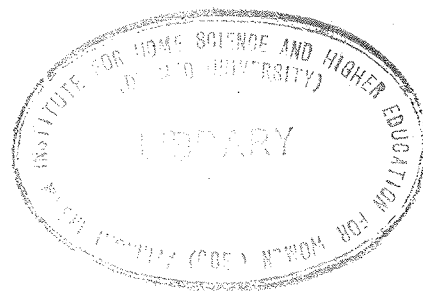


IMPACT OF AGRICULTURAL TECHNOLOGY ON FARM OUTPUT AND EMPLOYMENT

**By
Tmt.R.ANNAPOORANI**



***A thesis submitted to the Avinashilingam Institute
for Home Science and Higher Education for Women
(Deemed University), Coimbatore-641 043
in partial fulfilment of the requirements for
the degree of DOCTOR OF PHILOSOPHY***

July 1994

CERTIFICATE

This is to certify that the thesis entitled **"IMPACT OF AGRICULTURAL TECHNOLOGY ON FARM OUTPUT AND EMPLOYMENT"** submitted to the Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore - 641 043 for the award of **DEGREE OF DOCTOR OF PHILOSOPHY IN ECONOMICS** is a record of original research work done by **Mrs.R.ANNAPOORANI**, Lecturer, Senior Scale, Department of Economics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore during the period of her study in Avinashilingam Institute for Home Science and Higher Education for Women, under my supervision and guidance and the thesis has not formed the basis for the award of any Degree / Diploma / Associateship / Fellowship of similar title to any candidate of any University.

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Signature of the Guide

DECLARATION

I hereby declare that the matter embodied, in the thesis entitled "IMPACT OF AGRICULTURAL TECHNOLOGY ON FARM OUTPUT AND EMPLOYMENT" is the result of investigation carried out by me in Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, under the supervision of Dr.(Mrs.) G.RAMATHILAGAM, M.A., M.Phil., Dip. Ed. (Madras), Ph.D. (Bharathiar), Dean, Faculty of Humanities, Professor and Head of the Department of Economics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore and it has not been submitted for the award of any Degree / Diploma / Associateship / Fellowship etc. of any other university or Institute.

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ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

The investigator records her respectful gratitude to **Padmashree Dr. (Mrs.) Rajammal P. Devadas**, M.A., M.Sc., Ph.D., (Ohio State), D.Sc. (Madras), Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore for her constant encouragement and guidance.

The investigator expresses her thanks to **Dr. (Mrs.) Lakshmi Santa Rajagopal**, M.S. (Tennessee), Ph.D. (Madras), Vice Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore for her sincere help during the course of the study.

The investigator is deeply thankful to **Dr. Saroja Prabakar**, M.A., Dip.Ed. (Madras), Ph.D. (Mother Teresa), Registrar, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore for facilitating the conduct of the study.

The investigator expresses her profound gratitude and heartfelt thanks to **Dr. (Mrs.) G. Ramathilagam**, M.A., M.Phil., Dip. Ed. (Madras), Ph.D. (Bharathiar), Dean, Faculty of Humanities, Professor and Head of the Department of Economics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore for the valuable guidance and advice rendered throughout the period of the study.

Her sincerity of purpose, commitment, constant encouragement and constructive criticisms catered at every stage of the study have gone a long way in achieving the goal.

The investigator expresses her gratitude to **Dr.S.Saraswathi Bhatji**, Retired Dean, Faculty of Humanities, Avinashilingam Institute for Home Science and Higher Education, Coimbatore for having inspired and motivated for the research work.

The investigator offer her thanks to **Dr.S.Varadarajan**, Professor and Head of the Department of Agricultural Economics, Agricultural College and Research Institute, Madurai for the helpful comments made on the study design.

The investigator expresses her thanks to **Mr.K.U.Karuppuswamy**, B.A., DSADP Junior Agricultural Officer (Computer), Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore for extending the computer facilities during the course of the study.

The investigator is deeply thankful to **Miss.Shubala**, M.A. for her sincere help in tabulation and analysis of data. She records with gratitude the timely and effective assistance rendered by her in data processing.

The investigator expresses her thanks to **Mr.Gandhi**, **Ms.D.Shobha Pai** and **Ms.D.Sujatha Pai** of **M/s.FAST FORWARD** for their help in typing, xeroxing and binding the thesis.

CONTENTS

CHAPTER

PAGE NO.

List of Tables

List of Figures

List of Appendices

I	INTRODUCTION	1
II	REVIEW OF LITERATURE	
	A. Survey of the concept of agricultural technology and its relation with production and employment	17
	B. Role of technology in economic growth and development	22
	C. Studies relating to the impact of agricultural technology on farm output and employment in developed countries	31
	D. Studies in Indian agriculture relating to the impact of agricultural technology on farm output	34
	E. Studies in Indian agriculture relating to the impact of farm technology on employment	49
III	METHODOLOGY	
	A. Selection of the area	58
	B. Selection of the sampling units	62
	C. Size of the sample	74

CHAPTER**PAGE NO.**

D.	Selection of the crops	76
E.	Collection of data	77
F.	Period of study	77
G.	Definition of the concepts used	78
H.	Hypotheses framed	78
I.	Quantitative tools used	78
J.	Tabulation of data	97

IV**RESULTS AND DISCUSSION**

I.	Macro analytical study of the impact of agricultural technology on farm output and employment	
A.	Trends in land area, sources of water supply and rainfall	99
B.	Trends in area, production and productivity of foodgrains	105
C.	Trends in technology use in Tamil Nadu	111
D.	Technology - Foodgrains productivity relationships	125
E.	Technology - Employment relationships	128
II.	Micro analytical study of the impact of agricultural technology on farm output and employment	
A.	General profile of the sample respondents	134
B.	Resource use pattern	138
C.	Nature of technical change and measurement of technical change	156
D.	Adoption of agricultural technology	179

CHAPTER

PAGE NO.

E.	Analysis of cost of cultivation and profitability of farming enterprise	204
F.	Determination of factor shares, factor substitution and resource use efficiency due to technical change	234
G.	Effect of high yielding variety seeds, fertiliser, pesticides and tractors on farm output and output decomposition model	275
H.	Crop wise and size wise variations in technology impact relating to farm output	306
I.	Effect of high yielding variety seeds and tractors on farm employment	323
J.	Technology impact model with respect to employment	339
K.	Derivation of labour demand functions and employment decomposition model	343
L.	Determination of technological factors in operation wise demand for labour - Linear discriminant function analysis	359

V

SUMMARY AND CONCLUSION

381

BIBLIOGRAPHY

APPENDICES

LIST OF TABLES

Table No.	Title of the Table	Page No.
I	List of high irrigated blocks in Coimbatore District	63
II	List of low irrigated blocks in Coimbatore District	64
III	List of villages selected for the study	66
IV	Percentage of sample farmers covered to the total farming population in the selected villages	75
V	Trends in land utilisation pattern in Tamil Nadu from 1980 - 81 to 1990 - 91	100
VI	Trends in sources of irrigation in Tamil Nadu from 1980 - 81 to 1990 - 91	102
VII	Trends in rainfall in Tamil Nadu from 1980-81 to 1990 - 91	104
VIII	Trends in area, production and productivity of foodgrains in Tamil Nadu from 1980-81 to 1990 - 91	106
IX	Trends in area, production and productivity of foodgrains - Cropwise in Tamil Nadu from 1980 - 81 to 1990 - 91	108
X	Crop wise yield effect, area effect and interaction effect - 1981 - 91	110

LIST OF TABLES (Contd.)

