Wi = $\hat{Y}_i$ (1 - $\hat{Y}_i$).

Using the estimated Wi, we can transform the model as :

$$\frac{Y_i}{\sqrt{W_i}} = \frac{b_0}{\sqrt{W_i}} + b_1 \frac{X_{1i}}{\sqrt{W_i}} + b_2 \frac{X_{2i}}{\sqrt{W_i}} + b_3 \frac{X_{3i}}{\sqrt{W_i}} + b_4 \frac{X_{4i}}{\sqrt{W_i}} + b_5 \frac{X_{5i}}{\sqrt{W_i}} + \frac{U_i}{\sqrt{W_i}}$$

The disturbance term will now be homoscedastic, Ordinary Least Square can be run on the function thus transformed.

Cobb-Douglas Production Function

Among the various types of production functions that could be fitted to agricultural production data, the Cobb-Douglas function has the advantage that it also serves to provide information regarding economies of scale in farming operation. Therefore, this type of function which is linear in logarithms has been fitted to the data under consideration in this study. The general form which this function takes is, $Y = A X_1^{b_1} X_2^{b_2} \cdots\cdots X_n^{bn}$, the value of the constant (A) and the coefficients (b_i) in respect of independent variables have been estimated by using the method of least squares. The regression coefficients (bi) in respect of independent variables in the function represent elasticities and these help to estimate the marginal productivity of each resource on the farm.

The form of the function used in the study is :

$$Y = A X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4}$$

Where

Y = Gross value of output in Rupees.

X_1 = Human Labour in Mandays.

X_2 = Land area in Acres.

X_3 = Value of biochemical inputs in Rupees.

X_4 = Rental value of machineries.

From the regression analysis, the marginal value product of each input has been estimated. It is a measure of the efficiency of inputs used in production. The Marginal Value Product of each input factor, land, labour, biochemical inputs and machineries have been calculated by the following expression :

$$MVP_{xi} = \frac{\text{Estimated value of } Y \text{ by keeping } X_i \text{ at their Geometric Mean}}{\text{Geometric Mean of } X_i} \times b_i$$

Where b_i = Elasticity of output with respect to X_i.

The Marginal Value Product (MVP) derived in this manner can be compared with the Marginal Cost (MC) of the respective inputs to determine the profitability of additional investment.

1.4 Limitations of the Study

The present study depends upon both primary and secondary data and it faces different types of data problems. Recent data on certain factors were not available from secondary sources. The reliable secondary data may sometimes be insufficient to establish the problem under consideration.

Primary data also suffers from its usual drawbacks. In our sample, since Mathilakam Block has little paddy cultivation, we could trace only 85 percentage of cultivators under this crop. As the generalisation is made on the basis of the collected sample data for the year 1997-98, the results may sometimes deviate from the real facts.

1.5 Plan of the Study

The present study is an attempt to analyse the impact of modern technology adoption in agriculture. This study is divided into Seven Chapters.

The thesis opens with an introductory Chapter which mainly includes importance of the study, objectives, data and methodology. Second Chapter reviews the related literature.

Chapter Three discusses the technological transformation in agriculture since mid-sixties, based on secondary data on technological components. Chapter four deals with socio-economic profile of the study area and sample households. Sample design and profile of farmers have been discussed in this Chapter.

In the Fifth Chapter we analyse the adoption level of technological inputs based on primary data. Influence of socio-economic factors on the adoption level has also been analysed.

Next Chapter examines the impact of modern technology on Resource Use Efficiency. The following Chapter concludes with the Summary of findings and recommendations.

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REVIEW OF LITERATURE

Vimala. M "Determinants and impact of modern technology adoption in agriculture -A case study of Trichur district " Thesis. Department of Economics, Dr. John Matthai Centre , University of Calicut, 1999

CHAPTER - 2

REVIEW OF LITERATURE

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CHAPTER - 2

REVIEW OF LITERATURE

Both in the developed and developing countries of the world, a large number of researches have been conducted in the field of diffusion of agricultural innovations. These studies have analysed the problem from different viewpoints such as social, economic, psychological, cultural, ecological, agricultural and purely technological. A review of some of the major studies is necessary to formulate and project the problem of the present study in its wider theoretical perspective.

2.1 Review of Foreign Studies

Most of the studies done on diffusion of agricultural innovations relate to USA, Africa, China, Japan, Malaysia and Nepal. These studies focussed on various determinants of technological adoption in agriculture.

One of the studies which made significant contribution to the adoption research was made by C.M. Coughenour (1960).[1] He has built an empirical model on the proposition that the adoption of improved practices is a function of contact with information sources. The relationship of the farmers' personal and social characteristics to this basic casual linkage has been examined for 285 farm operators

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1. C.M. Coughenour, "The Functioning of Farmers' Characteristics in Relation to contact with Media and Practice Adoption", Rural Socio, Vol.25, 1960, pp 283-297.

in Washington. The study revealed that the exposure to media make large number of adopters of practices.

V.R. Eidman, G.W.Dean and H.O. Carter (1967)[2] have attempted to analyse the risk involved in the adoption of modern techniques in Turkish agriculture. They suggested that "Risk may play an important role in farmers' decision making about adoption of new technology." L.D. Hiebert (1974)[3] in his article "Risk, Learning and the Adoption of Fertiliser Responsive Seed Varieties" has observed a fact that farmers' risk perception depends in part on their knowledge and experience.

T.Kakko (1978)[4] has made an important decomposition analysis of derived demand for factor inputs in Japan Agriculture. He arrived at a conclusion that labour-saving technological change enabled more farm labour to migrate to non-farm sector and thus the technical change bias in agriculture has important effects on an economy.

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2. V.R.Eidman, G.W.Dean and H.O. Carter, "An Application of Statistical Decision Theory to Commercial Turkey Production" Journal of Farm Economics, Vol.49, No.4, 1967, pp 852-868.

3. L.D.Hiebert, "Risk, Learning and the Adoption of Fertiliser Responsive Seed Varieties", American Journal of Agricultural Economics, Vol.56, No.4, 1974, pp 764-768.

4. T.Kakko, "Decomposition Analysis of Derived Demand for Factor Imputs : the Case of Rice Production in Japan", American Journal of Agricultural Economics, Vol.60, 1978, pp 628-635.

Gershon Feder (1979)[5] has presented an analysis by introducing random elements in several components of the pest-pesticide-crop system. According to him, the increased effectiveness of the pesticide may be achieved either by obtaining information as to the proper way of its applicaton, or by buying an improved variety of the chemical.

Nicholas Lardy (1980)[6] has attempted to make a study about the development in Chinese Agriculture. The ill advised agriculture production planning imposed in the years prior to 1978 depressed the growth of agricultural output in China. He also observed that due to the inadequate supplies of water, labour, fertiliser and other inputs, the productivity has fallen even in the highly productive tripple-cropping regions.

J.H. Lee (1983)[7] has presented a paper on empirical method of measuring technological change biases in many factor production with an application to postwar Japanese Agriculture. He concluded

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5. Gershon Feder, "Pesticides, Information and Pest Management under Uncertainty", American Journal of Agricultural Economics, Vol.61, No.1, 1979.

6. Nicholas Lardy, "Chinese Agriculture : Development, Production and Trade Diffusion", American Journal of Agricultural Economics, Vol.62, No.2, 1980, pp 356-358.

7. J.H.Lee, "The Measurement and Sources of Technological Change Biases, with an application to postwar Japanese Agriculture", Economica, Vol.50, No.198, 1983.

that agricultural policy to support invention, activities and farm land mobility is required to make the structure of farm technology adjust at once to the requirement of the economy.

J.R.Anderson and K.B. Hamal (1983)[8] have attempted to examine the impact of risk and risk aversion on the adoption of credit for the purpose of assisting small farmers to adopt technologies. They observed that many farmers, especially those with small holdings do not take up loans linked to new methods because of higher risks perceived in new farm practices.

Gershon Feder and Roger Slade (1984)[9] have designed a dynamic model of diffusion of new technology involving a variable input. The model generated a number of hypotheses regarding the likely pattern of adoption and use of variable inputs over time by farmers of differing holdings, different access to information and different human capital endowments. Results showed that during the initial phases of diffusion, larger farmers are likely to allocate more resources to the acquision of information and therefore possess higher levels of cumulative information at any given period.

M.Antle and Ali.S.Aitah (1986)[10] have made a pioneering

8. J.R. Anderson and K.B. Hamal, "Risk and Rice Technology in Nepal", Indian Journal of Agricultural Economics, Vol.38, No.2, 1983, pp 217-221.

9. Feder Gershon and Roger Slade, "The Acquisition of Information and the Adoption of New Technology", American Journal of Agricultural Economics, Vol.66, No.3, 1984, pp. 312-320.

10 Antle M.John & Aitah S.Ali, "Egypt's Multi-product Agricultural Technology and Agricultural Policy", The Journal of Development Studies, Vol.22,No.4,1986, pp 709-723.

study of Egypt's multiproduct agricultural technology and agricultural policy. The study based on the hypothesis that Egyptian farmers maximise economic profits. The elasticity estimates indicated a generally high degree of price responsiveness.

Peter J. Matlon and Dunstan S. Spencer (1994) [11] have surveyed the evolving technical and social conditions of African agriculture and evaluated the current stock of technological innovations. They concluded that, with the exception of relatively limited high potential zones, the set of new technologies most often inappropriate, poorly responding to farmers' changing needs and couldn't bring about a sustainable response in aggregate supply.

The technological achievements of the Malaysian Agriculture have provided a partial solution to the labour problems. Mohd. Ghazali and Bin Mohayidin (1996) [12] have analysed the relationship between paddy land size and economics of size. The conclusion was that the paddy production in Malaysia experienced returns to scale. They suggested that group farming and paddy mini estates should be encouraged so that efficiency in large scale operations can be also be exploited.

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11. Matlon J.Peter and Spencer.S. Dunstan, "Increasing Food Production in Sub Saharian Africa : Environmental Problems and Inadequate Technological Solution", American Journal of Agricultural Economics, Vol.66, No.5, 1994, pp 671-675.

12. Mohd.Ghazali & Bin Mohayidin, "Economics of size in Paddy Farming in Kerala Muda District of Malaysia", The Asian Economic Review, Vol38, No.2, 1996, pp 287-296.

2.2 Review of Indian Studies

In India, a large number of programmes of agricultural development has been launched since independence. Much efforts have been taken to introduce new ideas, techniques and tools to farmers so that through such methods the output may be increased. The process of agricultural modernisation has been slow and beset with many problems. Social scientists, agricultural scientists and planners have undertaken many serious intensive studies of the problem.

Radhukar (1962)[13] has attempted to explore the relationship of selected personal and social characteristics of farmers to the adoption of improved farm practices. The auther found that none of the socio-economic characteristics of the farmers except the level of education are significantly related to the adoption of improved farm practices.

S.P.Bose (1964)[14] has tried to study the diffusion of a farm practice in Indian Villages. He observed that a new practice introduced in a village is not accepted straightway, but considerable time lapses before all or even a majority accept any new practice. Also the rate of acceptance is not even.

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13. W.B.Radhukar, "Farmers' Characteristics Associated with the Adoption and Diffusion of Improved Farm Practices", Indian Journal of Agricultural Economics, Vol.17, 1962, pp 83-84.

14. S.P.Bose, "The Diffusion of a Farm Practice in Indian Villages", Rural Socio, Vol.29, 1964, pp 53-66.

V.G.Panse and D.Singh (1966)[15] have done a work to promote and assess technological change in Indian agriculture with special reference to the contribution of the Institute of Agricultural Research Statistics. He reached at two general conclusions - one is that the farmers with larger holdings who can more readily adopt technological change which then steeps down gradually to farmers with smaller holdings. The second is that independently of the size of holding, farmers who accept one improved practice also accept similar other practices more readily than farmers not employing any improved practice.

Chenna Reddy (1967)[16] in his paper "Production efficiency in South Indian Agriculture" filled Cobb-Douglas function to study the production efficiency. He suggested that rapid and mass development in India would be achieved only by breaking through the traditional mental process of the cultivator and introducing modern technology consisting of new inputs, agricultural education, special skills and techniques and competent guidance in farm planning.

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15. V.G.Panse and D.Singh, "Promotion and Assessment of Technological Change in Indian Agriculture", Indian Journal of Agricultural Economics, Vol.21, No.1, 1966, pp 121-131.

16. V.Channa Reddy, "Production efficiency in South Indian Agriculture", Journal of Farm Economics, Vol.49, No.4, 1967, pp 816-820.

S.P.Dhondyal (1968)[17] has designed a study to provide a look at changes in the level of farm input, output and farm earnings resulting from the use of high yielding crop as an important input factor. The indication was that the 'demonstration effects' of the programme of HYVs in terms of benefit-cost ratio for individual crops would induce the farmers under study to put more area under improved crops.

Kerala Planning Board (1969)[18] has made an attempt to study the tractor use and its impact on the farm economy of Kerala. The analysis showed that the tractors provided the biggest incentive to pursue agricultural operation. Also, the cost of cultivation reduced and farm productivity and income raised substantially with the introduction of tractors.

In an attempt to study the income disparities due to the new technology of agriculture, Shah and Singh (1970)[19] have mentioned that with the technological changes the reutrn per hectare was much higher on large farms than that on small ones.

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17. S.P.Dhondyal, "Cost and effectiveness of Modern Technology on Farm Production and Farm Income", Indian Journal of Agricultural Economics, Vol.23, No.2, 1968, pp 58-62.

18. "A Study on Tractor use and its Impact on the Farm Economy of Kerala", Kerala Planning Board, 1969.

19. S.L.Shah and L.R. Singh, "Increasing Income Disparities due to the New Technology of Agriculture in North West U.P.", Indian Journal cf Agricultural Economics, Vol.25, 1970, P. 129.

They observed that as the medium and large farms move to the economic optima, the magnitude of income inequalities is likely to increase.

Sharma (1973)[20] has analysed the pattern of savings and investments in Punjab. He found out that the small holders gave high priority for increasing the intensity of cropping and better water management to increase the output. On the medium holdings, the emphasis shifted to the purchase and improvement of lands and on large holdings, investment in farm machinery accounted for a large proportion of farm investment.

C.H.Hanumanta Rao (1975)[21] in his book 'Technological Change and Distribution of Gains in Indian Agriculture' has discussed the emerging pattern of income distribution in the process of agricultural growth in India during the period of technological changes, such as the use of HYV of seeds, tractorisation etc. The study reveals that technological changes have contributed to the widening of income disparities between (i) different regions, (ii) small and large farms and (iii) land owners on the one hand and tenants and agricultural labourers on the other. In absolute terms, the gains from technoloical change have been shared by all sections.

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20. M.R. Sharma, "Summaries of Group Discussion on Income, Saving and Investment in Agriculture", Subject I, Rapporteur Indian Journal of Agricultural Economics, Vol.28, No.1, 1973, P.24.

21. C.H.Hanumantha Rao, "Technological Change and Distribution of Gains in Indian Agriculture", MacMillan Co.Ltd., Delhi, 1975.

Bureau of Economics and Statistics (1976)[22] has made a study about the extent and productivity of high yielding varieties of paddy in Kerala. The study revealed that with the introduction of superior strains of paddy, the overall yield rate had gone upto 1575 Kg per hectare in 1972-73 which was 1400 Kg per hectare in 1964-65. The percentage of HYV plots receiving phosphatic and potassic fertilisers were generally much higher than those growing local varieties.

In an analysis Biplab Dasgupta (1977)[23] has suggested that an important feature of the new technology is that it makes the farmer increasingly dependent on the market for the supply of inputs like new seeds, chemicals, fertilisers, pesticides, herbicides and hired labour for harvesting, sowing and other operations.

According to Theodor Bergmann (1978)[24] the use of tractors pumpsets and and other machanised equipments has contributed to the increased agricultural production in developing countries.

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22. "Extent and Productivity of HYVs of Paddy in Kerala", Bureau of Economics and Statistics, 1976.

23. Biplab Das Gupta, "Agrarian Change and the New Technology in India", UNRISD Publication, Geneva 1977.

24. Theodor Bergmann, "Mechanisation of Indian Farming", Popular Prakashan Limited, Bombay 1978.

Tractors and Motors have helped to multiply human effort and and replaced weak draught animals. He stressed that tractor is not only a new source of energy, but a catalyst of change in agrarian and social structure.

N.Mohammed and A. Majeed (1979)[25] in their study have analysed the impact of socio-economic factors on technological change and spatial diffusion of agricultural innovations in a district of eastern U.P. They have found significant and positive relationship of selected social factors viz. education, training, value orientation, caste and age with the process of adoption. The study has revealed that the extent of adoption of innovation by farmers has positive and significant relationships with economic factors viz., size of holding, tenurial status, irrigation, yield, credit and input.

P.G.K. Panikar (1981)[26] has presented a paper on the study of HYVs of rice in Kerala. He conducted a survey in Palghat and Kuttanad areas to examine the socio-economic factors underlying the adoption of HYVs. A major finding of the survey was that the yield rate of HYVs was far less than the expected yield rate because of the attack of pests and rising prices of fertilisers.

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25. N.Mohammad and A. Majid, "Socio-Economic Factors and Diffusion of Agricultural Innovations", in A.Mohammad (ed), "Dynamics of Agricultural Development in India", Concept Publishing Company, Delhi 1979, pp 151-174.

26. P.G.K.Panikar, "HYVs of Rice - A Study of selected areas in Kerala", Working Paper No.140, CDS, Trivandrum, 1981.

The study concluded that the rice economy in the study region was caught in a paradox of modernisation without commensurate improvement in net returns.

The specific object of the study made by C.K. Joshi and M.R. Alshi (1985) [27] was to evaluate the impact of HYVs on female labour employment by size-groups of holdings in a district in Maharashtra. The results showed that the adoption of HYV cotton and jowar increased the requirement of casually hired family labour to a large extent, implying that an increase in the employment opportunities for female labour seeking agricultural wage employment.

C.S. Murthy (1987), [28] in his attempt to study the impact of technological change on the extent of tenancy, has proposed two hypotheses for further study : (i) Technical progress need not have a depressing effect on tenancy and (ii) presence of the pure tenant class paves the way for increased exploitative hold of the landlords.

The paper presented by B.A. Khan and S.A. Alam (1988) [29] proposed to examine the effect of technological change in

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27. C.K. Joshi and M.R. Alshi, "Impact of HYVs on Employment Potential of Female Labour - A Study in Akola District in Maharashtra", Indian Journal of Agricultural Economics, Vol.50, No.3, 1985, pp 230-234.

28. C.S.Murthy, "Impact of Technological Change on the extent on tenancy and on composition of tenants - A Case Study in two delta villages", Indian Journal of Agricultural Economics, Vol.42, No.3, 1987.

29. B.A. Khan and S.A. Alam, "Impact of technological change on size Productivity Relationship and Resource Use Efficiency in Kashmir Agriculture", Agricultural Situation in India, Vol.53, No.4, 1988, pp 301-307.

agriculture on productivity, pattern of labour utilisation and returns to various input factors at different sized farms in a selected area of J & K State. In order to determine the efficiency of factor proportions within each category, Cobb-Douglas production function has been used for its theoretical properties and empirical fitness.

The results evolved from the study made by M.S. Bhatt and S.N. Alam (1989)[30] showed that the new farm technology is size neutral. The complementarity of raising farm income and reducing farm income inequality suggested the application of new farm technology, particularly land augmenting technology.

Under dryland conditions, the agricultural machinery and implements have played a vital role in Rajasthan in increasing productivity of land, labour and animals. The study made by Pratab Singh and Satish Verma (1992)[31] throws light into this fact.

The attempt made by V. Ratna Reddy (1993)[32] has revealed that the inverse relationship between farm size and land

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30. M.S. Bhatt and S.N. Alam, "Impact of New Agricultural Strategy on Farm Income Distribution in Anantnag District of J & K", Agricultural Situation in India, Vol.54, No.1, 1989.

31. Pratap Singh and Satish Verma, "Status and Scope of Agricultural Mechanisation in Rajasthan", Agricultural Situation in India, Vol.57, No.2, 1992, pp 97-104.

32. V.Ratna Reddy, New Technology in Agriculture and Changing Size-productivity Relationships - A Study of Andhra Pradesh" Indian Journal of Agricultural Economics, Vol.58, No.4, 1993, pp 633-647.

productivity has weakened with advent of new technology. The use of non-labour inputs like material inputs and tractor was expected to be higher on large farms.

Y.L. Das (1995)[33] has analysed the agrarian scene of the sone command area of Aurangabad District. On the basis of the analysis, he concluded that the sample villages of sone command area have been fastly moving towards modern agriculture. Transformation has been from labour intensive to capital intensive.

According to Jairath and Brijesh (1996),[34] capital formation in agriculture is a pre-requisite for the growth of agriculture and is vital for sustained growth of the sector in order to meet the increasing demands. They suggested that the declining growth of gross fixed capital formation in agriculture, particularly declining private capital formation needs to be arrested.

State Planning Board's[35] evaluation studies on HYVs of paddy has examined the spread of HYVs in different parts of the state, the performance of HYV, vis-a-vis the local varieties in

33. Y.L.Das, "Agrarian Scene of Sone Command Area - A Study of Aurangabad District", Indian Journal of Agricultural Economics, Vol.5, No.1, 1995.

34. M.S. Jairath and Brijesh.C.Purohit, "Trends in Capital Formation in Agriculture - A Case Study of Arid India", Indian Journal of Agriculture Economics, Vol.51, No.4, 1996, pp 587-595.

35. "HYVs Programme in Kerala, Virippu, Mundakan and Punja Paddy 1973-74 - An evaluation Report" - State Planning Board, 1976.

terms of their input-output relationships and cost structure, cultivator's reactions and the problems of implementation of the programme at different levels of administration. An important conclusion that emerges from the studies was that the cost of cultivation of HYVs is 30 percent higher than the cost of cultivation of traditional varieties.

Muraleedharan [36] has analysed the resource use efficiency in rice cultivation in Trichur District using data from the sample survey. The analysis at aggregate and individual farm levels showed that inputs such as human labour, bullock labour, fertilisers and manures were not efficiently used in the study area.

P.G.K.Panikar [37] has studied about the environmental factors in production and productivity of rice in Kerala. According to him, the most crucial factor which affects the yield rate of rice is the availability of water. He concluded by stating that Kerala has failed to fully exploit its abundant water resources.

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36. P.K. Muraleedharan, "Resource use efficiency in rice cultivation in low lying lands in Kerala" in P.P.Pillai (ed), Agriculture Development in Kerala.

37. P.G.K. Panikar, "Environmental factors in Production and Productivity of Rice in Kerala, CDS Working Paper No.15, September 1973.

P.P.Pillai[38] has examined the contributions of irrigation, fertilisers, pesticides, HYV seeds and modern implements in improving farm productivity in Kerala agriculture. According to his analysis, role of irrigation and HYV coverage in the state in improving paddy productivity is doubtful. Also the study reveals that eventhough at the aggregate level the link between agricultural productivity and fertiliser use has been very weak during the sixties and the seventies, increase in paddy productivity recorded since the early eighties in Kerala can be partly attributed to the increase in fertiliser consumption.

C.J.Joseph[39] has tried to examine the economic aspects of minor irrigation in Kerala on the basis of a field survey conducted at Piravam Village. He arrived at a conclusion that minor irrigation has helped paddy farmer's in the state to intensify cropping, increase the application of modern inputs and thereby to improve productivity.

Many writers have attempted o identify the important price and non-price factors responsible for the low level of absolute and relative profitability of paddy cultivation in Kerala and

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38. P.P. Pillai, "Kerala Economy", Institute of Planning and Applied Economic Research, John Mathai Foundation, Aranattukara, Thrissur, pp 59-101, 1994.

39. C.J. Joseph, "Economics of Minor Irrigation in Kerala - A Case Study", unpublished Ph.D. Thesis, 1984, Calicut University.

other matters that induce farmers to shift their paddy growing areas for other uses. After considering the drastic decrease in area under paddy in Kerala, V. Radhakrishnan, E.K. Thomas and Jessy Thomas [40] single out falling profitability of the crop as the prime cause for this situation. According to the authors, paddy cultivation in the State can be made more profitable by reducing the cost of production, improving paddy productivity or/and subsidising paddy cultivation.

In the analysis of the changes in cropping pattern and the resultant changes in the employment situation in Kerala, C. Gopinath and C.S. Sundaresan [41] have concluded that the decliniing share of labour in agricultural sector is due to the shift of cultivating area from labour intensive to capital intensive crops.

P.M.Thomas [42] has studied the economic causes of decline of paddy cultivation in Kerala. According to the author, the most important problem involved in paddy cultivation in the study area (Kuttanad in Alappuzha District) is the shortage of farm labourers. Growing employment opportunities for the rural

40. V.Radhakrishnan et.al., "Performance of Rice Crop in Kerala" in B.A. Prakash (ed), Kerala's Economy - Performance, Problems, Perspectives, Sage Publications, New Delhi, pp 160-179, 1994.

41. C.Gopinath and C.S. Sundaresan, "Cropping Pattern Changes and Employment Effects in selected Districts of Kerala", Centre for Management Development 1990, Thiruvananthapuram.

42. P.M. Thomas, "Decline of Paddy Cultivation in Kerala - A Study of Economic Causes", Ph.D. Thesis, 1996, Calicut University.

work force in other sectors, self employment opportunities, comparatively lower wage rates and poor working conditions of farm labourers, growing aversion of younger generation to farm works are found to be some of the major causes for labour shortage in the farm sector.

Thus, a large number of studies have been made in different parts of the world on technological adoption in agriculture. In India, several studies have focused on the socio-economic factors underlying the adoption of modern techniques. Trends in the productivity of different crops on the basis of the adoption of improved practices have been assessed in many attempts. In Kerala, certain attempts have been made by the Government agencies and individual researchers to study about the extent and productivity of high yielding varieties of paddy which is the main food crop of the state. Area under paddy shows a declining trend in the State. Also, the area under HYVs of paddy has been showing a declining trend since 1980. But the productivity has not decreased with area. No such studies to examine the reasons responsible for the decrease in HYV area and production and to analyse the efficiency of production of HYV seeds compared to that of local variety seeds along with the adoption of other improved techniques have been made in Kerala so far. Hence, with a view to bridging this research gap, an intensive study is attempted here to investigate into these aspects of technological adoption.

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TECHNOLOGICAL TRANSFORMATION IN AGRICULTURE

Vimala. M "Determinants and impact of modern technology adoption in agriculture -A case study of Trichur district " Thesis. Department of Economics, Dr. John Matthai Centre , University of Calicut, 1999

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CHAPTER - 3

TECHNOLOGICAL TRANSFORMATION IN AGRICULTURE

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CHAPTER - 3

TECHNOLOGICAL TRANSFORMATION IN AGRICULTURE

Technological change is one of the most crucial factors determining the pattern and pace of agricultural growth. It refers to the changes in all the factors connected with agriculture. Earlier an agricultural economy was characterised by subsistence farming. But with the advent of modern technology agriculture has become a profitable business.

After independence, Indian agriculture was passing through a more serious crisis. The country was not self sufficient in food production. It had to depend on food imports from USA. The world level distribution of foodgrains was not certain with increase in demand for the same from other countries those suffered from the problem of food-deficit. The possibility of increasing production by making use of more land under cultivation and the maximum use of cultivable wasteland was limited. In such a situation there was no other way, but to increase productivity. The Government adopted a strategy in this direction. The new strategy was outlined in the fourth Five Year Plan introduced in 1965. Application of scientific techniques at all stages of agricultural production, selection of a few areas with assured irrigation for application of package of inputs based on improved varieties of seeds and achievement of higher production of subsidiary foodcrops through intensive production programme were the highlights of the new strategy. There was no specific mention of high yielding varieties in the fourth plan draft.

The high yielding varieties of wheat were imported from Mexico in 1964-65. Though these were adaptable to Indian conditions, their adoption was not economically profitable because of their high fertiliser requirements. Later the high yielding varieties of rice, maize, bajra and sorghum were introduced effectively from 1966-67 as a part of the new strategy.

The last thirty years witnessed major changes in Indian agriculture. Undoubtedly during this period Indian agriculture has had a number of technological advancements in the form of neo-seed based technology, technical know-how, extent of irrigation, fertiliser consumption etc. This has helped us to achieve self-sufficiency in foodgrains and improve the productivity of resources in agriculture.

3.1 Foodgrains Production and Productivity in Indian Agriculture

For assessing the performance of the Indian agricultural sector, it is necessary to discuss the production and productivity trends of foodgrains which contributes two-third of total agricultural production.

Trends in foodgrains production since 1950-51 is presented in Table 3.1 The total production of foodgrains increased from 50.8 million tonnes in 1950-51 to 155 million tonnes in the Seventh

TABLE 3.1

TRENDS IN FOODGRAINS RPODUCTION 1950-51 TO 1995-96

(Tonnes)

Crops	1950-51 (Average)	1951-56 (Average)	1956-61 (Average)	1961-66 (Average)	1966-69 (Average)	1969-74 (Average)	1974-79 (Average)	1980-85 (Average	1985-90 (Average)	1995-96
Rice	20.6	25.0	30.3	35.1	35.9	41.8	47.3	54.5	65.1	77.0
Wheat	6.4	7.9	9.7	11.1	15.5	25.4	29.8	41.2	48.3	62.1
Jowar	5.5	7.5	8.7	8.8	9.7	8.3	10.8	11.3	10.9	9.3
Bajra	2.6	3.4	3.4	3.9	4.5	6.0	5.0	6.0	5.2	5.4
Maize	1.7	2.7	3.6	4.6	5.6	6.1	6.3	7.3	7.6	9.5
Other Cereals	6.1	6.6	6.5	6.3	6.2	6.4	7.1	6.0	5.4	4.8
Pulses	8.4	10.1	11.7	11.1	10.3	10.9	11.7	11.8	12.5	12.3
Total - Foodgrains	50.8	63.2	74.0	81.0	87.8	103.0	118.1	138.1	155.0	180.4

Source : Economic Surveys 1980-81, 1988-89, 1992-93, 1997-98.

Plan (annual average). The last year of the seventh plan, 1989-90, recorded a substantial foodgrains output of 171 million tonnes. This rose further to 176.4 million tonnes in 1990-91 but fell to 168.4 million tonnes in 1991-92. However, production increased substantially to 179.5 million tonnes in 1992-93. The goodgrains production rose to 191.5 million tonnes in 1994-95 but fell to 180.4 million tonnes in 1995-96. As per the provisional estimates,[1] foodgrain production for the years 1996-97 and 1997-98 are 199.3 and 194.1 million tonnes respectively.

Table 3.2 gives yield per hectare of major Crops.

TABLE 3.2

YIELD PER HECTARE OF MAJOR CROPS (Kg per Hectare)

Crops	1950-51	1960-61	1971-72	1985-86	1995-96
Rice	668	1013	1141	1552	1797
Wheat	655	851	1380	2046	2483
Jowar	353	533	460	633	823
Bajra	288	286	452	344	577
Maize	547	926	900	1146	1595
Pulses	441	539	501	547	552
Total Foodgrains	552	710	858	1175	1491

Source : Economic Surveys 1980-81, 1997-98

This shows that over the period 1950-51 to 1995-96, yield per hectare of all foodgrains has increased by 2.9 times from

1. The Hindu - "Survey of Indian Industry", 1998.

552 Kg. per hectare in 1950-51 to 1491 Kg. per hectare in 1995-96. Most significant increase has been recorded by wheat with its yield increasing from 655 Kg per hectare in 1950-51 to as high as 2483 Kg. per hectare in 1995-96. Productivity of coarse cereals - jowar, bajra and maize has risen relatively slowly.

A comparison of productivity levels in Indian agriculture with the levels in other countries shows lower productivity in Indian agriculture. As is clear from the Table 3.3, productivity of wheat in India is about 38 percent of the productivity in

TABLE 3.3

PRODUCTIVITY OF LAND IN SOME COUNTRIES, 1995

(100 Kgs. per hectare)

Crop	Countries	Productivity
Wheat	France	65.1
	China	35.4
	USA	24.1
	India	24.8
Rice	Japan	60.1
	China	60.2
	Indonesia	43.4
	India	28.8

Source : Tata Services Ltd., Statistical Outline of India, 1997-98.

TABLE 3.4

PERCAPITA FOOD PRODUCTION (1987=100)

Countries	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Australia	99.9	100	107.6	97.2	104.6	110.5	106.2	122.3	114.8	98.4	104.7	92.6	111.7	104.9	103.1	104	100	103.3	100.1	102.6	98.3
Bangladesh	112	106.3	114.4	108.7	117.2	109	114.6	114.6	110.4	109	105.5	106.4	106.2	103.7	104.5	102.7	100	99	105.2	103.4	100.5
Bhutan	84	84.5	84.8	85.3	85.8	86.3	86.8	87.6	88.1	89.4	92.5	92.5	93.4	99.7	93.2	92.8	100	83.3	83.2	84.9	84.5
Brazil	68.8	71.3	70.9	73.5	74.1	78.6	81.8	77.3	79.3	86.5	55.8	91.4	91.2	91.6	98.2	91.8	100	101.3	103.4	98.3	97.6
China	69.7	68	71.6	70.4	70.8	69.5	68.6	74.1	78	77.9	71.6	84.7	88.9	94.4	94.9	97.6	100	100.4	102	108.8	109.3
France	85.7	84.1	90.5	90.8	85	83.9	82.7	87.6	92.9	94.8	92.8	97.9	92.9	101.8	98.9	96.2	100	98.3	96.2	98	96.4
Germany	84.8	81.4	82.7	85.9	83.1	82.3	86.2	89.6	89.3	90.6	90.1	97.5	94.9	101.6	98.2	105.6	100	105.1	103.6	104.5	NA
India	94.3	87.2	92.4	87.4	95.9	93.5	99.2	100.7	92.8	92.9	98.7	96.2	105.6	104.3	103.9	102.6	100	109.5	112.7	112.5	111.6
Indonesia	75.1	74.3	77.7	79.4	77.6	76.8	76.4	80.2	81.7	87.7	88.6	93.6	97.4	97.6	101	102	100	103.4	105.7	107.6	106.8
Japan	94.4	98.2	96	98.1	101	94.8	100.2	99.1	100.2	94.4	95.3	98.3	96.9	99.4	100.9	100.3	100	96.9	97.2	95.9	93.7
Malasia	50.8	53.4	54.9	59.6	63.7	66.1	67.1	64.4	74.3	78.2	80.4	88.4	78.6	87.1	94.9	100.1	100	106	117.3	117.2	113.5
Mexico	94.7	95.8	95	93.2	96	94.3	98.3	105.4	98.5	101.8	104.2	100.9	102.3	100.4	101.8	103.4	100	101.6	105	104	101.6
Nepal	98.1	91.6	98.2	99	100.6	96	92.1	92.6	86.3	92.8	95	84.9	99.7	97.5	96.1	91	100	113.2	111.8	111.9	112.6
Pakistan	98	96.9	97.8	99.1	97.3	101	103.9	102.6	103.7	102.4	105.8	106	102.9	101.3	100.4	103	100	103.6	108	106.8	107
Philippines	108.4	103.7	106.5	113.6	120.6	128.1	123.8	121.1	121.6	121.2	121.6	121.4	108	108	100.9	106	100	99.5	102.1	101.7	99.3
South Africa	114.1	118.4	96.2	118.9	110	106.8	11.6	111.6	110.3	110.2	122.4	106	85.7	96.2	99.7	96.8	100	100.7	103.8	95.2	95.5
Sri Lanka	102.4	102.7	95.3	102.1	101.7	101.4	98.6	104.8	112.6	117.8	115.3	111.5	120.7	111.5	118.8	115.2	100	102.4	98.8	106.2	101.9
U.K.	78.2	79.8	81.1	86.5	81.6	77.9	86.5	88.7	90.6	95.5	93.9	96.9	97.3	105	100.9	100.7	100	96.7	97.8	97.1	98.1
U.S.	94.7	92.4	93.9	94.4	101	102.8	105.8	103.4	108.2	102.7	112.8	110.5	91.6	105.6	110.8	103.8	100	92.3	101.8	104.3	102

Source : World Tables 1993, A World Bank Book, The Johns Hopkins, Uty. Press.

France. It is 70 percent (ie, less than three-fourths) of the productivity in comparison to another developing country, China. As far as rice is concerned, productivity in India is 48 percent of the productivity in China and Japan. The low levels productivity in Indian agriculture point to the possibilities of increasing productivity by adopting right strategy and intensive efforts. But on the world scenario, India has achieved a growth in the percapita food production. Table 3.4 supports this fact.

3.2 Productivity of Important Crops in Kerala Agriculture

Trends in productivity of important crops in Kerala agriculture is given in Table 3.5. The indices of yield rates worked out with 1960-61 as base are also given. The crops whose yield rates increased during first half of sixties are sugar, rubber and tea. There was a decline in the yield of rice, coconut, arecanut and pepper during this period. In seventies, moderate increase in yield was registered by rice and tea and substantial increase by sugarcane and rubber. There was an accelerating tendency in the yield of rice, coconut, arecanut, sugarcane, rubber and tea in eighties. On average, the yield of almost all major crops showed an increase during 1990-91 to 1995-96. Of these, rubber showed the most substantial increase in the yield. Looking at the whole period it is observed that there was more or less no change in the yield of coconut, moderate increase in that of pepper, fairly impressive increase in that of rice, arecanut and remarkable increase in that of sugar, tea and rubber.

TABLE 3.5
PRODUCTIVITY OF IMPORTANT CROPS IN KERALA

(Kg/Hectare)

Year	Rice	Coconut (Nuts/Ha)	Arecanut	Sugarcane	Pepper	Rubber	Tea
1960-61	1371 (100)	6430 (100)	716.5 (100)	4233 (100)	270 (100)	187 (100)	1009.8 (100)
1965-66	1243 (90.64)	5617 (87.36)	625 (87.23)	4556 (107.63)	220 (81.48)	313.3 (167.38)	1114.8 (110.40)
1970-71	1484 (108.24)	5536 (86.10)	616.3 (86.02)	4700 (111.03)	209.5 (77.59)	439.2 (234.87)	1102.7 (109.20)
1975-76	1542 (112.47)	4964 (77.20)	623.4 (87.01)	5622 (132.81)	231.5 (85.74)	623.2 (333.26)	1131.6 (112.06)
1980-81	1587 (115.75)	4558 (70.89)	868.9 (121.27)	5775 (136.43)	273.6 (101.33)	566.8 (303.10)	1500 (148.54)
1985-86	1729 (126.11)	4792 (74.53)	877.2 (122.43)	5325 (125.80)	270.5 (100.22)	578.1 (309.14)	1485.7 (147.13)
1990-91	1940 (141.50)	5240 (81.41)	1026.2 (143.22)	6786 (160.31)	277.8 (102.89)	754 (403.21)	1749.2 (173.22)
1991-92	1960 (142.96)	5240 (51.41)	1025.2 (143.08)	6754 (159.56)	284.1 (105.22)	818.5 (437.70)	1925 (190.63)
1992-93	2020 (147.34)	4970 (77.29)	1206.4 (168.37)	6908 (163.11)	270.8 (100.30)	859.4 (459.57)	1587.8. (157.24)
1993-94	1880 (137.13)	5740 (89.27)	1250.5 (174.53)	8144 (192.31)	270.6 (100.22)	921.7 (492.89)	1911.1 (189.26)
1994-95	1920 (140.04)	5890 (91.60)	1125.5 (157.08)	8468 (200.05)	258.8 (95.85)	998.9 (534.17)	1865.3 (184.72)
1995-96	2023 (147.56)	5890 (91.60)	1014 (141.52)	8070 (190.64)	314.1 (116.33)	1056.9 (565.19)	1849.5 (183.16)

(Figures in brackets are indices with 1960-61 as base)

Source : Economic Review (Various Issues), Govt. of Kerala, SPB, Thiruvananthapuram

3.3 Components of Technological Change

Dynamic changes in foodgrain production and productivity were recorded in Indian agriculture since the mid-sixties. The improvement in agricultural productivity can be traced to developments in a number of directions. The most significant was the use of high yielding varieties (HYVs) of seeds of different goodcrops. Along with the use of HYVs, increased use of irrigation water, fertilisers and manures, insecticides, fungicides and weedicides have also been responsible for raising productivity. Also improved tools and implements have been brought into use for improving agricultural production by bringing culturable wastelands under the plough. Improvements have been taken place in the methods of soil and water management and in agricultural practices like seed treatment, inter-cultivation, weeding etc. Here we discuss the role of some of the crucial components of the new farm technology in India.

3.3.1 High Yielding Varieties (HYVs)

The discovery of HYVs was the result of continuous research undertaken over decades at various research institutions in India and abroad. The most outstanding research contribution in this respect came initially from the International Centre for wheat and maize improvement in Mexico for wheat and the International Rice Research Institute in Philippines for rice. They are a part of the network of research centres established to develop new varieties of seed for various crops in different parts of the world. Similarly, many other research institutes in other countries are engaged in research specific to the soil-crop-climate complexes of different areas.

The new dwarf varieties are the result of countless crossings of local varieties which exhibit greatly differing genetic characteristics. They react favourably to increased amount of input of fertilisers. HYVs can absorb high quantities of the order of 100 pounds to 120 pounds of nutrients per acre. The new varieties are photoinsensitive and are relatively less dependent on the sunlight than the traditional ones. Also the new varieties have a shorter maturing period which facilitates double cropping and multiple cropping.

3.3.1.1 HYVs in Indian Agriculture

The evolution and introduction of HYVs of seeds has laid a pavement of new technological change for Indian agriculture. The programme of evolution of new plant materials covers most of the foodcrops such as rice, wheat, maize, jowar and bajra. The progress of HYV programme is indicated in Table 3.6. The area under HYVs of paddy, wheat, jowar, bajra and maize increased from 0.89, 0.54, 0.19, 0.06 and 0.21 million hectares in 1966-67 to 29.43, 22.09, 7.62, 6.02 and 2.94 million hectares in 1990-91 respectively. The total area under HYV crops increased from 1.89 million hectares to 68.1 million hectares over the same period.

TABLE 3.6
AREA UNDER HYVS OF PRINCIPAL FOODGRAINS IN INDIA

(Million Hectares)

Year	Rice	Wheat	Jowar	Bajra	Maize	Total
1966-67	0.89	0.54	0.19	0.06	0.213	1.89
1967-68	1.79	2.94	0.6	0.42	0.29	6.04
1968-69	2.68	4.79	0.69	0.75	0.39	9.3
1969-70	4.34	4.91	0.55	1.16	0.45	11.41
1970-71	5.59	6.48	0.8	2.05	0.47	15.39
1971-72	7.41	7.86	0.69	1.78	0.44	18.17
1972-73	8.17	10.18	0.87	2.5	0.61	22.33
1973-74	9.98	11.03	1.16	3	0.87	26.04
1974-75	11.21	11.19	1.31	2.53	1.09	27.34
1975-76	12.44	13.46	1.96	2.9	1.13	31.89
1976-77	13.34	14.52	2.37	2.27	1.06	33.56
1977-78	16.22	15.8	3.14	2.63	1.24	38.93
1978-79	16.88	15.89	3.07	2.94	1.35	40.13
1979-80	15.99	15.03	3.05	2.96	1.35	38.38
1980-81	18.24	16.1	3.5	3.64	1.6	43.09
1981-82	19.69	16.75	3.88	4.57	1.6	46.49
1982-83	18.84	17.84	4.32	4.71	1.73	47.99
1983-84	21.74	19.4	5.28	5.42	1.91	53.75
1984-85	22.78	19.09	5.08	5.17	2.03	54.14
1985-86	23.47	19.08	6.08	4.99	1.8	55.43
1986-87	24.03	19.19	5.5	5.27	2.19	56.12
1987-88	22.25	19.69	6.06	3.96	2.15	54.1
1988-89	25.41	20.18	6.11	5.87	2.55	60.12
1989-90	27.05	20.84	7.39	5.36	2.61	62.87
1990-91	29.43	22.09	7.62	6.02	2.94	64.97
1991-92	28	20.5	6.8	5.4	2.8	64.7
1992-93	27.5	21.7	6.9	5.6	2.6	65.4
1993-94	28.9	22	6.8	5.1	2.7	66.7
1994-95	31.3	23.2	7.1	5.4	3.4	71.3

Source : Indian Agriculture in Brief, 22nd edition, Directorate of Economics and Statistics, Ministry of Agriculture. Economic Survey, 1989-90, Economic Survey 1997-98.

The success of this programme has revolutionised agriculture and brought about a phenomenal and rapid increase in foodgrain production in the country. Table 3.7 shows that the growth rate of rice production rose from 2.22 percent per annum during 1967-68 - 1980-81 to 3.35 percent per annum during 1980-81 - 1995-96. During the same period, the productivity of rice also increased significantly from 1.45 to 2.82 percent per annum. On the other hand, the growth rate of wheat production declined though that of wheat productivity rose. Pulses showed regative rates of growth in production and productivity during the first half of the green revolution and then showed growth rates of 1.21 and 1.14 percent per annum in production and productivity during 1980-81 to 1995-96. This shows that the green revolution is now spreading to more crops. One can therefore agree with Hanumantha Rao that "The major inter-crop imbalances in growth, witnessed in the early years of the green revolution, are getting redressed to some extent in the recent period".[2]

Wheat crop has proved to be a big success because of the absence of problem of pests and diseases and decentralised water management system in a large part of wheat growing areas like Punjab, Haryana and Western Uttar Pradesh. Also the price support policy of the government provided the necessary incentive for the increased use of new seeds. In fact, an increase in wheat production has become an important stabilising factor in foodgrain production in the country.

2. C.H.Hanumantha Rao, "Agriculture :Policy and Performance" in Bimal Jalan (ed), The Indian Economy : Problems and Prospects (New Delhi, 1992).

TABLE 3.7

ALL INDIA COMPOUND GROWTH RATE OF PRODUCTION AND YIELD OF SOME CROPS

GREEN REVOLUTION PERIOD

CROP	1967-68 TO 1995-96		1967-68 TO 1980-81		1980-81 TO 1995-96	
	Production	Yield	Production	Yeild	Production	Yeild
Rice	2.9	2.33	2.22	1.45	3.35	2.82
Wheat	4.72	3.11	5.65	2.62	3.62	2.91
Jowar	0.64	1.95	2.04	3.22	-0.7	1.83
Bajra	0.68	1.57	-0.38	0.77	1.15	2.33
Maize	1.66	1.64	0.02	0	2.43	2.24
Total pulses	0.93	0.72	-0.4	-0.67	1.21	1.14
Total Foodgrains	2.67	2.24	2.25	1.33	2.86	2.74

Source : Govt. of India, Ministry of Agriculture, Agricultural Statistics at a Glance, 1997

TABLE 3.8
ALL INDIA AREA UNDER PADDY'('000 Hectares)

Year	HYV Area	Total Area	HYV as % of Total	Percentage change over Previous Year	
				HYV Area	Total Area
1966-67	888	35251	2.52	-	-
1967-68	1785	36437	4.90	101.01	3.36
1968-69	2681	36966	7.25	50.20	1.45
1969-70	4342	37680	11.52	61.95	1.93
1970-71	5588	37592	14.86	28.70	-0.23
1971-72	7412	37758	19.63	32.60	0.44
1972-73	8168	36688	22.26	10.20	-2.83
1973-74	9981	38286	26.07	22.20	4.36
1974-75	11208	37889	29.58	12.29	-1.04
1975-76	12443	39475	31.52	11.02	4.19
1976-77	13337	38511	34.62	7.18	-2.44
1977-78	16122	40283	40.02	20.88	4.60
1978-79	16882	40482	40.57	4.71	0.49
1979-80	15991	39414	40.57	-5.28	-2.64
1980-81	18234	40152	45.41	14.00	1.87
1981-82	19687	40708	48.36	7.97	1.38
1982-83	18842	48262	39.04	-4.29	18.56
1983-84	21736	41244	52.70	15.36	-14.54
1984-85	22778	41159	55.34	4.79	-0.21
1985-86	23473	41137	57.06	3.05	-0.05
1986-87	24026	41167	58.36	2.36	0.07
1987-88	22250	38319	58.07	-7.39	-6.92
1988-89	25407	41736	60.88	14.19	8.92
1989-90	26162	42167	62.04	2.97	1.03
1990-91	27394	42640	64.24	4.73	1.12
1991-92	27953	41640	67.13	2.04	-2.35
1992-93	28427	42090	67.54	1.70	1.08
1993-94	28900	42539	67.94	1.66	1.07

Source : H.L. Chandhok and Policy Group, India Database : The Economy, Annual Time Series Date, Vol. II.
Govt. of India, Economic Survey 1997-98

Significant progress has also been made in the cultivation of HYVs of paddy, although the development is not as fast as in the case of wheat. Table 3.8 shows all-India area under paddy since 1966-67. It is clear from this data that the percentage of HYV area of paddy to total paddy area increased from 2.52 in 1966-67 to 67.94 in 1993-94. This large thrust on HYV area is evident from the value of coefficient of variation in HYV area calculated for the same period, which is equal to 54.09 percent.

Thus, the 'miracle seeds' has played a vital role in the development of Indian agriculture.

3.3.1.2 HYVs in Kerala Agriculture

Introduction of high yielding varieties was a milestone in the development process of Kerala agriculture. Several HYVs suited to our climate and soil were introduced by Kerala Agricutural University. The adoption of HYVs in Kerala started only by 1968-69 and it was mostly confined to rice. In 1968-69, the area under HYV of rice was 14 percent of the total area under rice. Table 3.9 gives the relevant data from 1969-70 onwards. It may be seen that the area under HYV has increased from 136.13 thousand hectares in 1969-70 to 282.21 thousand hectares in 1979-80. However, the area declined since then to 174.45 thousand hectares by 1994-95. In other words, HYVs of paddy area accounted for only 15.57 percent of total area in 1969-70, increased to 35.58 percent by 1979-80. But it declined

TABLE 3.9
AREA UNDER PADDY IN KERALA('000 Hectares)

Year	HYV Area				Total Area			
	Autumn	Winter	Summer	Total	Autumn	Winter	Summer	Total
1969-70	39.84 (10.12)	49.78 (13.03)	46.51 (47.39)	136.13 (15.57)	393.75	382.17	98.14	874.06
1970-71	58.04 (14.71)	48.14 (12.60)	53.04 (54.11)	159.22 (18.20)	394.52	382.07	98.02	874.83
1971-72	68.54 (17.34)	31.88 (8.35)	67.44 (68.90)	167.86 (19.18)	395.3	381.97	97.89	875.16
1972-73	94.29 (24.06)	55.03 (14.40)	60.05 (60.28)	209.38 (23.96)	391.9	382.18	99.62	873.7
1973-74	125.29 (31.90)	57.08 (14.98)	65.90 (65.30)	284.27 (32.50)	392.77	380.98	100.93	874.68
1974-75	77.54 (19.63)	50.99 (13.25)	39.13 (38.47)	167.65 (19.02)	394.93	384.84	101.7	881.47
1975-76	98.53 (26.27)	62.17 (15.68)	98.53 (94.21)	230.1 (26.27)	375.04	396.39	104.59	876.02
1976-77	115.76 (31.82)	74.8 (19.60)	73.41 (67.42)	263.97 (30.90)	363.82	381.68	108.87	854.37
1977-78	142.23 (38.93)	89.57 (24.15)	61.6 (59.00)	293.29 (34.90)	365.11	370.86	104.4	840.37
1978-79	144.91 (41.78)	77.91 (22.53)	56.42 (52.88)	279.23 (34.94)	346.83	345.73	106.68	799.24
1979-80	142.54 (40.92)	84.57 (24.90)	55.11 (52.35)	282.21 (35.58)	348.37	339.61	105.29	793.27
1980-81	136.24 (39.01)	92.39 (26.09)	51.1 (51.97)	279.73 (34.89)	349.24	354.13	98.32	801.7
1981-82	138.94 (40.03)	73.58 (20.66)	47.18 (45.50)	259.7 (32.19)	347.08	356.07	103.7	806.85
1982-83	113.09 (33.00)	51.87 (14.72)	31.44 (37.63)	196.4 (25.23)	342.67	352.27	83.55	778.49
1983-84	101.81 (31.06)	62.06 (19.12)	48.48 (55.25)	212.54 (28.69)	327.78	324.56	87.74	740.09
1984-85	112.4 (35.28)	63.69 (23.87)	44.45 (52.32)	220.54 (32.90)	318.61	226.81	84.96	670.38
1985-86	83.78 (29.95)	40.65 (12.97)	38.85 (45.62)	163.28 (24.07)	279.7	313.42	85.16	678.28
1986-87	80.08 (27.94)	44.6 (15.01)	41.25 (51.46)	165.93 (25.00)	286.57	297.07	80.17	663.8
1987-88	54.76 (22.77)	33.76 (11.49)	31.31 (44.89)	119.74 (19.82)	240.45	293.89	69.75	604.08
1988-89	62.35 (26.74)	37.97 (13.85)	36.69 (52.24)	137.02 (23.72)	233.17	274.15	70.23	577.56
1989-90	79 (32.43)	36.91 (13.74)	39.72 (55.80)	155.63 (26.68)	243.61	268.6	71.18	583.39
1990-91	80.03 (33.90)	40.01 (15.47)	42.79 (66.02)	162.82 (29.10)	236.08	258.56	64.81	559.45
1991-92	73.3 (33.51)	49.75 (19.59)	43.29 (63.12)	166.34 (30.73)	218.77	253.98	68.58	541.33
1992-93	78.09 (35.70)	45.42 (18.61)	51.59 (69.01)	175.1 (32.57)	218.75	244.1	74.76	537.61
1993-94	73.24 (35.94)	51.19 (21.62)	47.98 (71.30)	172.42 (33.95)	203.78	236.76	67.3	507.83
1994-95	74.43 (37.48)	55.58 (23.37)	44.39 (66.48)	174.45 (34.66)	198.73	237.79	66.78	503.29
C.V.	32.36	29.84	28.45	26.5	22.05	16.92	17.14	18.84

Figures in parantheses represent percentage of HYV area to Total Area

Source : Agriculture in Brief, 23rd Edition, DES, Ministry fo Agriculture, Govt. of India, Economic Survey 1997-98.

TABLE 3.10
PRODUCTIVITY OF PADDY IN KERALA (Kg./ha)

Year	HYV				Total			
	Autumn	Winter	Summer	Total	Autumn	Winter	Summer	Total
1969-70	1548.57	1603.39	2219.99	1798.02	1324.31	1377.84	1817.79	1403.12
1970-71	1644.10	1564.57	2345.71	1853.77	1422.14	1450.15	1862.65	1483.72
1971-72	2092.04	1802.80	2374.09	2150.44	1397.04	1562.44	2070.57	1544.57
1972-73	1537.00	2035.00	2123.99	1836.25	1470.25	1594.10	1916.64	1575.32
1973-74	1825.73	1327.97	1507.80	1420.87	1541.88	1332.76	1424.15	1437.21
1974-75	1684.00	1644.31	2054.54	1758.41	1356.06	1564.79	1929.15	1513.31
1975-76	1801.88	1593.17	1435.89	1816.91	1472.69	1508.54	1729.60	1519.59
1976-77	1604.85	1824.63	1930.37	1757.65	1340.35	1539.88	1640.60	1467.74
1977-78	2024.29	1859.53	1997.37	1968.32	1382.02	1580.45	1786.80	1519.87
1978-79	2012.32	1736.68	2243.05	1982.03	1477.29	1662.77	1636.32	1578.75
1979-80	2276.84	1997.74	2142.17	2166.91	1629.58	1550.20	1952.14	1638.41
1980-81	2070.45	1896.70	1995.01	1999.28	1585.57	1548.86	1726.07	1586.58
1981-82	2076.32	1923.96	2139.33	2044.60	1604.59	1654.58	1864.23	1660.03
1982-83	2250.11	2072.92	2143.61	2186.27	1689.18	1605.87	1935.00	1677.86
1983-84	1947.11	2032.27	2187.59	2026.90	1587.81	1604.09	1901.42	1632.13
1984-85	2075.04	1921.18	2210.34	2057.88	1723.19	2023.37	1965.91	1873.42
1985-86	1876.60	2053.85	2638.08	2101.89	1651.75	1681.37	2161.58	1729.45
1986-87	1783.62	2064.50	2466.66	2028.93	1634.54	1671.75	2105.06	1708.02
1987-88	1947.64	1972.48	2402.10	2074.94	1748.19	1600.28	2035.30	1709.38
1988-89	1732.41	2023.07	2365.10	1982.39	1663.17	1724.23	2164.98	1753.17
1989-90	2014.33	2314.90	2532.60	2217.89	1964.78	1877.14	2225.28	1956.21
1990-91	2082.56	2210.62	2437.22	2207.23	1961.32	1858.94	2204.94	1942.24
1991-92	1720.96	2440.39	2462.79	2129.17	1835.79	1998.28	2204.98	1958.80
1992-93	2057.51	2350.24	2554.81	2279.96	1992.19	1953.12	2305.16	2017.97
1993-94	1849.83	2360.28	2488.49	2116.57	1954.88	1947.80	2146.02	1976.91
1994-95	1481.01	2427.56	2410.62	2019.13	1647.38	2102.20	2213.53	1937.38
CV	11.45	15.42	13.54	9.79	12.50	12.09	11.22	11.19

Source : H.L. Chandhok and The Policy Group, India Database : The Economy, Annual Time Series Data, Vol. II.
Govt. of Kerala, Economic Review 1997, SPB, Thiruvananthapuram

to 26.68 percent by 1989-90. Thus the adoption of HYVs came to a halt by the beginning of eighties. After that, it showed an accelerating trend.

When we assess the productivity of HYV paddy in the state during this period it can be seen that it has increased from 1798.02 Kg. per hectare in 1969-70 to 2019.13 Kg. per hectare in 1994-95. It is surprising to find that the productivity of paddy went up by 20.52 percentage between 1969-70 and 1979-80 (i.e. from 1798.02 Kg per hectare to 2166.91 Kg. per hectare) with an increase in area under HYV by more than 107 percent and the productivity rose again by less than 1 percent between 1980-81 and 1994-95 with a fall in the area under HYV by more than 37 percent during the same period. Table 3.10 gives the data on HYV productivity in Kerala. The variation in the total paddy productivity during the relevant period was 9.79 percent whereas the coefficient of variation in HYV area of paddy was 26.50 percent during the same period. The correlation analysis between HYV area and productivity showed a low degree of relationship (R = 0.47) between these variables.

3.3.1.3 <u>District-wise Performance of HYV</u>

Table 3.11 provides the annual compound growth rates of HYV area and productivity during three periods : 1973-74 to 1982-83, 1982-83 to 1995-96 and 1973-74 to 1995-96. During first period (1973-74 to 1982-83), the districts Kollam, Kottayam, Idukki and Palakkad showed a substantial annual growth rate in HYV area. All other districts except Ernakulam marked negative

TABLE 3.11
ANNUAL COMPOUND GROWTH RATES(Percentage) OF HYV AREA AND PRODUCTIVITY
MODEL : logY = A+Bt

Districts	1973-74 to 1982-83		1982-83 to 1995-96		1973-74 to 1995-96	
	Area	Productivity	Area	Productivity	Area	Productivity
TVM	-12.76	0.15	11.28	-0.56	2.78	1.33
KLM	13.65	1.14	-0.80	0.42	3.92	-0.41
ALP	-5.50	2.78	3.29	0.92	-0.92	1.58
KTM	36.50	4.22	-0.18	0.94	-0.39	2.28
IDK	4.47	3.08	-5.20	-0.16	-8.17	2.03
EKM	0.17	2.43	1.33	2.07	-1.17	3.63
TSR	-4.70	3.18	-0.53	1.50	-3.18	2.36
PKD	10.75	1.62	-10.67	-0.68	-9.97	-0.18
MPM	-10.74	-0.02	3.17	0.06	-2.74	0.37
KKD	-9.64	0.03	-2.59	2.20	-7.16	0.85
KNR	-4.18	1.28	0.26	-0.99	-1.98	0.22
State	0.52	3.74	-0.41	0.05	-2.38	1.37

Source : Computed from Table 3.9 and Table 3.10

growth rates. On the other hand, all districts other than Malappuram and Kozhikode showed positive growth rates in HYV productivity.

In the second period (1982-83 to 1995-96), the districts Thiruvananthapuram, Idukki, Palakkad and Kannoor marked negative growth rates in productivity. But during the third period (1973-74 to 1995-96), the annual compound growth rates computed for Kollam and Palakkad were negative whereas for all other districts, these were positive. At the same time, annual compound growth rates of HYV area in the state during second and third periods were negative whereas the productivity rates were positive in all the three periods.

3.3.2 Irrigation

The use of HYVs of crops has been extended under well controlled irrigated conditions. Assured water supply is a pre-requisite for intensive agriculture based on HYVs of seeds and high levels of fertilisation. However, the availability of irrigation facilities is highly inadequate in India. About 65 percent of India's cropped area still depends on rainfall which is concentrated in a few months of the year.

3.3.2.1 Irrigation in Indian Agriculture

The gross irrigated area in the country in 1960-61 was 27.98 million hectares, accounting for 18.32 percent of the gross sown area. From 1960-61 onwards, the gross irrigated area has increased and it was 66.14 million hectares in 1992-93. Also the share of gross irrigated area to the gross sown area has increased over the period from 1960-61 to 1992-93 which is evident from Table 3.12.

TABLE 3.12
ALL INDIA CULTIVATED AND IRRIGATED AREA

(Thousand Hectares)

Year	Area Sown		Irrigated Area		Share of Gross
	Gross	Net	Gross	Net	Irrigated Area
1960-61	152.77	133.20	27.98	24.66	18.32
1961-62	156.21	135.40	28.46	24.88	18.22
1962-63	156.76	136.34	29.45	25.66	18.79
1963-64	156.96	136.48	29.71	25.89	18.93
1964-65	159.23	138.12	30.70	26.60	19.28
1965-66	155.28	136.20	30.90	26.34	19.90
1966-67	157.35	137.23	32.68	26.91	20.77
1967-68	163.74	139.88	33.21	27.19	20.28
1968-69	159.53	137.31	35.48	29.01	22.24
1969-70	162.26	138.77	36.97	30.20	22.78
1970-71	165.79	140.78	38.19	31.10	23.04
1971-72	165.19	140.04	38.43	31.55	23.26
1972-73	162.15	137.57	39.06	31.83	24.09
1973-74	169.87	143.06	40.28	32.55	23.71
1974-75	164.19	137.79	41.74	33.71	25.42
1975-76	171.30	141.57	43.38	34.59	25.32
1976-77	167.34	139.46	43.55	35.15	26.02
1977-78	172.26	141.91	46.03	36.55	26.72
1978-79	174.76	143.01	48.31	38.06	27.64
1979-80	169.66	139.02	49.18	38.48	28.99
1980-81	173.10	140.30	49.88	38.81	28.82
1981-82	177.04	142.00	51.55	39.92	29.12
1982-83	173.34	140.79	52.12	40.72	30.07
1983-84	180.17	142.75	53.94	41.96	29.94
1984-85	176.42	140.90	54.08	41.72	30.65
1985-86	178.50	140.90	54.30	41.90	30.42
1986-87	126.40	135.60	55.80	42.60	31.63
1987-88	176.40	134.10	56.00	42.90	32.81
1988-89	182.30	141.90	61.10	46.40	33.52
1989-90	182.30	142.30	61.90	46.70	33.96
1990-91	185.90	142.30	62.50	47.80	33.62
1991-92	182.70	141.40	64.00	48.80	35.03
1992-93	185.50	142.10	66.14	50.10	35.64

Source : H.L. Chandhok and The Policy Group, India Database : The Economy, Annual Time Series Data, Vol.I.

Minor irrigation schemes have the major thrust on the irrigation potential and its utilisation. As a result of efforts made in the development of water resources for irrigation since 1950-51, the gross area irrigated increased by more than two and half times. The gross irrigation potential increased to 87.1 million hectares in 1994-95 (32.3 million hectaes from major and medium schemes and 54.8 million hectares from minor schemes) and the actual utilisation was expected to 77.9 million hectares. Table 3.13 gives the development of irrigation in India since 1950-51.

Of different sources of irrigation, wells have an important role in irrigation because major share of net irrigation area is under this source. In 1960-61, about 29.6 percent of net irrigated area has been under this category and in 1992-93 it has increased to 53 percent. At the same time, the importance of other sources like ponds, tanks etc. have been decreased during this period. Table 3.14 gives an idea about these facts.

Thus, it would be seen that the fastest development has been recorded in the case of minor irrigation for tapping ground water to provide assured irrigation. Even in respect of major and medium irrigation the progress is noteworthy. However, no noticeable progress seems to have been made for the development of tanks, ponds etc.

TABLE 3.13
DISTRIBUTION OF NET AREA IRRIGATED BY SOURCES OF IRRIGATION

(Percentage)

Year	Canals			Wells			Tanks	Others
	Govt.	Pvt.	Total	Tubewells	Others	Total		
1950-51	34.40	5.50	39.90	-	28.70	28.70	17.30	14.20
1960-61	37.20	4.90	42.10	0.60	29.60	29.60	18.50	9.80
1970-71	38.50	2.80	41.30	14.30	23.90	38.20	13.20	7.30
1975-76	37.40	2.50	39.90	19.80	21.90	41.70	11.50	6.90
1980-81	37.30	2.20	39.50	24.60	21.10	45.70	8.20	6.60
1985-86	36.60	1.20	37.80	28.20	20.60	48.80	7.20	6.20
1986-87	36.60	1.20	37.80	28.20	20.60	48.80	7.20	6.30
1987-88	34.80	1.10	35.90	30.60	20.10	50.70	6.50	6.90
1988-89	35.20	1.10	36.30	30.50	19.30	49.80	7.30	6.60
1989-90	34.80	1.10	35.90	30.40	20.50	50.80	7.00	6.30
1990-91	34.50	1.10	35.60	29.80	21.10	50.90	7.00	6.50
1991-92	33.70	1.00	34.70	30.40	21.80	52.20	6.70	6.40
1992-93	33.10	1.00	34.10	31.60	21.40	53.00	6.50	6.40

Source: Indian Agriculture in Brief, 22nd edition in 1989 and 25th edition 1994, Fertiliser Statistics 1995-96

TABLE 3.14
IRRIGATION POTENTIAL AND ITS UTILISATION

(Million Hectares)

Year	Major & Medium Schemes		Minor Schemes		All Schemes	
	Potential	Utilisation	Potential	Utilisation	Potential	Utilisation
1950-51	9.70	9.70	12.90	12.90	22.60	22.60
1980-81	27.30	22.70	31.40	31.40	58.70	54.10
1985-86	30.50	25.80	39.10	36.40	69.60	62.40
1986-87	31.20	26.40	40.70	37.70	71.90	64.10
1987-88	31.90	26.40	42.40	39.20	74.30	68.60
1989-90	29.90	25.50	46.60	43.10	76.50	68.60
1990-91	33.60	26.00	49.20	44.80	81.00	72.90
1991-92	30.70	26.30	50.40	46.50	81.10	72.80
1992-93	31.40	26.60	51.90	47.90	83.00	74.50
1993-94	31.60	27.10	53.50	49.10	84.90	76.20
1994-95	32.30	27.60	54.80	50.20	87.10	77.90

Source: Seventh Five Year Plan, 1985-90 and Economic Survey, 1996-97

3.3.2.2 Irrigation in Kerala Agriculture

As far as Kerala is concerned water resources constitute one of the most important economic assets of the state with an average annual rainfall of about 3000mm and an estimated annual yield of 74200m.cum. and served by 44 rivers and rivulets.[3] Although Kerala accounts for only 1.2 percent of the land surface of the country, her water potential amount to 5.4 percent.

Table 3.15 shows percentage of gross irrigated area to gross sown area in the state. In 1976-77, the gross irrigated area was 3728 thousand hectares which constitute about 12.71 percent of the gross sown area. The gross irrigated area increased to 505.49 thousand hectares by 1994-95, which is only 15.66 percent of gross sown area. Thus it is observed that during the period from 1976-77 to 1994-95, the gross irrigated area has increased by 36 percent.

In Kerala several sources account for total irrigation. Among them the chief sources are canals, tanks, wells and lift irrigation. Table 3.16 shows source-wise net irrigated area in Kerala.

From the Table, it can be observed that the thrust upon canal irrigation decreased by 47.61 percent over the period from 1969-70 to 1992-93. At the same time, net irrigated area under tanks and wells has increased from 77.5 thousand hectares to 114.1 thousand hectares, an increase of 47.23 percent during the period.

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3. M.V.George & N.G.Nair, "Irrigation and Agricultural Development in Kerala" in P.P. Pillai (ed), Agricultural Development in Kerala, Agricole Publishing Academy.

TABLE - 3.15

PERCENTAGE OF GROSS IRRIGATED AREA TO GROSS SOWN AREA IN KERALA

Year	Percentage
1976-77	12.71
1977-78	12.10
1978-79	13.43
1979-80	13.95
1980-81	13.20
1981-82	13.19
1982-83	13.64
1983-84	13.65
1984-85	14.72
1985-86	13.92
1986-87	14.83
1987-88	13.54
1988-89	13.71
1989-90	13.14
1990-91	12.73
1991-92	12.72
1992-93	12.37
1993-94	14.60
1994-95	15.66

Source : Govt. of Kerala, Economic Review (Various Issues), S P B, Thiruvananthapuram.

TABLE - 3.16

SOURCE-WISE NET IRRIGATED AREA IN KERALA

(Hectares)

Source	1969-70	1976-77	1979-80	1980-81	1985-86	1990-91	1992-93
Canals	203656 (64.47)	92890 (42.02)	106550 (46.18)	104696 (43.99)	100650 (33.96)	107956 (32.19)	106687 (31.90)
Tanks & Wells	77491 (24.53)	51360 (23.23)	56990 (24.70)	55970 (23.52)	81520 (27.51)	114630 (34.18)	114066 (34.10)
Lift Irrigation	5460 (1.73)	46500 (21.04)	37530 (16.26)	33702 (14.16)	30948 (10.44)	22403 (6.68)	23495 (7.02)
Other sources	29300 (9.27)	30310 (13.71)	29680 (12.86)	43606 (28.08)	83209 (28.08)	88380 (26.35)	90209 (26.97)
Total	315907 (100)	221060 (100)	230750 (100)	237974 (100)	296337 (100)	335369 (100)	334457 (100)

Note: Figures in brackets represent presentage to total.
Source : Govt. of Kerala, Economic Review (Various Issues), S P B, Thiruvananthapuram.

Data shows that tanks and wells bear major share of net irrigated area in the state in 1992-93. During seventies the net area under lift irrigation was substantial. But after that its share has decreased. However, the total net irrigated area in the state has increased marginally from 315.9 thousand hectares to 334.5 thousand hectares (5.9 percent increase) during the same period.

3.3.2.3 District-wise development of Irrigation

To examine the changes in irrigated area in different districts of Kerala, compound growth rates are computed. Table 3.17 presents district-wise growth rates about gross irrigated area during 1977-78 to 1994-95.

The districts showing growth rates higher than that of the State were Alappuzha, Kottayam and Idukki. The growth rate of gross irrigated area in Thrissur district was 0.62 percent per annum, which was lower than that for state (0.79 percent). All other districts recorded negative growth rates during this period.

Source-wise irrigated area in different districts is also analysed in this context. The extent of canal irrigation is shown in Table 3.18. The area under canal irrigation has increased on average in the districts of Thiruvananthapuram, Kollam, Kottayam Kozhikode and Malappuram over the period from 1975-76 to 1992-93. In 1992-93, more than 50 percentage share were under canal

TABLE - 3.17

DISTRICT-WISE ANNUAL COMPOUND GROWTH RATES (PERCENTAGE) OF GROSS IRRIGATED AREA (1977-78 - 1994-96)

MODEL : LOG Y = A + Bt

District		C G R
Thiruvananthapuram	-	-3.45
Kollam	-	-4.13
Alappuzha	-	2.84
Kottayam	-	7.18
Idukki	-	3.72
Ernakulam	-	-0.87
Thrissur	-	0.62
Palakkad	-	-0.28
Malappuram	-	3.20
Kozhikode	-	-4.54
Kannoor	-	-0.13
State	-	0.79

Source : Computed by the Researcher.

TABLE 3.18
DISTRICTWISE CANAL IRRIGATION IN KERALA

(Area in Hectares)

Districts	1975-76	1980-81	1990-91	1992-93
TVM	5026 (43.67)	6559 (57.71)	4625 (56.85)	3865 (55.42)
KLM	80 (0.61)	426 (17.82)	317 (19.78)	358 (25.41)
ALP	610 (2.36)	6559 (57.71)	1896 (7.15)	2130 (8.38)
KTM	3 (0.03)	133 (4.12)	3392 (46.52)	3015 (40.78)
IDK	-	147 (8.77)	639 (20.40)	591 (19.29)
EKM	16682 (45.63)	18176 (38.24)	21026 (40.02)	21042 (39.74)
TSR	21349 (56.32)	21256 (54.91)	20000 (27.52)	18910 (26.53)
PKD	39823 (78.05)	45987 (77.79)	50097 (68.66)	50242 (67.97)
MPM	74 (0.36)	1716 (8.05)	1640 (5.14)	2163 (6.74)
KKD	2086 (25.89)	4543 (52.74)	2079 (42.14)	2186 (42.58)
KNR	-	3082 (16.15)	496 (3.65)	687 (4.97)

(Figures in parantheses represent percentage to total irrigated area)

Source: Govt. of Kerala, Economic Review (Various Issues), SPB, Thiruvananthapuram

TABLE 3.19
DISTRICTWISE IRRIGATED AREA UNDER TANKS & WELLS

(Hectares)

Districts	1975-76	1980-81	1990-91	1992-93
TVM	3979 (34.58)	1390 (12.23)	1453 (17.86)	1237 (17.74)
KLM	4574 (35.02)	696 (29.28)	527 (32.88)	479 (34.00)
ALP	20718 (80.17)	1390 (12.23)	18514 (69.82)	18289 (71.92)
KTM	979 (8.66)	1548 (48.00)	811 (11.12)	878 (11.88)
IDK	301 (10.91)	320 (19.08)	229 (7.31)	248 (8.10)
EKM	6131 (16.77)	9320 (19.61)	13991 (26.63)	13145 (24.82)
TSR	5948 (16.25)	6949 (17.95)	29311 (40.33)	28779 (40.37)
PKD	3384 (6.63)	8278 (14.04)	14922 (20.45)	15723 (21.27)
MPM	7665 (39.31)	7665 (35.94)	14440 (45.28)	14242 (44.44)
KKD	1789 (22.20)	919 (10.67)	1239 (25.11)	1346 (26.43)
KNR	2233 (18.47)	4847 (25.40)	5025 (37.01)	5023 (36.35)

(Figures in parantheses represent percentage to total irrigated area)

Source: Govt. of Kerala, Economic Review (Various Issues) SPB, Thiruvananthapuram

TABLE 3.20
DISTRICTWISE LIFT IRRIGATED AREA

(Hectares)

Districts	1975-76	1980-81	1990-91	1992-93
TVM	1751 (15.22)	2122 (18.67)	672 (8.26)	624 (8.95)
KLM	2789 (21.36)	497 (20.91)	104 (6.49)	126 (8.94)
ALP	3701 (14.32)	2122 (18.67)	2572 (9.70)	2544 (10.00)
KTM	6234 (55.48)	387 (12.00)	468 (6.42)	842 (11.39)
IDK	172 (6.24)	108 (6.44)	330 (10.54)	210 (6.86)
EKM	11421 (31.24)	14292 (30.07)	8013 (15.25)	8994 (16.98)
TSR	5247 (14.33)	4620 (11.93)	4760 (6.55)	4820 (6.76)
PKD	4862 (9.53)	1407 (2.39)	1164 (1.60)	1364 (1.85)
MPM	8340 (42.77)	4012 (18.81)	2976 (9.33)	2723 (8.44)
KKD	2199 (27.29)	1733 (20.12)	760 (15.40)	676 (13.26)
KNR	7508 (62.11)	634 (3.32)	42 (0.31)	38 (0.28)

(Figures in parantheses represent percentage to total irrigated area)

Source: Govt. of Kerala, Economic Review (Various Issues) SPB, Thiruvananthapuram

TABLE 3.21
DISTRICTWISE IRRIGATED AREA UNDER OTHER SOURCES

(Hectares)

Districts	1975-76	1980-81	1990-91	1992-93
TVM	752 (8.53)	1294 (11.39)	1385 (17.03)	1248 (17.90)
KLM	5617 (43.01)	758 (31.89)	655 (40.88)	446 (31.65)
ALP	815 (3.15)	1294 (11.39)	3533 (13.32)	2466 (9.7)
KTM	4026 (35.63)	1157 (35.88)	2621 (35.94)	2658 (35.95)
IDK	2285 (82.85)	1102 (65.71)	1934 (61.75)	2014 (65.75)
EKM	2326 (6.36)	5747 (12.09)	9505 (18.09)	9773 (18.46)
TSR	4060 (11.09)	5888 (15.21)	18599 (25.59)	18781 (26.34)
PKD	2954 (5.79)	3290 (5.58)	6778 (9.29)	6586 (8.91)
MPM	3420 (17.54)	7937 (37.21)	12837 (40.25)	12933 (43.34)
KKD	1983 (24.61)	1419 (16.47)	856 (17.35)	902 (17.71)
KNR	2347 (19.42)	10521 (55.13)	8013 (59.02)	8070 (58.40)

(Figures in parantheses represent percentage to total irrigated area)

Source: Govt. of Kerala, Economic Review (Various Issues) SPB, Thiruvananthapuram

irrigation in Thiruvananthapuram and Palakkad, whereas Kollam, Kottayam, Ernakulam, Thrissur and Kozhikode accounted for more than one-fourth of total irrigated area under canal irrigation.

Table 3.19 shows the gross irrigated area under tanks and wells. The districts of Ernakulam, Thrissur, Palakkad, Malappuram Kozhikode and Kannoor recorded an increasing trend in the irrigated area under these sources. But in other districts, this has declined during 1975-76 to 1992-93. Lift irrigated area showed fluctuations in almost all districts over this period and it accounted the lowest share of total irrigated area in 1992-93. Table 3.20 presents district-wise lift-irrigated area.

Table 3.21 shows the gross irrigated area under 'Other Sources'. More than 50 percent of the area irrigated from 'Other Sources' was in Idukki though it has declined over the period. In almost all other districts, it showed an accelerating trend.

3.3.3 Fertilisers

The core factor to growth in agricultural productivity during a short period is the intensive use of inputs like fertiliser. In the new strategy, fertiliser has been assigned an important role in providing fertility to the soil and thus improving the agricultural productivity. The continuous deteriorating soil fertility on account of regular cultivation can be replenished to a great extent by resupplying nitrogen in the soil through the use of fertilisers. Thus the plant-yields can be improved by the supply of adequate nutrition in the form of fertilisers. Fertilisers can thus play an important role in providing a major break-through in agricultural production.

Though it accelerates growth in plants, continuous use of fertilisers lead to the destruction of natural quality of the soil. Also the non-proportional use of components of fertilisers is harmful to the plants. If it is used in correct proportion and in wise manner without damaging natural fertility of soil, it would be a significant and inevitabe factor in promoting growth in plants.

3.3.3.1 Consumption of Fertilisers in Indian Agriculture

Indian farmers use only one tenth of manure that is necessary to maintain the productivity of soil.[4] Accordingly, proper use of manure and fertilisers alone can considerably enhance the productivity of soil. Indian soil is deficient in nitrogen and phosphorous and this deficiency can be made good by an increased use of fertilisers. The possibilities of extensive cultivation are extremely limited because most of the cultivable area is already cultivated. So, there is no option but to spread intensive cultivation in more and more areas by using larger quantities of fertilisers. The use of fertilisers in Indian agriculture has received a boost after the initiation of the High Yielding Varieties Programme (HYVP) in 1966. It is also recognised now that multiple cropping is possible only by increasing the use of fertilisers.

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4. S.K.Misra & V.K.Puri : Indian Economy - It's Development Experience, Himalaya Publishing House, 1998 Edition.

The annual growth rate in the consumption of fertilisers since 1965-66 is indicated in Table 3.22. The total consumption of fertilisers has increased over a period of thirty years (from 1965-66 to 1995-96). The annual growth rate in the consumption was in the range of 12 percent to 40 percent during 1965-71. The pace of growth slowed down considerably during the period from 1972 to 1974 and it was -9.35 percent in 1974-75. In the following years consumption started rising and it showed positive growth rates except in 1992-93. The compound growth rate of consumption for the period 1970-1995 was computed to be 8.33 percent per annum.

Fertiliser consumption has increased along with the gross sown area during 1960-61 to 1992-93. The computed correlation coefficient between gross sown area and total fertiliser consumption was 0.94 which implies a high degree of relationship between these factors.

The ideal NPK ratio aggregated for the country as a whole was 4:2:1. But at present this norm is violated which could be seen from Table 3.23. Consumption is biased in favour of nitrogenous fertilisers whose predominant use is a consequence of the past administered pricing policy adopted for different fertilisers. Urea continues to operate under a price control system after phosphatic and potassic fertilisers were decontrolled in August 1992.

Such a massive increase in fertiliser consumption over these decades would require an effort to strengthen the production

TABLE 3.22
CONSUMPTION OF FERTILISERS - ALL INDIA

(Thousand tonnes)

Year	N_2	P_2O_5	K_2O	Total	Percentage Change in Total Over Previous Year
1960-61	211.70	53.10	29.00	293.80	-
1961-62	249.80	60.50	28.00	338.30	15.15
1962-63	333.00	82.80	36.40	452.20	33.67
1963-64	376.80	116.50	50.60	543.90	20.28
1964-65	555.20	148.70	69.30	773.20	42.16
1965-66	574.80	132.50	77.30	784.60	1.47
1966-67	737.80	248.60	114.20	1100.60	40.28
1967-68	1034.60	334.80	169.60	1539.00	39.83
1968-69	1208.60	382.10	170.00	1760.70	14.41
1969-70	1356.00	416.00	210.00	1982.00	12.57
1970-71	1479.00	541.00	236.30	2256.30	13.84
1971-72	1798.00	558.24	300.62	2656.86	17.75
1972-73	1839.01	581.31	347.55	2767.87	4.18
1973-74	1829.02	649.71	359.82	2838.55	2.55
1974-75	1765.66	471.53	336.08	2573.27	-9.35
1975-76	2148.61	466.77	278.35	2893.73	12.45
1976-77	2456.93	643.71	319.24	3419.88	18.18
1977-78	2913.01	866.58	506.23	4285.82	25.32
1978-79	3419.50	1105.95	591.49	5116.94	19.39
1979-80	3498.14	1150.85	606.44	5255.43	2.71
1980-81	3678.09	1213.55	623.93	5515.57	4.95
1981-82	4068.65	1322.32	676.18	6067.15	10.00
1982-83	4242.47	1432.67	726.31	6401.45	5.51
1983-84	5204.38	1730.28	775.42	7710.08	20.44
1984-85	5486.05	1886.42	838.49	8210.96	6.50
1985-86	5660.80	2005.21	808.06	8474.07	3.20
1986-87	5716.05	2078.85	850.00	8644.90	2.02
1987-88	5716.79	2187.07	880.48	8784.34	1.61
1988-89	6956.41	3000.59	1079.00	11036.00	25.63
1989-90	7396.02	3012.02	1163.10	11571.14	4.85
1990-91	7997.00	3221.00	1328.00	12546.00	8.42
1991-92	8046.00	3321.00	1361.00	12728.00	1.45
1992-93	8426.00	2842.00	884.00	12152.00	-4.53
1993-94	8813.00	2700.00	853.00	12366.00	1.76
1994-95	9540.00	2900.00	1124.00	13564.00	9.69

Source: Fertiliser Statistics (Various Issues), The fertiliser Assoication of India, Ministry of Agriculture, New Delhi.