Table No.	Title of the Table	Page No.
XI	Trends in net irrigated area, area under high yielding variety seeds, fertiliser consumption, area under pest and disease control and use of agricultural implements in Tamil Nadu from 1980 - 81 to 1990 - 91	112
XII	Adoption values for technological variables in Tamil Nadu (Estimated coefficients of the logistic curve)	115
XIII	Estimated trend values in technology use in Tamil Nadu	117
XIV	Zero order correlation coefficients of foodgrains productivity as related to technological variables	126
XV	Trends in cultivators and agricultural labourers in Tamil Nadu (1981 - 91)	130
XVI	General profile of the sample respondents	135
XVII	Calculated chi square values of association between technology adoption and the selected characteristics	137
XVIII	Land use pattern in the selected villages	140
XIX	Cropping pattern in the selected villages	143
XX	Labour use pattern in the selected villages	146
XXI	Crop wise and operation wise of labour in the selected villages	150

LIST OF TABLES (Contd.)

Table No.	Title of the Table	Page No.
XXII	Capital invested by the selected farmers	154
XXIII	Empirical estimates of the agricultural production function	158
XXIV	Empirical estimates of the agricultural production function - Size wise	160
XXV	Block wise empirical estimates of the agricultural production functions	162
XXVI	Estimated crop wise efficiency parameters and slope coefficients due to technical change	167
XXVII	Extent of discrepancy between optimal and actual use of inputs in the selected villages	180
XXVIII	Size wise technology adoption index in the selected villages	187
XXIX	Crop wise technology adoption index in the selected villages	189
XXX	Factors inducing the adoption of agricultural technology as stated by the selected farmers	191
XXXI	Factors constraining the adoption of agricultural technology as stated by the selected farmers	198
XXXII	Components of per acre cost of cultivation in the study farms	205
XXXIII	Per acre net return in the selected farms	229

LIST OF TABLES (CONTD.)

Table No.	Title of the Table	Page No.
XXXIV	Estimated geometric mean of output and inputs in the selected farms	236
XXXV	Crop wise estimated marginal value productivity of inputs in the selected farms	243
XXXVI	Estimated marginal rate of substitution between factors in the selected farms	252
XXXVII	Estimated bias in share of different factors in total production	260
XXXVIII	Estimated value of resource ^a served and resource loss averted per acre by the selected farmers due to technical change	269
XXXIX	Differentials in output and yield between high yielding variety and non high yielding variety farms	277
XL	Partitioning of per acre differential output into components of variety effect and complementary input effect	283
XLI	Estimated fertiliser yield response coefficients in the selected farms	287
XLII	Estimated pesticide yield response coefficients in the selected farms	295
XLIII	Differentials in output and yield between tractor and non tractor farms in the selected villages	302

LIST OF TABLES (CONTD.)

Table No.	Title of the Table	Page No.
XLIV	Estimated multiple regression coefficients of farm income as related to technology adoption index, cultivated area and cropping intensity	307
XLV	Estimated crop wise regression coefficients of farm income as related to technology adoption index, cultivated area and cropping intensity	312
XLVI	Estimated size wise regression coefficients of farm income as related to technology adoption index, cultivated area and cropping intensity	318
XLVII	Differentials in man hours employed between high yielding variety and non high yielding variety farms	325
XLVIII	Differentials in man hours employed between tractor and non tractor farms	333
XLIX	Estimated multiple regression coefficients of employment as related to technology adoption index, cultivated area and cropping intensity	340
L	Estimated employment elasticities in the study farms	345
LI	Decomposition analysis of total change in per acre employment between high and low technology farms	354
LII	Linear discriminant function coefficients and percentage contribution of individual characteristics to total distance measured (Land preparation)	361

LIST OF FIGURES

FIGURE NO.	Title of the Figure	Page No.
I	Coimbatore District Map	61
II	Pollachi South Block Map	67
III	Perur Block Map	68
IV	Karamadai Block Map	69
V	Palladam Block Map.	70
VI	Annur Block Map	71
VII	Flow chart representing the sampling design used in the study	73
VIII	Actual and Trend values of technological variables in Tamil Nadu	
	A. Net Irrigated Area	119
	B. Area under high yielding variety seeds	120
	C. Fertiliser consumption	121
	D. Area under pest control	122
	E. Area under disease control	123
	F. Use of Agricultural implements	124
IX	Pie diagram to represent the components of per acre cost of cultivation in HYV and NHYV farms	
	A. Pollachi South - Type A Village	218

LIST OF FIGURES (Contd.)

Figure No.	Title of the Figure	Page No.
A.	Pollachi South - Type B Village	219
B.	Perur - Type A Village	220
B.	Perur - Type B Village	221
C.	Karamadai - Type A Village	222
C.	Karamadai - Type B Village	223
D.	Palladam - Type A Village	224
D.	Palladam - Type B Village	225
E.	Annur - Type A Village	226
E.	Annur - Type B Village	227

LIST OF APPENDICES

Appendix No.	Title of the Appendix
I	List of high and low irrigated villages in the selected blocks
II	An interview schedule to elicit information on the impact of new agricultural technology on farm output and employment
IIA	Definition of the concepts used in the study
III	Decomposition analysis of change ⁱⁿ foodgrains production in Tamil Nadu due to area effect, yield effect and interaction effect
IV	Coefficient of variation in fertiliser consumption in Tamil Nadu
V	Estimated growth rate of fertiliser consumption in Tamil Nadu
VI	Estimated coefficients of logistic curve in Tamil Nadu
VII	Estimated trend values in net irrigated area based on the logistic curve
VIII	Estimated multiple regression coefficient of foodgrains productivity as related to technological variables
IX	Chisquare analysis to find out the association between educational level of the farmers and technology adoption
X	Empirical estimates of agricultural production function

LIST OF APPENDICES (Contd.)

Appendix No.	Title of the Appendix
XI	Estimated multiple regression coefficients of HYV yield as related to cropped area, seed expenditure, pesticide expenditure, fertiliser expenditure, manhours employed capital invested and tractor timings
XII	Formulation of technology adoption index-
XIII	Estimated geometric mean of inputs
XIV	Estimated marginal value productivity of inputs
XV	Estimated marginal rate of substitution between factors
XVI	Estimated bias in factor shares
XVII	Impact of technical change on resource use efficiency
XVIII	'T' Test to find out the significant difference in yield between HYV and NHYV farms
XIX	Partitioning of differential output into components of variety effect and complementary input effect
XX	Estimated fertiliser yield response coefficients

LIST OF APPENDICES (Contd.)

Appendix No.	Title of the Appendix
XXI	Estimated pesticide yield response coefficients
XXII	Estimated multiple regression coefficients of farm income as related to technology adoption index, cultivated area and cropping intensity
XXIII	Estimated crop wise regression coefficients of farm income as related to technology adoption index, cultivated area and cropping intensity
XXIV	Estimated size wise regression coefficients of farm income as related to technology adoption index, cultivated area and cropping intensity
XXV	Estimated multiple regression coefficients of employment as related to technology adoption index, cultivated area and cropping intensity
XXVI	Estimated employment elasticities
XXVII	Decomposition analysis of change in employment due to technology effect normalised wage rate effect and input <i>effect</i>
XXVIII	Linear discriminant function analysis

INTRODUCTION

CHAPTER I

INTRODUCTION

Technology is the essential source of economic growth and it helps to speed up the process of economic development. The ability of an economy to achieve rapid growth in output depends on its ability to change the alternative paths available to it and more specifically, it must economise the scarce resources and facilitate its substitution with other resources. As the Indian Planning commission (1951) states, 'Basically development involves securing higher productivity all around and this is a function of the degree of technical advance a community is able to make'. Technological progress results in economic welfare by helping to enhance productivity at the same unit cost or maintaining current levels of productivity at a reduced cost. Hence, technical change is one of the forces which may cause economic decay in one region while other regions bloom and prosper.

The concept of technology and technical change has been defined differently by different economists. Kuznets (1969) opined that technical progress consists not only of inventions that require heavy capital costs, but also of a stream of relatively cheap changes or improvements whose cumulative effect is a drastic reduction in input resources accompanied by increase in output. Yudelman (1971) regards technology as the application of knowledge in the production process and that involves the use of a new resource. Snodgrass and Wallace (1984) defined technology as knowledge applied by human beings to improve production or marketing

process. In short, technology is a performing art by which new economic realities come into being.