TABLE 3.23

NPK CONSUMPTION RATIO

Year	N_2	P_2O_5	K_2O
1960-61	7.20	1.80	1
1970-71	6.50	2.00	1
1980-81	5.90	1.90	1
1990-91	6.00	2.40	1
1995-96	8.50	2.50	1
1996-97	8.00	2.90	1

Source: Economic Survey, 1997-98, Govt. of India and marketing infrastructure so as to make the needed type of fertiliser available to the farmer at the right place, in the right time and at the right price.

3.3.3.2 Overall Trends in Fertiliser Consumption in Kerala

In Kerala, pattern of growth of fertiliser consumption has not been steady over time. In some years growth has been spectacular, in others moderate and some years marked negative growth rates. A dis-sectional analysis of the growth of fertiliser consumption is possible with the help of Table 3.24.

From 1965-66 onwards there was an upward trend in fertiliser consumption till 1969-70. During this period absolute consumption of fertiliser nutrients increased by 1.8 times. While seventies, starting with a negative growth rate of -21.32 percent, presented wide annual fluctuations. The annual average rate of growth attained during this decade was 4.8 percent. This might be due to various factors such as high prices of fertilisers during the mid-seventies and wide fluctuations in rainfall during this period.

When we analyse the fertiliser consumption trend of 1980's, it is found that average annual rate of growth was 7.7 percent. But over a period of five years since 1990-91, all years except 1994-95 showed negative growth rates.

TABLE 3.24
CONSUMPTION OF NPK IN KERALA

(Thousand Tonnes)

Year	N_2	P_2O_5	K_2O	Total
1965-66	15.250	12.770	11.310	39.330
1966-67	21.020	13.370	11.010	45.420
1967-68	24.000	15.690	14.850	54.540
1968-69	28.570	20.440	21.510	70.530
1969-70	30.120	20.350	21.540	72.030
1970-71	26.340	14.180	16.140	56.660
1971-72	31.260	15.670	18.040	64.970
1972-73	31.480	22.310	20.470	74.270
1973-74	31.690	22.610	24.550	78.850
1974-75	32.100	17.200	18.100	67.400
1975-76	31.700	14.400	16.700	62.800
1976-77	33.500	15.700	20.100	69.300
1977-78	37.000	16.000	25.000	78.000
1978-79	46.000	23.000	31.000	100.000
1979-80	46.240	25.400	33.870	105.510
1980-81	41.700	23.400	32.500	97.600
1981-82	40.610	23.210	30.940	94.760
1982-83	45.230	26.560	38.010	109.790
1983-84	62.480	31.180	35.820	129.480
1984-85	57.670	32.640	37.350	127.650
1985-86	59.300	34.400	47.600	141.300
1986-87	60.780	35.860	54.720	151.360
1987-88	70.800	49.300	62.400	182.500
1988-89	80.240	50.880	82.810	213.930
1989-90	78.640	47.250	86.560	212.450
1990-91	93.810	55.420	95.160	244.380
1991-92	82.870	51.110	91.950	225.930
1992-93	83.900	47.250	71.790	202.970
1993-94	77.600	33.120	66.110	176.830
1994-95	81.180	39.930	78.210	206.330

Source : Govt. of Kerala, Statistics for Planning (Various Issues), DES.

3.3.3.3 Nutrient-wise Consumption of Fertilisers

Consumption of each nutrient increased significantly in absolute as well as in relative terms during 1965-66 to 1994-95. Between 1965-66 and 1994-95, nitrogen consumption recorded 5.32 times increase while phosphorous and potash attained an increase of 3.13 and 6.92 times respectively.

In order to pinpoint temporal variations in nutrient consumption it is helpful to analyse it in five-year intervals. Between 1965-66 and 1970-71, consumption of N_2, P_2O_5 and K_2O increased at an average annual rate of 19.35 percent, 18.08 percent and 12.62 percent respectively. But during 1970-71 to 1975-76, these nutrients recorded lower positive growth rates. In the successive periods, except in 90's all nutrients showed positive average growth rates. When nitrogen secured a negative growth rate of -0.99 percent between 1990-91 and 1994-95, corresponding growth rates for phosphorous and potash were 5.86 percent and -1.48 percent respectively.

Table 3.25 shows the share of each nutrient in the total consumption of fertilisers during the period from 1965-66 to 1994-95. On average, the share of nitrogen remained stagnant while phosphorous showed a declining trend. But the share of potash has increased by 32 percent. An increase in the annual rate of growth in consumption of potash during the recent years is a welcome change. Soil fertility status of Kerala shows that deficiency of potash is greater than that of nitrogen and phosphorous.[5]

5. 'Govt.of Kerala Report of the High Power Committee on Fertiliser Consumer Prices', Directorate of Agriculture.

TABLE 3.25
NUTRIENTWISE CONSUMPTION OF FERTILISERS IN KERALA

(Percentage Share of N_2, P_2O_5 and K_2O)

Year	N_2 (Share %)	P_2O_5 (Share %)	K_2O (Share %)	Total
1965-66	38.77	32.47	28.76	100
1966-67	46.28	29.44	24.28	100
1967-68	44.00	28.77	27.23	100
1968-69	40.51	28.98	30.50	100
1969-70	41.83	28.26	29.91	100
1970-71	46.49	25.03	28.49	100
1971-72	48.11	24.12	27.77	100
1972-73	42.39	30.04	27.56	100
1973-74	40.19	28.67	31.14	100
1974-75	47.63	25.52	26.85	100
1975-76	50.48	22.93	26.59	100
1976-77	48.34	22.66	29.00	100
1977-78	47.44	20.51	32.05	100
1978-79	46.00	23.00	31.00	100
1979-80	43.83	24.03	32.10	100
1980-81	42.73	23.98	33.30	100
1981-82	42.86	24.49	32.65	100
1982-83	41.20	24.19	34.62	100
1983-84	48.25	24.08	27.66	100
1984-85	45.18	25.57	29.26	100
1985-86	41.97	24.35	33.69	100
1986-87	40.16	23.69	36.15	100
1987-88	38.79	27.01	34.19	100
1988-89	37.51	23.78	38.71	100
1989-90	37.02	22.24	40.74	100
1990-91	38.39	22.68	38.94	100
1991-92	36.68	22.62	40.70	100
1992-93	41.35	23.28	35.37	100
1993-94	43.88	18.73	37.39	100
1994-95	39.34	19.35	37.91	100

Source: Govt. of Kerala, Statistics for Planning (Various Issues), DES

3.3.3.4 Consumption of Fertilisers - A District Level Analysis

An analysis of the district level data reveals that inter-district variations are significant in the absolute and relative consumpton of plant nutrients. District-wise fertiliser consumption is furnished in Table 3.26. Figures for 1974-75 show that Alappuzha district with the higher consumption of 11790 metric tonnes enjoyed the largest share of 17.5 percent of the state consumption. But from 1979-80 to 1991-92, Palakkad district stood for the higher fertiliser consumption, accounting for an average of 13.12 percent of the total fertiliser off-take. Percentage of fertiliser consumption to state consumption has decreased in the districts of Alappuzha, Thrissur, Palakkad, Malappuram and Kannoor during the period from 1974-75 to 1991-92.

Share of fertiliser nutrients in the consumption pattern of districts showed fluctuations during the period under study. From Table 3.27, it could be seen that the direction of change in the consumption of nutrients is more or less the same in all districts. While the share of nitrogen consumption has declined in all districts, there was an increasing tendency in the share of potash among the nutrients during the period. It is through this rapid shift in the consumption of nutrient share that we could reach a more ideal pattern of fertiliser consumption when compared to India.

TABLE 3.26
DISTRICTWISE FERTILISER CONSUMPTION

(Metric Tonnes)

Year	TVM	KLM	ALP	KTM	IDK	EKM	TSR	PKD	MPM	KKD	KNR	State
1974-75	3868	4090	11790	8616	1325	6566	7125	10820	4637	4251	4276	67364
	(5.74)	(6.07)	(17.50)	(12.79)	(1.97)	(9.75)	(10.58)	(16.06)	(6.88)	(6.31)	(6.35)	(100)
1978-79	6035	7321	12068	13863	5052	8770	9023	13478	6136	9742	8348	99836
	(6.04)	(7.33)	(12.09)	(13.89)	(5.06)	(8.78)	(9.04)	(13.50)	(6.15)	(9.76)	(8.36)	(100)
1979-80	6269	7550	13542	13719	6256	8734	9043	14989	6602	9927	8983	105614
	(5.94)	(7.15)	(12.82)	(12.99)	(5.92)	(8.27)	(8.58)	(14.14)	(6.25)	(9.40)	(8.51)	(100)
1980-81	55.94	7095	13694	13316	4449	8373	7923	138.03	6216	8491	8577	97531
	(5.74)	(7.27)	(14.04)	(13.65)	(4.56)	(8.58)	(8.12)	(14.15)	(6.37)	(8.71)	(8.79)	(100)
1981-82	5651	7787	11083	13364	2974	8535	8173	14599	6966	6024	7960	94761
	(5.96)	(8.22)	(11.70)	(14.10)	(3.14)	(9.01)	(8.62)	(15.41)	(7.35)	(6.36)	(8.40)	(100)
1982-83	9323	98.84	13294	12470	3762	7035	9014	15745	7106	11788	6501	109853
	(8.49)	(9.00)	(12.10)	(11.35)	(3.42)	(6.40)	(8.21)	(14.33)	(6.47)	(10.73)	(5.92)	(100)
1983-84	6528	9493	14201	19807	4226	13007	10433	20073	8389	9007	9157	129477
	(5.04)	(7.33)	(10.97)	(15.30)	(3.26)	(10.05)	(8.06)	(15.50)	(6.48)	(6.96)	(7.07)	(100)
1986-87	8037	7967	12241	17855	5431	15353	13435	19477	10686	8993	9069	151363
	(5.31)	(5.26)	(8.09)	(11.85)	(3.59)	(10.14)	(8.88)	(12.87)	(7.06)	(5.94)	(5.99)	(100)
1987-88	10574	10482	13634	29802	15022	21235	16148	24825	13617	17475	11679	213853
	(4.94)	(4.90)	(6.38)	(13.94)	(7.02)	(9.93)	(7.55)	(11.61)	(6.37)	(8.17)	(5.46)	(100)
1988-89	9670	10196	13618	34183	12246	20947	15437	22693	10851	17690	12133	203791
	(4.75)	(5.00)	(6.68)	(16.77)	(6.01)	(10.28)	(7.57)	(11.14)	(5.32)	(8.68)	(5.95)	(100)
1989-90	10420	12512	14047	36946	11605	21059	15944	24732	11241	19438	12744	212454
	(4.90)	(5.89)	(6.61)	(17.39)	(5.46)	(9.91)	(7.50)	(11.64)	(5.29)	(9.15)	(6.00)	(100)
1990-91	15415	13349	15203	38966	15715	24412	17374	29438	13864	18727	12833	244380
	(6.31)	(5.46)	(6.22)	(15.94)	(6.43)	(9.99)	(7.11)	(12.05)	(5.67)	(7.66)	(5.25)	(100)
1991-92	16223	13709	16554	43124	16941	26730	19613	30485	15021	20669	14116	267607
	(6.06)	(5.12)	(6.19)	(16.11)	(6.33)	(9.99)	(7.33)	(11.39)	(5.61)	(7.72)	(5.27)	(100)

(Figures in parantheses indicate percentage to state consumption)

Source : Govt. of Kerala, Statistics for planning (Various issues), DES

TABLE 3.27
SHARE OF CONSUMPTION OF FERTILISER NUTRIENTS IN THE DISTRICTS

Year		TVM	KLM	ALP	KTM	IDK	EKM	TSR	PKD	MPM	KKD	KNR
1974-75	N	46.59	41.54	45.73	42.78	41.06	50.21	48.69	54.32	54.60	47.47	42.73
	P	25.47	27.51	27.52	26.61	31.17	26.53	24.11	22.16	20.47	28.23	26.22
	K	29.08	30.95	26.74	30.61	27.77	23.26	27.20	23.52	24.93	24.30	31.06
1978-79	N	48.38	42.82	43.99	46.03	29.81	45.25	43.57	64.42	47.38	39.51	37.16
	P	24.03	24.78	24.05	23.58	35.53	24.06	20.41	15.75	22.78	27.45	24.01
	K	27.59	32.40	31.96	30.39	34.66	30.70	36.02	19.83	29.84	33.04	38.84
1979-80	N	45.88	40.11	44.15	40.79	31.63	41.48	43.64	62.89	44.70	37.57	35.69
	P	25.46	26.15	22.32	25.63	24.45	25.18	20.75	16.51	22.89	28.26	25.30
	K	28.66	33.75	33.53	33.58	33.92	33.34	35.62	20.61	32.41	34.17	39.01
1980-81	N	41.26	40.54	41.08	42.05	25.67	41.74	41.22	62.52	41.67	36.38	35.85
	P	25.56	27.20	22.21	25.13	34.93	26.27	21.71	16.48	23.49	26.59	25.53
	K	33.18	32.26	36.71	32.82	39.40	31.98	37.07	21.00	34.85	37.03	38.61
1981-82	N	44.13	39.10	40.83	39.44	36.25	39.71	41.58	61.46	42.10	34.45	34.59
	P	24.40	28.56	22.74	27.89	32.31	27.30	21.94	16.93	23.73	27.59	26.38
	K	31.46	32.34	36.43	32.67	31.44	32.99	36.49	21.61	34.17	37.96	39.03
1982-83	N	40.33	38.63	42.51	42.25	31.84	34.81	43.99	62.08	37.28	26.07	33.44
	P	21.67	27.86	25.58	27.55	35.75	31.53	22.82	13.26	24.19	22.67	27.52
	K	38.00	33.51	31.92	30.26	32.40	33.86	34.19	24.65	38.53	51.26	39.04
1983-84	N	43.44	42.67	46.05	52.25	35.97	46.73	46.47	63.95	42.77	46.96	40.09
	P	27.18	27.52	22.80	22.87	25.25	26.44	24.18	17.70	25.37	25.32	27.24
	K	29.38	29.81	31.15	24.88	38.78	26.83	29.35	18.36	31.86	27.71	32.67
1986-87	N	39.37	39.45	39.21	40.54	47.51	35.28	38.00	54.38	41.34	31.15	31.93
	P	26.51	24.84	19.78	26.49	26.15	23.72	19.55	19.07	23.51	24.27	23.20
	K	34.12	35.71	41.01	32.97	26.35	41.00	42.45	26.55	35.15	44.58	44.87
1987-88	N	39.74	37.08	36.68	38.02	37.75	34.21	38.17	51.95	39.08	30.94	32.19
	P	28.72	28.10	23.38	25.02	21.97	25.54	21.04	18.58	24.12	19.50	24.41
	K	33.34	34.82	39.94	36.96	40.27	40.24	40.79	29.47	36.80	49.56	43.40
1988-89	N	36.38	38.55	37.92	36.64	32.19	30.88	37.24	48.88	36.69	28.79	28.95
	P	26.18	28.86	21.19	23.96	19.48	24.92	14.05	17.57	23.11	18.55	22.02
	K	37.44	33.24	40.89	39.40	48.33	44.20	43.72	33.55	40.20	52.66	49.03
1989-90	N	39.29	50.84	39.45	35.10	31.45	34.08	36.39	48.73	39.77	27.77	31.42
	P	24.91	21.60	20.27	24.36	17.58	23.37	19.61	18.69	20.01	19.76	21.48
	K	35.80	27.50	40.28	40.54	50.97	42.55	44.00	32.58	40.22	52.47	47.10
1990-91	N	45.86	42.15	40.70	34.55	37.66	36.09	36.68	48.54	38.65	28.42	29.21
	P	28.86	29.36	23.89	21.86	15.48	22.70	20.63	18.91	21.81	17.39	24.27
	K	25.28	28.50	35.41	43.59	46.86	41.21	42.69	32.55	39.53	54.19	46.52
1991-92	N	47.66	42.82	42.01	35.31	38.27	36.06	36.33	47.54	37.71	28.10	29.94
	P	30.12	29.88	25.03	21.99	17.49	23.30	20.57	19.54	22.01	17.73	23.26
	K	22.22	27.30	32.95	42.70	44.24	40.64	43.10	32.92	40.28	54.18	46.79

Source : Govt. of Kerala, Statistics for Planning, DES

3.3.4 Mechanisation

Mechanisation is induced by the secular tendency for the biological sources of energy to become costlier as compared to mechanical sources. This is a part of labour-saving technological change and is biased with respect to the scale farm mechanisation can give the farmers greater leisure apart from making work more comfortable.

The basic essential of mechanisation consists in the use of mechanical power to drive or operate mechines. As such it means the use of power driven or operated mechines. The mechanisation is thus replacement of biological power for agricultural operations. It is when machines and mechanical power go together in farming that agriculture becomes mechanised. This revolutionises the very basis and content of agriculture. There is no doubt that fully mechanised farming operations can substantially raise agricultural production as has been the experience of developed countries. However, the course is not wholly justified in Indian conditions.

3.3.4.1 Mechanisation in Indian Agriculture

The well known factors which stand as deterrents to the introduction of mechanisation in India are small size of holdings, meagre financial resources etc. But if the efficiency of Indian agriculture is to be boosted up, application of modern technology such as introduction of mechanical power is said to be one of the essential requirements.

However, the use of certain machineries has become more popular since 1960 in Indian agriculure. It helped the farmers to adopt multiple cropping practices by avoiding the time-lag during land operating periods. Table 3.28 shows the degree of farm mechanisation of Indian agriculture over the period from 1961 to 1993. The pace of mechanisation gathered momentum as is evident from the increase in the number of oil engines with pumpsets for irrigation, tractors, operated tube wells etc. The number of electrical pumpsets has increased from 2 lakhs in 1961 to 96.20 lakhs in 1993. Similarly the number of diesel pumpsets which stood at 2.30 lakhs in 1961 has increased to 52 lakhs by 1993. The trend regarding these is evident from the table. The number of tractors has increased from 0.31 lakhs in 1961 to 17.63 lakhs in 1993. The coefficients of variation worked out for these mechanised inputs over this period (from 1961 to 1993) are also given in the Table. It shows a high variability in the number of tractors (79.51 percent) and in the electrical pumpsets (61.25 percent) though the variability in the gross cropped area is only 4.84 percent over the same period.

Regarding the consumption of power, it has increased from 5.5 KWH per thousand hectare in 1961 to 350.70 KWH per thousand hectare in 1993. The coefficient of variation of consumption of power is calculated to be 85.88. It also indicates the increased use of power driven machines in agricultural sector.

Thus Indian agriculture has experienced rapid changes in its mechanical innovations. It is undergoing transformation from traditional to more capital intensive farm technology.

TABLE 3.28
FARM MECHANISATION

(All India)

year	Gross Cropped Area(MHA)	Tractors		Oil Engines		Electrical Pumpsets (lakh Nos.)	Operated Tubewells Per lakhHA	Consumption of Power KWH/'000 Ha
		Per lakh Numbers	Per lakh Hectares	Per lakh Numbers	Per lakh Hectares			
1961	153	0.31	20	2.35	151	2.00	131	5.50
1966	155	0.54	34	4.65	295	5.13	330	12.40
1970	162	1.00	61	-	-	13.54	834	23.30
1971	166	1.43	86	-	-	16.20	977	27.00
1972	165	1.70	103	15.57	942	19.00	1150	30.30
1973	162	2.00	123	-	-	21.05	1298	36.30
1974	170	2.25	132	17.54	1032	24.26	1428	37.40
1975	164	2.50	152	-	-	26.05	1586	47.00
1976	171	2.80	163	-	-	27.34	1595	51.00
1977	167	3.15	188	-	-	30.35	1814	65.40
1978	172	3.50	203	23.50	1364	33.00	1915	68.50
1979	175	4.10	235	24.90	1425	36.00	2060	70.00
1980	170	4.73	279	26.54	1564	39.66	2331	79.50
1981	173	5.20	301	28.10	1623	43.24	2505	84.00
1982	177	5.97	337	29.80	1684	45.30	2558	87.00
1983	174	6.63	382	31.60	1822	49.75	2862	102.50
1984	181	7.40	409	33.50	1857	51.04	2823	101.00
1985	176	8.22	466	35.54	1969	57.09	3236	116.10
1986	179	8.99	503	37.70	2088	61.52	3440	131.00
1987	177	9.79	553	40.00	2222	66.57	3763	166.40
1988	177	10.70	605	42.50	2400	72.26	4082	196.70
1989	181	11.77	650	45.00	2472	78.19	4296	215.20
1990	181	13.16	727	47.00	2575	85.00	4658	241.80
1991	181	14.68	811	48.50	2680	91.00	5028	273.20
1992	182	16.19	890	50.00	2747	92.00	5055	322.60
1993	183	17.63	966	52.00	2849	96.20	5271	350.70
C.V.	4.84	79.51	76.93	45	42.97	61.25	58.37	85.88

Source : India's Agricultural Sector, A compendium of Statistics, July 1996, Economic Intelligence Service, CMIE.

3.3.4.2 Agricultural Implements in Kerala

Increased use of modern machineries in agriculture is supposed to contribute to the growth in productivity. In Kerala, mechanisation in agriculture has been slow. With the help of data obtained from livestock censuses for certain years from 1966 upto 1987, an attempt is made to understand the development in the use of agricultural implements in Kerala. Table 3.29 presents the number of agricultural implements. It could be noticed from the data that wooden ploughs have been gradually replaced by iron ploughs during the period. The number of wooden ploughs came down to 1.43 lakhs in 1987 from 4.76 lakhs in 1966, whereas the number of iron ploughs has gone upto 69 thousands in 1977 from 17 thousands in 1966 and then decreased to 40 thousands in 1987.

In the case of plant protection equipments, both hand operated and engine operated equipments have been increased in number. Hand operated equipments have increased by 2.42 times and engine operated equipments by 1.07 times during this period. Oil engines and electric pumps for irrigation have become more popular and their use widespread. From data, it is clear that electric pumpsets are more acceptable source of irrigation than oil Pumpsets. The number of electric pumpsets has increased by more than 36 times and oil engines by more than 5 times during this period.

TABLE 3.29
NUMBER OF AGRICULTURAL IMPLIMENTS IN KERALA

Year	Ploughs		Plant Protection Equipments & Dusters		Pumpsets for Irrigation		Power Tillers	Tractors	Paddy Threshers
	Wodden	Iron	hand Operated	Engine Operated	Oil	Electricity			
1966	475930	17179	-	-	6824	4869	-	418	-
1972	393714	35103	-	-	18649	9983	-	2752	-
1977	316975	69191	28582	2068	28759	25973	1211	1799	812
1982	228566	47385	62074	2058	24475	74456	3925	1335	330
1987	142482	40168	69097	2203	39286	176971	1700	1917	14

Source : Govt. of Kerla, Statistics for Planning (Various issues), DES

Recently, tractors have become more popular in ploughing the farms. A rapid increase in the number of tractors is an evident for this fact. The increase was higher during 1966-1972. The very recent development in the agricultural operations is the introduction of machineries like power tillers, paddy threshers etc. The number of power tillers has increased during 1977-82 whereas the number of paddy threshers decreased during the same period. In 1987, the number of both machineries has declined.

Though we could not assess the recent development in the use of agricultural implements due to the lack of data, by our mere observations, it could be seen that the acceptance of these machineries has been increasing now-a-days.

3.3.4.3 <u>District-wise Distribution of Agricultural Implements</u>

A district-wise analysis is necessary to get a clear picture of the use and transition of agricultural implements in the state. Table 3.30 provides the distribution of different types of agricultural machineries during 1966 to 1987 in the districts. Distribution of ploughs [(Table 3.30 (i)] showed a large decline (above 90 percent) in the number of wooden ploughs in Thiruvananthapuram, Kollam, Kottayam and Thrissur. Other districts also showed a gradual decline in the number of wooden ploughs. The total number of ploughs was higher in the initial years of the period 1966-87. In 1987, iron ploughs recorded major share in all districts as compared to the initial years.

TABLE 3.30
DISTRICTWISE DISTRIBUTION OF AGRICULTURAL IMPLIMENT AND MECHINARY

(i) Distribution of Ploughs

Districts	1996			1972			1977			1982			1987		
	Wooden	Iron	Total	Wooden	Iron	Total	Wooden	Iron	Total	Wooden	Iron	Total	Wooden	Iron	Total
TVM	20060	1222	21282	17379	3164	20543	9058	5786	14844	5462	5053	10515	3309	4949	8258
	(94.23)	(5.77)	(100)	(84.60)	(15.40)	(100)	(61.02)	(38.98)	(100)	(51.94)	(48.06)	(100)	(40.00)	(59.93)	(100)
KLM	37978	3825	41803	29462	15594	45056	19266	20519	39785	11501	13117	24618	7194	10760	17954
	(90.85)	(9.15)	(100)	(65.39)	(34.61)	(100)	(48.43)	(51.57)	(100)	(46.72)	(53.28)	(100)	(40.07)	(59.93)	(100)
ALP	18235	3329	21564	14250	5542	19792	15101	6506	21807	7385	4234	11619	3777	2412	6189
	(84.56)	(15.44)	(100)	(72.00)	(28.00)	(100)	(69.25)	(30.75)	(100)	(63.56)	(36.44)	(100)	(61.03)	(38.97)	(100)
KTM	24037	660	24697	8005	516	8521	7255	880	8135	4342	695	5037	1529	597	2126
	(97.33)	(2.67)	(100)	(93.94)	(6.06)	(100)	(89.18)	(10.82)	(100)	(86.20)	(13.80)	(100)	(71.92)	(28.08)	(100)
EKM	63879	2016	65895	51028	1482	52510	45357	6701	52058	29662	4055	33717	14237	2451	16688
	(96.94)	(3.06)	(100)	(97.18)	(2.82)	(100)	(87.13)	(12.87)	(100)	(87.97)	(12.03)	(100)	(85.31)	(14.69)	(100)
IDK	-	-	-	7156	355	7511	6114	662	6976	5523	1884	7207	2920	1083	4003
	-	-	-	(95.27)	(4.73)	(100)	(87.64)	(12.36)	(100)	(76.63)	(23.37)	(100)	(72.95)	(27.05)	(100)
TSR	49481	1711	51192	40896	2421	43317	27777	3968	31745	16080	3729	19809	7731	2499	10230
	(96.66)	(3.34)	(100)	(94.41)	(5.59)	(100)	(87.50)	(12.50)	(100)	(81.18)	(18.82)	(100)	(75.57)	(24.43)	(100)
PKD	134976	2069	137045	100750	2159	102909	71888	16711	88599	65279	4849	69928	38380	3714	42094
	(98.49)	(1.51)	(100)	(97.90)	(2.10)	(100)	(81.14)	(18.86)	(100)	(93.35)	(6.65)	(100)	(91.18)	(8.82)	(100)
MPM	-	-	-	52497	834	53331	48514	1051	49565	33225	3029	36254	21591	1685	23276
	-	-	-	(98.44)	(1.56)	(100)	(97.88)	(2.12)	(100)	(91.65)	(8.35)	(100)	(92.76)	(7.24)	(100)
KKD	72009	1433	71442	25963	1645	27608	18995	3291	22286	4952	608	5760	4292	1602	5894
	(98.05)	(1.95)	(100)	(94.04)	(5.96)	(100)	(85.23)	(14.77)	(100)	(85.97)	(14.03)	(100)	(72.82)	(27.18)	(100)
KNR	55275	914	56189	46346	1291	47637	47652	2914	50566	30354	1945	32299	3797	411	4208
	(98.37)	(1.63)	(100)	(97.29)	(2.71)	(100)	(94.24)	(5.76)	(100)	(93.98)	(6.02)	(100)	(90.23)	(9.77)	(100)
WND	-	-	-	-	-	-	-	-	-	14801	4347	19148	13833	5072	18905
	-	-	-	-	-	-	-	-	-	(77.30)	(22.70)	(100)	(73.17)	(26.83)	(100)

Source : Govt. of Kerala, Statistics for Planning (Various issues), DES

(Contd)

(ii) Plant Protection Equipments and Dusters

Districts	1972			1982			1987		
	Hand Operted	Engine Operated	Total	Hand Operted	Engine Operated	Total	Hand Operted	Engine Operated	Total
TVM	1121	95	1218	1992	37	2029	2657	50	2737
	(92.04)	(7.96)	(100)	(98.18)	(1.82)	(100)	(98.17)	(1.83)	(100)
KLM	1091	28	1119	2690	18	2708	6768	43	6811
	(97.50)	(2.50)	(100)	(99.34)	(0.66)	(100)	(99.37)	(0.63)	(100)
ALP	4816	120	4936	4053	127	4180	3656	78	3734
	(97.57)	(2.43)	(100)	(96.96)	(3.04)	(100)	(97.91)	(2.09)	(100)
KTM	4757	134	4891	5659	54	5713	2766	145	2911
	(97.26)	(2.74)	(100)	(99.05)	(0.95)	(100)	(95.02)	(4.98)	(100)
EKM	2809	150	2959	6752	158	6910	5953	131	6084
	(94.93)	(5.07)	(100)	(97.71)	(2.29)	(100)	(97.85)	(2.15)	(100)
IDK	3307	341	3648	10296	467	10763	10077	864	10941
	(90.65)	(9.35)	(100)	(95.67)	(4.34)	(100)	(92.10)	(7.90)	(100)
TSR	3226	208	3434	2922	211	3133	3622	114	3736
	(93.94)	(6.06)	(100)	(93.27)	(6.73)	(100)	(96.94)	(3.06)	(100)
PKD	1944	300	2244	4888	564	5452	4324	169	4493
	(86.63)	(13.37)	(100)	(89.64)	(10.34)	(100)	(96.24)	(3.76)	(100)
MPM	1002	96	1098	4267	135	4402	2862	179	3041
	(91.26)	(8.74)	(100)	(96.93)	(3.07)	(100)	(94.11)	(5.89)	(100)
KKD	1482	449	1931	6408	42	6450	3091	176	3267
	(76.75)	(23.23)	(100)	(99.35)	(0.65)	(100)	(94.61)	(5.39)	(100)
KNR	3027	167	3192	13449	212	13661	5023	21	5044
	(94.77)	(5.23)	(100)	(98.45)	(1.55)	(100)	(99.58)	(0.42)	(100)
WND	-	-	-	2028	33	2061	5392	132	5524
	-	-	-	(98.40)	(1.60)	(100)	(97.61)	(2.39)	(100)

Source : Govt. of Kerala, Statistics for Planning (Various issues), DES

(Contd)

(iii) Pumpsets Used for Irrigation

Districts	1966		1972		1977		1982		1987	
	Oil	Electricity	Oil	Electricity	Oil	Electricity	Oil	Electricity	Oil	Electricity
TVM	9	5	191	567	233	150	138	458	85	2389
KLM	15	32	327	207	287	289	135	922	153	5798
ALP	441	405	1468	546	2034	1205	1046	5070	1097	11217
KTM	124	258	709	255	768	409	270	2303	533	8886
EKM	646	1276	3417	3039	3976	10882	4288	25763	1168	22755
IDK	NA	NA	153	161	242	172	219	566	456	1806
TSR	1116	1940	1163	1849	3735	6971	4288	25783	2072	10292
PKD	1481	739	3861	2373	3839	3516	3198	7063	11609	12348
MPM	NA	NA	1658	366	3770	920	4959	5293	7333	65581
KKD	1122	138	906	538	966	431	198	773	4138	10598
KNR	1870	76	4796	543	8909	1028	8469	7841	1306	6372
WND	NA	NA	NA	NA	NA	NA	88	123	8095	4539

Source : Govt. of Kerala, Statistic for Planning (Various Issues), DES

(Contd)

(iv) Other Modern Machineries Used

District	1966			1972			1977			1982			1987		
	Power Tillers	Tractors	Paddy Threshers	Power Tillers	Tractors	Paddy Threshers	Power Tillers	Tractors	Paddy Threshers	Power Tillers	Tractors	Paddy Threshers	Power Tillers	Tractors	Paddy Threshers
TVM	-	7	-	-	99	-	58	51	37	30	29	11	20	14	NA
KLM	-	23	-	-	164	-	45	64	2	26	15	8	58	26	1
ALP	-	23	-	-	430	-	106	230	189	140	71	2	81	30	NA
KTM	-	61	-	-	306	-	74	111	72	285	50	2	118	30	NA
EKM	-	35	-	-	404	-	360	198	31	1589	141	24	477	207	3
IDK	-	-	-	-	306	-	109	49	47	63	85	NA	50	41	NA
TSR	-	75	-	-	292	-	150	155	66	1589	132	179	41	10	1
PKD	-	108	-	-	482	-	122	704	168	359	593	3	167	44	1
MPM	-	-	-	-	87	-	18	32	-	170	65	1	202	227	2
KKD	-	26	-	-	166	-	87	130	20	28	12	1	185	802	1
KNR	-	26	-	-	221	-	82	75	180	228	45	98	25	16	NA
WND	-	-	-	-	-	-	-	-	-	87	77	1	50	193	2

Source : Govt. of Kerala, Statistics for Planning (Various Issues), DES

(Contd)

The distribution of plant protection equipments [(Table 3.30 (ii)] and dusters showed an increase in their number during 1977-87 in most of the districts. The equipments can be classified into hand operated and engine operated. Of these two types, hand operated equipments have a major role. More than 95 percent of the total equipments is hand operated in all districts.

Table 3.30(iii) gives the distribution of pumpsets for irrigation. These are of two types - working with oil and working with electricity. In the initial years of the period 1966-1987, pumpsets working with oil were more significant and they constituted a major share of total pumpsets. But by 1982, the trend has changed and in eighties electric pumpsets placed a major share in most of the districts.

The increase in the number of tractors was more significant during 1966-1972 in all districts. The use of power tillers and paddy threshers started by 1977 in all districts. Table 3.30 (iv) reveals these facts.

3.3.5 Plant Protection Measures

Though there are certain advantages for using new varieties, they may get easily diseased due to the low resistive power. The serious problems of pests and diseases can be controlled using certain measures. In this context, the use of insecticides, pesticides and rodenticides has been effectively spread over the cropped area.

In India, it has been estimated that the monetary loss in agriculture due to weeds, diseases, insects, nematodes, storage pests, rodents and birds runs into about Rs.6,000/- crore per annum.[6] This is a massive loss and points to the need of evolving appropriate plant protection measures. The adoption of new high yielding varieties entails a high cost of cultivation and hence a cultivator cannot afford to lose his crop.

Consumption of pesticides was negligible in the early fifties. Whereas only 100 tonnes of pesticides were consumed in the agricultural sector at the beginning of the First Five Year Plan, the country used 67219 tonnes of pesticides in 1985-86. Again it has increased to 80684 tonnes in 1994-95. Thus the consumption has increased by 20 percent over the decade.

The main facets of the plant protection system currently in use are the following three - pest and disease control through Integrated Pest Management (IPM) schemes, locust surveillance and control, and plant and seed quarantine. IPM includes pest monitoring, promotion of biological control of pests, organising demonstration, training and awareness of IPM technology. As a result of the adoption of IPM, particularly in cotton, vegetables and rice, the use of pesticides has come down from 82000 tonnes during 1990-91 to 73650 tonnes during 1995-96.

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6. Y.K.Alagh, "Pesticides in Indian Agriculture", Economic and Political Weekly, September 17, 1988, p.1959.

Emphasis is now on training farmers in different aspects of I.PM technology including agro economic system analysis so that indiscriminate use of pesticides is avoided.

3.3.5.1 Consumption of Pesticides in Kerala

Table 3.31 shows the consumption of fungicides, insecticides, weedicides and rodenticides in the State from 1980-81 to 1995-96. Of these, consumption of fungicides has increased on average over this period. Compound growth rate worked out for the period from 1980-81 to 1994-95 showed an annual growth rate of 4 percent in the consumption of fungicides. The period 1988-89 to 1996-97 recorded the highest annual growth rate of 10.20 percent in its consumption. Whereas the consumption of insecticides recorded positive growth rate of 1.11 percent per annum in the period of 1980-81 to 1988-89, it marked a negative growth rate of 5.02 percent per annum during 1980-81 to 1995-96. Weedicides showed negative annual growth rate throughout the period. But the use of rodenticides has increased recently. Compound growth rate calculated for rodenticides during 1988-89 to 1995-96 supports this fact. However, State's share of pesticide consumption has declined from 1.68 percent in 1985-86 to 0.87 percent in 1994-95.

3.4 Role of State Government in Promoting Technological Progress in Agriculture

State Government has initiated different schemes in different time periods for the development of important crops,

TABLE 3.31
Consumption of Fungicides, Insecticides, Weedicides & Roderiticides

(Tonnes)

Year	Fungicides	Insecticides	Weedicides	Roderticides
1980-81	304.17	615.76	153.62	18.52
1981-82	334.96	536.83	42.27	10.9
1982-83	552.59	319.68	60.43	17.24
1983-84	335.25	679.65	17	18.05
1984-85	380.29	627.24	16.34	4.93
1985-86	490.75	466.48	21.49	5.28
1986-87	536.45	472.15	24.35	6.5
1987-88	488.81	556.54	25.73	7.92
1988-89	469.08	667.72	27.68	11.02
1989-90	445.97	547.08	23.4	12.55
1990-91	465.85	436.93	29.84	12.88
1991-92	374.46	325.24	20.46	4.09
1992-93	349.01	302.17	36.72	17.65
1993-94	264.5	297.64	20.46	21.1
1994-95	1038.99	305.67	16.63	20.12
1995-96	1001.87	249.37	12.76	18.74

Source : Govt. of Kerala, Economic Review (Various Issues), SPB, Thiruvananthapuram

especially rice which is the main foodcrop and coconut, the main cashcrop of our state.

Government has given development support for coconut production through various schemes such as Comprehensive Coconut Development Programme on area basis, Production and Distribution of quality Seedlings, Coconut Development Board Schemes for Integrated Farming in small holdings etc.

The activities supported by Comprehensive Coconut Development Programme are supply of Coconut Seedlings, supply of pumpsets and sprayers, distribution of magnesium sulphate and green manure seed, supply of climbing devices and training for farmers. The HYV seedlings of TXD are produced and distributed under the scheme of Production and Distribution of quality seedlings. Coconut Board Scheme provides financial assistance for replanting with quality seedlings in the area of diseased or senile palms and for the construction of wells, installation of pumpsets etc.

Quality coconut planting materials distributed by the Government agencies during the period from 1980-81 to 1995-96 is given in Table 3.32. It includes coconut seedlings of WCT, TxD and DxT. Among these three varieties, WCT recorded the major share of total seedlings distributed. From the Table, it could be seen that there were fluctuations in the number of total seedlings during this period. The number of total seedlings distributed was the highest (54.55 lakhs), in 1982-83 and the lowest (3.90 lakhs only) in 1992-93.

TABLE 3.32
QUALITY COCONUT PLANTING MATERIALS DISTRIBUTED

(Lakh Nos)

Year	WCT	TXD	DXT	Total
1980-81	9.27	4.931	1.18	15.38
1981-82	24.42	4.31	0.15	28.88
1982-83	27.34	24.53	2.68	54.55
1983-84	20.03	18.26	1.49	39.78
1984-85	12.69	1.28	0.08	14.05
1985-86	15.24	0.53	0.04	15.81
1986-87	17.82	0.47	0.63	18.92
1987-88	13.43	0.3	0.09	13.82
1988-89	12.64	0.64	0.14	13.42
1989-90	15.94	0.64	0.099	16.68
1990-91	16.86	0.9	0.14	17.9
1991-92	13.12	0.84	0.12	14.08
1992-93	2.81	0.79	0.3	3.9
1993-94	NA	NA	NA	10.04
1994-95	NA	NA	NA	9.87
1995-96	NA	NA	NA	19.39

Source : Govt. of Kerala, Economic Review (Various Issues), SPB, Thiruvananthapuram

TABLE 3.33
DISTRIBUTION OF HYVs OF PADDY SEEDS DISTRIBUTED FROM STATE SEED FARM AND OTHER GOVERNMENTAL AGENCIES

(Tonnes)

Year	Quantity of Seeds
1980-81	1376.42
1981-82	1785
1982-83	2010
1983-84	2190
1984-85	2315
1985-86	4810
1986-87	2691.21
1987-88	2450.22
1988-89	1980.14
1989-90	4184
1990-91	2344
1991-92	1675
1992-93	2865.74
1993-94	4500
1994-95	4598
1995-96	4200

Source : Govt. of Kerala, Economic Review (Various Issues), SPB, Thiruvananthapuram

Likewise the government has introduced certain measures for the development of rice production. The important schemes are Group Farming for Rice Production, Seed Programme through Group Farming Samithies or Service Co-operatives, Integrated Programme for Rice development and Development of Rice in areas with special problems. Through the scheme of Group Farming, the activities like community nurseries, distribution of weedicides, distribution of equipments like Sprayers, Power Tillers, Tractors, Pumpsets and Threshers etc. are supported. Seed Programme includes seed growers programme and paddy seeds distribution. The constitution of Kole lands and infrastructural works facilitating additional cropping come under the Development Scheme for rice production in areas with special problems.

Table 3.33 shows the quantity of HYV paddy seeds distributed from State Seed Farms and other Government agencies since 1980-81. The distributed quantity of seeds has increased from 1376.42 tonnes in 1980-81 to 4200 tonnes in 1995-96. This shows the progress of seed programme introduced by the government.

3.5 Conclusion

The notable increase in production and productivity of foodgrains since mid-sixties have been attained through the modern scientific farm practices. The growth of the selected indices of scientific agriculture in the country indicates the favourable movement of agricultural sector towards the modern practices.

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SAMPLE PROFILE

Vimala. M "Determinants and impact of modern technology adoption in agriculture -A case study of Trichur district " Thesis. Department of Economics, Dr. John Matthai Centre , University of Calicut, 1999

C H A P T E R - 4

SAMPLE PROFILE

4.1 PROFILE OF THRISSUR DISTRICT

4.2 DESIGN OF THE SAMPLE

4.3 PROFILE OF THE STUDY AREA

4.4 SOCIO-ECONOMIC PROFILE OF THE SAMPLE

**

CHAPTER - 4

SAMPLE PROFILE

This Chapter includes 3 Sections. The First Section deals with the Profile of Thrissur District. Sample design and profile of study area are discussed in the Second Section. The last Section describes the socio-economic profile of the sample.

4.1 Profile of Thrissur District

Thrissur is one of the Fourteen Districts of Kerala. It came into existence on 1st July 1949. It is known as the cultural capital of Kerala.

4.1.1 Location

Thrissur District lies between latitude 10° 10' x 10°46' and longitude 76° 57' x 76° 54' in the central part of Kerala and is surrounded by Arabian Sea on the West, Coimbatore District of Tamil Nadu and Palakkad District in the East, Malappuram and Palakkad Districts in the north and Ernakulam and Idukki Districts in the South.

4.1.2 Administrative Set-up

The District is divided into 5 Taluks. They are Thalappilly, Thrissur, Chavakkad, Kodungallur and Mukundapuram. The Headquarters of these taluks are at Wadakkanchery, Thrissur,

TABLE - 4.1

Taluk-wise Distribution of Blocks and Panchayats

SlNo.	Taluk	Block	No.of Panchayats	
1.	Thalappilly	Chowannur	7	22
		Pazhayannur	6	
		Wadakkancherry	9	
2.	Thrissur	Anthikad	4	24
		Cherpu	6	
		Ollukkara	7	
		Puzhakkal	7	
3.	Chavakkad	Chavakkad	7	16
		Mullassery	4	
		Thalikulam	5	
4.	Kodungallur	Kodungallur	3	8
		Mathilakam	5	
5.	Mukundapuram	Chalakudy	6	28
		Irinjalakuda	5	
		Kodakara	7	
		Mala	5	
		Vellangallur	5	
	Total Nummber of Panchayats			98

Source : Credit Plan, Canara Bank 1997.

Chavakkad, Kodungallur and Irinjalakuda respectively. These taluks are further divided into 255 revenue villages spreading over 98 Panchayats. There are 7 Municipalities - Thrissur, Chalakudy, Kodungallur, Irinjalakuda, Kunnamkulam, Chavakkad and Guruvayur. For implementing developmental schemes of the Government the District is divided into 17 NES Blocks. Taluk-wise distribution of Blocks and Panchayats are given in Table 4.1.

4.1.3 Topography

Topographically the District has three distinct regions - the highland, the midland and the lowland. All these three regions are found in Thrissur and Mukundapuram Taluks. Thalappilly Taluk consists of both the highland and midland regions while Chavakkad and Kodungallur Taluks lie in low land regions.

In highlands, the mountain ranges with thick forests, valuable trees like teak, ebony are grown. The main crops in highlands are tea, coffee and rubber. In midlands coconut, arecanut, cashew and other perennial cash crops are grown. A number of streams make the low lying area fertile.

4.1.4 water Resources

The District is situated between two longest rivers, Bharathapuzha in the north and Periyar in the south.

Chalakudy, Karuvannur and Kecheri are the main rivers of the District. Puthenthodu in Thrissur Taluk, Canoli Canal in Chavakkad taluk and Shanmukham Canal in Mukundapuram taluk are the important waterways in the district.

4.1.5 Climate and Rainfall

The climate in the district is tropic with uniform temperature throughout the year. It receives southwest monsoon from June to September and northeast monsoon from October to November. The rest six months from December to May are considered to be dry months though the pre-monsoon showers are received during April and May. The average normal rainfall is about 31.77mm.

4.1.6 Soil

The soil of the district is broadly divided into four types namely sandy, alluvial, laterite and forest soil. The soil of the coastal taluks of Kodungallur and Chavakkad vary from almost pure sand to sandy loan and are deficient in all major plant nutrients. The alluvial soil occur in the low lying areas of Thrissur and Mukundapuram taluks and is well enriched with organic matters, nitrogen and potash, but deficient in phosphorous and calcium.

Coconut is the predominant perennial crop grown in sandy belt. Seasonal crops like tapioca, banana and vegetables are grown in the midland regions, where laterite soil is abundant. In back water areas, soil is loamy type and fertile due to sedimentation.

4.1.7 Population

According to 1991 Census, Thrissur District is having a population of 27.34 lakhs, out of which 20.15 lakhs are in rural area. The rate of growth recorded during the decade 1981-91 was 12.08 percent against the State growth rate of 13.98 percent. The density of population as per 1991 census is 902 per sq.Km. as against 747 per Sq.Km. in the State.

4.1.8 Land Use Pattern in the District

The data on land use pattern is given in Table 4.2. Total geographical area of the district is 299390 hectares which forms 7.71 percent of the total area of the State. Area under forest has decreased by 21.28 percent during last two decades. But land put to non-agricultural uses has increased by 52.16 percent during the same period. Net sown area of the district in 1994-95 was 61004 hectares which formed only 6.87 percent of the net sown area of the State.

4.1.9 Agriculture

Agriculture continues to be the main economic activity of the people in the district. More than half of the income

TABLE - 4.2

Land Use Pattern in the District - 1994-95

Particulars		Area (in Hectares)
Total Geographical Area	-	299390
Forest	-	103619
Land put to non-agricultural uses	-	28527
Barren and uncultivable land	-	1937
Permanent pastures and grazing land	-	67
Land under miscellaneous tree crops	-	744
Cultivable Waste	-	3115
Fallow other than current fallow	-	2961
Current fallow	-	5579
Net area sown	-	153741
Area more than once	-	61004
Total cropped area	-	214745

Source : Credit Plan, Canara Bank 1997.

is generated from Agriculture and allied activities. Only 35 percent of the total workers are having full time employment in this important sector.

The main crops cultivated in the district are rice, coconut, arecanut, tapioca, rubber, banana, cashewnut, pepper and pulses. Area and productivity of these crops during the period from 1985-86 to 1993-94 are given in Table 4.3

The most important crop in the district is paddy. Three crops namely Virippu, Mundakan and Punja* are raised in certain areas of the district in a year. One of the striking features of the agricutural operations in the district is the 'Kole Cultivation'. Though area under rice has decreased from 95215 hectares in 1985-86 to 62144 hectares in 1994-95 (34.73%), its productivity has increased from 1595.7 Kg. per hectare to 1835.4 Kg per hectare (15.02%) during the same period.

Coconut is an important cash crop which can be considered as a dryland crop. Both the area and productivity of coconut have increased during 1985-86 - 1994-95. Arecanut and rubber also showed an increase in their area and

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* The sowing and harvesting periods of the three rice seasons in Kerala are as follows :-

	Sowing	Harvesting
Virippu (Autumn)	April - May	September - October
Mundakan (Winter)	Sept. - Oct.	December - January
Punja (Summer)	Dec. - Jan.	April - May.

TABLE 4.3

AREA (Ha) AND PRODUCTIVITY (Kg/Ha) OF IMPORTANT CROPS IN THE DISTRICT

YEAR	RICE		COCONUT		ARECANUT		PEPPER		CASHEWNUT		RUBBER		TAPIOCA		BANANA		PULSES	
	A	P	A	P(Nuts/Ha)	A	P	A	P	A	P	A	P	A	P	A	P	A	P
1985-86	95215	1595.7	60366	6112.7	6165	191.4	3739	151.4	7790	356.1	9493	675.4	5515	11829.9	5180	4727.0	2402.0	714.0
1986-87	89527	1600.6	61200	5098.0	5982	196.9	3876	252.1	7164	499.4	10048	654.9	5446	16349.9	5429	5806.2	2420.0	714.0
1987-88	84176	1554.9	69715	5393.4	6569	204.0	4481	284.5	5807	532.8	8992	847.1	4510	16740.6	5337	5666.3	1939.0	713.8
1988-89	78862	1558.3	74198	6940.9	6023	207.5	4711	121.6	6159	522.2	8784	962.1	4424	14379.5	5548	5420.2	1789.0	714.9
1989-90	74451	1674.9	77452	6830.0	5670	192.6	5472	156.6	6294	508.1	7778	1248.4	4147	16079.1	6190	5642.3	1590.0	715.1
1990-91	74038	1746.2	80856	5751.0	5670	212.3	5657	189.1	5637	548.1	6861	1603.4	3756	19030.4	6284	6750.8	1797.5	701.3
1991-92	69065	1762.4	84789	6439.5	5421	272.1	5747	166.7	5549	637.4	6753	1503.3	3360	16620.2	6087	6418.9	1058.0	715.5
1992-93	67151	1777.1	85600	7406.5	5721	244.7	5596	173.7	5793	611.4	7571	1399.0	3101	17441.5	6455	5676.7	919.0	716.0
1993-94	63508	1726.2	87118	6749.5	6582	222.7	5171	154.7	5524	382.7	12264	1030.6	3330	15440.8	6921	6057.7	598.0	715.7
1994-95	62144	1835.4	86206	7122.4	6637	298.6	4983	149.5	5039	563.8	12493	1103.8	2114	21292.2	7063	7109.3	549.0	715.8

Source : Economic Review (Various Issues) productivity during this decade.

There was a gradual decline in the area of cashewnut, tapioca and pulses in the district. But their productivity has increased over this period. Pepper showed fluctuations in its productivity though it's area has increased.

4.1.10 Irrigation

Distribution of gross irrigated area in the District under paddy and coconut is given in Table 4.4. Gross irrigated area under paddy has declined from 55840 hectares in 1986-87 to 37300 hectares in 1994-95. In other words, while it formed 18.71 percent of gross irrigated area under paddy in the state in 1986-87 it was only 13.67 percent of the same in 1994-95. At the same time gross irrigated area under coconut has increased from 28914 hectares to 48855 hectares (68.97%) during the same period.

When we compare total irrigated area to the total cropped area in the district, it has risen from 41.81 percent in 1986-87 to 53.95 percent in 1994-95. While the proportion of gross irrigated area under coconut to total area under coconut has increased from 47.25 percent to 56.67 percent, it showed a decrease from 62.37 percent to 58.73 percent in the case of paddy during the period under study.

4.1.11 Planting Materials

The centres for the distribution of planting materials in the district are Seed Farm, Mannuthy, State

TABLE - 4.4

Gross Irrigated Area in Thrissur District

(Hectares)

Year	Gross irrigated area under paddy	Gross Irrigated area under coconut	Total Irrigated area
1986-87	55840 (18.71)	28914 (35.84)	89798 (21.10)
1987-88	47967 (18.70)	31764 (34.59)	85705 (21.83)
1988-89	48367 (19.45)	35327 (33.37)	80885 (19.91)
1989-90	45174 (18.58)	29678 (28.74)	81151 (20.46)
1990-91	45227 (20.10)	31014 (29.57)	82452 (21.44)
1991-92	44825 (19.60)	29015 (27.96)	79672 (20.56)
1992-93	36508 (17.17)	31985 (30.26)	75558 (20.08)
1993-94	37534 (17.90)	41000 (27.95)	95709 (21.71)
1994-95	37300 (13.67)	48855 (28.32)	115861 (22.92)

Note : Figures in parantheses indicate percentage of the corresponding area in the State.

Source : Economic Review (Various issues).

Seed Farms situated in Kodassery, Nadavaramba, Edathuruthy, Pananchery and Pazhayannur and Coconut Nurseries situated in Wadakkanchery, Irinjalakuda and Chelakkara. The materials available from Seed Farm Mannuthy are Coconut Seedlings, rooted pepper cuttings, Fruit Plants, Clove and Nursery Seedlings, Vegetable Seeds, Pulses Seed and Paddy Seeds. State Seed Farms distribute paddy seed and coconut seedlings. Details of paddy seed production in 1994-95 by the State Seed Farms are given in Table 4.5.

4.1.12 Agricultural Machineries

Agriculture machineries are supplied through different schemes in the district. Number of different machineries distributed in the district in the years from 1991-92 to 1994-95 is given in Table 4.6.

4.1.13 Fertilisers

Farmers in the district use both organic and inorganic manures. Consumption of fertilisers in Thrissur District during 1986-91 is given in Table 4.7. Consumption of Nitrogen and Potash has decreased during this period. But consumption of Phosphorous has remained at the same level without much fluctuations.

TABLE - 4.5

Details of Paddy Seed Production - 1994-95

Sl. No.	Institution	Season	Variety	Seed Obtained (Kg.)
1.	State Seed Farm, Kodassery	Virippu	(Red Triveni,	2557
			(Jyothi	11950
		Mundakan	(Red Triveni	7340
			(Jyothi	6109
		Punja	(Jyothi	5880
2.	State Seed Farm, Edathuruthy	Virippu	(Jyothi	705
		Mundakan	(Red Triveni	17871
			(Neeraja	3017
3.	State Seed Farm, Pazhayannur.	Virippu	(Red Triveni	7417
			(Jyothi	7445
		Mundakan	(Red Triveni	16106
			(Jyothi	7911
4.	State Seed Farm, Nadavaramba	Virippu	(Red Triveni	12205
		Mundakan	(Jyothi	8050
5.	State Seed Farm, Mannuthy.	Virippu	(Jyothi	6400
			(Pavizham	250
		Mundakan	(Jyothi	1577
			(Red Triveni	200
6.	State Seed Farm, Pananchery	Virippu	(Jyothi	2300

Source : Deputy Director of Agriculture for Principal Agricultural Officer.

TABLE - 4.6

Details of Agricultural Machineries Supplied through Agriculture Department (Thrissur District)

Sl. No.	Scheme Details	1991-92	1992-93	1993-94	1994-95
1.	Group Farming				
	Power Tiller	10	21	-	-
	Tractor	46	15	-	-
	Thresher	30	10	-	-
2.	I.P.R.D.				
	Power Tiller	52	90	31	-
3.	Prime Minister's scheme				
	Power Tiller	-	112	-	-
	Thresher	-	179	-	-
4.	Special Component Plan for SC/ST.				
	Power Tiller	3	-	-	-
	Tractor	-	1	1	-
	Thresher	-	-	2	-
5.	Agro Service Centre - Supply of Tractors, Tillers and other farm machineries at subsidised rate.				
	Power Tiller	4	-	-	-
	Tractor	-	3	2	-
6.	Distribution of improved Agricultural implements.				
	Power Tiller	-	11	-	-
	Thresher	-	5	-	-
7.	Promotion of Agricultural Machanisation - Supply of Tractors upto 18 HP.				
	Tractor	-	2	-	-
8.	Small Farm Machanisation				
	Tractor	-	-	1	15
	Power Tiller	-	-	21	14
	Thresher	-	-	54	10
	Winnover	-	-	-	2

Source : Agriculure Department.

TABLE - 4.7

Consumption of Fertilisers in Thrissur District

(Metric Tonnes)

Fertilisers	1986-87	1987-88	1988-89	1989-90	1990-91
Nitrogen	3849.91	3292.70	3068.00	3119.00	2808.29
Phosphorous	1513.90	1551.80	1544.50	1487.00	1519.76
Potash	3011.71	2976.10	2847.00	2366.00	2452.67

Source : Agriculture Department.

4.2 Design of the Sample

The present study is restricted to Thrissur District which consists of five taluks. One block from each taluk is selected based on the information that the main crops cultivated in these blocks are paddy and coconut. The selected blocks are Mala, Chavakkad, Mathilakam, Puzhakkal and Wadakkanchery. Then two Panchayats from each block have been selected and thus the study is confined to 10 Panchayats. Finally, 10 farm households from each panchayat are drawn randomly to constitute a total of 100 farm households. Thus a multistage random sampling method has been adopted in the present study.

Out of 100 households selected, only 85 households are cultivating paddy while all of them have coconut cultivation. To state specifically, in Mathilakam Block, the coconut cultivators outnumber the paddy cultivators due to the peculiar nature of the soil. So we could find only 5 paddy cultivators instead of 20 from this block.

4.3 Profile of the Study Area

4.3.1 Mala Block

Mala block lies in Mukundapuram taluk which consists of 14 villages and 5 panchayats. Geographical area of this block is 126.71 Sq.Kms. which forms 4.18 percent of the area of the district. According to 1991 Census total population in this block is 133734. Administrative details of the block is presented in Table 4.8. Out of 5 panchayats, Annamanada and Mala Panchayats are selected for the study.

4.3.1.1 Mala Grama Panchayat

(a) General Features

Mala Grama Panchayat includes Kuruvittissery, Vadama-North and Annallur Villages. Total geographical area under this Panchayat is 28.35 Sq.Kms. which forms 22.37 percent of the Block area. This Panchayat is bounded by Aloor Panchayat in the north, Annamanada Panchayat, Chalakudy Municipality and Kadukutty Panchayat in the east, Kuzhur Poyya Panchayats in the south and Puthenchira Panchayat in the west. There are 12 wards in this Panchayat. Total population of the Panchayat is 30787 which consists of 47.73 percent male and 52.27 percent female.

(b) Agriculture

Paddy and coconut are the main crops cultivated in the Panchayat. Arecanut, Banana, Mangotree and Cashew are also cultivated as intercrops.

Area under coconut is the largest (1755 hectares) and the second place goes to the paddy crop which constitutes 1212 hectares. Three crops of paddy - Virippu, Mundakan and Punja are cultivated in this Panchayat and area under these crops bear 40.43 percent, 43.89 percent and 15.68 percent respectively.

Agricultural implements and planting materials are distributed through Krishi Bhavan for the development of these crops. The distibuted implements include Pumpset, Rocker Sprayer, Climbing device etc. The seedlings of coconut, fruit trees,clove and cinnamon are also distributed.

Chalakudy Puzha is the only irrigation source of the Panchayat and the deficiency of irrigaton facilities is one of the reasons for the decline in the area under cultivation.

4.3.1.2. Annamanada Grama Panchayat

(a) General Features :

Annamanada Panchayat lies in the south-east region Mala Block with 11 wards. Alathur and Kallur-Thekkumuri are the vilages in the Panchayat. Total geographical area of tne Panchayat is 25.08 sq.km which forms 19.79 percent of the block area and total population in the Panchayat is 26448 with sex ratio 1037. Population density of the Panchayat is 1054 per Sq.Km.

(b) Agriculture :

Paddy, coconut, arecanut, plantain, pepper and rubber are the crops cultivated in the Panchayat. Paddy is cultivated

TABLE - 4.8

Administrative Details of Mala Block

Name of Panchayats	No. of Wards	Name of Villages
Alur	13	Alur, Kallettumkara, Thazhekkad.
Annamanada	11	Alathur, Kallur Thekkumuri.
Kuzhur	9	Kakkulissery, Thirumkulam.
Mala	12	Annallur, Vadama, Kuruvilassery, Vadakkum-bagam.
Poyya	9	Poyya, Pallipuram, Madathumpady.

Source : Development Report, Mala Block Panchayat, 1997.

TABLE - 4.9

Administrative Details of Chavakkad Block

Sl.No.	Name of Panchayat	No.of Wards	Name of Villages.
1.	Punnayurkulam	11	Punnayurkulam
2.	Punnayur	11	Punnayur
3.	Vadakkekad	10	Vadakkekad
4.	Pookode	10	Pookodu
5.	Thaikad	8	Thaikad
6.	Orumanayur	8	Orumanayur
7.	Kadappuram	10	Manathala.

Source : Development Report, Chavakkad Block Panchayat, 1997.

in an area of 1250 hectares under three crops - Virippu (22 percent), Mundakan (42 percent) and Punja (36 percent). Area under coconut is 1500 hectares with an average production of 2000 nuts per hectare. Arecanut, rubber and pepper are the other cash crops cultivated in the Panchayat under the area of 100 hectares, 35 hectares and 100 hectares respectively. Krishi Bhavan gives assistance to the farmers by providing irrigation facilities, agricultural implements and seedlings for the deveopment of agriculture.

4.3.2 Chavakkad Block

It is one of the blocks in Chavakkad Taluk. There are 2 Municipalities, 7 villages and 7 panchayats under this block and its total geographical area is 86.21 sq.km. (i.e. 2.84 percent of the district area). Total population is 1.59 lakhs according to 1991 census. Administrative details are as shown in Table 4.9. Of the 7 Panchayats, Punnayurkulam and Vadakkekad Panchayats are included in the study area.

4.3.2.1 Punnayurkulam Grama Panchayat

(a) General Features

Punnayurkulam Panchayat lies north to Thrissur District and it is also in the northmost end of Chavakkad Block. This panchayat consists of an area of 18.71 sq.kms. (i.e. 21.70 percent of the block area) and there are 12 wards altogether in the Panchayat. Tota population of the panchayat is 29795.

Land records of the panchayat reveals that 54.11 percent of total area is under cultivation.

(b) Agriculture

Paddy and coconut are the important crops cultivated in the Panchayat. Of the three paddy crops, area under Punja crop is larger and also productivity of this crop is highest of 3.5 tonnes per hectares. Coconut is cultivated in 252 hectares which provides 40 nuts per coconut. Arecanut, pulses topioca, plantain etc. are the other crops cultivated in this area.

Assistance for agricultural development is available through 'Krishi Bhavan'. Agricultural implements like tractors, tillers, sprayers, climbing devices etc. and seedlings of coconut, banana, mangotree and pepper are supplied through Krishi Bhavan. About 98 percentage of farmers in the Panchayat are small farmers having cultivated land area of below 1 hectare.

4.3.2.2. Vadakkekad Grama Panchayat

(a) General Features

Vadakkekad Panchayat is situated in the north to Thrissur District. Total area of this Panchayat is 13.72

Sq.Kms i.e., only 0.45 percent of the district area and total population in the Panchayat is 23575 with sex ratio 1134. There are 10 wards in this panchayat and Vadakkekad Village comes under this Panchayat.

(b) Agriculture

Main crops cultivated in this panchayat are paddy and coconut. Area under paddy has declined from 407 hectares to 300 hectares during the last decade. There are various reasons for this and some of them are increase in the cost of production, inadequacy of irrigation facilities, increased demand for housing plots etc.

Area under coconut in the panchayat is 850 hectares. Also its productivity has decreased because of certain diseases like leaf rott, stem bleeding, root wilting etc. and inadequate of water.

4.3.3 Mathilakam Block

Mathilakam Block is under Kodungallur taluk. It is composed of 9 villages and 5 panchayats. Geographical area under this block is 71.81 Sq.Kms. which forms 2.37 percent of the district area. It is bounded by Arabian Sea in the west, Talikulam Block in the north, Vellangallur Block in the east and Kodungallur Municipality in the south. According to 1991 census, total population in the block is 137386 with sex ratio 1136 and population density is 1913

Sq.Kms. There are 5 panchayats with 53 wards and 9 villages in the block. The administrative details are given in Table 4.10. Mathilakam and Sreenarayanapuram panchayats are the selected panchayats for sample study.

4.3.3.1 Mathilakam Grama Panchayat

(a) General Features

Mathilakam Panchayat is in the southern part of Mathilakam Block. It consists of Pappanivattom Village and there are 10 wards in the panchayat. Total area of the Panchayat is 12.92 sq.kms and there is a total population of 25417 with sex ratio 1151. Density of population is 1967 per sq.km.

(b) Agriculture

Coconut is the main crop in the Panchayat. Area under coconut is 1095 hectares and its productivity is 5900 nuts per hectare. Paddy cultivation was in a satisfactory state till 1960. But now the area under paddy has declined to a very low level of 13 hectares with productivity 800 Kgs. per hectare. This is because of severe flood in the area. Pepper, arecanut and vegetables are also cultivated in this Panchayat.

4.3.3.2 Sreenarayanapuram Grama Panchayat

S.N.Puram Panchayat is in the southernmost end of Mathilakam Block. Panangad, Ala and Padinjare Vemballur

TABLE - 4.10

Administrative Details of Mathilakam Block

Sl.No.	Name of Panchayats	No.of wards	Name of Villages
1.	Kaipamangalam	11	Kaipamangalam
2.	Edathuruthy	11	Edathuruthy,Chendrappinni.
3.	Mathilakam	10	Pappinivattom
4.	Sreenarayanapuram	12	Panangad, Ala, Padinjara Vemballur.
5.	Perinjanam	9	Perinjanam, Koolimuttom.

Source : Development Report, Mathilakam Block Panchayat, 1997.

TABLE - 4.11

Administrative Details of Puzhakkal Block

Sl.No.	Name of Panchayats	No. of wards	Name of Villages
1.	Adat	10	Puzhakkal, Puranattukara, Chittilappally, Adat.
2.	Arimpur	10	Manakody, Veluthur, Eravu, Parakkad.
3.	Ayyanthole	14	Aranattukara (Portion) Pullazhi, Poonkunnam, Thrissur (Portion), Ayyanthole (Portion).
4.	Avanur	8	Avanur, Thangaloor, Choolissery, Velappaya.
5.	Kaiparamba	10	Kaiparamba, Peramangalam, Anjur.
6.	Killannur	8	Killanur
7.	Tholur	8	Tholur, Edakolathur,Chavakad

Source : Development Report, Puzhakkal Block Panchayat, 1997.

Villages are included in this Panchayat. There are 12 wards in this panchayat and its total geographical area is 19.26 sq.Kms which bears 26.82 percent of the block area. Total population in the panchayat is 34878 with sex ratio 1115 and density of population 1811 per sq.km.

(b) Agriculture

Coconut is the main crop which constitutes 1928 hectares of area with productivity of 7884 nuts per hectare. Krishi Bhavan provides assistance for the development of coconut cultivation through different schemes. Paddy is cultivated in 15 hectares only, whose productivity is 1000 Kg. per hectare. Arecanut, cashew and vegetables are the other crops grown in the panchayat.

4.3.4 Puzhakkal Block

Puzhakkal block lies in the centre region of Thrissur District. It includes 7 panchayats with 68 wards and 24 villages. Total geographical area of the block is 145.96 sq.km. which constitutes 4.8 percentage of the district area. There is a population of 164359 in the block with population density of 1126 per sq. km and sex ratio 1060. The administrative set up of the block is as shown in Table 4.11.

Puzhakkal block is an important agricultural region of Thrissur District. Paddy, coconut and banana are the main crops cultivated in the block. Paddy is cultivated in more than 7000 hectares which constitutes 10% of the total cultivated area of paddy in the district. Kole land spread in the Panchayats of Adat, Ayyanthole, Arimbur and Tholur is the main source of paddy production. Coconut is cultivated in more than 3000 hectares of land.

4.3.4.1 Ayyanthole Grama Panchayat

(a) General Features :

Ayyanthole Panchayat lies in the south-east part of Puzhakkal Block. It includes Pullazhi Village, Poonkunnam Village, portion of Aranattukara, Thrissur and Ayyanthole Villages. There are 14 wards in the Panchayat. It is a special grade panchayat having 23.14 sq.km. area which forms 15.85 percent of the block area. Total population in the panchayat is 23571 with sex ratio 1069. Density of population is 1971 per sq.km.

(b) Agriculture:

Paddy and coconut are the main crops of the Panchayat. Three crops of paddy - Virippu, Mundakan and Punja are cultivated in the Panchayat. According to the project report published by Puzhakkal Block

Grama Panchayat in 1996, total area under paddy in the Panchayat is 900 hectares which constitutes 11.11 percent of Virippu, 36.11 percent of Mundakam and 63.89 percent of Punja Crops. Coconut is cultivated under an area of 528 hectares which constitutes 17.22 percent of total area under coconut in the block. Arecanut, plantain, pepper, cashew and tapioca are the other crops cultivated in this Panchayat.

4.3.4.2 Adat Grama Panchayat

(a) General Features :

Adat Panchayat is in the central part of Puzhakkal Block. It consists of 10 wards and 4 villages of Puzhakkal, Puranattukara, Chittilappally and Adat. Total geographical area of the Panchayat is 23.02 sq.km which forms 15.77 percent of the block area. According to 1991 census, total population in the Panchayat is 23441 with sex ratio 1101. Density of population is 1018 per sq. km.

(b) Agriculture :

Paddy, coconut and banana are the main crops of the Panchayat. Area under paddy is 1535 hectares and area under Punja crop is more than (74.92 percent) that of the other two crops. Coconut is cultivated under 385 hectares. Arecanut, banana, pepper, cashew and vegetables are also grown in the Panchayat.

4.3.5 Wadakkanchery Block

Wadakkancherry Block is in the north of Thrissur District and it consists of 9 panchayats with 86 wards and 34 villages. Total geographical area of the block is 24870 hectares which forms 8.31 percent of the district area. This block includes a total populaton of 203544 with sex ratio 1095 and density of population 686 per sq.km.

Paddy and coconut are the main crops in the block. Paddy is cultivated in the area of 10062 hectares which forms 70.73 percent of the net cropped area of the block and its productivity is 1.97 tonnes per hectare. Area under coconut is 4401 hectares with productivity 4207 nuts per hectare. Rubber, arecanut and plantain are the other important crops in the block. Administrative set-up of the block is given in Table 4.12. Wadakkancherry and Velur are the Panchayats selected for the sample survey.

4.3.5.1 Wadakkancherry Grama Panchayat

(a) General Features :

Wadakkancherry Panchayat lies at the central part of the block which consists of 11 wards. Wadakkancherry, Enkakkad and Kumaranellur villages come under this Panchayat. It has a total area of 1498.06 hectares which forms 6.02 percent of the block area. It is a special grade panchayat with a population of 28692 and sex ratio 1095. Density of the population is 1006 per sq. km.

TABLE - 4.12

Administrative Details of Wadakkanchery Block

Sl. No.	Name of Panchayat	No.of Wards	Name of Villages.
1.	Desamangalam	9	Thalassery, Pallur, Desamangalam, Arangottukara.
2.	Varavur	9	Trichur, Pilakkad, Varavur.
3.	Mundathikode	9	Puthuruthy, Mundathikode, Parlikad, Peringandoor, Minalur.
4.	Wadakkancherry	11	Wadakkancherry (Portion), Enkakad Kumaranallur.
5.	Thekkumkara	10	Karumathara, Viruppaka, Manalithara, Thekkumkara.
6.	Kadangode	10	Kadangode, Vallarakad, Eyyal, Chiramanangad.
7.	Velur	10	Velur, Vellattanjur, Thayyur, Kirallur.
8.	Mulloorkara	8	Mulloorkara, Attur.
9.	Erumapetty	10	Kanjirakode, Chittana, Kottapuram Nelluvaya, Kariyannur.

Source : Development Report, Wadakkancherry Block Panchayat, 1997.

(b) Agriculture :

Paddy and coconut are the main crops grown in the Panchayat. Area under paddy is 510 hectares and share of the area under Virippu, Mundakan and Punja are 42.16 percent, 51.96 percent and 5.88 percent respectively. According to the Krishi Bhavan records, productivity of paddy in Virippu seasons was 1.5 tonnes per hectare and that in Mundakan and Punja was 2 tonnes per hectare each. Other crops in the Panchayat are coconut, arecanut, rubber and pepper. Coconut is cultivated under an area of 800 hectares and its productivity is an average of 50 nuts per palm.

4.3.5.2 Velur Grama Panchayat

(a) General Features :

Velur is the first grade panchayat in Wadakkancherry Block. It lies in the north-west part of the block and spreads over an area of 28.32 sq. km which forms 5.98 percent of total area of the block. Total population of the panchayat is 22155 with sex ratio 1118 and density of population 782 per sq. km. There are 10 wards and 4 villages in the panchayat.

(b) Agriculture :

Paddy, coconut and arecanut are the main crops in the Panchayat with respective areas of 1145 hectares, 480 hectares and 320 hectares respectively. Paddy is cultivated under two crops of Virippu and Mundakan with productivities 2 tonnes per hectare and 2.5 tonnes per hectare respectively. The productivity of coconut is 50 nuts per palm.

4.4. Socio-economic Profile of the Sample

For the present study, 100 farm households are selected at random from five blocks of Thrissur District. The main characteristics of the sample population in terms of age, sex, community, education and income are studied. Besides, the area under paddy and coconut cultivation and their farm income are also described.

4.4.1. Population

The total number of persons in the sample households is worked out to 504. It gives an average family size of 5.04 per household. Out of them 274 (54.37 percent) are males and 230 (45.63 percent) females. The sex ratio of the sample is thus 839.

Age-wise classification of population is given in Table 4.13. Of the sample population, 13.29 percent are below 15 years of age, 73.61 percent come under the age group of 15-60 and the remaining 13.10 percent are above 60 years. From this, we can conclude that a large number of the sample population are constituted by potential labour force coming under the age group of 15 to 60.

TABLE - 4.13

Age-wise Classification of Sample Population

Age	MALE		FEMALE		TOTAL	
	Number	Percentage	Number	Percentage	Number	Percentage
Below 15	43	15.69	24	10.43	67	13.29
15 - 30	89	32.48	80	34.78	169	33.53
31 - 45	54	19.71	43	18.70	97	19.25
46 - 60	50	18.25	55	23.91	105	20.83
Above 60	38	13.87	28	12.17	66	13.10
Total	274	100.00	230	100.00	504	100.00

Source : Computed from the Primary Data.

TABLE - 4.14

Classification of Sample Households by Religion

Religion	No. of Households
Hindu	
(i) Nair	19
(ii) OBC	35
Total	54
Christian	26
Muslim	20
Total	100

Source : Computed from the Primary Data.

4.4.2 Community Composition

The classification of households by religion is as shown in Table 4.14.

The sample consists of 54 percent of Hindus, out of which 35.19 percent belong to Nair and 64.81 percent belong to other Backward Caste, 26 percent are Christians and the remaining 20 percent belong to Muslim Religion.

4.4.3 Educational Status

Table 4.15 describes the educational status of population.

Out of the total population, 4.37 percentage come under the age group of below 6 years. Of the remaining, 1.98 percent are illiterates, 9.33 percent have lower primary level of education and 9.13 percent attained upper primary level of education. Majority of the population (40.08 Percent) are educated upto high school level and 15.08 percent are higher educated at degree level or above.

4.4.4 Farmers

In the present study, one member from each family who is interested or involved in farming activities is considered as 'farmer'. Thus there are 100 farmers altogether in this sample.

TABLE - 4.15

Educational Status of Sample Population

Educational Level	MALE Number	MALE Percentage	FEMALE Number	FEMALE Percentage	TOTAL Number	TOTAL Percentage
Illiterate	1	0.38	9	4.09	10	2.07
Upto L.P.	27	10.31	20	11.00	47	9.75
Upto U.P.	21	8.02	25	11.36	46	9.54
H.S. Level	116	44.27	86	39.09	202	41.91
High Secondary	56	21.37	45	20.45	101	20.95
Degree & above	41	15.65	35	15.91	76	15.77
Total	262	100.00	220	100.00	482	100.00

Source : Computed from the Primary Data.

TABLE - 4.16

Age Composition of Farmers

Age	MALE Number	MALE Percentage	FEMALE Number	FEMALE Percentage	TOTAL
Below 30	2	2.17	0	0	2
30 - 40	8	8.70	2	25	10
40 - 50	17	18.48	2	25	19
50 - 60	29	31.52	2	25	31
60 - 70	26	28.26	2	25	28
70 & above	10	10.87	0	0	10
Total	92	100.00	8	100	100

Source : Computed by the Researcher.

Of the 100 farmers, 92 are males and 8 are females. Thus the ratio of male farmers to female farmers is 23:2. Distribution of farmers by their marital status reveals that 97 percent of them are married.

Age composition of the farmers is given in Table 4.16. Of the 100 farmers, there are only 2 male farmers below 30 years and 29 percentage come under the age group of 30 - 50. It is interesting to note that 69 percent of the farmers belong to the age group of 50 and above. From this it is revealed that the youngsters are not coming forward to work in this field.

Educational status of farmers is presented in Table 4.17. Of the 100 farmers, only one female farmer is illiterate. 33 percent of the farmers have attained primary level education. Majority of them (44 percent) are educated upto high school level. The remaining 22 percent are higher educated. This is due to the reason that majority of them are retired educated persons who are interested in cultivation.

Table 4.18 shows the distribution of farmers by their occupational status. It is revealed that 73 percent of the farmers are engaged in agriculture only so that they can be considered as 'full-time farmers', 18 percent are retired persons and 9 percent are employed in other private or public sectors. So, these 27 farmers can be considered as 'part-time farmers'.

TABLE - 4.17

Distribution of Farmers by their Level of Education

Education Level	MALE		FEMALE		Total
	Number	Percentage	Number	Percentage	
Illiterate	0	0	1	12.5	1
Upto L.P.	17	18.47	2	25	19
Upto U.P.	14	15.22	0	0	14
H.S. Level	41	44.57	3	37.5	44
Higher Secondary	14	15.22	0	0	14
Degree & Above	6	6.52	2	25	8
Total	92	100.00	8	100.00	100

Source : Computed by the Researcher.

TABLE - 4.18

Distribution of Farmers by their Occupational Status

Occupation		No. of Farmers
Agriculture	-	73
Retd. Persons	-	18
Business	-	7
Govt. Employees	-	2
Total	-	100

Source : Computed by the Researcher

4.4.5 Paddy Cultivation

The main food crop, paddy is cultivated by 85 percent of the sample households. Details of paddy cultivation are collected on the basis of cultivation that has been done during 1997-98. On the basis of the size of holdings, farms are classified in to three strata - small farms (below 1 acre), medium farms (1 acre - 2 acres) and large farms (above 2 acres).

Paddy lands owned by the sample households are distributed among 3 crops - Virippu, Mundakan and Punja. Distribution of holdings based on the crops cultivated is given in Table 4.19. Out of the total holdings, 42.35 percentage are being cultivated under single crop, 50.59 percentage under double crops and the rest 7.06 percentage come under tripple crops. Thus, the gross number of farms under study comes to 140.

Area under paddy in three seasons and its productivity are discussed below.

4.4.6 Area under Paddy

Gross area of paddy under three crops (Virippu, Mundakan and Punja) is 241.2 acres while the net area (gross area minus area under more than one crop) is 137.79 acres. Gross number of farmlands is 140 in which the share of small, medium and large farms are 32.86 percent, 31.43 percent and 35.71 percent respectively.

TABLE - 4.19

Distribution of Holdings based on the Number of Crops under Paddy

Particulars	No. of Holdings	Gross No. of holdings (No. of Holdings x No. of times the crops done
Single Crop	36	36
Double Crop	43	86
Tripple Crop	6	18
Total	85	140

Source : Computed from the Primary Data.

TABLE - 4.20

Size-wise Distribution of Gross and Net Area under Paddy (Acres)

Size	Gross Area	Net Area	Cropping intensity
Small	30.8	19.92	1.55
Medium	61.66	39.60	1.56
Large	148.74	78.27	1.90
Total	241.2	137.79	1.75

Source : Computed from the Primary Data.

Table 4.20 represents size-wise distribution of gross and net area under paddy. Gross area of small, medium and large farms are 30.8 acres, 61.66 acres and 148.74 acres respectively with an average size of 0.67, 1.47 and 2.97 acres in each category. Also, the net area is distributed among small, medium and large holdings with average size of holdings of 0.66, 1.41 and 2.89 acres respectively. Cropping intensity is the highest in large holding category (1.90) whereas it is 1.75 altogether.

Table 4.21 shows the distribution of gross area under paddy in the three seasons. From this it can be noticed that the proportion of gross area in Punja season is higher than that in the other two seasons in the categories of small and large farms. But in Mundakan season, a large area of cultivation come under medium farms. However, the shares of total area under paddy for Virippu, Mundakan and Punja are 24.83 percent, 36.38 percent and 38.79 percent respectively.

Table 4.22 describes the distribution of area under paddy in the selected panchayats. It can be seen from the Table that the gross area under paddy in different panchayats is distributed among the different combinations of three crops such as Virippu, Mundakan and Punja. Paddy cultivation is becoming very rare in Mathilakam Block and so we could trace no paddy cultivators from S.N.Puram and only 5 from Mathilakam panchayats. The sample cultivators in

TABLE - 4.21

Season-wise Distribution of Gross Area under Paddy Cultivation

Size	Virippu	Mundakan	Punja	Total
Small	7.61 (0.69)	11.04 (0.65)	12.15 (0.68)	30.80 (0.67)
Medium	17.27 (1.44)	24.80 (1.31)	19.59 (1.51)	61.66 (1.40)
Large	35.00 (2.92)	51.92 (2.88)	61.82 (4.76)	148.74 (2.97)
Total	59.88 (1.71)	87.76 (1.63)	93.56 (1.83)	241.20 (1.72)

Note : Figures in parantheses indicate average size of holdings in each category.