Technical change is the corner stone of economic productivity. It signifies the process of perception and the consequent generation of scientific ideas and their transformation into products and services. Leve (1964) defined technical change as the shift of the production function for achieving efficiency in the use of resources. Kendrick (1964) considered technical change as decrease of real costs per unit of output and improvement in the quality and variety of final consumer goods and producer goods. Ruttan (1979) defined technical change as the change in one or more parameters of the aggregate production function resulting from the addition of new production technology to the existing one.

Technical change has been classified into embodied technical change and disembodied technical change. Embodied technical change refers to the introduction of change in physical capital inputs. But disembodied technical change is not embodied in the physical capital. These changes are organisational and they tend to increase managerial ability of the farm.

Technical change is also classified into neutral and non-neutral technical change. Neutral technical change is denoted by equal proportionate change in labour and capital coefficients. However, technical change is non neutral if the capital coefficient is greater than labour coefficient or vice versa.

The role of technology in economic development was recognised from classical era. According to the classical theory of growth, the development of capitalistic economy is a race between technological progress and population growth. Marx (1930) stressed on technological progress as the motor of capitalist growth and identified the stage of economic growth by employing the type of production technology used. Schumpeter (1951) viewed that the discontinuous disturbance for equilibrium comes in the form of an innovation. Schumacher (1961) noted that economic development is impossible without the introduction of technology. According to Harrod (1965) technical progress increases the efficiency of factor inputs. Joan Robinson (1965) stressed the role of induced technical progress in considering the conditions under which golden age can exist. Swan (1956) and Solow (1962) have also emphasised the role of technology in economic growth. Cairn Cross (1979) opined that development is an ongoing process that rests on the constant injection of new technology and on the capacity to generate and absorb technical change. Hence, as Hayami and Ruttan (1979) stated, technical change should be treated as endogenous in the development process rather than as exogenous factor that operates independently of the development process.

In the sphere of agriculture, technology plays a significant role in strengthening the farmers hold on agricultural resources. Technological change as the most powerful source of productivity growth in agriculture has been recognised by Schultz (1964) and Hayami and Ruttan (1971). Schultz (1964) in 'Transforming traditional agriculture' has advanced the hypothesis that traditional inputs are costly sources of growth but

the non-conventional inputs fetch a much higher rate of return. High pay off input model of agricultural development stressed the proposition that the key to transform a traditional agricultural sector into a productive sector of economic growth is investment designed to make modern high pay off inputs, and the capacity of the farmer to acquire new knowledge and to use new input effectively.

Agricultural technology refers to the art of production. According to Mosher (1966) the technology of farming means the way it is done. It includes the methods by which the farmers sow, cultivate and harvest crops. Misra (1969) defined agricultural technology as the whole mechanism adopted to achieve rising production and it is the art of using production factors most efficiently. Bartsch (1977) defined agricultural technology as the application of knowledge involving the use of combination of material inputs of biological chemical nature in conjunction with cultivating practices typically associated with such inputs and in increasing agricultural production. Farm technology has a significant role in enhancing global food production to meet the growing food requirements caused by demographic explosion. Recognising the role of agricultural technology, Tarlok Singh (1969) states, 'The growth and transformation of agriculture is by far the most important determinant of economic development and that the crux of the process of modernisation of a society is the modernisation of agriculture'. Dharam Narain (1977) remarked that the major limiting factor on agricultural development was a technical constraint rather than resource constraint. As early as in 1969 Swaminathan asserted that it was possible to get a minimum of 10 tonnes of grains per hectare

in the Indian context if all results of scientific work were adopted in the fields.

Heady (1949) classified farm innovations into biological innovations ie., those having a physiological effect in increasing total output from a given land base and mechanical innovations as those which substitute capital for labour. However, in practical application, the concept of agricultural technology refers to input mix, particularly its major components (viz.) irrigation, high yielding variety seeds (HYV), fertiliser, mechanisation and plant protection measures.

Irrigation is an essential component of agricultural transformation and can be viewed as a land augmenting technology. Provision of irrigation facilities results in effective utilisation of land available through changes in land use intensity. As such, the percentage of land that can be provided with assured supply of water imposes a limit to the rate of growth that can be attained by technical change. In this context Lewis (1974) stated "Secret of food is water, and where there is enough water, the use of HYV seeds with fertiliser and pesticides banishes the food problem". The potentials of genetic improvement in crop varieties and agronomic innovation can be fully tapped only if irrigation is made available in the areas in which rainfall is inadequate. Avoidance of risk in farming and stability in production are largely ensured through irrigation.

High yielding variety seeds (HYV) serve as a catalyst in modern innovation. The use of HYV seeds helps to improve the efficiency of

other inputs and raise the yield. Without HYV seeds, the investment on fertiliser, water and pesticides will not pay the required dividend to the farmers. Hence, Kahlon (1984) remarked HYV is one of the greatest facets of biological engineering. The new seeds have a high reproductive potential and short maturity span ranging from 110 to 140 days.

HYV seeds are non photo sensitive (ie) their period of maturity is independent of the length of exposure to sunlight. The important HYV seeds introduced during the last five years and which have found favour with the farmers include short duration rice varieties, ADT 27, IR 8, TKM 6, ASD 5, ASD 11, ADT 36, ADT 37 and ASD 16, medium duration rice varieties Co 43, Co 44 and white Ponni; maize varieties Co 1, Co 7 and Co 8; cholam varieties Co 12, Co 18, Co 20, Co 29 and CSH 1, groundnut varieties TMV 2, TMV 7, TMV 1, TMV 2, TMV 3 and TMV 4; cotton varieties K 6, K 7, MCU 1, MCU 2, MCU 5, MCU 10 and P 215; and sugarcane varieties Co 671, Co 771 and Co 776, Co 7201 and Co 7527.

Fertiliser is the kingpin for increasing production in agriculture, since about 70 percent of the growth in agricultural production can be attributed to increased fertiliser use (Trivedi, 1979). Chemical fertiliser is an essential input in removing soil fertility constraints and continuously raising land productivity. It is considered to be one of the most important components of yield increasing technology even under rainfed conditions.

The major fertilisers used by Indian farmers are urea, mixture, ammonium sulphate, calcium ammonium nitrate (CAN), ammonium phosphate and super phosphate.

Pesticide is the most crucial input deciding the difference between actual and normal yields. The success of HYV in agricultural production depends on adequate plant protection measures being adopted. In order that the plants get the maximum food from the soil, the unwanted wild plants which compete with them are to be repeatedly weeded out. The use of pesticides is influenced by the potential yield which in turn is determined by the extent of use of inputs like fertilisers. While other inputs are meant to step up agricultural yield, pesticides are used to save the potential yield from damage due to pests. Indian farmers are largely using pesticides like endrin, folidol, benzene hexa chloride (BHC), diethyl diethyl tetrachloride (DDT), bluecopper, roger, metasytex etc.

The use of agricultural implements helps to speed up the process of farm operations. The main agricultural implements and machinaries used by the farmers include seed drills, power sprayers and dusters, oil engines with pumpsets, electrical pumpsets, tractors, seed cum fertiliser drill and sugarcane crusher.

The availability of agricultural technology constitutes a necessary condition for raising the productivity in agriculture, the sufficient condition being that it is adopted by the farmers. Linde Smith (1956) says, that adoption will occur only when the individual perceives that

the potential reward for adoption outweighs the expected efforts required for adoption. Grillichies (1957) reported that in the long run economic factors were the major determinants of the patterns of technical change. At the farm level, there are significant factors favouring and limiting the adoption of agricultural technology.