Source : Computed by the Researcher.

TABLE - 4.22

Season-wise Distribution of Area under Paddy in the selected Panchayats

Panchayat	SMALL			MEDIUM			LARGE		
	V	M	P	V	M	P	V	M	P
Vadakkekad	-	1.65 (0.67)	0.37 (0.37)	-	3.63 (1.21)	-	-	7.9 (3.95)	12.45 (3.11)
Punnayurkulam	-	-	2.89 (0.72)	-	-	4 (1.33)	-	-	8.75 (2.92)
Mala	0.67 (0.34)	2.2 (0.55)	-	2.06 (1.03)	3.37 (1.12)	-	4.55 (2.28)	6.60 (2.20)	2.05 (2.05)
Annamanada	-	1.65 (0.55)	2.07 (0.52)	-	3.54 (1.18)	3.54 (1.18)	-	6.75 (2.25)	6.75 (2.25)
Mathilakam	0.95 (0.95)	0.50 (0.50)	0.95 (0.95)	3.90 (1.95)	3.20 (1.60)	1.95 (1.95)	-	-	-
S.N.Puram	-	-	-	-	-	-	-	-	-
Adat	-	-	1.75 (0.58)	1.94 (1.94)	3.19 (1.60)	3.20 (1.60)	10 (5)	10 (5)	18 (4.5)
Ayyanthole	1.90 (0.95)	-	2.50 (0.83)	1.50 (1.50)	-	6.90 (1.73)	5.55 (2.78)	3.50 (3.50)	8.55 (2.85)
Wadakkan-cherry.	1.57 (0.79)	2.52 (0.84)	1.62 (0.81)	4.32 (1.44)	4.32 (1.44)	-	7.80 (2.60)	10.07 (2.52)	5.27 (2.64)
Velur	2.52 (0.63)	2.52 (0.63)	-	3.55 (1.18)	3.55 (1.18)	-	7.10 (2.37)	7.10 (2.37)	-

Note : Figures in parantheses indicate average size of holdings in each category.

Source : Computed from the Primary Data.

Vadakkekad and Annamanada Panchayats are not doing paddy cultivation in Virippu season while those in Velur Panchayat are not doing Punja Crop. Some of the sample farms in Mala, Adat, Ayyanthole and Wadakkancherry Panchayats are cultivated in all the three seasons. Also it could be seen that the average size of small holdings is comparatively larger in Ayyanthole and Wadakkanchery Panchayats (0.88 and 0.82 acres respectively) and smaller in Mala Panchayat (0.48 acres). At the same time, the average area under medium holdings is higher in Mathilakam (1.81 acres) and Adat (1.67 acres) Panchayats and smaller in Mala (1.09 acres) and Velur (1.18 acres) Panchayats whereas that under large farms is higher in Vadakkekad and Adat Panchayats (above 3 acres).

4.4.7 Productivity of Paddy

It is necessary to determine the productivity of paddy in study area to assess the state of paddy cultivation. Table 4.23 gives average productivity of paddy in different size categories in different seasons. It could be noticed from the Table that productivity is relatively higher in Punja Crop and it is the highest among small farms. Productivity of Mundakan crop is comparatively higher in medium farms and that of Virippu is higher in large farms.

Table 4.24 shows the average productivity of paddy in the selected Panchayats with respect to the large farms,

TABLE - 4.23

Average Productivity of Paddy (Kg/Ha)

Size	Virippu	Mundakan	Punja
Small	3650.69	3936.60	4707.32
Medium	3228.29	3890.49	4269.43
Large	3933.04	3651.01	4620.91

Source : Computed from the Primary Data.

TABLE 4.24

AVERAGE PRODUCTIVITY OF PADDY (Kg/Ha) - SIZEWISE AND SEASONWISE

	SMALL				MEDIUM				LARGE			
PANCHAYAT	V	M	P	AVERAGE	V	M	P	AVERAGE	V	M	P	AVERAGE
Vadakkekad	-	5731.61	6010.54	5871.08	-	8913.25	-	8913.25	-	6940.60	4925.04	5932.82
Punnayurkulam	-	-	5708.26	5708.26	-	-	5463.66	5463.66	-	-	4008.51	4008.51
Mala	2939.83	3058.09	-	2998.96	3115.26	3494.34	-	3342.71	1836.98	2262.07	-	2049.53
Annamanada	-	3860.94	4472.56	4166.75	-	2490.61	2569.06	2529.84	-	2514.21	2554.39	2534.30
Mathilakam	2340.95	1482.60	2601.05	2141.53	1520.62	1329.26	1900.77	1583.55	-	-	-	
S.N.Puram	-	-	-	-	-	-	-		-	-	-	
Adat	-	-	4887.09	4887.09	2292.68	2692.63	5485.62	3490.31	4324.25	4324.25	4818.45	4488.98
Ayyanthole	3706.50	-	4616.87	4161.69	3624.13	-	4633.13	4128.63	4263.98	3883.00	5530.33	4559.10
Wadakkancherry	3036.91	3153.54	3442.52	3210.99	3460.58	3673.55	-	3567.07	5447.18	4924.45	6271.84	5547.82
Velur	4612.53	4612.53	-	4612.53	4389.75	4554.48	-	4472.12	3334.85	3455.38	-	3395.11

Source :Comuted from the Primary Data.

average productivity is higher in the panchayats of Wadakkancherry and Ayyanthole.Vadakkekad panchayat stands top with an average productivity of 8913.25 Kg. per hectare in medium farms. Also the productivity of small farms is higher in Vadakkekad and Punnayurkulam panchayats of Chavakkad Block. Average productivity is found to be the lowest in Mathilakam Panchayat and it may be one of the reasons for the large scale shifting from paddy to coconut cultivation in this block.

4.4.8 Profitability of Paddy Cultivation

Profit from paddy cultivation is calculated by working out the total value of output and the total cost of production Table 4.25 describes the distribution of paddy farms on the basis of annual profit per acre. Out of 140 farms under paddy, 47 farms have incurred negative profit and the average amount of this loss is higher in the case of Punja crop. But majority of the loss-incurring farms come under the Mundakan Crop. All other farms have incurred profit in varying ranges and in which the majority come under the annual profit range of Rs.1000 to Rs.5000 per acre. Of the three crops, number of profitable paddy farms is higher under Punja and lower under Virippu crops.

4.4.9 Coconut cultivation

All the 100 sample households own area under coconut cultivation. Coconut is cultivated in an area of 159.86 acres by these 100 households with an average area of 1.60

TABLE - 4.25

Distribution of Paddy Farms according to the Annual Profit per Acre

Annual Profit (Rs.)	No. of Paddy Farms			Total
	Virippu	Mundakan	Punja	
Negative	18 (-2039.33)	25 (-2165.31)	4 (-2837.78)	47 (-2174.29)
0 - 1000	8 (608.03)	8 (415.33)	10 (647.08)	26 (563.76)
1000 - 5000	3 (2833.43)	16 (2568.3)	20 (3038.82)	39 (2829.91)
5000 - 10000	4 (6456.93)	4 (5989.8)	14 (7474.55)	22 (7019.57)
10000 & Above	2 (13409)	1 (14043)	3 (13642.07)	6 (13631.2)
		Total		140 (1850.38)

Note : Figures in parantheses indicate average profit per acre.

Source : Computed by the Researcher.

TABLE - 4.26

Size-wise Distribution of Area under Coconut Cultivation

Size	No. of Farms	Area (Acres)	Percentage to total area
Small	33	17.36 (0.54)	10.86
Medium	34	47.24 (1.35)	29.55
Large	33	95.26 (2.89)	59.59
Total	100	159.86 (1.60)	100.00

Note : Figures in Parantheses indicate average size of holdings.

Source : Computed from the Primary Data.

TABLE : 4.27

Size-wise Distribution of Coconut Farms according to the Number of Actual Palms per Acre

No. of Palm/ Acre	No. of Farms			Total
	Small	Medium	Large	
25 - 50	3	2	5	10
50 - 75	8	18	18	44
75 - 100	16	13	10	39
100 - 125	4	1	0	5
125 & above	2	0	0	2
Total	33 (82.48)	34 (70.29)	33 (64)	100 (72.24)

Note : Figures in parantheses indicate average No. of Palms/Acre.
Source : Computed from the Primary Data.

acres per household. Of the total area, 17.36 acres come under the small size, 47.24 acres come under the medium size and 95.26 acres belongs to the large size with an average size of 0.54, 1.35 and 2.89 acres respectively (Table 4.26).

Since the whole area under coconut is not covered by coconut palms only, it is necessary to assess the number of palms per acre under different size of holdings. Table 4.27 represents size-wise distribution of coconut farms according to the number of adult palms per acre. It can be seen that 44 percentage of the farms possess palms between the range of 50 to 75 numbers per acre out of which the shares of medium and large holdings are the same (40.91% each) and the remaining 18.18 percent come under the small holdings. It is to be noted that 50 percentage of the 10 farms with the lowest intensity of 25 to 50 palms per acre come under the category of large holdings. Medium and large holdings are not existing in the category of the highest intensity of more than 125 palms per acre. Seasonwise figures depict that there is an inverse relationship between the size of holdings and average number of palms per acre.

4.4.10 Productivity of Coconut

Annual productivity is determined in terms of nuts per palm which is described in Table 4.28. Majority of the coconut farms (39 percent) come under the category of annual productivty of 70 to 100 nuts per palm with an average annual productivity of 83.68 nuts per palm and the small holdings constitute relatively higher share in this category.

TABLE - 4.28

Size-wise Distribution of Coconut Farms according to to the Annual Productivity

Annual Productivity (Nuts/Palm)	No. of Farms			Total
	Small	Medium	Large	
70-100	14	13	12	39 (83.68)
100 - 130	8	19	11	38 (107.96)
130-160	6	1	7	14 (140.56)
160 - 190	2	1	2	5 (170.00)
190 - 220	1	0	1	2 (200)
200 & above	2	0	0	2 (275)
Total	33 (122.37)	34 (100.14)	34 (112.21)	100 (111.23)

Note : Figures in parantheses indicate average annual productivity in each category.

Source : Computed by the Researcher.

TABLE - 4.29

Average Productivity of Coconut in Different Panchayats

Panchayat	Average Productivity (Nuts/Palm)			Total
	Small	Medium	Large	
Vadakkekad	115.00	115.46	100	109.09
Punnayurkulam	86.67	88.53	90	88.41
Mala	86.67	92.50	80	87.00
Annamanada	86.67	90.67	104	95.00
Mathilakam	104.89	99.33	114.71	107.15
S.N.Puram	132.00	79.00	137.50	118.30
Adat	145.83	109.50	91.11	114.88
Ayyanthole	209.45	120.00	244.83	156.26
Wadakkanchery	123.33	102.50	130.00	117.00
Velur	106.67	103.75	120.00	109.50
District Average				110.26

Source : Computed from the Primary Data.

Of the total farms, 38 percentage have attained an average annual productivity of 107.96 nuts per palm in which the share of medium farms is relatively higher than the other two categories. Also 4 percentage have an average of above 200 nuts per palm out of which 75 percentage is constituted by the small farms and the remaining 25 percentage by the medium farms. Seasonwise average annual productivity reveals that it is the highest in small holdings and the lowest in medium holdings.

Table 4.29 shows variations in average productivity of coconut in different panchayats. Average productivity is the highest in Ayyanthole Panchayat (156.26 nuts/palm) while it is the lowest in Mala Panchayat (87 nuts/palm). With respect to the size of holdings, average productivity of small and medium farms is relatively higher in Vadakkekad, Mala and Adat Panchayats.

4.4.11 Profitability of Coconut Cultivation

Annual Profit from coconut cultivation is calculated on the basis of total value of output and total cost of cultivaton. Table 4.30 reveals that only one of the 100 households has incurred an average loss of Rs.197 per palm and 51 percent of the cultivators have attained an average annual profit of Rs.423.09 per palm. It can also be noticed that about 7 percent have incurred an average annual profit of Rs.900 per palm.

TABLE - 4.30

Size-wise Distribution of Coconut Cultivators according to the Annual Profit per Palm

Profit/Palm (Rs.)	NO. OF CULTIVATORS			Total
	Small	Medium	Large	
Negative	1	0	0	1 (-197)
0 - 100	1	0	0	1 (96.67)
100 - 300	2	1	1	4 (258.43)
300 - 500	11	23	17	51 (423.09)
500 - 700	12	8	7	27 (583.67)
700 - 900	2	1	6	9 (754.85)
900 - 1100	2	1	2	5 (978.11)
1100 & above	2	0	0	2 (1444.96)
Total	33 (556.33)	34 (474.01)	33 (547.00)	100 (524.44)

Note : Figures in parantheses indicate average profit per palm in each category.

Source : Computed from the Primary Data.

4.4.12 Income Distribution of Sample Households

Annual income of the sample households is calculated by working out their total farm income and income from other sources. Table 4.31 shows the income distribution of sample households. Majority of the households (67 percent) depend on wage income other than the farm income. The rest of the 33 percent of households fully depend on the farm income in which 48.48 percent of them have got an annual income in the range of Rupees 50,000 - 1,50,000. Thus the household exclusively depending on agriculture are earning relatively higher income. Besides 39 percentage of the households are getting more than 50 percentage of their income from cultivation. Also it can be seen that 23 percentage of the total sample households have an annual family income between Rs.10,000 and Rs.50,000.

4.4.13 Conclusion

Paddy and coconut are the main crops cultivated in the sample area and also by the sample households. Paddy is cultivated among three crops (Virippu, Mundakan and Punja) in which the proportion of gross area in Punja season is higher (38.79 percent) than that in the other two seasons. Also the productivity of paddy in Punja crop is relatively higher and it is the highest among small farms (4707.32 Kg/hectare). 33.57 percent of the sample farms have incurred loss in paddy cultivation and majority of the loss incurring

TABLE - 4.31

Distribution of Sample Households according to their Annual Income

Total Income (Rs.) \ Farm Income (Rs.)	No. of sample Households						
	10000-25000	25000-50000	50000-100000	100000-150000	150000-200000	Above 200000	Total
1000-5000	1	-	1	1	-	-	2
5000-10000	-	-	1	-	-	-	1
10000-25000	6	6	3	1	-	-	16
25000-50000	-	10	13	4	-	1	28
50000-100000	-	-	22	7	5	1	35
100000-150000	-	-	-	8	1	3	12
150000-200000	-	-	-	-	2	2	4
above 200000	-	-	-	-	-	2	2
Total	7	16	40	20	8	9	100

Source : Computed by the Researcher.

farms come under the Mundakan crop. The remaining 66.43 percent have incurred profit in the range of Rs.1000 - 5000 per acre. In the case of coconut, density of cultivation is in the range of 25 - 150 palms per acre in which majority of the farms come under the density range of 50 - 100 palms per acre. The annual productivity of coconut in majority of the farms (77 percent) is between 70 and 130 nuts per palm. Compared to paddy cultivation, profitability of coconut is high and thus most of the sample cultivators compensate their loss or low profit in paddy cultivation through coconut cultivation.

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ADOPTION OF MODERN PRACTICES IN AGRICULTURE

Vimala. M “Determinants and impact of modern technology adoption in agriculture -A case study of Trichur district ” Thesis. Department of Economics, Dr. John Matthai Centre , University of Calicut, 1999

C H A P T E R - 5

ADOPTION OF MODERN PRACTICES IN AGRICULTURE

5.1 ADOPTION AND DIFFUSION

5.2 TYPES OF DIFFUSION

5.3 ADOPTION OF MODERN PRACTICES AMONG PADDY CULTIVATORS - AN ANALYSES.

5.4 ADOPTION OF MODERN PRACTICES IN COCONUT CULTIVATION - AN ANALYSIS.

5.5 ADOPTION OF HYVs AND SOCIO-ECONOMIC FACTORS.

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CHAPTER - 5

ADOPTION OF MODERN PRACTICES IN AGRICULTURE

This Chapter aims to analyse the adoption of modern practices among farm households. The influence of socio-economic factors on the adoption level and the problems faced by the farmers while adoption are discussed in detail.

5.1 Adoption and Diffusion

'Adoption' and 'Diffusion' are quite common concepts. Sometimes, these two terms make confusion among researchers. However, each of these terms has a vivid and distinct meaning.

The word 'adoption' means acceptance of an innovation. Farmer's adoption of any agricultural innovation may be comprised of a single improved practice or a package of such practices. It depends primarily on three factors - (a) farmer's awareness of the innovation (b) physical suitability of the innovation to the specific farming environment and (c) the possible economic benefits of the innovation to the farmers. Hence a farmer will adopt a new practice only if he is convinced of its economic benefits in his farming conditions. Thus, adoption is an action executed at a point of time or during a particular period.

'Diffusion' can be defined as a process of spreading an innovation. It is a continuous action executed for a long period of time. Hence diffusion can also be considered as a continuous adoption of innovations. In agriculture, this implies the acceptance and approval of a farm practice among farmers.

Thus the terms 'diffusion' and 'adoption' are so much related. A cause and effect relationship is existing between them. Diffusion is the cause of adoption and adoption is the result of diffusion. In other words, they are complement to each other because one is the cause of other. However, these two words are often used synonymously.

'Diffusion' is analysed and assessed by a number of scholars in different periods. These theoretical and empirical evaluations throw light in to the fact that there are different types and forms of diffusion. Some experiences regarding spread and adoption of ideas and practices seemed to be necessary in order to test the validity of the theories of diffusion.

According to Bhola Nath Ghosh,[1] diffusion of new ideas, technologies and their subsequent adoption by the people is a continuous process in the course of development.

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1. Bhola Nath Ghosh, "The Theories of Diffusion : Some Empirical Observations on Agricultural Activities in Rural Areas", Indian Journal of Regional Science, Vol.29, 1997, No.2, pp : 1-18.

The degree and extent of adoption may depend on what, how and among whom the ideas and technologies are diffused.

Rogers[2] defines diffusion as a process of spread of a new idea from its source of invention or creation to its ultimate users or adopters. From various theories of diffusion it appears that there is no unique definition of diffusion. But all definitions have common characteristics namely spread of new ideas or inventions from one community to the other. It is a process rather than an end in itself.

Every behavioural science and recently agricultural science have interest in the diffusion of new ideas. Studies on agricultural technology diffusion, especially farmers decision about adoption of new technology attracted the attention of a number of scholars as to how a farmer influenced while making a decision regarding adoption of new farm practices within the existing farming system.

According to Mosher,[3] farmer's decisions are greatly influenced by attitude and relationships within the local communities in which they live. Individual's activities, whatever and whenever it may be, are influenced largely by

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2. Rogers Everett.M., "Diffusion of Innovation", Free Press of Glence, London, 1962.

3. Mosher Arther.T., "Getting Agriculture Moving : Essentials for Development and Modernisation", New York, Praeger,1966.

the situation in which an individual lives and works. It is argued that a good deal of variation in behaviour is a result of variation in the immediate situation, the individual finds himself at different times. It is for this reason that the environment in which a farmer lives has to be studied to make out'what causes what'.

The situational aspect influencing the adoption behaviour of farmers can be viewed from different angles, one of which being the distance of habitance of farmers from village to village. According to Davis,[4] the rural urban differential is a gradient, with the rural end of the scale never approaching absoute rurality.

Hoffer [5] has studied adoption technique related to farming among Dutch Farmers. He has examined certain characteristics of ideas related to their rate of adoption.

5.2 Types of Diffuson

There are various types of diffusion. These various types would be classified by their sources which are

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4. Davis Alice, "Technicways in American Civilization", Social Force, Vol.18, pp 317-330.

5. Hoffer Charles R, "Acceptance of Approved Farming Practices Among Farmers of Dutch Descent, "East Lansing, Michigan Experiment Station Special Bulletin 316.

endogenous and exogenous. For the purpose of agricultural development, the kinds of experiences gained by different members of the community belongs to endogenous sources. The exogenous sources refer to some practice evolved, innovated outside the community beyond local scenario.

The forms of diffusion may be beginning from a vertex, spreading like wave-around it, may be linear proceeding over time and space, may be non-linear having some discontinuity in between. These are caused by migration of group of people from one area to the other, marriage, socio-cultural interaction, outside market contact and exposure to media like audio-visual communication and some such forms. It is quite possible that various forms may be adopted simultaneously which shortens the diffusion adoption process. It may be lengthened by inhibiting factors present in the existing system.

5.3 Adoption of Modern Practices Among Paddy Cultivators - An Analysis

The inputs such as HYV seeds, fertilisers, irrigation, machineries and insecticides are considered as modern inputs and the farm practices by adopting these inputs are termed as modern farm practices. Here, adoption of these single inputs and their different combinations in the cultivation process has been discussed.

5.3.1 Adoption of High Yielding Varieties

Among the technological changes responsible for increase in productivity of farm resources, adoption of improved seed varieties meets with ready response and adoption. Even under conditions of small holdings and meagre resources, increase in yield during a short period can be brought about by these HYV seeds.

In the present study, 85 percentage of the paddy cultivators have adopted HYVs which covered 86.04 percent of the gross area under cultivation. Table 5.1 shows the adoption indices of area and acceptance in the case of HYV seeds. It reveals that adoption index of area* under large holdings is higher whereas that of medium holdings is lower. Adoption indices of acceptance** also give the same result in this respect. Seasonwise indices show that the adoption of HYV seeds is the highest under Punja Crop in which the adoption is cent percentage in small and medium holdings whereas the acceptance is 90 percentage in large holdings. Adoption index with respect to total area is the highest under Punja and the lowest under Mundakan Crop. Seasonwise area under adoption of this practice in small, medium and large farms is illustrated in figure 5.1. Table 5.2 presents adoption indices of area and acceptance in the case of modern

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* Percentage of farm area under a particular farm practice.

** Percentage of farms which adopt a particular farm practice.

TABLE - 5.1

ADOPTION INDICES OF AREA AND ACCEPTANCE - HYVs of PADDY

(Percentage)

Size	Virippu	Mundakan	Punja	Total
Small	85.28 (81.82)	67.39 (70.59)	100.00 (100.00)	84.68 (82.61)
Medium	75.39 (75.00)	71.53 (73.68)	100.00 (100.00)	81.66 (79.55)
Large	94.14 (91.67)	83.44 (83.33)	88.68 (90.00)	88.13 (88)
Total	87.61 (82.86)	78.05 (75.93)	92.52 (96.08)	86.04 (85)

Note : Figures in parantheses indicate adoption indices of acceptance

Source : Computed from the Primary Data.

FIGURE 5. 1

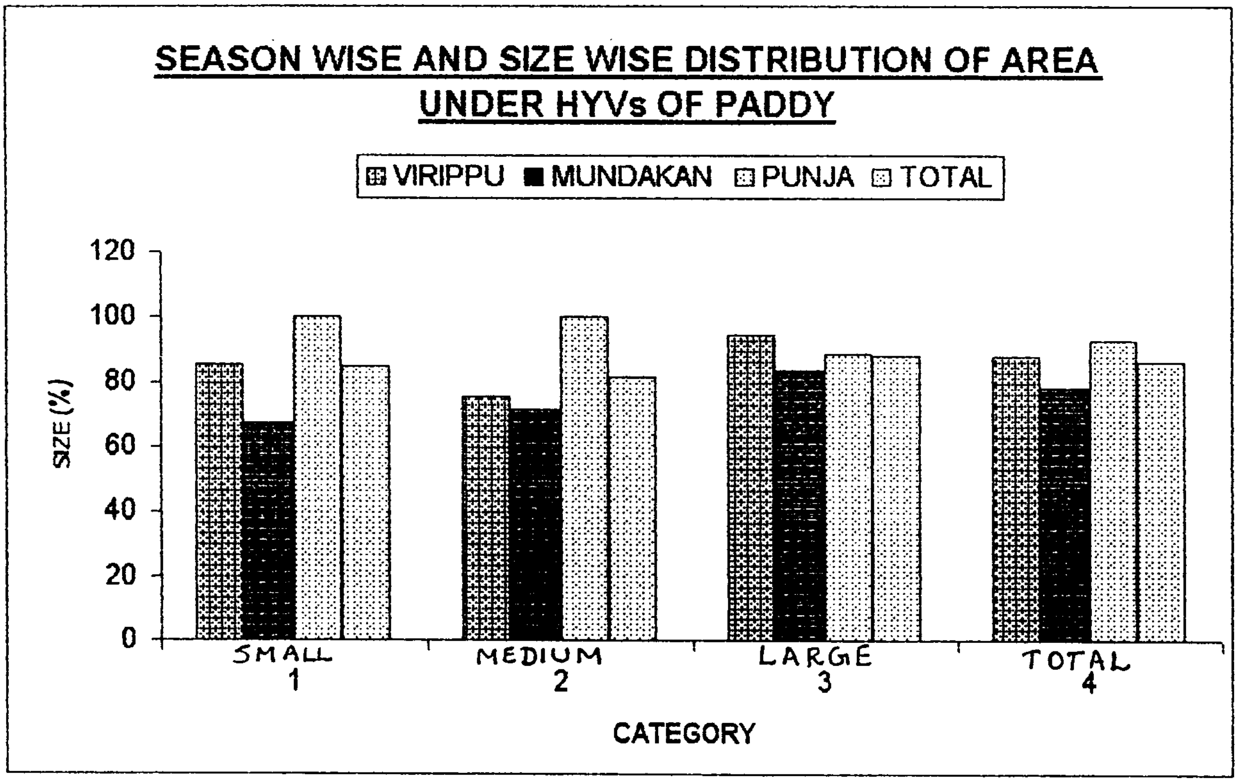

SEASON WISE AND SIZE WISE DISTRIBUTION OF AREA UNDER HYVs OF PADDY
VIRIPPU
MUNDAKAN
PUNJA
TOTAL
120
100
80
60
40
20
0
SIZE (%)
SMALL
1
MEDIUM
2
LARGE
3
TOTAL
4
CATEGORY

TABLE - 5.2

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS - HYVs OF PADDY

(Percentages)

Panchayats	Small	Medium	Large	Total
Vadakkekad	52.97 (66.67)	58.68 (66.67)	43.49 (50.00)	46.35 (58.33)
Punnayurkulam	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mala	46.69 (66.67)	37.20 (40.00)	84.47 (83.33)	67.49 (64.71)
Annamanada	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mathilakam	100.00 (100.00)	56.91 (60.00)	Nil	65.94 (75.00)
Adat	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Ayyanthole	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Wadakkanchery	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Velur	55.56 (50.00)	64.79 (66.67)	71.13 (66.67)	81.25 (60.00)

Note : Figures in Parantheses indicate adoption indices of acceptance.

Source : Computed from the Primary Data.

varieties in selected panchayats. It reveals that all of the sample cultivators in Punnayurkulam, Annamanada, Adat, Ayyanthole and Wadakkanchery Panchayats have adopted high yielding varieties. Of the remaining panchayats, Vadakkekad is at the lowest position in the adoption of HYVs.

5.3.2. Adoption of Fertilisers

Use of fertilisers in farming is of crucial importance in the package of modern inputs. Increasing agricultural production in general, and utilisation of potential productivity of new varieties in particular, depend largely on application of chemical fertilisers in adequate quantities. An interesting fact in this study is that most of the sample cultivators have adopted the dual strategy of using both organic and inorganic manures. So, both the exclusive adopters of dual strategy have been considered while computing the adoption indices. The exclusive adopters of inorganic manures constitute 20 percentage while the adoption index of area in this case is 29.71 percentage.

Table 5.3 presents the adoption indices in the case of fertilisers. It can be noted that the area index is 96.48 percentage whereas the index of acceptance is 92.86 percentage. Area index under large holdings show complete adoption of fertilisers. Of different seasons, the adoption is cent percentage in Mundakan and the lowest in Virippu.

TABLE - 5.3

ADOPTION INDICES OF AREA AND ACCEPTANCE FOR FERTILISERS - PADDY CULTIVATION

(Percentage)

Size	Virippu	Mundakan	Punja	Total
Small	83.57 (81.82)	100.00 (100.00)	92.18 (88.89)	91.88 (91.30)
Medium	74.23 (75.00)	100.00 (100.00)	90.05 (76.92)	85.57 (86.36)
Large	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Total	90.48 (85.71)	100.00 (100.00)	96.90 (92.00)	96.48 (92.86)

Note : Figures in parantheses indicate adoption indices of acceptance.

Source : Computed from the Primary Data.

FIGURE 5. 2

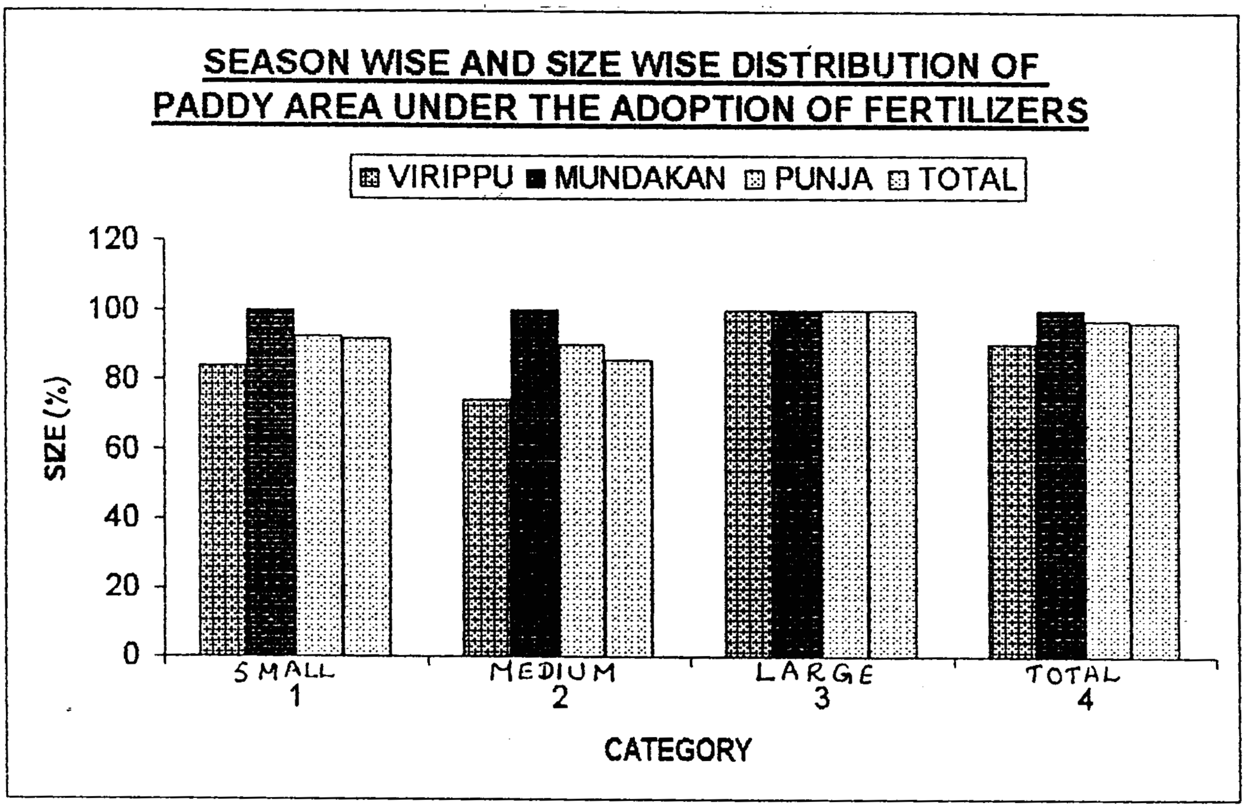

SEASON WISE AND SIZE WISE DISTRIBUTION OF PADDY AREA UNDER THE ADOPTION OF FERTILIZERS
VIRIPPU
MUNDAKAN
PUNJA
TOTAL
120
100
80
60
40
20
0
SIZE (%)
SMALL 1
MEDIUM 2
LARGE 3
TOTAL 4
CATEGORY

TABLE - 5.4

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS : FERTILISERS IN PADDY CULTIVATON

(Percentage)

Panchayats	Small	Medium	large	Total
Vadakkekad	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Punnayurkulam	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mala	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Annamanada	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mathilakam	20.83 (33.83)	56.91 (80.00)	Nil	49.34 (50.00)
Adat	100.00 (100 00)	100.00 (100 00)	100.00 (100.00)	100.00 (100.00)
Ayyanthole	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Wadakkanchery	100.00 (100.00)	71.06 (66.87)	100.00 (100.00)	93.33 (90.91)
Velur	88.10 (75.00)	64.79 (66.87)	100.00 (100.00)	88.23 (80.00)

Note : Figures in parantheses indicate adoption indices of acceptance.
Source : Computed from the Primary Data.

Seasonwise area under this practice in small, medium and large farms is depicted in figure 5.2.

Table 5.4 shows the adoption indices of fertilisers in selected panchayats. In Mathilakam Panchayat, the adoption of fertilisers is at lower level with area index 49.34 percent, because this area is exposed to flood and drought damage and so the application of chemical fertilisers entails considerable risks. In other panchayats except Wadakkancherry and Velur, whole area is under the adoption of fertilisers.

5.3.3 Adoption of Irrigation Practices

Among three crops, only Punja crop comes under the irrigation practice. In our sample farms, only 36.43 percentage of farms come under Punja crop which constitute about 38.79 percentage of total area. The remaining farms are not cultivated in summer season because of the inadequate facilities of irrigation. Majority of the Punja cultivators depend on Canal irrigation (82 percent) while the remaining 18 percentage depend on well.

Adoption indices of area and acceptance computed for irrigation are given in Table 5.5 and the corresponding area is picturised in Figure 5.3. The figures reveal that the adoption is comparatively higher in small holdings and lower in medium holdings. Table 5.6 shows the adoption indices

TABLE - 5.5

ADOPTION INDICES OF AREA AND ACCEPTANCE - IRRIGATION IN PADDY CULTIVATION

(Percentage)

Size	AI (area)	AI (acceptance)
Small	39.45	39.13
Medium	31.77	29.55
Large	36.86	36.00
Total	35.89	36.43

Source : Computed from the Primary Data.

FIGURE 5. 3

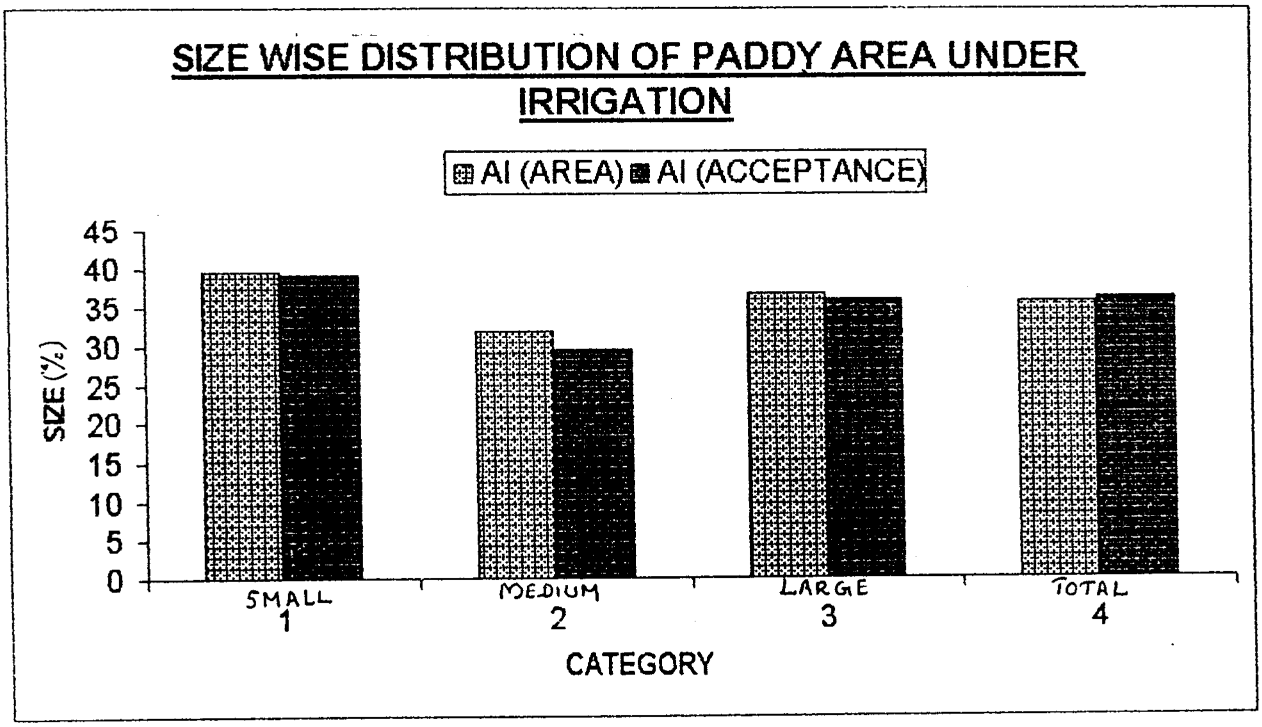

SIZE WISE DISTRIBUTION OF PADDY AREA UNDER IRRIGATION
AI (AREA)
AI (ACCEPTANCE)
SIZE (%)
45
40
35
30
25
20
15
10
5
0
SMALL
1
MEDIUM
2
LARGE
3
TOTAL
4
CATEGORY

TABLE - 5.6

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS :

IRRIGATION IN PADDY CULTIVATION

(Percentage)

PANCHAYATS	SMALL	MEDIUM	LARGE	TOTAL
Vadakkekad	18.32 (33.33)	0.00 (0.00)	61.18 (66.67)	49.35 (41.67)
Punnayurkulam	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mala	0.00 (0.00)	0.00 (0.00)	15.53 (16.67)	9.53 (5.88)
Annamanada	55.65 (57.14)	50.00 (50.00)	50.00 (50.00)	50.86 (52.63)
Mathilakam	39.58 (33.33)	27.54 (20.00)	Nil	25.33 (25.00)
Adat	100.00 (100.00)	38.42 (40.00)	47.37 (50.00)	47.73 (56.25)
Ayyanthole	56.82 (60.00)	82.14 (80.00)	48.58 (50.00)	59.05 (62.50)
Wadakkanchery	28.37 (28.57)	0.00 (0.00)	22.77 (22.22)	36.78 (18.18)
Velur	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

Note : Figures in parantheses indicate adoption indices of acceptance.

Sources : Computed from the Primary Data.

in different panchayats. The adoption index of irrigation in Punnayurkulam Panchayat (100 percent) reveals that the land area (low lying land) in this panchayat is suited only to Punja cultivation. Also the comparatively lower adoption index of irrigation in Mala Panchayat (A I area = 9.53% and A I accep. = 5.88%) throws light in to the fact that a severe problem of water scarcity is existing in the Panchayat during Punja Crop.

5.3.4. Adoption of Machineries

Recently, the use of machineries is being widespread allover the district. In our study, it is found out that tractor and tiller are being widely used among the farmers. 96.43 percentage of the sample farms have adopted tractor or tiller for ploughing out of which 7.06 percentage have used harvesters while 34.12 percentage have used threshers. The other commonly used machineries are electric or diesel pumps for irrigation and hand pumps for spraying insecticides. The adoption level of machineries like harvesters and threshers was in infancy in the district during the period of sample survey. So, in this study, we consider the farms, which have used at least one machinery for cultivation, under the category of adopters of machineries. Seasonwise distribution of area under this practice is illustrated in Figure 5.4.

The adoption indices of area and acceptance computed for machineries are given in Table 5.7. In large farms, all of the farmers have adopted at least one machine for

TABLE - 5.7

ADOPTION INDICES OF AREA AND ACCEPTANCE - MACHINERIES IN PADDY CULTIVATION

(Percentage)

Size	Virippu	Mundakan	Punja	Total
Small	100.00 (100.00)	95.47 (94.12)	88.56 (88.89)	93.86 (93.48)
Medium	88.71 (91.67)	92.14 (94.74)	100.00 (100.00)	93.67 (95.45)
Large	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Total	96.74 (97.14)	97.10 (96.30)	98.51 (98.00)	97.60 (96.43)

Note : Figures in parantheses indicate adoption indices of acceptance.

Source : Computed from the Primary Data.

FIGURE 5. 4

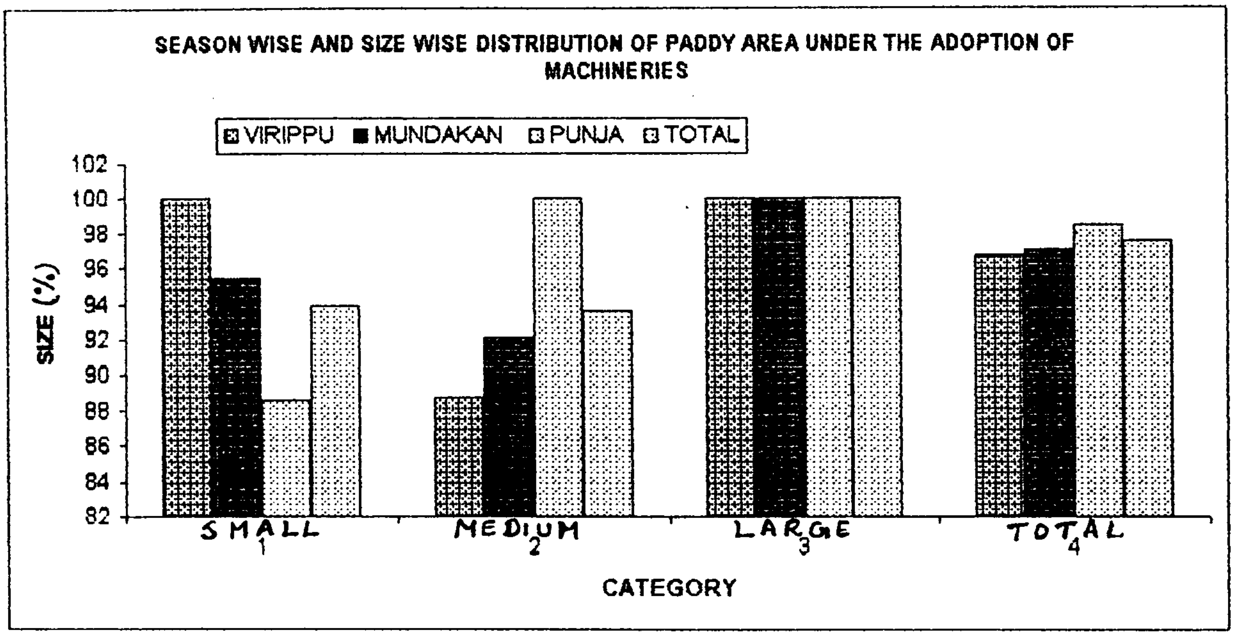

SEASON WISE AND SIZE WISE DISTRIBUTION OF PADDY AREA UNDER THE ADOPTION OF MACHINERIES
VIRIPPU
MUNDAKAN
PUNJA
TOTAL
SIZE (%)
102
100
98
96
94
92
90
88
86
84
82
SMALL 1
MEDIUM 2
LARGE 3
TOTAL 4
CATEGORY

TABLE - 5.8

ADOPTION INDICES OF AREA AND ACCEPTANCE IN

SELECTED PANCHAYATS : MACHINERIES IN PADDY CULTIVATION

(Percentage)

Panchayat	Small	Medium	Large	Total
Vadakkekad	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Punnayurkulam	51.90 (50.00)	100.00 (100.00)	100.00 (100.00)	91.11 (80.00)
Mala	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Annamanada	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mathilakam	79.17 (66.67)	66.30 (80.00)	100.00 (100.00)	69.00 (75.00)
Adat	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Ayyanthole	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Wadakkanchery	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Velur	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)

Note : Figures in parantheses indicate adoption indices of acceptance.

Source : Computed from the Primary Data.

cultivation during three seasons. Adoption level is the highest during Punja season (98.51 percentage) in which that of medium and large holdings is 100 percentage each.

Panchayatwise figures show that most of the panchayats have achieved 100 percentage adoption with respect to the small, medium and large holdings. (Table 5.8).

5.3.5 Adoption of Insecticides

Though the chemical insecticides have various harmful effects, about 80 percentage of the sample farmers have accepted this toxic method to kill the insects. None of the farmers has adopted biological methods to control the insects because of the higher cost of its execution.

From Table 5.9, it can be seen that 92.62 percentage of gross area have used insecticides. Of all categories of holdings, index of large holdings is comparatively higher (A I area = 95.97). Seasonwise indices show that the use of insecticides in sample farms is the lowest in Virippu season (A I area = 85.69% and A I accept. = 80%) and the highest in Punja season (A I area = 96.29% and A I accept. = 96.08%). Figure 5.5 illustrates the seasonwise distribution of area under the adoption of this practice.

Panchayatwise adoption indices of area and acceptance for insecticides are given in Table 5.10. The sample farms

TABLE - 5.9

ADOPTION INDICES OF AREA AND ACCEPTANCE-INSECTICIDES

IN PADDY CULTIVATION

(Percentage)

Size	Virippu	Mundakan	Punja	Total
Small	68.86 (63.64)	78.53 (76.47)	94.49 (94.44)	82.44 (80.43)
Medium	81.47 (83.33)	94.96 (94.74)	90.05 (92.31)	89.62 (90.91)
Large	91.43 (91.67)	94.22 (94.44)	100.00 (100.00)	95.97 (96.00)
Total	85.69 (80.00)	92.46 (88.89)	96.29 (96.08)	92.62 (89.29)

Note : Figures in parantheses indicate adoption indices of acceptance.

Source : Computed from the primary data.

FIGURE 6 .5

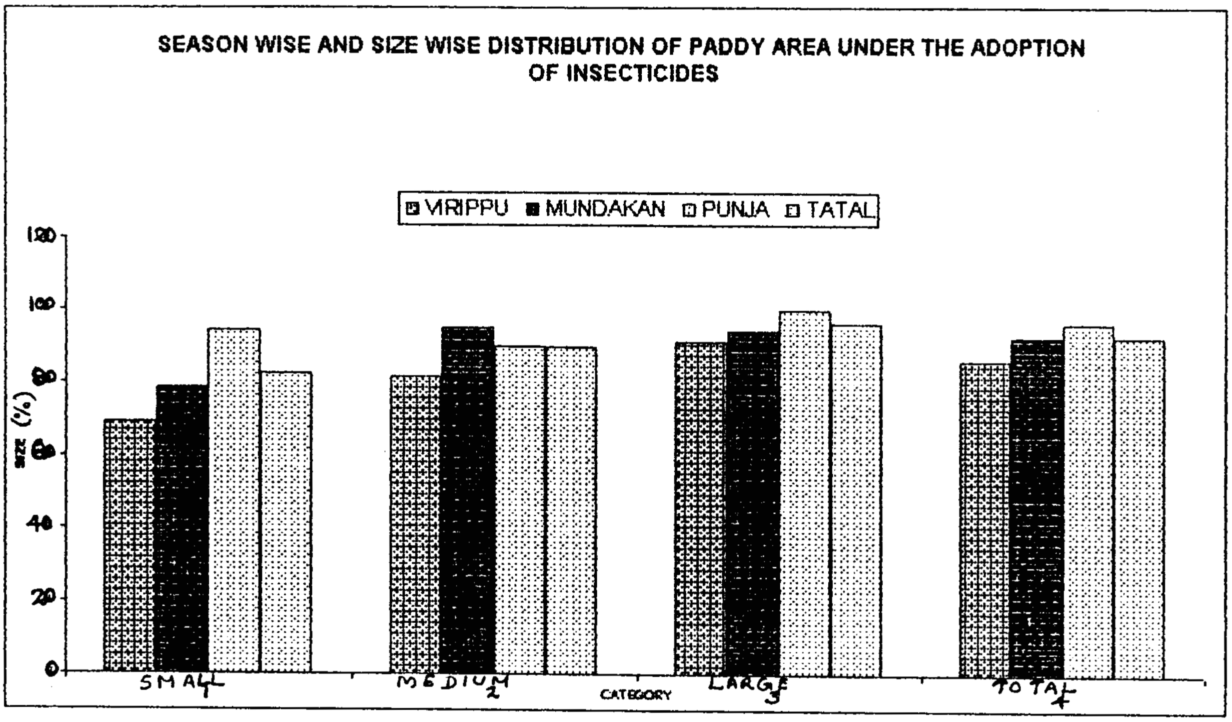

SEASON WISE AND SIZE WISE DISTRIBUTION OF PADDY AREA UNDER THE ADOPTION OF INSECTICIDES
VIRIPPU
MUNDAKAN
PUNJA
TATAL
SIZE (%)
0
20
40
60
80
100
120
SMALL
MEDIUM
LARGE
TOTAL
CATEGORY

TABLE - 5.10

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS :

INSECTICIDES IN PADDY CULTIVATION

(Percentage)

Panchayats	Small	Medium	Large	Total
Vadakkekad	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Punnayurkulam	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mala	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Annamanada	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mathilakam	100.00 (100.00)	56.91 (80.00)	-	65.94 (75.00)
Adat	100.00 (100.00)	100.00 (100.00	100.00 (100.00)	100.00 (100.00)
Ayyanthole	100.00 (100.00)	100.00 (100.00)	100.00 (100)	100.00 (100.00
Wadakkanchery	33.27 (28.57)	71.06 (66.67)	100.00 (100.00)	83.17 (68.18)
Velur	68.25 (50.00)	100.00 (100.00)	57.75 (66.67)	71.15 (70.00)

Note : Figures in parantheses indicate adoption indices of acceptance.

Source : Computed from the Primary Data.

in all panchayats except Mathilakam, Wadakkancherry and Velur have adopted insecticides as one among the farm practices.

5.3.6 Adoption of Different Combination of Practices

The different modern practices adopted in farm operation are highly correlated and certain combination of practices in right proportion may provide better results. So, in this context, it is necessary to evaluate the intensity of adoption of certain combinations among sample farmers.

5.3.6.1 HYV and Fertilisers

Since most of the high yielding varieties of paddy need right amount of fertiliser for their growth, these two practices are so much related. Table 5.11 gives adoption indices of area and acceptance for HYV and fertilisers together. 82.60 percentage of gross area are under this combined operation. When we compare this figure with that for HYV only, we can conclude that all of the HYV adopters have not adopted fertilisers. But sizewise indices reveal that all of the large holders who adopted HYV also have adopted fertilisers.

Table 5.12 indicates that all sample cultivators in the panchayats of Punnayurkulam, Annamanada, Adat and Ayyanthole come under this combined strategy. In Vadakkekad and Mala panchayats, all of the HYV adopters have used fertilisers also in their farm operations.

TABLE - 5.11

ADOPTION INDICES OF AREA AND ACCEPTANCE : HYV AND FERTILISERS IN PADDY CULTIVATION

(Percentage)

Size	Virippu	Mundakan	Punja	Total
Small	72.80 (72.73)	67.39 (70.59)	92.18 (94.44)	78.51 (80.43)
Medium	56.88 (58.33)	66.49 (68.42)	90.05 (92.31)	71.28 (72.73)
Large	94.14 (91.67)	83.44 (83.33)	88.68 (90.00)	88.13 (88.00)
Total	80.68 (74.29)	76.63 (74.07)	89.42 (92.16)	82.60 (80.71)

Note : Figures in parantheses indicates indices of acceptance.

Source : Computed from the Primary Data.

TABLE - 5.12

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS

HYV AND FERTILISERS IN PADDY CULTIVATION

(Percentage)

Panchayats	Small	Medium	Large	Total
Vadakkekad	52.97 (66.67)	58.68 (66.67)	43.49 (50.00)	46.35 (58.33)
Punnayurkulam	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mala	46.69 (66.67)	37.20 (40.00)	84.47 (83.33)	67.49 (64.71)
Annamanada	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mathilakam	20.83 (33.33)	13.81 (20.00)	100.00 (100.00)	15.28 (25.00)
Adat	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Ayyanthole	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Wadakkanchery	100.00 (100.00)	71.06 (66.67)	100.00 (100.00)	93.33 (90.91)
Velur	56.56 (50.00)	64.79 (66.67)	71.13 (66.67)	66.44 (60.00)

Note : Figures in parantheses indicate indices of acceptance.

Source : Computed from the Primary Data.

5.3.6.2 HYV and Irrigation

Availability of irrigation facilities has been found to be an important favourable factor for adoption of modern varieties. Especially in the dry season irrigation is undoubtedly a crucial factor for adoption of modern rice varieties.

Table 5.13 represents adoption indices for this combined strategy, HYV and irrigation. When we compare these figures with those in Table 5.5, it can be realised that 100 percentage of the Punja cultivators under small and medium holdings have adopted HYV also and thus they come under this combined package. At the same time, a few of the Punja cultivators under large holdings have not accepted modern varieties.

Panchayatwise adoption indices (table 5.14) reveal that the sample cultivators in all panchayats except Vadakkekad have adopted high yielding varieties for their Punja cultivation. In Punnayurkulam panchayat, 100 percentage of the sample area come under this combined adoption of inputs.

5.3.6.3 HYV and Machineries

Since the life period of HYVs is comparatively smaller it facilitates multiple cropping of paddy. So, the availability of machineries is a necessary for the fast and

TABLE - 5.13

ADOPTION INDICES OF AREA AND ACCEPTANCE

HYV AND IRRIGATION IN PADDY CULTIVATION

(Percentage)

Size	AI (Area	AI (Acceptance)
Small	39.46	39.13
Medium	31.77	29.55
Large	36.86	36.00
Total	35.89	35.00

Source : Computed from the Primary Data.

TABLE - 5.14

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS : HYV AND IRRIGATION IN PADDY CULTIVATION

(Percentage)

Panchayats	Small	Medium	Large	Total
Vadakkekad	18.32 (33.33)	0.00 (0.00)	26.78 (33.33)	22.40 (25.00)
Punnayurkulam	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mala	0.00 (0.00)	0.00 (0.00)	15.53 (16.67)	9.53 (5.88)
Annamanada	55.65 (57.14)	50.00 (50.00)	50.00 (50.00)	50.86 (52.63)
Mathilakam	39.58 (33.33)	27.54 (20.00)	-	25.33 (25.00)
Adat	100.00 (100.00)	38.42 (40.00)	47.37 (50.00)	47.73 (56.25)
Ayyanthole	(56.82) (60.00)	82.14 (80.00)	48.58 (50.00)	59.05 (62.50)
Wadakkanchery	28.37 (28.57)	0.00 (0.00)	22.77 (22.22)	36.78 (18.18)
Velur	-	-	-	-

Note : Figures in parantheses indicate indices of acceptance.

Source : Computed from the Primary Data.

efficient execution of farm operations like ploughing, harvesting, threshing etc.

Adoption indices for this combined practice, HYV and Machineries (Table 5.15) show that 85.25 percentage of sample area come under this strategy in which the proportion of accepters is greater under large holdings. It is a fact that a few of the HYV adopters (4.23 percentage) have not used any of the machineries for farm operation. All those who have used harvesters are HYV adopters, but only 86.21% have adopted HYV among the users of threshers. Punja crop shows higher index (A I area = 91.03) in this respect whereas the value of index is lower (A I area = 77.48) for Mundakan Crop.

Adoption indices in different panchayats (Table 5.16) show that all of the sample cultivators in Annamanada, Adat, Ayyanthole and Wadakkanchery panchayats have adopted this combined practice. The index of area is the smallest in Vadakkekad Panchayat (33.27 percent) while the corresponding acceptance index is 50 percentage.

5.3.6.4 <u>HYV and Insecticides</u>

Since the high yielding varieties may get easily diseased, insecticide is an inevitable factor during the growth of plants. Figures in Table 5.17 show that 78.90 percentage of sample area is under this combined strategy.

TABLE - 5.15

ADOPTION INDICES OF AREA AND ACCEPTANCE : HYV AND MACHINERIES IN PADDY CULTIVATION

(Percentage)

Size	Virippu	Mundakan	Punja	Total
Small	85.28 (81.82)	62.86 (64.71)	88.56 (88.89)	78.54 (78.26)
Medium	75.39 (75.00)	71.53 (73.68)	100.00 (100.00)	81.66 (81.82)
Large	94.14 (91.67)	83.44 (83.33)	88.68 (90.00)	88.13 (88.00)
Total	87.61 (82.86)	77.48 (74.07)	91.03 (92.16)	85.25 (82.86)

Note : Figures in parantheses indicate indices of acceptance.

Source : Computed from the primary data.

TABLE - 5.16

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS : HYV AND MACHINERIES IN PADDY CULTIVATION

(Percentage)

Panchayats	Small	Medium	Large	Total
Vadakkekad	52.97 (66.67)	58.68 (66.67)	26.78 (33.33)	33.27 (50.00)
Punnayurkulam	51.90 (50.00)	100.00 (100.00)	100.00 (100.00)	91.11 (80.00)
Mala	46.69 (66.67)	37.20 (40.00)	84.47 (83.33)	67.49 (64.71)
Annamanada	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mathilakam	79.17 (80.00)	80.11 (80.00)	-	79.91 (75.00)
Adat	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Ayyanthole	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Wadakkanchery	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Velur	55.56 (50.00)	64.79 (66.67)	71.13 (66.67)	66.44 (60.00)

Note : Figures in parantheses indicate indices of acceptance.

Source : Computed from the Primary Data.

TABLE - 5.17

ADOPTION INDICES OF AREA AND ACCEPTANCE :

HYV AND INSECTICIDES IN PADDY CULTIVATION

(Percentage)

Size	Virippu	Mundakan	Punja	Total
Small	50.08 (54.55)	48.64 (52.94)	94.49 (94.94)	69.06 (69.57)
Medium	56.86 (58.33)	66.49 (68.42)	90.05 (92.31)	71.28 (72.73)
Large	85.57 (83.33)	77.66 (77.78)	88.68 (90.00)	84.10 (84.00)
Total	73.80 (65.71)	70.85 (66.67)	89.72 (92.16)	78.90 (75.71)

Note : Figures in parantheses indicate indices of acceptance.

Source : Computed from the primary data.

TABLE - 5.18

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS :

HYV AND INSECTICIDES IN PADDY CULTIVATION

(percentage)

Panchayats	Small	Medium	Large	Total
Vadakkekad	52.97 (66.67)	58.68 (66.67)	43.49 (50.00)	46.35 (58.33)
Punnayurkulam	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mala	46.89 (66.67)	37.20 (40.00)	84.47 (83.33)	67.49 (64.71)
Annamanada	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mathilakam	100.00 (100.00)	13.81 (20.00)	-	31.88 (50.00)
Adat	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Ayyanthole	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Wadakkanchery	33.27 (28.57)	71.06 (66.67)	100.00 (100.00)	83.17 (68.18)
Velur	35.71 (25.00)	64.79 (66.67)	28.87 (33.33)	39.86 (40.00)

Note : Figures in parantheses indicate indices of acceptance.

Source : Computed from the primary data.

Also it can be realised that 8.45 percentage of the HYV adopters have not used insecticides.

Panchayatwise figures (Table 5.18) reveal that cent percentage of the sample cultivators in Punnayurkulam, Annamanada, Adat and Ayyanthole Panchayats have adopted this strategy. But, only a few of the HYV cultivators in Mathilakam, Wadakkancherry and Velur Panchayats have used insecticides.

5.3.6.5 HYV, IRRIGATION AND FERTILISERS

The combined use of these technological inputs would give better results in normal situations. Adoption indices of area and acceptance (Table 5.19) in this respect reveal that most of the irrigated area (95.29%) has made use of the other two inputs of HYV and fertilisers. Adoption of this combined strategy is greater in small and large holdings. However, only 34.68 percentage of total area studied has adopted this combined strategy.

Panchayatwise figures of adoption indices (Table 5.20) show that none of the sample cultivators in Mathilakam and Velur Panchayats has adopted this strategy while 100 percentage of the sample cultivators in Punnayurkulam Panchayat have accepted these three practices together.

5.3.6.6 HYV, Irrigation, Fertilisers, Machineries and Insecticides

The entire package of modern inputs includes all of these inputs like HYV, Irrigation, Fertilisers, Machineries

TABLE - 5.19

ADOPTION INDICES OF AREA AND ACCEPTANCE : HYV, IRRIGATION AND FERTILISERS IN PADDY CULTIVATION

(Percentage)

Size	AI (Area)	AI (Acceptance)
Small	36.36	36.96
Marginal	28.61	27.27
Large	36.86	36.00
Total	34.68	33.57

Source : Computed from the primary data.

TABLE - 5.20

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS :

HYV, IRRIGATION AND FERTILISERS IN PADDY CULTIVATION

(Percentage)

Panchayats	Small	Medium	Large	Total
Vadakkekad	18.32 (33.33)	0.00 (0.00)	26.78 (33.33)	22.38 (25.00)
Punnayurkulam	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Mala	0.00 (0.00)	0.00 (0.00)	15.53 (16.67)	9.53 (5.88)
Annamanada	55.65 (57.14)	50.00 (50.00)	51.14 (50.00)	50.86 (52.63)
Mathilakam	0.00 (0.00)	0.00 (0.00)	-	0.00 (0.00)
Adat	100.00 (100.00)	38.42 (40.00)	47.37 (50.00)	47.73 (56.25)
Ayyanthole	56.82 (60.00)	64.29 (60.00)	48.58 (50.00)	54.11 (56.25)
Wadakkanchery	28.37 (28.57)	0.00 (0.00)	22.77 (22.22)	18.38 (18.18)
Velur	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

Note : Figures in parantheses represent indices of acceptance.

Source : Computed from the primary data.

and Insecticides. If this package is adopted in correct proportion in right time, this would result in better yield.

In our study, 33.83 percentage of the total area comes under the use of this package while the corresponding acceptance index is 31.43 percentage. Figures in Table 5.21 reveal that the indices of area and acceptance for this package is relatively higher in large holdings (A I area = 36.86% and A I accep. = 36%). It is to be noted that all of the irrigated area under large holdings has adopted all other inputs.

Among the selected Panchayats, adoption rate of this modern package is the highest in Punnayurkulam panchayat (AI area = 91.11% and A I accep. = 80.00%). None of the farmers in Mathilakam and Velur panchayats has adopted this combined practice. (Table 5.22).

5.3.6.7 HYV, Fertilisers, Insecticides and Machineries

Since the adoption of irrigation practices is confined only to Punja cultivation, the intensity of adoption of other inputs could not be assessed along with irrigation. So, an attempt is made to compute the adoption indices by considering the inputs like HYV, fertilisers, insecticides and machineries.

Table 5.23 shows adoption indices in this respect. It can be understood that 77.33 percentage of total area

TABLE - 5.21

ADOPTION INDICES OF AREA AND ACCEPTANCE : HYV, IRRIGATION, FERTILISERS, INSECTICIDES AND MACHINERIES IN PADDY CULTIVATION

(Percentage)

Size	AI (Area)	AI (Acceptance)
Small	29.68	30.43
Marginal	28.61	27.27
Large	36.86	36.00
Total	33.83	31.43

Source : Computed from the Primary Data.

TABLE - 5.22

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS : HYV, IRRIGATION, FERTILISERS, INSECTICIDES AND MACHINERIES IN PADDY CULTIVATION

(Percentage)

Panchayats	Small	Medium	Large	Total
Vadakkekad	18.32 (33.33)	0.00 (0.00)	26.78 (33.33)	22.38 (25.00)
Punnayurkulam	51.90 (50.00)	100.00 (100.00)	100.00 (100.00)	91.11 (80.00)
Mala	0.00 (0.00)	0.00 (0.00)	15.53 (16.67)	9.53 (5.88)
Annamanada	55.65 (57.14)	50.00 (50.00)	51.14 (50.00)	50.86 (52.63)
Mathilakam	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Adat	100.00 (100.00)	38.42 (40.00)	47.37 (50.00)	47.73 (56.25)
Ayyanthole	56.82 (60.00)	64.29 (60.00)	48.58 (50.00)	54.11 (56.25)
Wadakkanchery	16.64 (14.29)	0.00 (0.00)	22.77 (22.22)	18.38 (18.18)
Velur	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

Note : Figures in parantheses indicate indices of acceptance.

Source : Computed from the Primary Data.

TABLE - 5.23

ADOPTION INDICES OF AREA AND ACCEPTANCE : HYV, FERTILISER, INSECTICIDES AND MACHINERIES IN PADDY CULTIVATION

(Percentage)

Size	Virippu	Mundakan	Punja	Total
Small	45.60 (45.45)	44.11 (47.06)	75.23 (77.78)	56.75 (58.70)
Medium	56.86 (58.33)	66.49 (68.42)	90.05 (92.31)	71.28 (72.73)
Large	85.57 (83.33)	77.66 (77.78)	88.68 (90.00)	84.10 (84.10)
Total	72.21 (62.86)	70.28 (64.81)	87.22 (86.27)	77.33 (72.14)

Note : Figures in parantheses indicate indices of acceptance.

Source : Computed from the Primary Data.

FIGURE 6. 6.

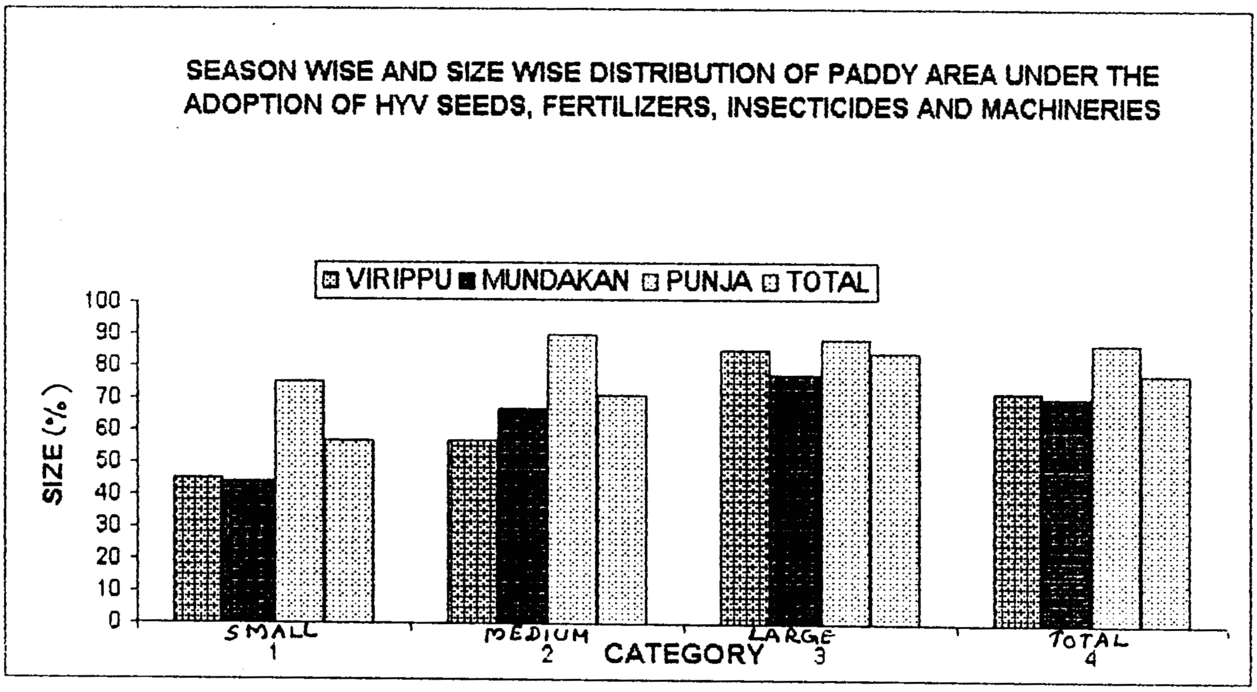

SEASON WISE AND SIZE WISE DISTRIBUTION OF PADDY AREA UNDER THE ADOPTION OF HYV SEEDS, FERTILIZERS, INSECTICIDES AND MACHINERIES
VIRIPPU
MUNDAKAN
PUNJA
TOTAL
100
90
80
70
60
50
40
30
20
10
0
SIZE (%)
SMALL
1
MEDIUM
2
LARGE
3
TOTAL
4
CATEGORY

TABLE - 5.24

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS :

HYV, FERTILISERS, INSECTICIDES & MACHINERIES IN PADDY CULTIVATION

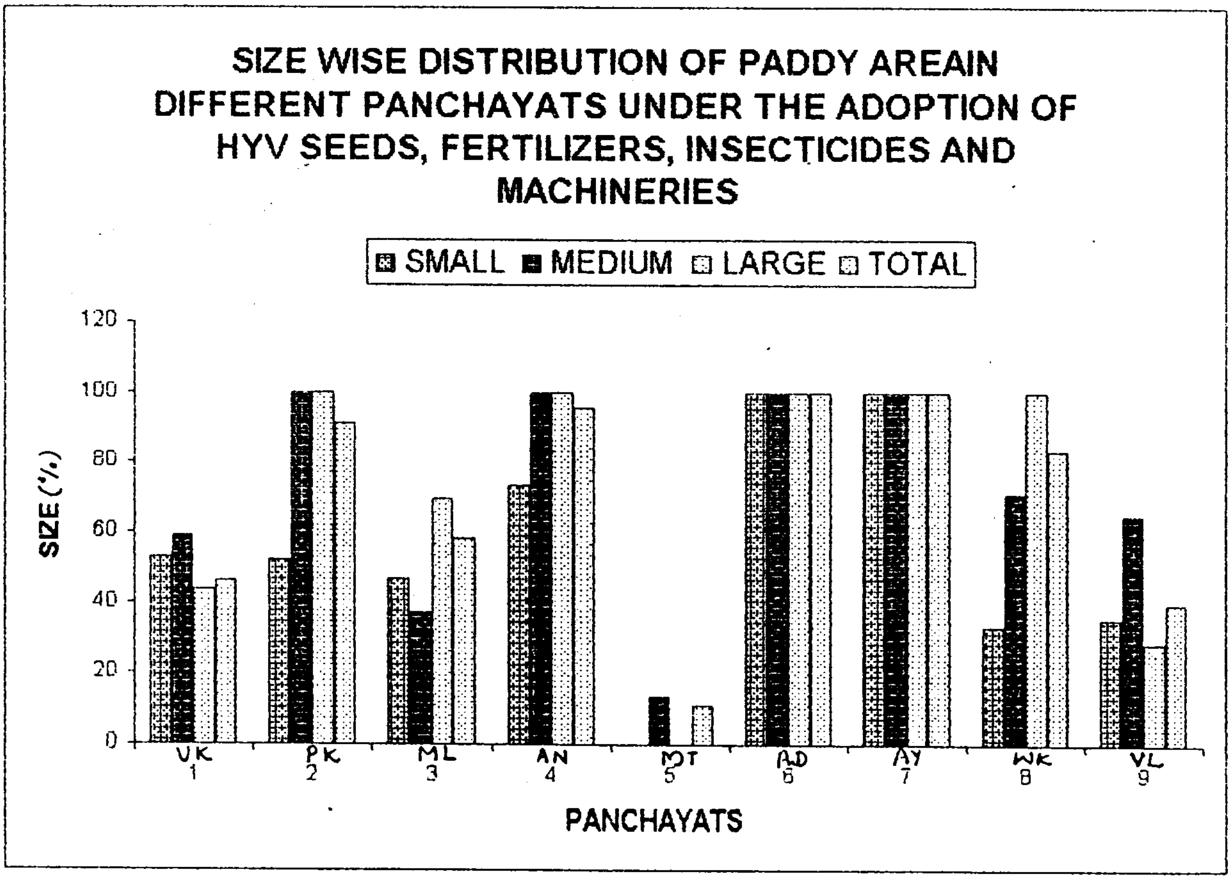
(Percentage)

Panchayats	Small	Medium	Large	Total
Vadakkekad	52.97 (66.67)	58.68 (66.67)	43.49 (50.00)	46.35 (58.33)
Punnayurkulam	51.90 (50.00)	100.00 (100.00)	100.00 (100.00)	91.11 (80.00)
Mala	46.69 (66.67)	37.20 (40.00)	69.32 (83.33)	58.19 (64.71)
Annamanada	73.12 (77,31)	100.00 (100.00)	100.00 (100.00)	95.88 (100.00)
Mathilakam	0.00 (0.00)	13.81 (20.00)	-	10.92 (12.50)
Adat	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Ayyanthole	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)	100.00 (100.00)
Wadakkanchery	33.27 (28.57)	71.06 (66.67)	100.00 (100.00)	83.17 (68.18)
Velur	35.71 (25.00)	64.79 (66.67)	28.87 (33.33)	39.86 (40.00)

Note : Figures in parantheses indicate indices of acceptance.

Source : Computed from the Primary Data.

FIGURE 5.7.


SIZE WISE DISTRIBUTION OF PADDY AREAIN DIFFERENT PANCHAYATS UNDER THE ADOPTION OF HYV SEEDS, FERTILIZERS, INSECTICIDES AND MACHINERIES
SMALL
MEDIUM
LARGE
TOTAL
SIZE (%)
0
20
40
60
80
100
120
VK 1
PK 2
ML 3
AN 4
MT 5
AD 6
AY 7
WK 8
VL 9
PANCHAYATS

come under the adoption of these practices. The acceptance is higher in large holdings (84 percentage) and smaller in small holdings (58.70 percentage). These practices are adopted largely in Punja cultivation. This can be visualised from the Figure 5.6.

Panchayatwise figures (Table 5.24) show that the adoption is cent percentage in Adat and Ayyanthole Panchayats whereas it is the lowest in Mathilakam Panchayat (10.92 percent). The adoption level of this combined practice in different panchayats is depicted in figure 5.7.

5.4 Adoption of Modern Practices in Coconut Cultivation - An Analysis

The potential for increasing productivity of coconut crucialy depends on the availability of technologies for raising the same and the diffusion of technologies at the farm level. In this context it is necessary to have an understanding of the nature and magnitude of technology adopted by the coconut cultivators in the district.

The technologies may broadly be conceived to consist of improvements in planting material (HYVs), information on manurial and irrigation practices and methods of insect control. The adoption level is assessed by considering exclusively the adult palms.

Adoption indices of area and acceptance for single inputs and combination of inputs are given in Table 5.25. High yielding varieties of coconut are adopted by only 23 percentage of the sample cultivators in which the adoption index of area is 24.34 percentage. Also, in the small and large categories of holdings, adoption level of HYVs is comparatively higher than that in the medium holdings.

At the same time, irrigation practice is adopted by 86 percentage of the farmers whereas the corresponding area index is 87.48 percentage. This practice is largely adopted by medium holdings (A I area = 90.22 percent). The index for combined practice of HYV and irrigation reveal that a few of the HYV adopters have not adopted irrigation practices. They depend exclusively on rain.

Adopters of fertilisers include not only the users of inorganic manures alone but also both organic and inorganic manures. 58 percentage of the farmers use fertilisers for the cultivation. Also it is clear that only 15 percentage of the cultivators have adopted the combined strategy of HYV and fertilisers while the acceptance index for HYV alone is 23 percentage. That is, 8 percentage of HYV adopters have not used fertilisers. Also it is to be noted that only 14 percentage of the cultivators have accepted the input package of HYV, irrigation and fertilisers.

TABLE - 5.25

ADOPTION INDICES OF AREA AND ACCEPTANCE -

COCONUT CULTIVATION (ADULT PALMS)

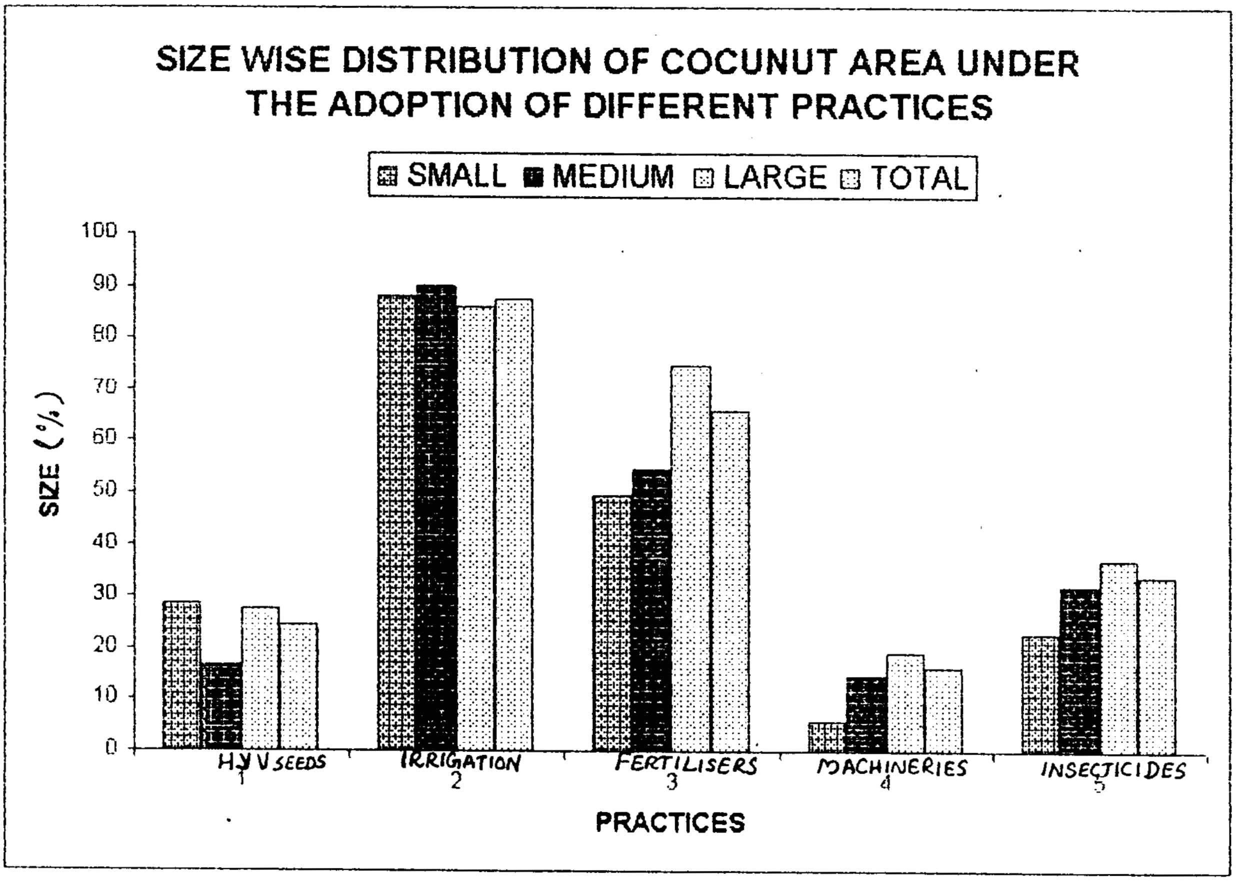
(Percentage)

Sl.No.	Practices	Small	Medium	Large	Total
1.	H Y V	28.60 (28.13)	16.47 (16.67)	27.78 (25.00)	24.34 (23.00)
2.	Irrigation	88.13 (84.38)	90.22 (88.89)	85.93 (84.38)	87.48 (86.00)
3.	Fertilisers	49.53 (53.13)	54.62 (52.78)	74.92 (68.75)	65.87 (58.00)
4.	Machineries	5.57 (3.13)	14.87 (13.89)	19.19 (18.75)	16.39 (12.00)
5.	Insecticides	23.16 (21.88)	32.30 (30.56)	37.42 (37.50)	34.28 (30.00)
6.	HYV & Irrigation	23.04 (25.00)	13.48 (13.89)	24.56 (21.88)	20.93 (20.00)
7.	HYV & Fertilisers	11.02 (15.63)	8.88 (8.33)	24.62 (21.88)	18.25 (15.00)
8.	HYV & Insecticides	8.21 (6.25)	3.89 (2.78)	12.89 (9.38)	9.58 (6.00)
9.	HYV, Irrigation & Fertilisers.	11.02 (15.63)	5.89 (5.56)	24.62 (21.88)	17.32 (14.00)
10.	HYV, Irrigation, Fertilisers and Insecticides.	2.64 (3.13)	3.89 (2.78)	12.89 (9.38)	8.99 (5.00)

Note : Figures in brackets indicate adoption index of acceptance.

Source : Computed from the Primary Data.

FIGURE 5. 8.


SIZE WISE DISTRIBUTION OF COCUNUT AREA UNDER THE ADOPTION OF DIFFERENT PRACTICES
SMALL
MEDIUM
LARGE
TOTAL
SIZE (%)
100
90
80
70
60
50
40
30
20
10
0
HYV SEEDS
1
IRRIGATION
2
FERTILISERS
3
MACHINERIES
4
INSECTICIDES
5
PRACTICES

In the case of single inputs, adoption level is the least for machineries. Adoption index of acceptance in this respect is 12 percentage in which the share of large holdings is relatively higher. This low level of adoption is due to the cultivation of other crops along with coconut in the same area.

The figures for insecticides indicate that 30 percentage of the farmers have used the same in which the share of acceptance is comparatively higher in large holdings. Also it is to be noted that only a few of the HYV adopters (6 percent) has used insecticides.

Adoption indices for the whole package of inputs except machineries show that only 5 percentage of the total farmers come under this practice. From this, we can conclude that the adoption of modern practices in coconut cultivation is very rare in the study area. Area under the adoption of single practices and the combined practice excluding machineries is illustrated in figure 5.8.

5.4.1 Adoption of Modern Practices in Coconut Cultivation in Selected Panchayats

Though the overall adoption level is the lowest among coconut cultivators, it is necessary to examine whether there is any concentration of these practices in any of the selected panchayats. Table 5.26 shows adoption indices in selected

TABLE - 5.26

ADOPTION INDICES OF AREA AND ACCEPTANCE IN SELECTED PANCHAYATS FOR DIFFERENT MODERN PRACTICES - COCONUT CULTIVATION

(Percentage)

Panchayats	H Y V	Irrigation	Fertilisers	Machineries	Insecticides
Vadakkekad	12.2 (10.0)	80.30 (80.0)	75.12 (60.0)	11.89 (10.0)	23.72 (20.0)
Punnayurkulam	0.00 (0.0)	87.33 (70.0)	88.08 (80.0)	74.52 (50.0)	16.77 (10.0)
Mala	23.1 (20.0)	82.67 (90.0)	44.19 (40.0)	0.0 (0.0)	34.26 (40.0)
Annamanada	45.7 (30.0)	100.0 (100.0)	81.23 (70.0)	28.87 (10.0)	43.31 (30.0)
Mathilakam	35.3 (40.0)	93.90 (80.0)	81.97 (70.0)	0.0 (0.0)	32.09 (40.0)
S.N.Puram	43.3 (40.0)	100.0 (100.0)	84.09 (70.0)	26.45 (30.0)	63.96 (60.0)
Adat	20.5 (30.0)	57.32 (70.0)	59.06 (60.0)	0.0 (0.0)	43.62 (40.0)
Ayyanthole	12.6 (30.0)	90.05 (90.0)	51.66 (70.0)	0.0 (0.0)	39.34 (30.0)
Wadakkanchery	23.8 (20.0)	76.17 (80.0)	53.43 (30.0)	9.03 (10.0)	0.0 (0.0)
Velur	4.5 (10.0)	100.00 (100.00)	14.93 (20.0)	15.30 (10.0)	33.21 (30.0)

Note : Figures in parantheses indicate adoption indices of acceptance.