However, there are some problems associated with agricultural technology. Adoption of agricultural technology is expensive since the inputs are new and mostly to be found outside the farm. The use of agricultural technology is risky since technically, the HYV seeds are liable to be damaged if there is excess or deficiency of water. Rastogi (1978) stated that the extent of adoption of farm technology depends upon its pay offs, resource strategy, farmer's financial position, risk component, institutional factors and Government policies and programmes.

Adoption of agricultural technology has got a significant impact on farm output. Improved farm technology can lead to better methods of production resulting in saving of time and effort. Further, adoption of agricultural technology enables larger volume of output to be produced out of the same area of land. The constantly improving technology facilitates higher production by providing the capacity to replenish the loss in soil fertility. Improved technology helps to generate positive gains to the farmers by increasing the marginal productivity not only of non traditional resources, but also of traditional resources like human labour and bullock labour.

Farm technology is an important determinant of farm income. Since farmers operate under conditions of pure competition and regard prices facing them as set by the market, the individual farmer feels that he can benefit from an innovation. By adopting a new technology, a farmer can reduce costs / and / or increase profits. Therefore, the farmers who take the initiative of adopting the technology early reap the rich benefits compared to those who fail to do so.

The use of agricultural technology brings about a significant effect on resource use since it calls for adjustment of resources within the farm. With the adoption of new technology, there will be saving of land resource and the use of human and bullock labour. Singh and Das (1984) maintain that the use of farm technology involves complex adjustment in agricultural operation, their sequence, timings and input combinations. It involves a change in factor proportions too since innovation alters the marginal physical rate of substitution in favour of one factor, thereby altering the entire production surface. Rao's (1976) hunch is that such changes in factor proportions may make land and labour no more predominant in determining growth in farm production as they would be in traditional agriculture.

The use of agricultural technology has got a notable impact on employment since it has the potential to increase output per unit of land and to absorb more human resources. Technology helps to increase employment by increasing output and by changing the product mix.

There has been controversial views with regard to the impact of technology on employment. Dennison (1973) opined that technology helps to increase employment by increasing output and by changing the product mix. Basu (1981) observed that the ultimate result of technical change will be the increased demand for agricultural labour, the magnitude of which will depend upon the actual increase in cropping intensity and the nature of multiple cropping. Grasowski (1987) stated that the effect of new technology is to enhance the seasonal peaks of labour requirements. Subramaniam (1987) opined that only through agricultural technology, only by increasing productivity, one would be able to provide more opportunities for gainful employment. Agricultural innovations would involve a change not only in the volume but also in the pattern and composition of agricultural labour and it helps to shift income to the rural poor by increasing the demand for hired as well as family labour. Hence as Upadhyaya (1991) remarked though apparently one may feel that the use of agricultural technology would displace labour force, in reality agricultural technology will create a new demand for labour force.

However, the unfavourable impact of technology on employment had been recognised by various economists. Rao et al. (1989) pointed out that although technical changes introduced in agriculture have been land saving, they have been capital using and not sufficiently labour absorbing. The Indian Planning Commission (1971) remarked that, in agriculture, except under certain conditions, the possible economic advantages of technology may be more than offset by the social cost of unemployment that such technology would involve. In this context, Galbraith (1969) observed that technical knowledge is treated as a free commodity available

to everyone and as a consequence the person using technical progress will never be credited with the total benefits resulting from an innovation.

Theoretically speaking, technology is scale neutral and all sections of farmers have equal access to its gains. However, the small farmers may not introduce technology as quickly as the large farmers since they have less formal education, inadequate credit and less contact with extension agencies. As the credit system is imperfect, loans are available only with land as collateral and hence the small farmers are unable to raise sufficient amount of credit to purchase material inputs. In this context, Walker (1983) states that for the use of farm technology the farmers need besides management skill strong resource support. Griffin (1974) says that unequal access to land and capital is accentuated by unequal access to water and technical knowledge. Therefore as Upadhyaya (1991) stated in the study of agricultural development, one cannot overlook the problem of social inequality.

The impact of technology is also not uniform for various crops and for various regions. The adoption of agricultural technology for commercial crops brings out higher rate of increase in production as compared to food crops. Similarly, the impact of technology is less pronounced in rainfed areas as compared to irrigated areas. This is due to the problems of rainfed areas like shortage of water from rainfall, uncontrolled flow of water from field to field and lack of suitable crop varieties adopted to the soil moisture condition of unirrigated area. Hence Ashok Rudra's (1991) observation that Green revolution, had resulted

in a break-through in production for some crops in some regions but not for all crops in all regions holds good.

In the Indian economy, agricultural technology has got a significant role in bringing out additional growth in food production required to meet the basic necessity of a growing population. In 1991, the per capita arable land in India was only 0.23 hectares as against 1.8 hectares in U.S.A. The pressure on land would increase due to rise in population and consequently per capita arable land would be 0.15 hectares by the end of the Century. Hence, the bulk of the growth in agricultural production will have to come from continued increase in the productivity of land. Yield based growth cannot be sustained without removing soil fertility constraints and promoting technical change. Stressing the role of agricultural technology in Indian economic development. Ford Foundation Team (1969) stated that instead of spreading the development efforts more or less on uniform basis throughout the country, intensive efforts for production should be undertaken with a combination of technical improvement in selected areas.

In India, in recent times, there has been widespread controversy about the implications of Dunkel Draft for agricultural development. By emphasising the role of patent seeds, cut in fertiliser subsidy, Dunkel Draft might create change in the use of agricultural technology. This in turn might affect farm output. Hence the study on impact of agricultural technology on farm output is of much significance in the wake of Dunkel Draft controversy.

At the State level in Tamil Nadu, agricultural technology has got a remarkable role in augmenting agricultural production. Tamil Nadu is faced with many natural handicaps to agriculture. The average rainfall is moderate at 90 cm as against the national average of 105 cm. Mean land holding in Tamil Nadu is much smaller than in most other parts of the country. It is around 1.5 hectares against 9 hectares in Punjab. The cultivable area is limited to about 50 percent of the total geographical area of the state, percapita area sown is only 0.15 hectares as compared to the All India average of 0.26 hectares. (Sivasubramaniam, 1986).

Tamil Nadu has four distinct agro climatic zones. Thanjavur (normal rainfall of 1143 mm) a paddy growing canal irrigated region; North Arcot (normal rainfall of 966 mm) a paddy and groundnut growing region irrigated by tanks and wells; Tirunelveli (normal rainfall of 809 mm) a dry district; and Coimbatore district (normal rainfall of 694 mm) a very dry district with well irrigation (Kurien, 1984).

Though Tamil Nadu occupies 11th rank in food grains production, its share in All India food grains production decreased from 6.26 to 4.62 percent during 1981-86. Hence attention is now being paid in Tamil Nadu to a host of agricultural practices designed to improve production. The adoption of agricultural technology with its emphasis on the use of HYV seeds, fertilisers, pesticides etc., helps to overcome the natural obstacles and bring out higher production.

At the District level in Coimbatore the role of agricultural technology in the development of the District is more crucial. Coimbatore has a total area of 1,56,067 square kilometers, being the largest district in Tamil Nadu State. The district does not have any perennial rivers. The agro climatic conditions are predominantly influenced by the quantum and distribution of rainfall. The normal rainfall in the district is 718.4 mm. In Coimbatore, the average size of land holding is 5.28 hectares, considerably less than in Thanjavur District (Farm Management Survey, Coimbatore, 1987). Due to limited farm size, the farmers depend on intensive farm operations rather than on extensive cultivation. The farmers of Coimbatore District have got the advantages of knowing the new varieties of seeds, optimum quantity of fertiliser and pesticide use earlier than the farmers of other districts. This is due to the fact that Tamil Nadu Agricultural University is situated in Coimbatore and this facilitates wide popularisation of the technology. However, the effect of new technology at the farm level is limited by such attributes as location specificities and relatively narrow range of options. Therefore there is a gap between the targetted and the realised benefits of technology. Hence the Coimbatore District was purposively chosen as the broad area for the micro-analytical part of the study.

Need for the Study

Each specific agricultural innovation calls for readjustment of resources within the farm while technical change in the aggregate calls for change in the total amount of resources employed in agriculture.

Hence the analysis about the nature and effect of technical improvement is an important area of analysis in production economics.

The previous studies relating to agricultural technology (Sidhu and Sarkhayan (1973), Bisaliah (1976), Rangasamy (1980), Apparao (1980), Singh and Bokil (1980), Srivatsava (1983), Sinha and Sharma (1985), Jain (1990) and Yoginder Alagh (1990) have concentrated either on the progress of technology at the macro level or on the diffusion of technology at the micro level. But, the current study by adopting micro analytical and macro analytical approach tries to analyse both the progress and constraints so that ways for improving the returns to the technology can be suggested.

Objectives of the study

The overall objective of the study is to evaluate the impact of agricultural technology on farm income and employment.

The specific objectives of the macro analytical study are to :

- * find out the nature of adoption pattern of agricultural technology in the State ;
- * study the trends in the use of agricultural technology and to identify the significant technological variables influencing foodgrains production; and

- * study the relationship between the use of technology and employment in agriculture.

The major objectives of the micro analytical study are to :

- * find out the nature of technical change ;
- * find out the extent of adoption of agricultural technology by the farmers ;
- * identify the factors favouring and limiting the adoption of agricultural technology ;
- * evaluate the impact of agricultural technology on resource use, income and employment in farms with special attention to the change in factor proportions ; and
- * suggest measures for realisation of full potentials of agricultural technology.

Limitations of the study

The current study is restricted only to crop production technology and hence it excludes non crop farm activities such as livestock and post harvest technology. Further, the study is region specific and hence generalisation to other areas needs to be done with care.

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

The literature relating to the study 'Impact of Agricultural Technology on Farm Output and Employment' is presented and discussed under the following heads :

- A. Survey of the concept of agricultural technology and its relation with production and employment ;
 - B. Role of technology in economic growth and development ;
 - C. Studies relating to the impact of agricultural technology on farm output and employment in developed countries ;
 - D. Studies in Indian agriculture relating to the impact of agricultural technology on farm output ; and
 - E. Studies in Indian agriculture relating to the impact of agricultural technology on employment.
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- A. Survey of the Concept of Agricultural Technology and its Relation with Production and Employment**

The concept of agricultural technology was emphasised from the era of Mercantilism. William Petty (1623 - 1687) who was recognised as the precursor of scientific economics contended that the wealth of a nation was a result of land, art, labour and stock. In modern terminology the inputs of Petty's aggregate production function are land, labour and technological progress. Petty's view on art is revealed in the passage :

"If by such simple labour I could dig and prepare for seed a hundred acres in a thousand days, suppose then, I spend a hundred days studying a more compendious way and in contriving tools for the same purpose but in all that hundred days did nothing but in the remaining nine hundred days dig two hundred acres of ground, then I say that the said art which cost but one hundred days invention is worth one man's labour for ever, because the new art and one man performed as much as two men could have done without it".

Petty recognised technological unemployment and believed that the introduction of labour saving devices would generate unemployment.

Agriculture held a central position in Quesnay's (1694 - 1774) programme of economic policy. He believed that the revolution of agricultural technique helped to solve agricultural problems. The Physiocrats recognised the role of avances primitive (primitive advances) (i.e.) the investments made by a farmer for agricultural implements and avances annuella (annual expenses) (i.e.) the expenses on seeds, manure etc. for agricultural development.

Adam Smith (1723 - 1790), the founder of classical economics favoured the application of technology and he opined that annual output was determined by the state of technology which increased the productivity of the labour force.

Ricardo (1772 - 1823) maintained that he would not tolerate any law to prevent the use of machinery and he recognised technological

unemployment. He originally followed the optimistic Smithian view of the impossibility of chronic technological unemployment, but in the third edition of his *Principles*, he considered that the substitution of machinery for human labour is often very injurious to the interest of labourers : "The one fund from which landlords and capitalists derive their revenue may increase, while other, that upon which the labourers mainly depend may diminish and hence it follows that the same cause which may increase the net revenue of a country may at the same time render the population redundant and deteriorate the condition of the labourers."

John Stuvart Mill (1806 - 1873) questioned the Ricardian view on technological unemployment. He contended that "Machinery can never be injurious to the labouring class, since by cheapening production it creates such an increasing demand for the commodity as enables a greater number of persons than ever to find employment in producing it."

Karl Marx's analysis (1818 - 1883) among others basically related to the problem of how technological advance affected the interests of labour and he tried to link distributive shares and technological advance. Marxist unemployment is essentially technological unemployment and according to him machines tended to throw the labourers on the pavement. This technological unemployment created a permanent industrial reserve army which depressed real wages to levels of ever increasing misery, degradation etc. that would eventually goad the proletariat into the final revolution. However, in his 'Theory of Compensation', Marx opined that "the working class is being compensated for initial sufferings incident

to the introduction of a labour saving machine by favourable ulterior effects."

Sismondi (1773 - 1842) as a practical farmer and pro labour believed that the use of machinery led to the unemployment of workers. The immediate effect of machinery is to throw some of the workers out of employment and to lower their wages. Machinery produces useful results only when its introduction is preceded by increased revenue consequently by the possibility of giving new work to those displaced.

As such, except Adam Smith and Mill, other classical economists were concerned with the unfavourable effect of technology on employment.

However, the economists of twentieth century had a different perception about technology. Hopkins (1939) classified technological improvements in agriculture as

- a) those not involving any appreciable change in either organisation or the management of the farm ;
- b) those modifying the farmer's organisation primarily but affecting the management practice only to a lesser degree; and
- c) those affecting the management practices primarily but changing the organisation of the farm only to a lowest degree.

Heady (1949) classified farm technology as biological and mechanical technology. Biological technologies tend to increase total output from

a given land base and mechanical innovations are that which substitute capital for labour.

Ruttan (1960) defined technical change as the change in one or more parameters of the aggregate production function resulting from the addition of a new production technology to the existing one. According to Ackley (1961), new technical change should raise the output per given input or should lower input per given output. Schultz (1964) viewed that the notion of technical change is in essence a consequence of either adding or dropping or changing at least one factor of production.

According to Mosher (1966) the technology of farming means the way it is done. It included the methods by which farmers sow, cultivate and harvest crops and it includes seeds, fertilisers, pesticides, tools, implements and source of power. Bhati (1966) restricted the concept of technical change to the use of wonder seeds coupled with the use of fertiliser, pesticides, irrigation and modern inputs. According to Kuznets, (1970) technical progress consisted not only of inventions and innovations that require heavy capital investment but also of a stream of relatively cheap changes whose cumulative effect was a drastic decrease in input resource accompanied by increase in output.

Pandey and Singh (1971) defined new technology as all forms of new farm inputs and practices such as HYV seeds, chemical fertiliser, insecticides and improved farm machinery. Boblen (1972) classified technical change in agriculture as a) simple change in materials and

equipment b) an improved practice and c) an innovation. Meier (1974) defined new technology as a new set of inputs or factors of production which are different from a traditional set. (i.e.) atleast one factor has been added, dropped or changed. According to him technological change involves the substitution of a new and relatively abundant resource for a scarce conventional resource.

Shah (1979) defined technological innovation as a concrete identifiable new factor of production to which the increase in production is attributed and which is not explained by the traditional factors of production. Johl (1984) defined technology as the knowledge applied by human beings to improve production.

The review of literature on the concept of agricultural technology and its relation with output and employment indicated that the role of agricultural technology in economic development was emphasised from 16th to 20th century.