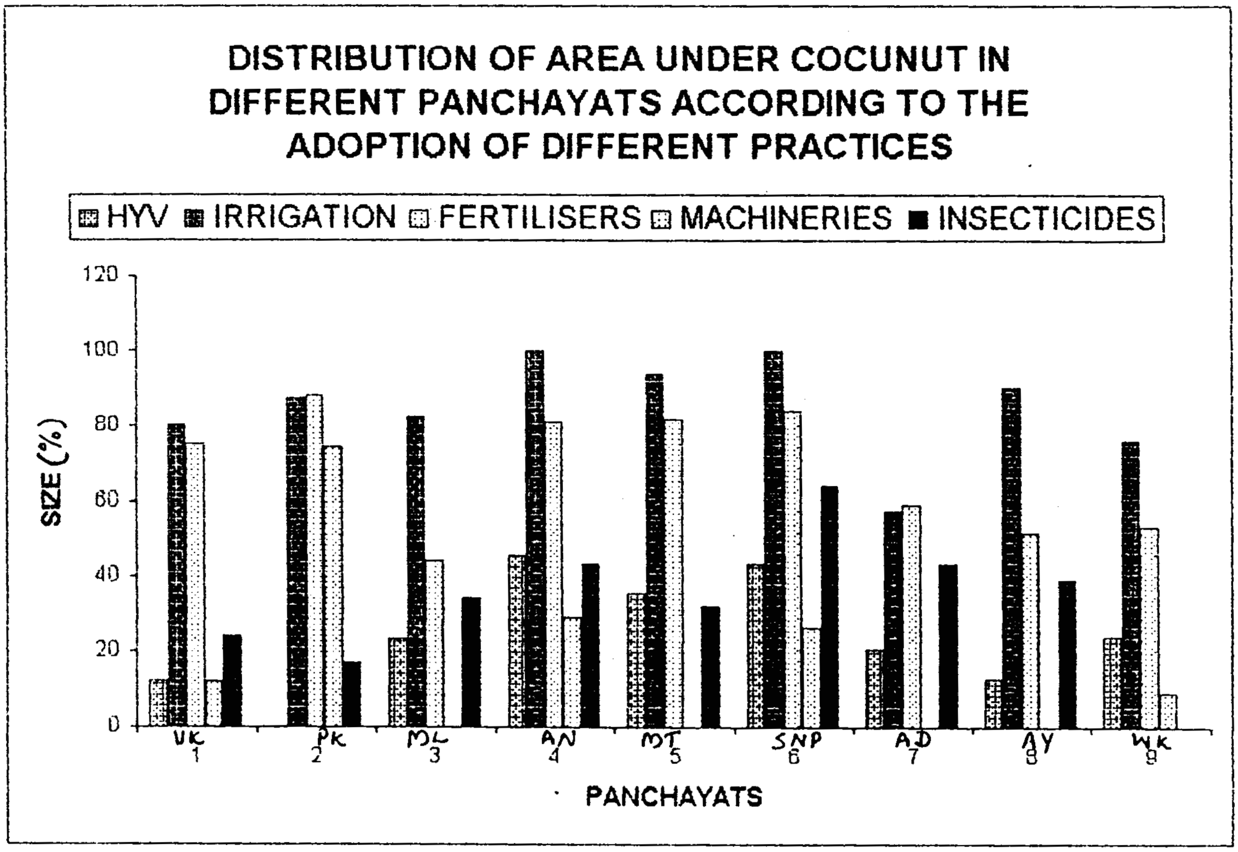
Source : Computed from the Primary Data.

panchayats. Adoption indices of acceptance for HYVs reveal that the adoption is relatively higher in Mathilakam and SN Puram panchayats (40% each) while none of the cultivators in Punnayurkulam panchayat come under this category. But, with respect to the area, Annamanada panchayat is at the top level because of the reason that all of the HYV adopters in this panchayat belong to the categories of medium and large holdings.

Indices for irrigation reveal that 100 percentage of the cultivators in Annamanada, SN Puram and Velur Panchayats have adopted irrigation.Adoption of this practice is comparatively higher in all panchayats than that of other inputs. In the case of fertilisers, adoption is the highest among cultivators in Punnayurkulam Panchayat whereas it is the lowest in Velur Panchayat. Use of machineries is highly concentrated in Punnayurkulam Panchayat whereas it is absolutey absent in Mala, Mathilakam, Adat and Ayyanthole Panchayats.

Insecticides are largely adopted in SN Puram Panchayat (A I area = 63.96 and A I accept = 60.0) whereas none of the sample cultivators in Wadakkancherry has used insecticides. The use of insecticides mainly depends upon the spread of diseases and the attack of insects and pests. From the field survey, it is very much lucid that eventhough the farmers face problems related to the palm diseases, they don't use insecticides due to their own personal problems.

FIGURE 5. 9


DISTRIBUTION OF AREA UNDER COCUNUT IN DIFFERENT PANCHAYATS ACCORDING TO THE ADOPTION OF DIFFERENT PRACTICES
HYV
IRRIGATION
FERTILISERS
MACHINERIES
INSECTICIDES
SIZE (%)
120
100
80
60
40
20
0
VK 1
PK 2
ML 3
AN 4
MT 5
SNP 6
AD 7
AY 8
WK 9
PANCHAYATS

In SN Puram panchayat, the adoption of practices like HYV, irrigation and insecticides is higher whereas in Punnayurkulam Panchayat, eventhough they don't use HYVs, the adoption of other inputs like fertilisers and machineries is very much in practice. From this we can conclude that the adoption of HYVs is not a necessary precondition for the adoption of other inputs like machineries and fertilisers. Area under the adoption of single practices in different panchayatsis depicted in Figure 5.9.

5.5 Adoption of HYVs and Socio-economic Factors

HYV seeds form the very core of the new farm technology which constitutes the main strand of this strategy. Accordingly, adoption of HYVs by farmers is a vital necessary pre-condition for the success of the strategy of agricultural development. Though the adoption of these varieties by farmers on itself is unlikely to be sufficient to bring about any marked improvement in agriculture, it acts as a stimulant for adopting other practices. However, in our sample, HYVs are widely accepted in paddy cultivation rather than in coconut cultivation.

The present section concentrates on identification of factors which determine the adoption of HYVs of paddy by the farmers. The anaysis will be carried along the following lines. First, a list of some probable socio-economic factors determining the adoption of HYVs will be drawn and then the significance of these factors will be examined in the light of the data collected in the field survey by using a multiple regression model.

5.5.1 Probable socio-economic factors determining the adoption of HYVs

(a) Educational Status of the Farmer :

Since use of HYV seeds is not merely a question of replacing some old seeds by new ones but a process of adoption of a host of new practices, it is believed that a farmer with a fair amount of schooling would be in a more advantageous position to use them than a less educated farmer. So here arises a question whether the extent of use of HYVs tend to increase with the educational standard of the farmer.

(b) Age of Farmer :

Farmers' outlook in the adoption of HYVs seems to vary according to their age. Reasonably, it is believed that a young farmer accepts modern methods more easily compared to an old farmer. So, it is necessary to examine whether this assumption is valid or not.

(c) Farm Size :

It may be recalled that during the first five years under the new agricultural strategy, the large farmers adopted the new farm technology to a greater extent than the small farmers. However, studies referring to the subsequent periods found small farmers quickly catching up with large ones in adoption of HYV seeds. So, it is worth to examine whether there is any impact of farm size on adoption level.

(d) Net Income from Paddy per Acre :

As the net income from paddy per acre increases, the farmer's interest for the adoption of new practices increases. That is, when the net income from cultivation increases, he will adopt more new methods for a further increase in their farm income. So, it is assumed that the net income from paddy per acre is an important component that determines the adoption of HYVs.

(e) Percapita Income of the Farm Family :

In addition to farm income, farmers depend on other sources of income. The total family income affects the adoption of HYVs and so percapita income becomes one of the determining factors of adoption. In this context it is worthwhile to examine whether this factor affects the adoption of HYVs.

5.5.2 The Regression Model : Linear Probability Model (LPM)

In order to find out which of the afore mentioned factors have had significant bearing on farmers' decision regarding adoption of HYVs, the following multivariate Linear Probability Model has been used.

$$Y_i = b_0 + b_1 X_{1i} + b_2 X_{2i} + b_3 X_{3i} + b_4 X_{4i} + b_5 X_{5i} + U_i$$

Where

Y_i = 1 if the farmer adopts HYV.

= 0 if the farmer does not adopt HYV.

X_{1i} = educational status of ith farmer*

X_{2i} = age of the ith farmer**

X_{3i} = size of the ith farm

X_{4i} = Per capita income of the farm family.

X_{5i} = Net income from paddy per acre.

U_i = random disturbance term.

b_0 = constant which represents the mean effect on Y of all those variables which could not be explicitly introduced in the model.

b_1, b_2, b_3, b_4, and b_5 are the coefficients of X_{1i}, X_{2i}, X_{3i}, X_{4i}, and X_{5i} respectively. Of these b_1, b_4, and b_5 are expected to be positive. The coefficient b_2 is expected to be negative and b_3, the coefficient of X_{3i} would be positive or negative depending on whether in general it is the larger farmer or the smaller farmer who adopts HYVs.

In the present analysis, five models have been fitted by the successive omission of each variable from its

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* X_{1i}, the educational status of the farmer is based on the scores awarded on the basis of their level of formal education. The scores awarded ranged from 1 for complete illiterary to 5 for graduation and above.

** X_{2i} the age of the farmer is based on the scores given as follows : Below 30 = 1, 30-40 = 2, 40-50 = 3, 50-60 = 4, above 60 = 5.

preceeding model. Another model is also fitted by taking the per capita income and net income from paddy per acre as the independent variables.

5.5.2.1 Results of the Regression Model

The parameters of the above mentioned regression models have been estimated by the method of 'Ordinary Least Squares (OLS). The results of this regression analysis are presented in Table 5.27 and the corresponding ANOVA coefficients are given in Table 5.28. These results consist of the estimates of the regression coefficients bo, b1, b2, b3, b4 and b5 with respective standard errors, the values of R^2, the coefficient of determination for the fitted equations and the values of the F statistic for testing the overall significance of the estimated regression equations.

5.5.2.2 Implications of the Results of the Regression Analysis

(1) The value of intercept in each of the first four models indicate that the 'probability' of adoption of HYVs by a farmer is 1* when all independent variables are assumed to be zero. But in Model V, the corresponding probability is 0.83 or 83 percent. However, the intercept coefficient is significant in all the 5 models.

(2) b1, the coefficient of the variable X_1 representing educational status of farmer has not been found statistically

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* Since the probability cannot be greater than one, we treated this value as one.

TABLE - 5.27

REGRESSION MODELS - ADOPTION OF MODERN PRACTICES IN PADDY CULTIVATION (LPM)

Variables	Model I	Model II	Model III	Model IV	Model V
Intercept	1.013*** (0.228)	1.147*** (0.241)	1.143*** (0.239)	1.170*** (0.231)	0.828*** (0.131)
X_{1i}	-0.003 (0.044)	-0.019 (0.047)	-0.011 (0.044)	-0.012 (0.044)	0.007 (0.043)
X_{2i}	-0.054** (0.038)	-0.074*** (0.041)	-0.069*** (0.040)	-0.071*** (0.040)	
X_{3i}	-0.003 (0.015)	0.003 (0.016)	0.007 (0.014)		
X_{4i}	6.15×10^{-7} (3.4×10^{-6})	1.75×10^{-6} (3.6×10^{-6})			
X_{5i}	3.03×10^{-5}*** (8.6×10^{-6})				
R^2	0.173	0.043	0.040	0.038	0.0003
F	3.316***	0.904	1.138	1.609*	0.024
N	85	85	85	85	85

Note : Figures in parantheses represent corresponding standard Errors.

* Significant at 25% level.

** Significant at 10% level

*** Significant at 5% level.

TABLE - 5.28

ANOVA TABLES - L P M

	df	SS	MS	F	Significance F
MODEL - I					
Regression	5	1.910	0.382	3.316	0.009
Residual	79	9.102	0.115		
Total	84	11.012			
MODEL - II					
Regression	4	0.476	0.119	0.904	0.466
Residual	80	10.540	0.132		
Total	84	11.012			
MODEL - III					
Regression	3	0.445	0.148	1.138	0.339
Residual	81	10.566	0.130		
Total	84	11.012			
MODEL IV					
Regression	2	0.416	0.208	1.809	0.206
Residual	82	10.596	0.129		
Total	84	11.011			
MODEL - V					
Regression	1	0.003	0.003	0.024	0.878
Residual	83	11.009	0.133		
Total	84	11.012			

significant for any of the estimated models. Also this factor shows a negative relationship with the adoption in all of the models except Model V. Thus educational status of farmer has little to do with the extent of adoption of HYVs.

(3) As expected, b_2, the coefficient of X_{2i}, the age of farmer, takes negative sign in all models. Also the coefficient is significant in all models involving X_{2i}. Thus we can reach the conclusion that 'age' is an important factor determining the adoption of HYVs.

(4) b_3, the coefficient of X_{3i}, the variable representing the size of farm, has been found to be insignificant in all of the models involving X_{3i}. The negative sign of b3 in model I indicates that the adoption of HYVs is higher in smaller farms, but the corresponding probability is only 0.3 percent. But the values of b3 in other two models imply that the adoption is higher in large farms with probabilities 0.3 percent and 0.7 percent.

(5) b_4, the coefficient of X_{4i}, which indicate percapita income of the farm family has been found to be positive but statistically insignificant in all models involving X_{4i}.

(6) b_5, the coefficient of X_{5i}, which represents the net income from paddy per acre has been found to be positive

and also statistically significant in Model I. Thus farmers with higher net income from paddy adopt HYV by a very small probability of 3.03 X 10^{-5}.

In all of these models the value of R^2 ranges between 0.03% and 17.3%, which implies their overall insignificance. In this context, we can recall the contension made by John Aldrich and Forrest Nelson that "use of the coefficient of determination as a summary statistic should be avoided in models with qualitative dependent variable".*

However, given a particular level of all these independent variables, we can estimate the actual probability of adopting HYV. Even if the estimated Yi were all positive or less than 1, the LPM still suffers from the problem of heteroscedasticity. As a consequence, we cannot trust the estimated standard errors reported in the models given in Table 5.27.

5.5.3 Weighted Least Square (WLS) Procedure in LPM.

We can use the WLS procedure to obtain more efficient estimates of the standard errors. The necessary weights Wi required for the application of WLS are given in Appendix (3). Since two of the Xi coefficients are negative, the Wi corresponding to these values are negative. So we cannot use these observations in WLS. Omitting these observations, the WLS regression for the models mentioned in Section 5.5.2.1 is as follows :

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* Damodar N.Gujarathi, Basic Econometrics, M.C.Graw-Hill International Editions, P.546.

TABLE - 5.29

REGRESSION MODELS - ADOPTION OF MODERN PRACTICES IN PADDY CULTIVATION (LPM - WLS MODEL)

Variable	Model I	Model II	Model III	Model IV	Model V
Intercept	5.838*** (1.071)	0.646 (0.873)	0.455 (0.824)	0.452 (0.823)	0.906*** (0.253)
X_{1i}	0.035* (0.036)	0.170*** (0.037)	0.178*** (0.028)	0.185*** (0.027)	0.185*** (0.267)
X_{2i}	-0.438*** (0.094)	0.029 (0.076)	0.036 (0.072)	0.042* (0.072	
X_{3i}	0.004 (0.016)	0.014* (0.020)	0.016* (0.019)		
X_{4i}	10.146*** (3.518)	1.343 (4.031)			
X_{5i}	7.99×10^{-5}*** (1.2×10^{-6})				
R^2	0.604	0.383	0.383	0.377	0.374
F	23.502***	12.126***	16.313***	24.173***	48.405***
N	83	83	83	83	83

Note : Figures in parantheses represent corresponding standard errors.

* Significant at 25% level

** Significant at 10% level

*** Significant at 5% level

TABLE - 5.30

ANOVA TABLES - LPM-WLS MODEL

	df	SS	MS	F	Significance F
MODEL - I					
Regression	5	92.94	18.59	23.50	29×10^{-14}
Residual	77	60.90	0.79		
Total	82	153.85			
MODEL II					
Regression	4	58.98	14.75	12.13	1.03×10^{-7}
Residual	78	94.86	1.22		
Total	82	153.85			
MODEL - III					
Regression	3	58.85	19.62	16.31	2.4×10^{-8}
Residual	79	95.00	1.20		
Total	82	153.85			
MODEL - IV					
Regression	2	57.95	28.98	24.17	6.1×10^{-9}
Residual	80	95.89	1.20		
Total	82	153.85			
MODEL - V					
Regression	1	57.55	57.55	48.41	8.1×10^{-10}
Residual	81	96.30	1.19		
Total	82	153.85			

These results show that, compared with the models in Section 5.5.2.1., the estimated standard errors are smaller for the independent variable X1i, 'educational status' and correspondingly, the estimated 't' ratios are larger (Table 5.29). So the variable is highly significant in all of the models except in model I (significant at 25% level only). Also, it is positively related to the adoption of HYVs. But in the case of the variable X2i, age of farmer, our assumption is correct in model I only. Of the other variables, X4i and X5i are highly significant and also show positive correlation with the adoption of HYVs in Model I. Thus the 'goodness of fit' of Model I is higher than the other models (R^2 = 0.604). The 'farm size' is significant at 25 percent level in determining the adoption level according to the Models II and III. ANOVA coefficients for these models are given in Table 5.30.

It could be noted that, though the standard error of X1i has decreased in all of the models, that of other independent variables have not decreased by WLS procedure. However, the 'goodness of fit' of the models has increased by this procedure.

5.6 Problems in the Adoption of New Farm Technology

In the field survey, each farmer interviewed was requested to identify the main problems in the adoption of HYV-seed-fertiliser based new farm technology. The responses of the farmers in connection with paddy and coconut cultivation have been summarised in Table 5.31.

TABLE - 5.31

PROBLEMS CITED BY THE FARMERS FOR THE ADOPTION OF NEW FARM TECHNOLOGY

No.	Problems Cited	Percentage of Respondents with respect to	
		Paddy Cultivation	Coconut Cultivation
1.	Non-availability of Bio-Chemical inputs in time:		
	(a) HYV Seeds	11.90	35.00
	(b) Fertilisers	14.29	20.00
	(c) Insecticides	17.86	22.00
	(d) Irrigation	62.14	10.00
2.	Non-availability of Machineries:		
	(a) Ploughing	4.71	-
	(b) Harvesting	91.76	-
	(c) Threshing	65.88	-
3.	Non-Suitability of land in certain seasons :	57.14	-
4.	Lack of efficient labourers at various stages.	71.43	27.00
5.	Lack of proper guidance for using the inputs.	47.62	45.00
6.	Difficulty in financing the new package.	49.42	45.00

It can be seen that among the inputs used, availability of irrigation is the factor cited by the largest number of farmers as the main hurdle in using the new farm technology more extensively in paddy cultivation. 62.14 percentage of the farmers have reported this as their main problem which hinders the cultivation process in Mundakan and Punja seasons. Due to the uncertainty of monsoon in the Mundakan season, the paddy cultivators have to undertake risk in their cultivation. Farmers depend exclusively on irrigation during Punja season. But adequate irrigation facilities are not available in certain areas during that period. The problem related to the cultivation in Virippu season is the existence of floods in certain areas which makes the land unsuitable for cultivation. 57.14 percentage of the sample farmers are facing this problem. Unlike irrigation, a few of the farmers have cited the non-availability of bio-chemical inputs like HYV seeds (11.90 percent), fertiliser (14.29 percent) and insecticides (17.86 percent) in right time as their main problems. But the intensity of irrigation problem is very minute in coconut cultivation (10 percentage). Compared to irrigation, the percentage of farmers complaining of the non-availability of other bio-chemical inputs is larger in coconut cultivation (HYV seeds - 35%, fertilisers - 20% and insecticides - 22%).

With respect to paddy cultivation it can be suggested that if the irrigation facilities are increased effectively, the cropping intensity could be increased so as to raise the gross production level. Since the productivity in in Punja cultivation is relatively higher (which could be analysed from sample study), the annual production could be increased by raising the area under Punja cultivation.

The most severe problem in paddy cultivation is the non-availability of efficient labourers at various stages. In most of the areas, the supply of agricultural labourer is very low compared to demand. The available labourers are willing to work only at a higher wage rate. So the farmers are compelled to depend upon labourers from other states by paying them higher wages. To a large extent, this labour scarcity could be reduced with the introduction of mechanisation. The availability of harvesters and threshers in the district was lower. Eventhough only a small percentage of the sample farmers have adopted these machines, they are satisfied with its efficiency and cost. In the case of some other farmers, eventhough these are available to them, they are not using them due to the awareness of its advantage. The use of tractors has widely overspread among the cultivators which gives greater satisfaction to them than old methods. In coconut cultivation, a few farmers (12 percent) have used tractors for ploughing and others did not want to use it.

Another problem faced by the farmers is the lack of proper guidance for using the inputs. Though most of the farmers have used fertilisers and insecticides, they are not aware of the proportion in which these inputs are to be used. Most of them (72.86 percentage) believe that the use of chemical fertilisers alone destroy natural quality of the soil. So, they use chemical fertilisers along with organic manures. Also, in the study, none of the farmers has the soil testing facility.

Some of the farmers (49.42% with respect to paddy cultivation and 45% with respect to coconut cultivation) have cited the problems in financing the new package. They reported that the numerous formalities, redtapism and malpractices associated with the issue of institutional credit deterred them from approaching financial institutions and agricultural departments for loan and subsidies. But all of the paddy cultivators have received a small amount (Rs.140 per acre) as production incentive for cultivation.

Although a number of branches of rural credit institutions were operating in the study area, only 17.86 percentage of the sample farmers have received crop loans in the year of field survey. It seems that institutions of agrcultural credit are yet to take firm roots in the rural society of the district and participate very actively in the process of transfer of agricultural technology.

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MODERN TECHNOLOGY AND RESOURCE-USE EFFICIENCY

Vimala. M "Determinants and impact of modern technology adoption in agriculture -A case study of Trichur district " Thesis. Department of Economics, Dr. John Matthai Centre , University of Calicut, 1999

CHAPTER - 6

MODERN TECHNOLOGY AND RESOURCE-USE EFFICIENCY

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CHAPTER- 6

MODERN TECHNOLOGY AND RESOURCE USE EFFICIENCY

The level of farm income is determined largely by the efficiency with which farmers are able to utilise the resources by allocating them among alternative production activities. If farmers are inefficient in the use of their scarce resources, there certainly exists an unexploited potential for increasing farm income and generating surpluses which can serve as an inexpensive source of economic growth. if, on the other hand, they are extremely efficient in the allocation of their resources among alternative production activities, additional contribution from agriculture can come only through growth-oriented development of agriculture itself. Resource-use and allocation efficiency on farms in low income countries, thus becomes an important issue in determining the existng opportunities in agriculture for economic growth and welfare of farm families.[1]

The studies in Economics of Farm Management suggested the existence of some economic relationships in the field of Indian agriculture and provoked economists to offer alternative explanations of the observed phenomena. One of the central issues has been the existence of an inverse relationship between size of the farm and productivity.

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1. G.R.Saini, "Farm Size, Resourse Use Efficiency and Income Distribution - A Study in Indian Agriculture with special Reference to U.P. and Punjab", Allied Publishers Pvt.Ltd., New Delhi, 1979.

Amartya Sen initiated the debate when in his paper (1962) he stated a proposition based on the Farm Management Survey (FMS) that, by and large, productivity per acre decreased with the size of holding. The attempted the analytical explanation of this proposition coupled with two other observations, namely that, when the market wage is inputed to family labour. Many of the farms how losses, and that, by and large, profitability increases with the size of holdings. Sen also expressed some caution regarding the statistical basis of the proposition concerning this inverse relation. The same phenomenon was taken more or less as well established by most economists [Agarwala (1962), Muzumdar (1963), Khusro (1964)] who proceeded to provide a number of alternative explanations for the 'observed' tendency. Some doubts were expressed about the statistical validity of this inverse relation by A.P.Rao (1967) on the basis of disaggregated data covered by the FMS, came up with results contradicting the proposition.

Rudra's analysis was an important turning point in the"size and productivity" controversy. Rudra[2] reported that 15 out of 17 rank correlation coefficients between farm size and productivity per acre to have a negative sign and 9 of these to have a negative coeficient, statistically significant too. Rudra used in his analysis farm class averages as against the

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2. Rudra Ashok, "Farm Size and Yield Per Acre", Economic and Political Weekly, Special Number, July 1968, P. A-33.

disaggregated farm level observations. Even if one gets constant productivity relationship on the basis of gross cropped area, the results will still be consistent with inverse relationship between farm size and productivity.[3] According to Saini,[4] a strong positive or negative rank correlation coefficient between farm size and productivity is perfectly consistent with constant returns to scale which are a matter of proportionate relation between output and all inputs taken together.

Hanumantha Rao[5] argued that despite better access to resources, output per acre among large farms under the traditional labour intensive technology was higher than for small family farms, as the cost of labour was higher for the former than for the latter. He has analysed the size productivity relationship in the late sixties in Muzaffarnagar (U.P.), Ferozepur (Punjab) and and West Godavari (A.P.). His study found out the weakening or disappearance of the inverse relationship between farm size and output per acre which implied a higher rate of growth of output among large farms when compared to small farms. This has been achieved by large farms not through greater application of labour inputs per acre but through the greater use of capital inputs or the increasing substitution of capital for labour.

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3. G.R.Saini, "Farm Size, Resource Efficiency and Income Distribution", (A Study in Indian Agriculture with Special Reference to U.P. and Punjab), Institute of Economic Growth, New Delhi (1979).
4. Ibid.
5. C.H.Hanumantha Rao, "Technological Change and Distribution of Gains in Indian Agriculture", Institute of Economic Growth, Delhi, 1975.

The studies in different regions of India brought out marked differences in productivity and efficiency between farms arising mainly out of the pattern of ownership and intensity of use of farm resources. Theoretically, one can think of a large number of factors that affect the efficiency of farms. A debate occurred among economists regarding the relative efficiency of small versus large farms, particularly after the introduction of HYV technology.

In this context, we proceed to present an analysis of the primary data collected from the district and examine the statistical validity of the relationship between farm size and productivity. Also an attempt is made to analyse the resource-use efficiency in the cultivation of paddy and coconut.

6.1 Average Productivity - A Comparison of HYVs and LVs Of Paddy

Out of 140 farms under study, 15 percentage come under the cultivation of local varieties (LVs). Most of the cultivators choose high yielding varieties (HYVs) because of its higher productivity. But some of them are anxious about the success of HYV cultivation in each season because of their easy submissiveness to the attack of pests and insects. However, our sample reveals relatively higher productivity of HYVs.

TABLE - 6.1

Size-wise Average Productivity of HYVs and LVs of Paddy

Kg/Hectare

Size	HYV	LV	Productivity Range $\frac{(HYV-LV)}{(HYV+LV)} \times 100$
Small	3961.13	3880.91	1.02
Medium	3977.68	3784.06	2.49
Large	4121.4	3887.64	2.92
Total	4035.3	3937.78	1.22

Source : Computed from the Primary Data.

TABLE - 6.2

Season-wise Average Productivity of HYVs and LVs of Paddy.

Kg/Hectare

Season	HYV	LV	Productivity Range $\frac{(HYV-LV)}{(HYV+LV)} \times 100$
Virippu	3690.4	3257.96	6.22
Mundakan	3903.35	3783.96	1.55
Punja	4349.8	6012.77	16.05

Source : Computed from the Primary Data.

Table 6.1 shows size-wise average productivity of HYVs and LVs. In each size category, the average productivity is relatively higher for HYVs. Also it could be seen that as the size of holdings increases, the average productivity of HYV increases. It is the maximum for large holdings (4121.4 Kg/Hectare) and minimum for small holdings (3961.13 Kg/Hectare). This reveals a positive relationship between the size of holdings and average productivity. At the same time, this type of relationship does not strictly hold in the case of LVs. Here the average productivity of medium holdings is less than that of small holdings, but it is slightly higher in large holdings.

Season-wise average productivity (Table 6.2) shows that it is the highest in Punja season in which the average productivity of local varieties is the maximum (6012.71 Kg/ hectar). But it is unreasonable to consider this as a general feature becuse we could find only two farms of LV cultivation under Punja Crop. Of the three crops, productivity in Virippu season is relatively lower for both HYVs and LVs (3690.4 Kg/ha and 3257.96 Kg/ha respectively).

6.2 Costs and Returns in Paddy Cultivation

Table 6.3 presents a comparison of the average costs and returns per hectare of high yielding and local varieties of paddy for the selected sample.

TABLE - 6.3

Average Costs and Returns of Paddy - HYV and LV

No.	Item	HYV	LV
1.	Average Cost/Hectare (Rs.)	17486.66	10501.91
2.	Average Return/Hectare (Rs.)	26242.76	24537.52
3.	Average Return over Cost/Hecture(Rs)	8756.1	14035.61

Source : Computed from the Primary Data.

The average cost of cultivation per hectare of high yielding variety of paddy is nearly 66 percentage higher than that of local varieties. Among the selected cultivators it worked out to Rs.17486.66 per hectare for HYVs and Rs.10501.91 per hectare for local varieties. A large part of this difference is due to high biochemical (34.62 percent) and labour costs (53.71 percent) incurred on the high yielding variety. Thus the labour cost constitutes the major items of cost for HYV.

The gross returns per hectare under the HYV is Rs.26242.76 whereas that of LV is Rs.24537.52. This means that the gross returns from HYV is Rs.1705.24 more than that from LV. The net return over total variable costs is Rs.5279.51 more for the LVs than that for HYVs. It is Rs.8756.10 per hectare for HYVs and Rs.14035.61 for local varieties.

The costs and returns incurred on the high yielding varieties are analysed for different holding size groups in Table 6.4.

TABLE 6.4

Size-Wise Average Costs and Returns of HYVs of Paddy

No.	Item	Small	Medium	Large
1.	Average Cost/Hectare (Rs)	25144.38	18922.92	15526.28
2.	Average Returns/Hectare (Rs)	28992.38	25078.18	26151.53
3.	Average Returns over Cost/ Hectare (Rs.)	3837.6	6155.26	10625.25

Source : Computed from the Primary Data.

The average cost per hectare of HYVs of paddy showed a tendency to decrease as the size of the farm increased. It is the highest for small holdings (Rs.25144.38) and lowest for large holdings (Rs.15526.28).

The average gross returns per hectare of HYVs for small holdings is worked out at Rs.28992.38, which is relatively higher whereas it is the lowest for medium holdings (Rs.25078.18). Also it is significant that the income over variable cost among the sample cultivators, showed a tendency to increase with the increase in the size of holdings. It is Rs.3837.6 per hectare for small holdings and Rs.10625.25 for large holdings. This partly explains the reasons why the rate of adoption of the HYVs is relatively more among the larger size holdings.

Table 6.5 explains the average costs and returns from HYVs of paddy in different seasons.

TABLE - 6.5

Season-Wise Average Costs and Returns of HYVs of Paddy

No.	Item	Virippu	Mundakan	Punja
1.	Average Cost/hectare (Rs)	16765.24	18120.86	17449.71
2.	Average Returns/Ha. (Rs)	23480.63	24816.25	29044.13
3.	Average returns over cost / Hectare (Rs.)	6715.39	6695.39	11594.42

Source : Computed from the Primary Data.

Average cost per hectare is the lowest in Virippu season (Rs.16765.24) and the highest in Mundakan season (Rs.18120.86). The average return per hectare during the three seasons, showed relatively higher incme in Punja season (Rs.29044.13) and lower income in Virippu season (Rs.23480.63). The net returns from HYV is much greater in Punja season (Rs.11594.42 per hectare) compared to that in other two seasons. This is partly because of the higher yield during Punja season.

6.3 Inter Panchayat Variations

Considerable variations could be seen among different Panchayats under study regarding cost of cultivation as well as the yield of HYVs of paddy among selected cultivators. (Table 6.6).

TABLE - 6.6

Average Costs and Returns of HYVs of Paddy in different Panchayats

Panchayats	Average Cost/ hectare (Rs.)	Average Yield/ Hectare (Kg)	Average Income/ hectare (Rs.)	Average Income over Cost/Ha.(Rs.)	Benefit cost ratio
Vadakkekad	28256.10	5909.22	34245.39	5989.29	1.21
Punnayurkulam	25677.29	5125.15	35196.47	9519.18	1.37
Mala	15342.94	2643.17	16571.33	1228.39	1.08
Annamanada	13339.56	2999.21	19708.08	6368.52	1.48
Mathilakam	11700.98	2144.49	14036.06	2335.08	1.20
Adat	13222.53	4367.58	24233.16	11010.63	1.83
Ayyanthole	16667.30	4526.53	27374.57	10707.27	1.64
Wadakkanchery	16991.48	4199.81	28450.75	11459.27	1.67
Velur	23857.79	4497.30	27658.35	3800.56	1.16

Source : Computed from the Primary Data.

Cost of cultivation per hectare varied from Rs.11700.98 in Mthilakam Panchayat to Rs.28256.10 in Vadakkekad Panchayat. The yield ranged from 2144.49 Kilogram per hectare (Mathilakam Panchayat) to 5125.15 Kilogram per hectare (Punnayurkuam Panchayat). Variations in the soil quality, application of manures, incidence of pests and disease and to some extent biases in the system of reporting may have accounted or this difference.

Average gross income per hectare is relatively higher in Punnayurkulam Panchayat whereas it is the lowest in Mathilakam Panchayat. The net returns worked out for these Panchayats reveal that it is the highest in Wadakkancherry Panchayat (Rs.11459.27 per hectare) and the lowest in Mala Panchayat (Rs.1228.39 per hectare).

6.4 Benefit-Cost Ratio

From the investment point of view the benefit cost ratio is used as a measure of the economic viability of a programme. The present analysis is confined to private cost and benefits only. Benefit Cost Ratio is obtained by dividing the gross value of output by the cost of production.

Size-wise and seasonwise detail of the Benefit Cost Ratio of HYV and LV of paddy are given in Table 6.7 and 6.8 respectively. For HYVs, the ratio is greater in large holding category (1.68) and lower in small size category (1.15). At the same time, the benefit-cost ratio of local varieties is 1.21 in large holdings where as it is less than 1 in the other two size categories. Seasonwise ratios reveal that it is the highest in Punja season with 1.66 and 1.34 respectively for HYVs and LVs of paddy.

TABLE - 6.7

Benefit-Cost Ratio of HYV and LV of Paddy (Size-wise)

Size	HYV	LV
Small	1.15	0.83
Medium	1.33	0.85
Large	1.68	1.21

Source : Computed from the Primary Data.

TABLE - 6.8

Benefit-Cost Ratio of HYV and LV of Paddy (Seasonwise)

Season	LYV	LV
Virippu	1.40	0.77
Mundakan	1.37	0.97
Punja	1.66	1.34

Source : Computed from the Primary Data.

Benefit Cost Ratio of HYV cultivation in different Panchayats are given in Table 6.6. The high ratio for Adat Panchayat supports the high returns from HYVs. At the same time, the low ratio for Mala, Velur and Mathilakam Panchayats was on account of the fact that some of the sample farmers in these Panchayats reported damages due to natural calamities, attack of pests and diseases particularly on the cultivation of high yielding paddy resulting in very low paddy yield.

Although the benefit cost ratio is more favourable to HYVs compared to LVs its differential is too small to enthuse the cultivators to go in for these new varieties because the risk and uncertainties are definitely much higher for HYVs compared to the traditional ones.

6.5 Resource Use Efficiency in Paddy Cultivation

The High Yielding Varieties programme consists of a package of superior technology involving high yielding seeds, larger doze of fertiliser, adequate plant protection measures, intensive use of labour and machineries etc. The use of any one input in isolation will not yield commensurate returns. Hence it is necessary to determine the extent to which important factors such as land, labour, bio-chemical inputs, machineries etc, explain the variations in the output or yield of paddy. Further, for policy making one would be interested to know the contribution to yield of individual factors (resources) in a situation where more than one resource interact together. For this purpose marginal analysis based on the production function approach is generally used. Among the various types of production functions that could be fitted to agricultural production data, the Cobb-Douglas function has the advantage that it also serves to provide information regarding economies of scale in farming operation. Therefore this type of function has been fitted to the data under consideration in this study. The log-linear form of function is :-

$$\text{Log } Y = \text{Log } A + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4$$

Where Y = Gross Value of output.

X_1 = Labour in mandays.

X_2 = Land in acres.

X_3 = Cost of biochemical inputs.

X_4 = Rental Cost of machineries.

The function is fitted for HYVs and LVs of paddy separately. Also the size-wise and season-wise performance of HYV is analysed with the help of corresponding production functions. These models help to estimate the elasticities of output with respect to each input and thus the marginal value product of each resource on the farm.

6.6 Returns to Scale and Elasticities of Output - A Comparison of HYVs and LVs of Paddy

The results of the least square regression suggested by the model for HYV and LV are given below :

$$\text{HYV}: \log Y = \underset{(0.650)}{7.787} + \underset{(0.058)}{0.222} \log X_1 + \underset{(0.080)}{0.702} \log X_2 + \underset{(0.064)}{0.172} \log X_3 - \underset{(0.048)}{0.099} \log X_4$$

SE = (0.650) (0.058) (0.080) (0.064) (0.048)

$$\text{LV}: \text{Log } Y = \underset{(1.887)}{7.266} + \underset{(0.288)}{0.937} \log X_1 + \underset{(0.185)}{0.429} \log X_2 + \underset{(0.200)}{0.008} \log X_3 - \underset{(0.242)}{0.278} \log X_4.$$

It is noted that the value of the coefficient of determination is high, the value of R^2 being 0.81 for both HYVs and LVs. It shows that the input categories included in the production function are able to explain 81 percent of the variability in the value of output. The unexplained part of the variability in 'Y' is obviously due to other factors which have not been taken into account. The regression coefficients for individual inputs have been examined along with their respective standard errors. It is found that for all of the considered inputs, the regression coefficients are statistically significant at 5% more for the high yielding varieties. In the case of local varieties also, the regression coefficients of resources except bio-chemical inputs are statistically significant (coefficients of land and labour are significant at 5% level and that of machineries is significant at 25% level). All of the inputs except machineries have positive relationship with the value of output for the high yielding as well as local varieties.

Table 6.9 presents returns to scale and elasticities of output with respect to each input for HYVs and LVs. It is noted that returns to scale for HYV (0.997) is slightly less than that for LV (1.095). Also it is found out that elasticity of output with respect to land is higher for HYVs whereas that with respect to labour is higher for LVs.

TABLE - 6.9

Returns to Scale and Elasticities of Output with respect to various inputs in Paddy Cultivation

Variety	Returns to scale	Elasticity of output with respect to			
		Labour (X_1)	Land (X_2)	Biochemical input (X_3)	Machineries (X_4)
HYV	0.997	0.222*	0.702*	0.172*	-0.099*
LV	1.095	0.937*	0.429*	0.008	-0.278***

* Significant at 5% level

*** Significant at 25% level

The results of size-wise analysis of returns to scale and elesticities for HYVs are presented in Table 6.10. It reveals that return to scale from large holdings (1.222) is comparatively higher than that from other size categories. Returns to scale is the lowest in medium holdings (0.763). For small holdings, elasticities of output with respect to land,

TABLE - 6.10

Sizewise Returns to Scale and Elasticities of Output with respect to various Inputs in HYVs of Paddy Cultivation

Size	Returns to scale	Elasticity of Output with respect to			
		Labour (X_1)	Land (X_2)	Biochemical (X_3)	Machineries (X_4)
Small	1.030	0.225*	0.598*	0.156**	0.051
Medium	0.763	0.539*	0.204***	0.120***	-0.100***
Large	1.222	-0.002	1.471*	0.030	-0.276*

* Significant at 5% level.

** Significant at 10% level

*** Significant at 25% level.

TABLE - 6.11

Seasonwise Returns to Scale and Elasticities of Output with respect to various inputs in HYVs of Paddy Cultivation

Season	Returns to Scale	Elasticity of output with respect to			
		Labour (X_1)	Land (X_2)	Biochemical inputs (X_3)	Machineries (X_4)
Virippu	1.081	0.575*	0.571*	0.098***	-0.164*
Mundakan	1.045	0.287*	0.781*	0.097***	-0.121***
Punja	0.932	0.171*	0.650*	0.195*	-0.084***

* Significant at 5% level.

*** Significant at 25% level.

labour and biochemical inputs are significant (land and labour are significant at 5% level and biochemical input is significant at 10% level). In this category though the rental cost of machineries shows a positive relationship with gross value of output, the corresponding coefficient is not significant. In medium holdings, elasticity of output with respect to labour is significant at 5% level while the elesticities with respect to other inputs are significant only at 25% level. Only the cost of machineries shows negative relationship with the gross value of output. But in large holdings, the elasticities of output with respect to land and machineries are significant while that with respect to other inputs are insignificant. Unlike other size-categories, in large holdings, output bears a negative relationship with the input, land. Total output is well determined by the considered inputs in the case of large holdings (R^2 = 0.75) compared to other size categories.

Seasonwise returns to scale and elasticities of output for HYVs are given in Table 6.11. The returns to scale of HYVs cultivated in Virippu and Mundakan seasons are higher than that in Punja season. The elasticities computed for these models show that all the inputs are significant in determining the output of HYVs under three seasons. In Virippu season, elasticity of output with respect to labour is relatively more whereas that with respect to land is higher for Mundakan and Punja Crops. However, machineries bear a negative relationship with the HYV output in all seasons.

6.7 Marginal Value Product of Inputs in Paddy Cultivation

From the regression analysis, the marginal value product of each input is estimated. It is a measure of efficiency of inputs used in the production. The marginal value product of each input factor, labour, land, biochemical inputs and machineries have been calculated which is given in Table 6.12. The marginal value product (MVP) derived in this manner is compared with the marginal cost (MC) of the respective inputs to determine the profitability of additional investment.

TABLE - 6.12

Marginal Value Product and Marginal Cost Relating to Various Input Items in Paddy Cultivation (HYV & LV)

Items of Input	Marginal Value product (MVP) (Rs.)		Marginal Cost (MC) (Rs.)
	HYV	LV	
Labour days (X_1)	0.568	2.108	125
Land Area in Acres (X_2)	20.650	16.176	-
Cost of biochemical inputs (X_3)	0.201	0.008	1.00
Rental Cost of Machineries (X_4)	−0.135	−0.375	1.00

Source : Computed from the Primary Data.

The marginal value product for labour is calculated per manday and that for land as per acre. For the rest of the inputs viz. biochemical inputs and machineries, MVP is estimated per rupee of investment. These values may be compared with the value of marginal cost (MC) for the respective inputs.

The marginal value product worked out for labour is Rs.0.568 for HYV and Rs.2.11 for the Local Varieties. This compares unfavourably with the marginal cost of labour which is Rs.125 per manday. It means that the productivity of labour is not commensurate with the cost of employing them.

For land, the MVP worked out to Rs.20.65 for HYV and Rs.16.18 for the local varieties. This implies that land being a scarce resource, it is advisable for the farmers to replace the area under local varieties with high yielding varieties of paddy to increase their farm income.

Also it is found that the MVP for biochemical inputs worked out to Rs.0.20 for the HYVs and Rs.0.01 for the LVs. It means that the application of additional one rupee worth of biochemical inputs to the HYVs would yield additional return of Rs.0.20. The corresponding rate of return for the local varieties is only Rs.0.01. Hence additional use of biochemical inputs on the holdings seems to be less worthy in the case of both HYV and LV of paddy.

Table 6.13

Size-wise Marginal Value Product and Marginal Cost Relating to Various Input Items (HYV)

Item of Input	Marginal Value Product			Marginal Cost (MC)(Rs.)
	Small	Medium	Large	
Labour days (X_1)	0.617	2.598	-0.005	125.00
Land area in acres (X_2)	10.893	1.400	14.410	-
Cost of Bio-chemical Inputs (X_3)	0.185	0.141	0.035	1.00
Rental cost of Machineries (X_4)	0.069	-0.142	-0.372	1.00

Source : Computed from the Primary Data.

Table 6.14

Season-wise Marginal Value Product and Marginal Cost Relting to Various Input Items (HYV)

Item of Input	Marginal Value Product			Marginal Cost (MC)(Rs.)
	Virippu	Mundakan	Punja	
Labour days (X_1)	1.424	0.721	0.462	125
Land area in acres (X_2)	14.440	25.890	19.473	-
Cost of Bio-chemical Inputs (X_3)	0.115	0.114	0.233	1
Rental cost of Machineries (X_4)	-0.223	-0.161	-0.118	1

Source : Computed from the Primary Data.

On the other hand, the MVP of machineries is found to be negative for both HYV and LV. This may be due to the low cost of machineries compared to the cost of other inputs. The use of machineries is common among the cultivators only in the ploughing periods.

Sizewise and Seasonwise marginal value products of inputs relating to HYVs of paddy are given in Table 6.13 and 6.14 respectively. For small holdings, the marginal value products of biochemical inputs and machineries are greater than that in the other two size categories. On the other hand, the MVP of labour is comparatively higher in medium holdings. The MVP of land favours the large holdings for cultivating HYVs, which is equal to Rs.14.41.

Seasonwise marginal value product of the inputs reveal that land can provide more to the total product in Mundakan Season than the other two seasons. But the marginal value product of labour is comparatively higher in Virippu Season (1.42) while that of biochemical inputs is higher in Punja Season.

6.8 Costs and Returns of Coconut Cultivation

A comparative analysis on the cost and return of high yielding variety and local variety of coconut is made with the help of Table 6.15. Average cost per palm is Rs.5.64 more for HYV of coconut than that for local variety. It is Rs.127.21 for HYV and Rs.121.57 for Local Varieties.

Table 6.15

Average Costs and Returns of Coconut.
HYV and LV

No.	Item	HYV	LV
1.	Average Cost/Palm (Rs.)	127.21	121.57
2.	Average Nuts/Palm	128.00	106.00
3.	Average Returns/Palm (Rs.)	711.67	624.52
4.	Average Returns over Cost/Palm (Rs.)	584.46	502.96

Source : Computed from Primary Data.

Table 6.16

Average Costs and Returns of Coconut in different Panchayats

Panchayat	Average Cost/Palm (Rs.)		Average Nuts/Palm (Rs.)		Average Returns/Palm (Rs.)		Average Returns over Cost/Palm(Rs.)	
	HYV	LV	HYV	LV	HYV	LV	HYV	LV
Vadakkekad	45.66	125.31	100	110	600	631.23	554.34	505.42
Punnayurkulam	-	104.52	-	79	-	523.25	-	418.73
Mala	129.00	121.48	100	84	600	474.10	471.00	352.62
Annamanada	90.93	124.16	99	93	578.25	585.22	487.32	461.06
Mathilakam	208.82	127.18	114	103	715.92	644.58	507.10	517.40
S.N. Puram	139.77	141.47	153	96	888.20	596.34	748.43	454.87
Adat	140.09	111.77	99	119	559.09	613.01	419.00	501.24
Ayyanthole	152.62	125.72	196	154	1134	908.85	981.38	783.13
Wadakkancherry	151.24	117.70	135	113	828	667.91	676.76	550.21
Velur	125.42	120.99	120	108	720	660.65	594.58	539.66

Source : Computed from Primary Data.

The annual yield from high yielding variety of coconut is 128 nuts per palm whereas it is 106 nuts per palm for local variety. Also the gross income per palm is greater for HYV (Rs.711.67) while it is only Rs.624.52 per palm for local variety. The benefit cost ratios worked out for HYV and LV of coconut are 5.59 and 5.14 respectively.

Returns over costs per palm is Rs.584.46 for HYV which is Rs.81.5 more than that for local variety of coconut.

Table 6.16 gives costs and returns of High Yielding and Local Varieties of coconut in different Panchayats. From Punnayurkulam Panchayat, the cultivators of high yielding varieties of coconut happened to be absent in our sample. The average cost per palm is greater for HYVs in Mala, Mathilakam, Adat, Ayyanthole, Wadakkancherry and Velur Panchayats and the average yield per palm is also greater in these Panchayats except in Adat. The average annual yield per high yielding palm ranges from 99 in Annamanada and Adat Panchayats to 196 in Ayyanthole Panchayat while that of local varieties rnges from 79 in Punnayurkulam Panchayat to 154 in Ayyanthole Panchayat. Accordingly the gross returns showed fluctations in these panchayats.

Net return from HYV palms is the maximum in Ayyanthole Panchayat (Rs.981.38 per palm) and minimum in Adat Panchayat

(Rs.419 per palm). But the return from local variety palms varies from the minimum of Rs.352.62 per palm in Mala Panchayat to the maximum of Rs.783.13 in Ayyanthole Panchayat.

6.9 Returns to Scale and Elasticities of output - A comparison of HYVs and LVs of Coconut

Table 6.17 gives the returns to scale and elasticities of output with respect to the inputs, number of palms, labour days and biochemical inputs. Of these inputs considered, number of palms is found to be highly significant at 5 percent level in determining the value of gross output of both high yielding and local varieties of coconut. The other two inputs are not significant in the case of HYVs while they are less significant (25% level) in determining the output of LVs of coconut.

However, the overall significance of the production functions fitted by using these three inputs is high which is evident from the high R^2 values for both HYV and LV. (R^2 = 0.85 for HYV and 0.89 for LV).

Returns to scale for HYV and LV of coconut are 0.91 and 0.99 respectively, both indicate decreasing returns to scale. Thus it appears that under the existing farm management practices, coconut production is not amenable to the economies of scale.

Table 6.17

Returns to Scale and Elasticities of output with respect to various Inputs in Coconut Cultivation

Variety	Returns to Scale	Elasticity of output with respect to		
		No. of Palms (x1)	Labour (x2)	Biochemical Inputs (x3)
HYV	0.91	0.86*	0.07	-0.02
LV	0.99	0.85*	0.08**	0.06**

* Significant at 5 % level.

** Significant at 25% level.

Source : Computed from Primary Data.

Table 6.18

Marginal Value Product of various Input Items HYV and LV of Coconut

No.	Items of Input	Marginal Value Product (MVP) (Rs.)	
		HYV	LV
1.	No. of Palms (X_1)	48.86	160.37
2.	Labour days (X_2)	4.67	17.77
3.	Cost of biochemical inputs (X_3)	-0.58	5.92

Source : Computed from Primary Data.

6.10 Marginal Value Product of Inputs

The marginal value products calculated for the inputs, number of palms, labour days and biochemical inputs are given in Table 6.18

With respect to the number of palms, the marginal product of local variety of coconut is higher than that of HYV. It is 48.86 for HYV and 160.37 for LV. Also the marginal value products relating to the other two inputs are higher for local variety. The efficiency for utilisation of the inputs is lower for HYVs and it is the lowest with respect to the biochemical inputs.

Thus the average return per palm over variable cost for HYVs of coconut is greater than that for LVs. But returns to scale worked out from the production function for HYVs is comparativey lower. This is because of the fact that the considered inputs could determine 81 percentage of gross output in the case of HYV while in the model fitted for LVs, it could determine 85 percentage of gross output. As a result, the marginal value products of all inputs are greater for LVs.

6.11 Conclusion

In paddy cultivation, though the average gross returns per hectare is higher from HYVs, its net returns per hectare is lower. This is because of the higher cost incurred in the cultivation of high yielding varieties. As a result returns to scale worked for HYVs by considering the inputs like labour, land, biochemical inputs and machineries is slightly lower than that for LVs. Of all these inputs, the elasticity of output with respect to land is higher for HYVs. Sizewise analysis of HYVs reveals that the net returns per hectare is comparatively higher from large holdings. It supports the higher returns to scale of large holdings. Land is more significant in determining the HYV output in small and large holdings. The cultivation of HYVs in Punja season provides comparatively higher net returns. But its returns to scale worked out from the related production function is comparatively lower. This is due to the reason that the coefficient of determinaton of the model fitted for Punja Crop is 0.81 which is relatively lower than that in other two seasons. The marginal value product of labour, computed for LVs is comparatively greater whereas that of land and biochemical inputs are higher for HYVs.

In coconut cultivation, annual yield of HYV per palm is greater so that it's net returns per palm is also greater. But the corresponding functional analysis doesn't favour this result, because about 20% of output of HYVs is determined by some other factors that we didn't take into account.

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SUMMARY AND CONCLUSION

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CHAPTER - 7

SUMMARY AND CONCLUSION

7.1 SUMMARY OF FINDINGS.

7.2 RECOMMENDATIONS.

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CHAPTER 7

SUMMARY AND CONCLUSION

Dynamic changes have taken place in Indian Economy with the introduction of new strategy in mid-sixties. These changes are one of the most important forces which have altered the structure of the agricultural production process. Both the physical and value productivities have changed due to the adoption of modern practices. Technological change in agriculture can be classified in to two - labour augmenting changes and land augmenting changes. Labour augmenting changes result in an increase in the marginal physical productivity of labour by the introduction of machines in farm operations and land augmenting changes consist of introduction of improved inputs which increase the marginal yield of cultivated areas.

The adoption of new or modern innovations is a complex process which is governed by many socio economic factors related with the adopters. The essential components of such techniques include use of improved variety of seeds, fertilisers, assured irrigation water, pesticides and improved implements.

Agriculture occupies a significant position in the Indian economy as well as in the state economy. Total food grain production in the country showed a sharp increase over the last three decades as a result of new strategy adopted in mid sixties. But in the state economy, food grain production showed a marked negative growth. This is due to the drastic decline in the area under rice which is the most important food crop in our state since 1975-76. But the productivity of rice has been considerably increased from 1243 kg/hectare in 1965-66 to 1942 kg/ha in 1990-91. So it can be argued that the increase in productivity was the result of adoption of improved practices in farm operation. The indigenous use of modern inputs and adoption of new farm practices result in agricultural growth within the land constraint.

Thus the questions arise at this point are: "whether the farmers have used a right composition of the complimentary inputs with HYV seeds to utilise effectively the potentials of the new technology?" and "if not, what are the factors that have been restricting farmers from doing so?" The question such as "What is the efficiency of resources used in the production process in determining the total output?" is also relevant in this context. A deep attempt has not been made so far in Kerala Agriculture regarding these questions.

So , with a view to answering these questions we set certain specific objectives such as: (1) to discuss the extent and magnitude of HYV technology that has been adopted in agriculture (2) To measure the intensity of adoption of various improved farm practices and their combinations based on sample (3) To analyse the impact of socio economic factors on the level of technological adoption and (4) To examine the impact of modern technology on resource-Use efficiency.

The first objective has been fulfilled with the help of secondary data. The extent and magnitude of HYV technology in agriculture have been examined using simple analytical tools like ratio, index, coefficient of variation and compound growth rate. The other four objectives have been analysed on the basis of primary data collected from Thrissur District which is specially featured by its Kole lands. Also there is existing tripple cropping farms in the district. The sample is collected from ten panchayats in five blocks (two panchayats from each block) by multistage random sampling method and the study is concentrated on two important crops in the district paddy and coconut.

The intensity of adoption of various improved farm practices has been measured by calculating the Adoption Index (AI) of area and acceptance. Regarding the third objective, in our sample, since HYVs are widely accepted only in paddy cultivation, the present study is concentrating on the socioeconomic factors which determine the adoption of HYVs of paddy by the farmers. This is analysed by fitting Linear probability Model (LPM) in which the dependent variable is treated as qualitative. Also weighted least square (WLS) procedure in LPM has been used to obtain more reliable results. For examining the Resource-use efficiency in agriculture, cobb Douglas Production function has been fitted. This model has helped to estimate the elasticity of output with respect to each input and thus the Marginal value products (MVP) of each resource.

7.1. Summary of findings

The discussion on the extent and magnitude of different components of HYV technology in Indian and State agriculture has provided the following results.

The HYV seeds have played a vital role in the development of Indian agriculture. The percentage of HYV area of paddy to total paddy area has increased from 2.52. in 1966-67 to 67.94

in 1993-94. But in the state, area under HYV has increased from 136.13 thousand hectares in 1969-70 to 282.21 thousand hectares in 1979-80. However, the area has declined since then to 174.45 thousand hectares by 1994-95. HYVs of paddy area accounted for only 15.57 percent of total area in 1969-70 increased to 35.58 percent by 1979-80. But it declined to 26.68 percent by 1989-90. Since then, it showed an accelerating trend. The Productivity of HYV paddy has increased from 1798-02 Kg per hectare in 1969-70 to 2019.13 Kg per hectare in 1994-95. While Thrissur District showed a negative compound growth rate in HYV area during 1973-74 to 1982-83, its productivity showed positive growth rate. During the succeeding period, both area and productivity showed positive growth rates.

In India, minor irrigation schemes have a major thrust on the irrigation potential and its utilisation. In the state, the chief sources of irrigation are canals, tanks, wells and lift irrigation, The thrust upon canal irrigation has decreased by 47.61 percent over the period from 1969-70 to 1992-93. At the same time, the net irrigated area under tanks and wells has increased from 77.5 thousand hectares to 114.1 thousand hectares. The total net irrigated area in the state has increased marginally from 315.9 thousand hectares to 334.5 thousand hectors during 1969-70 to 1992-93. The growth rate of gross irrigated area in Thrissur District during 1977-78 to 1994-95 was 0.62 percent per annum, which was lower than that for state (0.79 percent).

Consumption of fertilisers in India showed positive growth rates. In the state, fertiliser consumption showed an upward trend and faced annual fluctuations in the succeeding periods. An increase in annual rate of growth in consumption of potash during the recent years is a welcome change. But in the district, percentage of fertiliser consumption to state consumption has decreased during the last two decades.

The pace of mechanisation gathered momentum as is evident from the increase in the number of oil engines with pump sets for irrigation, tractors, operated tube wells, harvesters, threshers etc. But in Kerala, mechanisation in agriculture has been slow. Tractors have become more popular in ploughing the farms. Now it could be seen that the use of other machineries like harvesters and threshers has been increasing in the State. The same pattern of growth in the use of machineries could be seen in the district.

In India, the consumption of pesticides has increased by 20 percent over the last decade. State's share of pesticide consumption has declined from 1.68 percent in 1985-86 to 0.87 percent in 1994-95. However, the State government has initiated different schemes for the development of crops.

The notable increase in production and productivity of food grains since mid sixties have been attained through the modern scientific farm practices. The growth of the selected indices of scientific agriculture in the country indicates the favourable movement of agricultural sector towards the modern practices.

Paddy, coconut, arecanut, tapioca, rubber, banana, cashew nut and pulses are the main crops cultivated in Thrissur District. The most important crop in the district is paddy. Three crops namely Virippu, Mundakan and Punja are raised in certain areas of the district in a year. Coconut is an important cash crop which can be considered as a dryland crop. However, paddy and coconut are the main crops cultivated in the sample area (selected blocks) and also by the sample households. Paddy is cultivated among Virippu, Mundakan and Punja in which the proportion of gross area in Punja season is higher than that in other two seasons. Also the productivity of paddy in Punja crop is relatively higher and it is the highest among small farms. 33.57 percent of the sample farms have incurred loss in paddy cultivation and majority of the loss incurring farms come under the Mundakan crop. In the case of coconut, density of cultivation is in the range of 25 to 150 palms per acre in which the majority of the farms come under the density range of 50 to 100 palms per acre. Annual productivity of coconut in 77 percent of the farms is between 70 to 130 nuts per palm. Compared to paddy cultivation, profitability of coconut is high and thus most of the sample cultivators compensate their loss or low profit in paddy cultivation through coconut cultivation.

It could be noticed that even though the small holdings and meagre resources are common features of Kerala agriculture, increase in yield during a short period can be brought about by HYV seeds. In the present study, 85 percentage of the paddy cultivators have adopted HYVs which covered 86.04 percent of the gross area under cultivation. Sizewise indices show that the adoption is higher in large holdings while seasonwise indices give the result that it is higher under Punja crop. Regarding fertilisers, most of the sample cultivators have adopted the dual strategy of using both organic and inorganic manures. The adoption index of area for fertilisers is 96.48 percentage. Among three crops, only Punja crop comes under the irrigation practice. In our sample, only 36.43 percent of farms belong to this category which constitute 38.79 percent of the total area. Also it is found that tractors and tillers are being widely spread among the farmers. 96.43 percent of the farms have used tractors or tillers for ploughing, out of which 7.06 percentage have used harvesters while 34.12 percentage have used threshers. The other commonly used machineries are electric or diesel pumps for irrigation and hand pumps for spraying insecticides. It could be found that 92.62 percent of gross area have come under the use of insecticides. None of the farmers has adopted biological methods to control the insects because of the higher cost of its execution.

Adoption of different combination of modern inputs give the following results. Most of the HYV adopters have used fertilisers (96.56%). A few of the HYV adopters (4.23%) haven't used any of the machineries for farm operations. Also it is revealed that 8.45 percentage of the HYV adopters have not used insecticides. The entire package of modern practices including HYV, irrigation, fertilisers, machineries and insecticides is adopted in only 33.83 percentage of the total farm area under study. Since the adoption of irrigation practices is confined only to Punja cultivation, the intensity of adoption of other inputs could not be assessed along with irrigation. So the adoption index of area is calculated by considering all other inputs except irrigation which is equal to 77.33 percentage.

The adoption level in coconut cultivation is assessed by considering exclusively the adult palms. High Yielding Varieties of coconut are adopted by only 23 percentage of the sample cultivators. At the same time, irrigation practice is adopted by 86 percentage of the farmers and 58 percentage of the farmers have used fertilisers. Adoption level is the least for machineries (12 %) and 30 percent of the farmers have used insecticides. Adoption index for combined practices reveal that 8 percentage of the HYV adopters have not used fertilisers and 14 percent of the cultivators have accepted the input package of HYV, irrigation and fertilisers. Also a few of the HYV adopters (6 %) have used insecticides.

Weighted Least Square procedure in LPM gives more significant results in the analysis of the impact of socioeconomic factors on HYV adoption. Educational status of farmer, farm size, per capita income of the farm household and farm income are more or less significant and positively related to the adoption level.

In an attempt to identify the problems faced by farmers, it is found that their main problem which hinders the cultivation process in Mundakan and Punja season is the non-availability of irrigation. The most severe problem in paddy cultivation is the non-availability of efficient labourers at various stages. Another problem faced by the farmers is the lack of proper guidance for using the inputs.

Analysis of the costs and returns from paddy cultivation brings out the following results - Average cost per hectare of HYVs of paddy (Rs.17,486.66) is greater than that of LVs (Rs.10,501.91). Also the gross returns per hectare from HYVs is greater than that from local varieties because of the higher yield of HYVs. But average net returns per hectare of HYVs is less than that of LVs implies that the cost for HYVs is higher compared to that for LVs. Sizewise analysis of HYVs reveals that the average cost per hectare of small holdings is the largest and that of large holding is the smallest. As a result, the net returns from large holdings is the largest and that from small holdings is the smallest. This supports the average yield level of these size categories. Also it is found that the net returns per hectare from Punja crop is the highest corresponding to its higher yield level.

Cobb-Douglas Production function fitted for analysing Resource-use Efficiency provides the following results. The resources like land, labour, biochemical inputs and machineries are significant in determining the gross value of HYV output. But in the case of local varieties, biochemical input is not statistically significant. All of the inputs except machineries show positive relationship with the value of output for high yielding as well as local varieties. This is because, a smaller rental cost of machineries can provide an increase in the gross value of output. It is noted that returns to scale for HYV (0.997) is slightly less than that for LV (1.095). It supports the lower net returns per hectare from HYVs. The elasticity of output with respect to land is higher for HYVs where as that with respect to labour is higher for LVs. Sizewise analysis of HYVs reveals that returns to scale from large holdings is comparatively higher (1.22) and it is the lowest in medium holdings (0.763). The validity of the result obtained for medium holdings is comparatively lower due to the reason that the coefficient of determination of the corresponding model is only 0.41. Unlike other size categories, in large holdings, output bears a negative relationship with the input, land which shows an inverse relationship between these variables. Seasonwise analysis for HYVs reveals that the returns to scale from Virippu and Mundakan crops is higher than that from Punja season. It is against the result of higher net returns from Punja cultivation. This result could be explained on the basis of comparatively lower coefficient of determination of the model fitted for Punja crop.

The marginal value products worked out for land and biochemical inputs favour HYVs while that for labour is higher for LVs. Sizewise figures of MVPs show that the MVP of biochemical inputs is greater in small holdings while that of labour and land are higher in medium and large holdings respectively. Also the MVP of land is higher in Mundakan season. In Virippu and Punja seasons, the MVPs of labour and biochemical inputs respectively are the highest.

In coconut cultivation, number of palms is highly significant in determining the value of gross output of both HYVs and LVs. The other two inputs, labour and biochemical inputs are not significant in the case of LVs. Under the existing farm management practices, coconut production is not amenable to the economies of scale (returns to scale for HYV = 0.91 and that for LV = 0.99). The marginal value products of all inputs are higher for local varieties of coconut.

7.2 Recommendations

In certain regions of the district, Virippu crop is not cultivated due to severe flood. Mundakan cultivation is risky because it exclusively depends upon rain which is uncertain during the season. However, Punja season is more suitable for paddy cultivation if adequate irrigalton facilities could be provided. According to the farmers, the attack of pests and insects is comparatively smaller during punja season. So the productivity of Punja crop is high and its operation cost is low. So by spreading Punja cultivation in the district, the productivity of paddy in the district could be increased.

Measures should be taken to adopt effective machineries at various stages of farm operations so that total cost could be reduced and thus the labour problem could be solved to a certain extent.

Even though all resources like labour, land, biochemical inputs and machineries are significant in determining the gross output, the marginal value products of these inputs are comparatively unfavourable. This may be due to two reasons. First, the gross value of output is lower compared to the cost of inputs. Second, excessive use of biochemical inputs like fertilisers and insecticides reduces the productive efficiency of plants. So effective management of available resources is very much needed and suitable measures should be taken by the Government in favour of cultivators in order to increase production and to make it profitable.

Since the marginal value product of land is relatively higher, land should be utilised at its maximum level so as to increase the production. So effective measures should be taken to sustain the cultivable paddy land and to prevent the conversion of land for other purposes rather than cultivation. And adequate measures should be adopted to make use of the fallow lands.

Most of the farmers are unaware of using inputs in the proper manner. So intensive training and proper guidance should be given to promote the effective utilisation of resources.

With the introduction of Panchayati Raj System in the country, the GramaPanchayats have been given adequate powers to formulate and implement development plans for the areas they represent. So the Panchaysts should plan their development activities on scientific lines by linking the state agricultural policies and activities of Agricultural Universities.

Thus by the adoption of afore cited measures and also by the joined venture of the Government institutions and the farmers, we can improve the agricultural production and productivity levels in the district.

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APPENDICES

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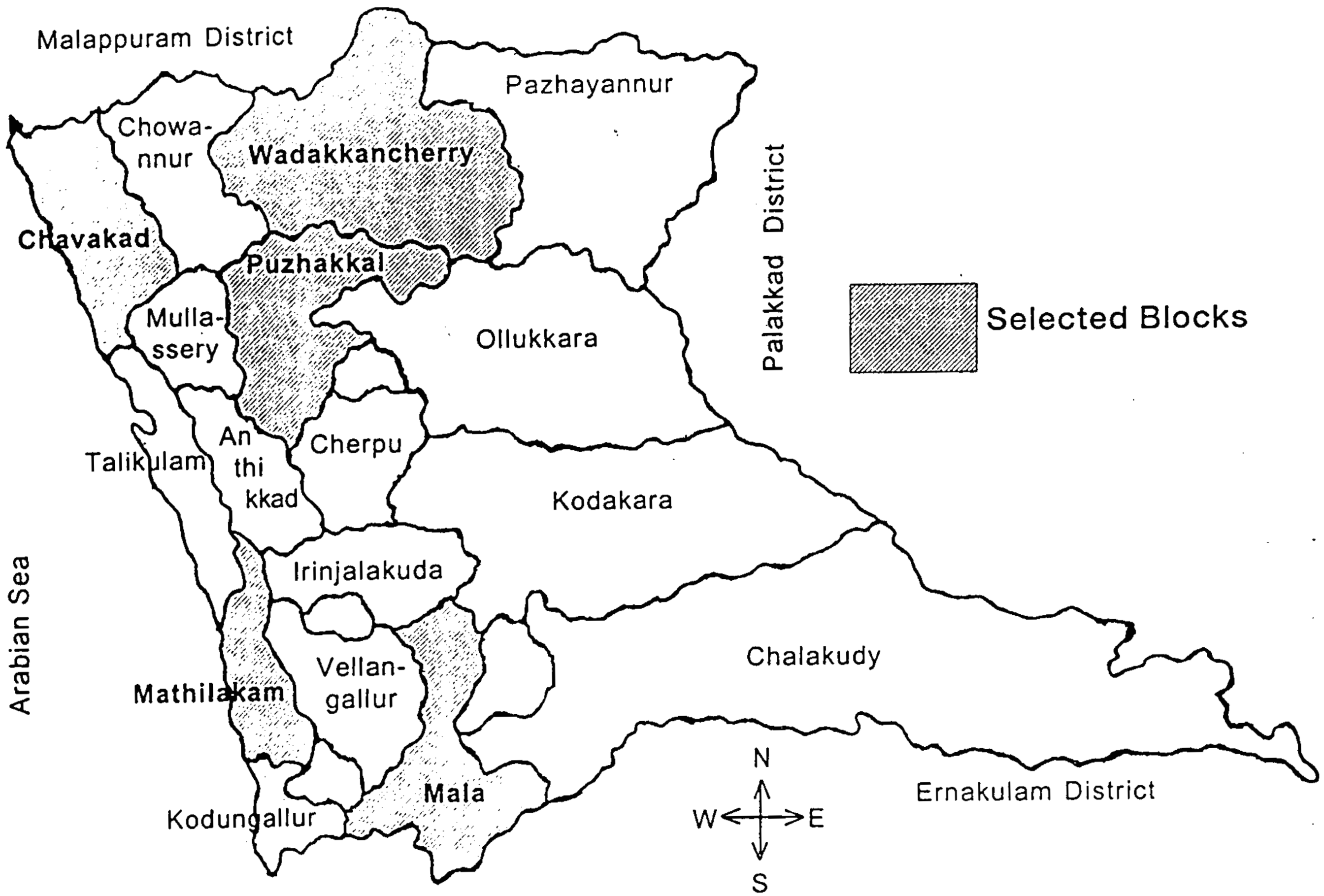
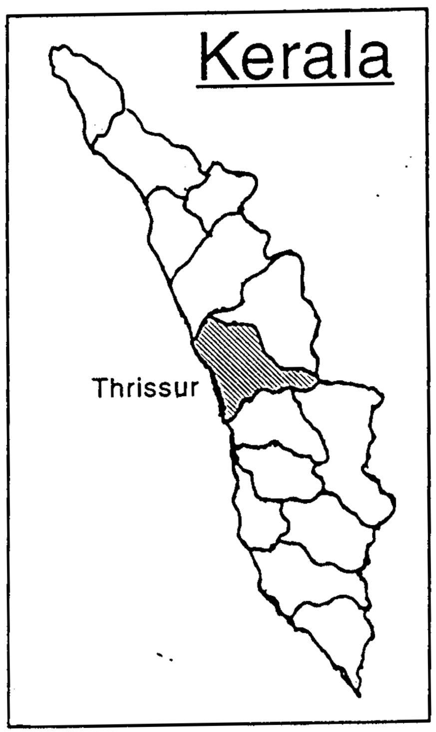
APPENDIX - I

THRISSUR DISTRICT

MAP SHOWING BLOCK PANCHAYATS





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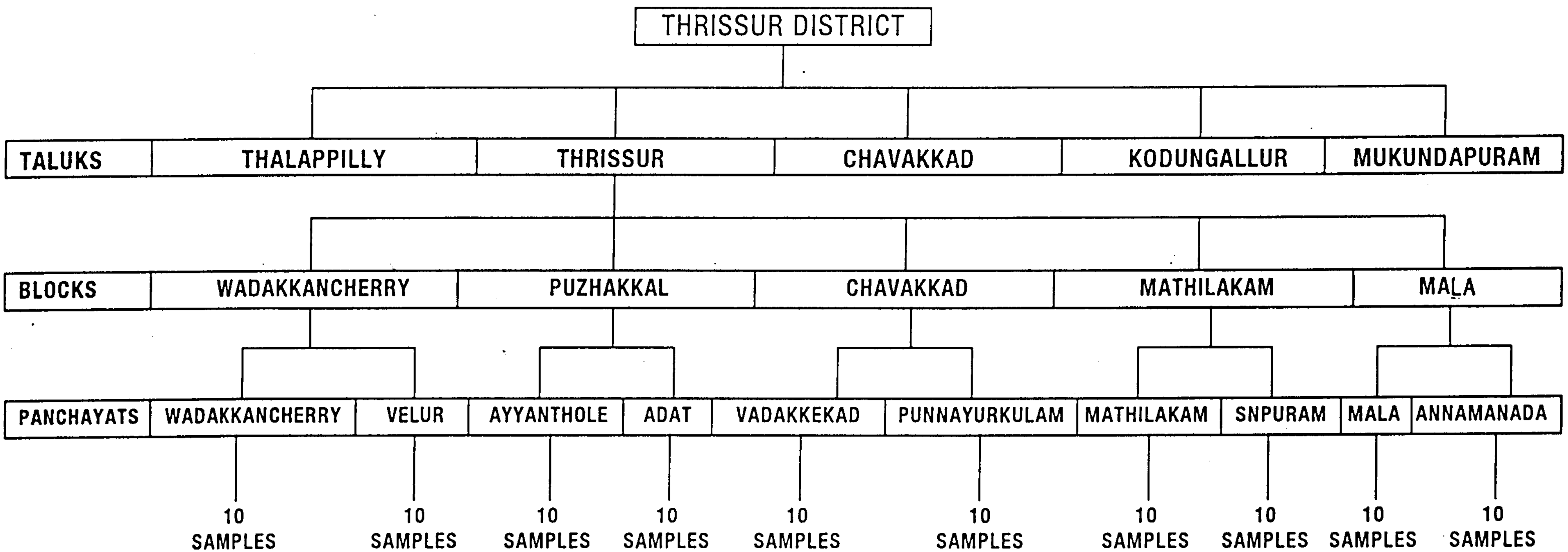
APPENDIX - II

SAMPLING PROCEDURE



APPENDIX IV

DEPARTMENT OF ECONOMICS

UNIVERSITY OF CALICUT

Determination and Impact of Modern Technological Adoption in Agriculture: A Case Study of Thrissur District

(QUESTIONNAIRE)

1. Block : Panchayat: Ward: House No:
2. Name of the Head of the Family :
3. Religion and Caste :
4. Family Particulars :

Sl. No.	Name of Member	Sex	Age	Marital Status	Level of Education	Occupation	Income

5. Details of Paddy Cultivation :

(A) Cultivated Area under Paddy :

VIRIPPU		MUNDAKAN		PUNJA	
HYV	LV	HYV	LV	HYV	LV

B. Soil Preparation : V M P

(i) Ploughing Method used (Tractor/Tiller/Traditional) :

(ii) Source of Machinery. (hired/owned) :

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V M P

(iii) If hired, how many hours ? :

(iv) Cost of ploughing/hour (including hiring charge) :

(v) Do you prefer new machineries to traditional Method ? Yes/No. Give reasons. :

C. Type of Seeds used :-

(i) Name of the brand :

(ii) Hybrid/Local :

(iii) Duration :

(iv) Source of Seed (Own/Seed Farm/ Community Nursery/Agri.Dept/ Other sources) :

(v) Quantity of seed used per Acre :

(vi) Nature of sowing (Dry sowing/ Seedling Njattady) :

(vii) Cost of Seed/Acre : HYV LV

(viii) Do you prefer HYV to LV,Yes/No : Give reasons.

D. Fertiliser Application :

(i) Quantity of Fertiliser used (Kg/Acre)

ORGANIC									INORGANIC											
Cow-dung			Compost			Others			N			P			K			Paddy Mixture		
V	M	P	V	M	P	V	M	P	V	M	P	V	M	P	V	M	P	V	M	P

....3

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(ii) Cost per acre

ORGANIC									INORGANIC											
Cowdung			Compost			Others			N			P			K			Paddy Mixture		
V	M	P	V	M	P	V	M	P	V	M	P	V	M	P	V	M	P	V	M	P

(iii) Which type of fertilisers do you prefer? Why?

E. Plant Protection : V M P

(i) Quantity of insecticides/ Pesticides used: :

(ii) Cost of Insecticides/pesticides used. :

(iii) Source of sprayer (hired/owned) :

(iv) If hired, hiring charge per hour:

(v) Whether you use weedicides? Yes/No. If Yes, Quantity used :

(vi) Cost of Weedicides :

F. Irrigation :

(i) Source of irrigation :

(ii) Cost of Irrigation :

(iii) Whether you use oil engines/ electric motors ? :

G. Harvesting :

(i) Harvesting method used (traditional/machineries) :

(ii) Cost of harvesting/acre :

(iii) Source of machineries (hired/owned) :

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H

V M P

(iv) If hired, how many hours used? :

(v) Hiring charge per hour :

(vi) Do you prefer machineries to traditional methods. Why? :

H. Threshing :

(i) Threshing method used (Traditional/Machineries) :

(ii) Cost of threshing :

(iii) Source of threshers (hired/ owned) :

(iv) If hired, how many hours used :

(v) Hiring charge per hour :

(vi) Do you prefer threshers to traditional methods. Why? :

I. Labour used :

(i) Type of labour used (hired/ family labour) :

(ii) No. of labourers used in each stage :

Sl. No.	Nature of Work	No. of Labourers						Total labour hours					
		M			F			M			F		
		V	M	P	V	M	P	V	M	P	V	M	P
1.	Soil Preparation												
2.	Sowing												
3.	Transplanting												
4.	watering												
5.	Weeding												
6.	Menuring												
7.	Spraying												
8.	Harvesting												
9.	Threshing												
10.	Post harvesting operations.												

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(iii) Labour Cost per Hour : M F

J. Yield and Income : V M P V M P

(i) Yield of grain : HYV LV

(ii) Market price of grain :
(iii) Income per Acre :
(iv) Yield of hay :
(v) Market price of hay :
(vi) Income from hay :

K. Subsidy:

(i) Mode of subsidy (Cash/kind/both):
(ii) If in cash, how many rupees for each purpose :

Sl.No.	Purpose	Amount (Rs.)
1.		
2.		
3.		
4.		
5.		

(iii) If in kind, what is the nature? :

(iv) Which type of subsidy is desirable Why? :

L. Credit :

(i) Credit availed for each purpose :

Sl. No.	Purpose	Source of credit	Amount Obtained(Rs.)	Interest Rate	Period of Loan
1.					
2.					
3.					
4.					
5.					

M. Whether Agroclinics helped :

(i) To reduce the attack of pests/ diseases : : Yes/No

(ii) To reduce the intake of pesticides : Yes/No

N. Major constraints experienced in paddy cultivation:

(i) In relation to land :

(ii) In the availability of irrigation facilities :

(iii) In the availability of financial support :

(iv) In the availability of inputs (seeds, fertilisers, insecticides) in time :

(v) In getting adequate information about new technology :

(vi) In getting machineries in time :

(vii) In getting efficient labourers in various stages :

(viii) In storing and exchanging the grain. :

(ix) In getting reasonable price :

6. Details of coconut cultivation :

A. Area under cultivation

HYV		LV	
Irrigated	Unirrigated	Irrigated	Unirrigated

B. Total production per year (Nos):

HYV	LV

C. Market price of coconut :

D. Total income from coconut :

(i) Ploughing method used (Tractor/Tiller/Traditional) :

(ii) Cost of ploughing :

(iii) Source of machinery (hired/ owned) :

(iv) If hired, how many hours ? :

(v) Hiring charge per hour including labour cost :

F. Manuring and Tillage :

(i) Manures used :-

QUANTITY OF MANURES USED (Kgs)						
Organic				Inorganic		
Green Manure	Cowdung	Compost	Others	N	P	K

(ii) Cost of organic manures per Kg. :

(iii) Cost of inorganic manures per Kg. :

(iv) Whether you think inorganic manuring is better than the other? Why? :

G. Irrigation :

(i) Source of irrigation :

(ii) Cost of irrigation :

(iii) Whether you use oil engine/ electric pump ? :

H. Type of seeds used :-

(i) Name of the brand :

(ii) Hybrid/Local :

(iii) Duration for the first yielding. :

(iv) Source of seed (Own/Seed Farm/ Community Nursery/Agri.Dept/ other source) :

(v) Cost of seed : HYV LV

(vi) Whether you prefer HYV? Why ? :

I. Palm Protection :

(i) Quantity of insecticides/ pesticides used per palm. :

(ii) Cost of insecticides/ Pesticides used. :

(iii) Source of Sprayer (hired/ owned) :

(iv) If hired, hiring charge per hour. :

(v) No. of hours used :

(vi) Whether any of your palm had destroyed during 1 year ? (Yes/No). If Yes, No. of palm destroyed :

Reasons :

J. Harvesting :

(i) Method used (Traditional/ Machineries :

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(ii) Source of machineries (hired/owned) :

(iii) No. of hours used :

(iv) If hired, hiring charge per hour. :

K. Labour used :

(i) Type of labour used (hired/ family labour) :

(ii) No. of labourers employed for each work. :

Sl. No.	Nature of Work	No. of Labourers		Total Labour Hours	
		M	F	M	F
1.	Ploughing				
2.	Manuring & tillage				
3.	Watering				
4.	Harvesting				
5.	Post harvesting				

(iii) Labour cost per hour : M F

L. Subsidy :

(i) Mode of subsidy (Cash/kind/both):

(ii) If in cash, how many rupees for each purpose : :

Sl.No.	Purpose	Amount (Rs.)
1.		
2.		
3.		
4.		

(iii) If in kind, what is the nature ? :

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(iv) Which type of subsidy is desirable and why ? :

M. Credit :

(i) Credit availed for each purpose :

Sl. No.	Purpose	Source of credit	Amount obtained Rs.	Interest rate	Period of loan

N. Major constraints experienced in coconut cultivation :

(i) In the availability of irrigation facilities. :

(ii) In the availability of inputs (seeds, fertilisers, insecticides). :

(iii) In getting efficient labourers :

(iv) In getting financial assistance:

(v) In getting adequate information about new technology. :

8. Details of other crops, if any.

Sl. No.	Crops	Area		Production/ Year	Subsidy obtained	Credit availed
		Irrig.	Unirri.			

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