B. Role of technology in economic growth and development

a) Role of technology in overall economic growth

According to the classical theory of growth, the development of capitalist economies is a race between technological progress and population growth. Technological progress, in turn depends on capital accumulation, which would permit increasing mechanisation and greater division of labour. Adam Smith, Malthus and Mill considered that total output depended

on the size of the labour force, the stock of capital, the amount of land available and the level of technique.

Marx stressed on technological progress as the motor of capitalist growth and propounded that technological progress provides the opportunities for profitable investment. According to him, the technology of each era in a country's development determines not only the economic situation, but also the style of the whole society. He opined that capitalism brings a very high stage of technological advance but it also leads to a bitter class struggle between workers and capitalists, from which the workers will emerge victorious and establish the dictatorship of the proletariat.

Schumpeter in his 'Theory of Economic Development' (1911) considered economic development as a distinct phenomenon and as a spontaneous and discontinuous disturbance of equilibrium. It alters and displaces the equilibrium state previously existing. According to him, the discontinuous disturbance comes in the form of an innovation and it may take the form of the introduction of a new method of production. In his view, autonomous investment depends on rate of resource discovery (K) and the rate of technological progress (T).

Rostow's five stage growth model (1932) was based on the notion that with technological change, certain economic sector forges ahead causing increased growth in the whole economy. Growth in the leading sector then slows due to saturation of demand and other factors, while another sector moves ahead further increasing national growth.

Swan (1956) also recognised the role of technology in his model of growth. According to Jain (1956) mechanisation has increased per acre and per man productivity, reduced cost of production, increased farmer's income, created possibilities for huge capital formation, withdrawn surplus farm population and converted the farms more and more into commercial units and lesser and lesser exposed to the hazards of weather.

According to Hansen's theory of Secular Stagnation (1960), there is a tendency for innovations to become increasingly capital absorbing as time goes by and this tendency becomes a retarding factor in economic growth.

Joan Robinson (1965) elaborated on induced technical progress while considering the conditions under which golden age can exist. She remarked that a saving profit ratio greater than natural population growth might lead to labour augmenting technical progress.

Galbraith (1961) believed that HYV maize, the Japanese method of rice cultivation, use of fertiliser etc., help in the process of economic development since they economise all resource. They are as appropriate and important for the less as for the more developed countries.

Schumacher (1961) in his analysis of 'Roots of Economic growth' noted that economic development is obviously impossible without the introduction of 'higher technology' or 'better methods'. The rich countries are rich because they employ high technology leading to high productivity.

Solow (1962) treated the role of technology empirically by estimating the aggregate production function of the United States between 1909 to 1949. Solow demonstrated that with variable technical coefficient, there will be a tendency for the capital labour ratio to adjust itself through time. Salter (1960) related technical knowledge to technique of production and introduced these techniques into the production function presumably as integral part of the observable factors of production.

Brozen (1964) pointed out that efficient technological advance which will raise productivity and increased income required a supply of innovating entrepreneurs supported by a free market.

Fei and Ranis (1964) in their study of the relationship between 'technological transfer, employment and development' observed that technological transfers result in a modification of the ways in which the developing economy's labour force is utilised and brings in major changes in its output and employment performance. According to them, the notion of technological transfer is based on the recognition that a major source of technological change in the developing world derives from the importation of technology from the advanced countries. They introduced the notion of technology shelf represented by a set of unit activities (K_0, n_0) (K_1, n_1) (K_2, n_2) and technology shelf contains technologies which have been demonstrated to be feasible in the mature economies either at present or at some historical point in the past. They did agree that in the initial stage, the transfer of technology may result in increased technical unemployment and hence a lower value

of per capita income (Q/L) in spite of the fact that labour productivity (Q/N) is raised.

In their model, the initial time period was denoted as $t = t_0$, and the initial capital output ratio is K_0 . The initial supply of capital stock (K_0) then determines the scale of operation of the technology at (F_0), the amount of labour which can be accommodated (N_0) and the output (θ_0). The initial population (L_0) determined the volume of unemployment (U_0).

In the next period, t_1 the skill level (p_1) determines the imported unit technology (A_1) which becomes the effective unit technology (B_1) after capital stretching. With the aid of the average propensity to save (s) and output (θ_0), $I = s \theta_0$ in the second period and hence the new capital stock (K_1), the total population (L_1) is given by the population growth curve. In this way, employment path, $F_0, F_1, F_2, \dots$ as well as endowment path E_0, E_1, E_2 are determined. Through time, the horizontal gap between the two curves gives the time path of technical unemployment, $U_0, U_1, U_2, \dots$. Fei and Ranis were of the view that technical unemployment can be eliminated over time, only when the endowment path bends upward fast enough to catch up with and finally intersect the employment path as technological transfer and assimilation take place.

According to Fei and Ranis, raising of per capita income ($\theta^0 - \theta/L$) and the elimination of unemployment or raising the extent of

employment $N^* = \frac{N}{L}$ were the major social objectives. They viewed that the employment effect is favourable ($n_N > 0$) if and only if the output effect is favourable ($n_Q > 0$). As the process of development in the mature economy unfolds, increasing labour productivity p through time must be accompanied by a sustained decrease of the capital output ratio K/Q . With actual Japanese historical experience, they empirically proved that both per capita income and the degree of employment were monotonically increasing through time.

In the induced technical progress model, Phelps - Samuelson (1965) pointed out that the effect of technical progress is the increase of factor substitutability in such a way that less input will be required to produce a given output. According to him there is a trade off between the labour augmenting and capital augmenting technical progress. Arrow and Lavhari (1966) considered a model in which disembodied technical progress augments labour efficiency. Uzawa (1965) argued that technical progress takes the pure labour augmenting form and therefore technical progress would not affect the capital labour ratio adversely.

According to Feller (1972) technological change is an important way by which a firm can allocate its scarce resources towards redressing a disequilibrium position.

Analysing biased technological progress and labour force growth in a dualistic economy Kelly et al. pointed out that technical change accounts for a very large share of output growth in American

and Latin American Countries. He propounded that rapid rate of technical change helped to raise achievable rates of capital accumulation and to lower rates of population growth by stimulating urban industrial development.

According to Krugman (1979) technological innovation in developed countries and the transfer of technology to less developed countries play an important role in determining the pattern of World trade and changes in that pattern over time.

Summing up the classical economists considered technology as one of the prime determinants of production along with other inputs. For Marx, technology determined the style of the whole society and precipitated the dictatorship of the proletariat. For Schumpeter, the rate of technological progress was as important as the rate of resource discovery and the two together determined the level of autonomous investment. Schumpeter and Feller (1972) maintained that technology brings about a disequilibrium situation that is desirable. According to Rostow (1932) that sector in the economy which is marked by technical change would have a leading role in the development of the economy. Hansen was apprehensive that in course of time innovations may become capital absorbing retarding economic growth. Joan Robinson (1965) believed that a savings profit ratio greater than the natural population growth was a precondition for labour augmenting technical progress. Schumpeter (1961) said that unless technology is acceptable to the majority of existing producers it may not be consistent with equity. Fei and Ranis (1964)

had shown with Japanese example that technology had indeed raised both percapita income and the degree of employment over time.

b) Role of technology in agricultural development

Economists had incorporated the role of technology as an important variable responsible for agricultural development in terms of the production function method of analysing the technological behaviour. Leibeg's 'Law of Minimum' (1885) was the first attempt to establish a relationship between fertiliser and crop yields. Mitscherlich (1909) fitted algebraic production function based upon acceptance of diminishing productivity of a single factor to a fixed area of land thereby suggesting a non linear production function relating nutrient and crop output. Spillman (1923) developed an experimental yield equation by relating yield with variable inputs.

In the high pay off input model, Schultz (1964) stated that the economic growth from the agricultural sector of a poor country depends predominantly upon the availability and price of modern agricultural factors. With respect to the technological progress of agriculture in more developed nations, he maintained that higher productive capital equipment and other inputs to farmers were the sources of high pay off inputs for agriculture.

Janvry (1973), through the socio economic model of induced innovations for Argentine agricultural development tried to prove that

stagnation of the Argentine agricultural sector was due to the non availability of land saving, yield increasing technology to farmers. He classified the technology as mechanical, biological, chemical and agronomic. According to him, mechanical innovations helped to raise the productivity of labour through increase in land per worker. Biological innovations are moderately yield increasing and chemical and agronomic innovations aim at increasing yield and they are fundamentally land saving in permitting substitution of capital and labour for land.

Bhaduri (1973) found that application of agricultural technology helped to remove stagnation in backward agriculture and helped the peasants to escape indebtedness.

The induced development model of agricultural development by Hayami and Ruttan (1981) incorporates Schultz's concept that high pay off investment was the core strategy for more rapid growth. As per this induced innovation model, investment in technological and institutional change plays a central role. If the farmers do not adopt lower cost production techniques from the stream of technologies they will earn less income and be forced to leave farming. It proposes that private and Government institutions will seek to develop new agricultural technologies that either enable substitution of lower cost resources in agricultural production or increase output with the same resource costs.

Stevens and Jahara (1985) noted that the use of agricultural technology helped to achieve economic growth and equity. The use of

agricultural technology with the highest rates of return will increase the demand for labour, and hence can at least maintain labourer's relative income. In less developed nations many of the new biological and chemical technologies that increase agricultural yields are often more productively used, in small, rather than in large farms leading to reduced income inequalities.

To sum up, in the sphere of agriculture, Schultz (1964) assigned a key role for modern inputs in transforming traditional agriculture. Janvry and Bhaduri (1973) maintained that application of agricultural technology helped in removing stagnation in backward agriculture. Hayami and Ruttan (1981) and Stevens and Jahara (1985) observed that the adoption of production techniques was essential for rapid growth.

C. Studies relating to the impact of agricultural technology on farm output and employment in developed countries

Herdt and Mellor (1964) compared the fertiliser response functions for United States of America and India for rice crop. They found that at any given level of nitrogen application, the yield per acre was considerably higher in United States of America than in India and a positive response to further application of nitrogen occurred at a much higher level of nitrogen application in United States of America as compared to India. The difference might be due to the development of HYV seeds as acceptable to the farmers.

According to Hegedug (1970), in Hungary agriculture about 60 percent of the yield was due to the application of fertiliser and one percent increase in the application of fertiliser would bring about two percent increase in the production value.

The study on 'Employment and technical Change in Philipines agriculture' by Randolph and William (1972) revealed that the introduction of the new technology had not resulted in more labour displacement. The reduced labour requirement for land preparation had been more than offset by increased labour requirements for weeding, harvesting and threshing.

The study on 'Fertiliser Use and Agricultural Development in Brazil' by Williams and Richard (1973) found insignificant fertiliser response based on individual crop functions and the aggregate production functions. The study was based on farm level data through a survey of 174 farmers in Saopaulo for 1969-70. According to the study, on an average, the selected farmers used 74 pounds of nutrients and this represented only 60 percent of the maximum recommended for cotton, rice, corn etc.

Ray and David (1974) analysed the progress of seed fertiliser revolution in Philipines. According to the study, HYV was planted in 50 percent of the low land rice area in 1969-70 and yields averaged 20 percent higher for HYV than for other varieties in the irrigated area and about 10 percent in the non irrigated low lands.

According to Anderson (1976), during the period 1948-1973, about 15 percent of total cereal production, 30 percent of incremental cereal production and 56 percent of incremental cereal yield in developing countries could be attributed to fertiliser use.

According to Eckert (1977), due to use of modern varieties of seeds in Pakistan, national average wheat yields increased by one fourth and national wheat production increased by approximately one third.

Wortman and Cummings (1978) noted that, in Columbia, between 1969-1974, total rice production doubled in commercial irrigated farms, as the modern rice varieties were being adopted. In Turkey during 1966-1976 wheat yields increased about 40 percent due to the use of HYV seeds.

According to the Food and Agricultural Organisation (1980), in Turkey, the use of fertilisers increased wheat production by 52 percent and for each dollar spent on fertilisers, increased value of the harvest was \$ 2.60. Similarly in Ghana, the use of fertiliser increased the yield of groundnut by 57 percent and each dollar spent on fertilisers increased the value of the harvest by \$ 3.90.

DeRubinstein (1985) analysed the impact of HYV rice varieties in Latin America. The study found that between 1970-81, due to the use of HYV, rice production increased by 20 percent in all Latin American countries as a whole. However in Brazil, rice production increased by

957.05 percent due to use of HYV seeds, while it was the lowest (2.10 percent) in Jamaica.

Upadhyay et al. (1989) studied the differential adoption of modern rice technology and regional wage differential in Nepal. According to them, labour input particularly hired labour increases with the adoption of modern varieties of seeds. The study estimated that by complete adoption of modern varieties, demand for hired labour will increase by 49 percent.

Summing up, Ray and David (1974), Eckert (1977), Wortman and Cummings (1978), Derubinstein (1985) and Upadhyay (1989) noted that the use of HYV seeds helped to raise farm output in developed countries. Herdt and Mellor (1964), Hegedug (1970) and Anderson (1976) found that the use of fertilisers had a favourable impact on farm output. Randolph and William (1972) maintained that the introduction of new technology had not resulted in labour displacement.

D. Studies in Indian Agriculture Relating to the Impact of Agricultural Technology on Farm Output

In India, studies on the impact of agricultural technology on farm output had been carried out both at the macro level and micro level.

(a) Macro level studies

The macro level studies were related to All India or State wise or District wise analysis, while micro studies were confined to the selected sample farmers.

At the macro level, Boserup (1965) discussed the relationship between technology levels on the one hand and yields of land on the other. She divided countries into pre technology categories and found that per hectare yield was the highest in technologically advanced areas. Bhatnagar (1967) viewed that at the All India level, 5 to 15 percent increase in crop yields might be obtained by use of HYV seeds and fertiliser and 30 to 40 percent increase in yield could be obtained by adequate and regular supply of water. Rao and Prasad (1970) in the study on 'Expectations and Achievements of High Yielding Varieties of Paddy', attempted an analysis of 'Performance gaps in Andhra Pradesh'. The study revealed that for R.P. 6-17 variety, there was no yield gap since the management yield was 5000 kilograms while the experimental, yield was only 4000 kilograms. As per the study, the gap in HYV yield was less than 5 percent in West Godavari district, but in Chittoor and Nalgonda district, the performance was low since the quantum of fertiliser used was below the recommended level.

'A Comparative Study of the Cultivation of Hybrid Maize and Paddy on Experimental Farms in Karimnagar District - Andhrapradesh' by Krishna (1970) revealed that the application of a rupee worth of fertilisers would

yield an additional output worth of Rs.0.15 in the case of paddy and Rs.2.38 in the case of hybrid maize. Similarly the study on 'Economics of Local and High Yielding Varieties of Paddy and Wheat in Panagar Village of Madhyapradesh" by Chourasia and Singh (1970) indicated that per acre yield of HYV paddy (20.98 quintals) was higher than that of local variety (7.56 quintals) and per acre net return for HYV paddy (Rs. 855.29) was higher than that of local paddy (Rs. 232.89). Umakesan (1971) found that in Coimbatore taluk, increase in yield was noticeable to the tune of 66 percent to 123.37 percent in tractor farms and the return per rupee invested on tractor farms was Rs. 1.92 while it was only Rs.1.29 in non tractor farms. A study jointly undertaken in 1970-71 by the Indian Institute of Management (Ahmedabad) and the National Institute of Bank Management (Bombay) in parts of Bellary (Karnataka) and Panchmahal (Gujarat) revealed that hybrid varieties fared better compared to local varieties.

Moorthi and Mellor (1972) viewed that availability of perennial irrigation raised the intensity of cropping and enabled the farmers to use the best quality seeds at right time and to reap bigger output. Sovani and Shahtawat (1973) found that in Chitorgah and Bhilwara districts, balanced fertiliser use increased the yield by 118.6 percent providing a net additional return of Rs.1159.63 per hectare.

The study by Sidhu and Sankhayan (1973) on the 'Effect of Green Revolution on Cropping Pattern in Punjab' revealed that due to the use of new technology, production of rice, maize, wheat, barley, gram,

groundnut and oilseeds had increased at a higher pace. The study on 'Economics of Local and High Yielding Varieties of Paddy and Wheat in Madhya Pradesh' by Chaourasia and Singh (1973) also indicated that per acre gross returns were higher for HYV seeds (Rs. 1374.60) as compared to local variety seeds (Rs.552.61).

Iqbal (1974) studied the impact of HYV seeds on farm output. He found that as a result of switch over from traditional to HYV seeds, per acre marginal net profit for wheat ranged from Rs.306.2 in Uttarpradesh to Rs.325.4 in Rajasthan. For paddy it varied from Rs.178.8 in Andhra Pradesh to Rs.262 in Orissa.

The study on 'The impact of Green Revolution on Changes in Cropping Pattern in Uttar Pradesh' by Prakash and Singh (1974) revealed that due to the impact of technological change, during 1961-70, shift had taken place in favour of cereals as against pulses. Prakash and Rajan (1975) studied the impact of modern technology on the growth of agricultural output in Madhya Pradesh. The decomposition analysis of the study revealed that between 1965 to 1975, 81.1 percent of the total growth of agricultural output was explained by the growth of yield per hectare, while the growth of area accounted for 34 percent of the increase in total output.

In confirmity with this, the study on 'Effects of Technological Change on Output, Employment and Functional Income Distribution in Indian Agriculture' by Bisaliah (1975) tried to decompose the differentials in

per acre output between farms employing new technology and those employing old technology into two - technical change and change in the volume of complementary inputs. The study revealed that due to the adoption of new farm technology, the yield rates of rice, wheat and maize increased by 90.41, 88.26 and 36.36 percent respectively.

According to Behari (1977), between 1966-71, due to the adoption of new agricultural strategy, total foodgrains output increased at the rate of 8.3 percent per annum, rice production increased at the rate of 6.8 percent per annum, and cereals production increased at the rate of 9 percent per annum.

Vidyasagar (1977) found that during 1964-74, due to the use of HYV seeds, the output growth in all States ranged from 20 percent to 42 percent per annum. Similarly Batra (1978) found that hybrid bajra seed and fertiliser consumption explained 66 percent of the variance in yield during the new technology period.

Sain's (1979) study on 'The Impact of High Yielding Variety Seeds on Agricultural Growth in West Bengal' revealed that between 1968-77, agricultural productivity recorded the linear growth rate of 1.38 percent per annum while that of the area under HYV seeds increased by 16.64 percent per annum.

The study on 'The Impact of Technological Innovations, Specifically, the use of Fertiliser on Agricultural Growth' by Shah (1979) estimated

annual compound growth rates of output and input in India for the period 1966-76. According to the study, seeds contributed 15 percent of the yield growth while the share of fertiliser and irrigation was 30 percent and 18 percent respectively of the growth of overall agricultural production. The study on 'Output Growth and Technical Change in Maharashtra Agriculture' by Patel and Dayanantha (1978) revealed that in 14 districts, total factor productivity growth rates were positive and in these districts, total inputs accounted for 22 to 75 percent of the output growth.

The study on fertiliser use in Indian agriculture by Appa Rao (1980) revealed that between 1950-1979, fertiliser consumption increased from 60000 tonnes to 5 million tonnes and correspondingly foodgrains output had increased from 55 million tonnes to 130.5 million tonnes.

Singh (1980) believed that the introduction of farm mechanisation helped to increase the productivity of land in North India. In the study on 'Impact of Tractors on Cropping Pattern, Resource Use and Farm Earnings in Punjab' Dhawar (1980) noted that the introduction of tractors helped to increase cropping intensity.

Sharma and Diwakar (1989) found that in Bhella and Kharat villages of Palampur tehsil in Himachal Pradesh, due to adoption of improved technology per hectare productivity of rice increased by 16.67 percent. Tewari et al. (1977) studied the influence of fertiliser on crop yield and found that 99 percent of the variation in output was brought about

by the use of fertiliser. The study also analysed the response of HYV wheat to nitrogen and found that the most profitable dose of nitrogen per acre for wheat was 123.99 kilograms and the corresponding response yield was 2014.62 kilograms.

Singh and Bokil (1980) compared the trend of production of wheat in pre HYV period (1954-55) and post HYV period (1977-78) for Uttar Pradesh, Punjab, Madhya Pradesh, Bihar, West Bengal and Gujarat. The study revealed that except Punjab and Madhya Pradesh, all other States recorded an increase in the growth rate of production in post HYV period as compared to pre HYV period.

According to Ghodake and Jha (1981) pesticide use was the most critical input deciding the difference between actual and normal yields. The study, on 'Impact of New Farm Technology on Farm Produce in Punjab' by Kainth (1980), revealed that in post Green revolution period (1976-77), foodgrains output increased by 114.86 percent, while the area under HYV seeds increased by 22.63 percent and fertiliser consumption increased by 75.12 percent.

Giles (1976), Desai (1981) and Krishnamurthy (1984) opined that tractors helped to raise the yield per hectare by facilitating multiple cropping, by increasing cropping intensity and by ironing out seasonal labour shortage. The study on the 'Impact of Improved Agricultural Implements on Crop Production in Assam' by Agro Economic Research Centre (1982) indicated that, for 51 percent of the cultivators, the use of improved implements resulted in increase in production.

Parameshwara Rao (1982) believed that farm mechanisation is necessary to increase total production and for timely and effective farm operations.

Ashok and Trivedi (1982) studied the impact of irrigation and fertiliser on the growth of output in Andhra Pradesh for the period 1959-75. By estimating Cobb Douglas production function, the study found that the marginal productivity of irrigated area compared with unirrigated area was about one and a half times higher in the case of groundnut and tobacco. The contribution of fertiliser to output was constantly positive for sugarcane, groundnut and tobacco.

Singh (1983) studied the effect of irrigation on production in Kosi and Non Kosi area and the study was related to paddy for 1959-66 and 1967-75 in six districts of North Bihar. As per the study, paddy yield in Kosi area was higher due to the positive effect of increased irrigation availability.

Srivastava (1983) examined the impact of increasing fertiliser application on agricultural production in Tamil Nadu and Punjab and it estimated the partial correlation coefficient between the variation in agricultural production and fertiliser use as .26. By analysing the impact of fertiliser use on the growth rate of agricultural output in Punjab, Grewal and Rangi (1983) estimated fertiliser adoption level for wheat as 258.7 kilograms for getting the yield range of above 42 kilograms. The study on 'Impact of New Technology on Agriculture in Karnataka

State' by Bisaliah (1984) revealed that the yield of major crops were higher in new production technology and new extension system as compared to old production technology and old extension system.

Ray and Sharma (1984) estimated the growth rate of output of .7 to 1.5 percent for the fertiliser use of Rs.978.3 per hectare and above 3 percent for the fertiliser use of Rs.1218.15 per hectare. Nath (1984) in the study on 'Economics of New Agricultural Technology in Punjab' found that per acre yield of HYV wheat was 83 percent higher than the indigenous wheat.

In the study on 'Technical Change and Agricultural Production in Punjab', Lekhi and Gupta (1985) estimated the growth rate of productivity as 15.37 in the post Green revolution period as compared to 4.96 in the pre Green revolution period.

Dhawan (1986) by studying irrigation performance during drought, found that in Coimbatore district, despite the severity of the droughts in 1973-74 and 1974-75, the output reduction amounted to only 14 percent due to the role of canal seepage in enhancing performance of well irrigation.

Chatopadhyay (1986) analysed the impact of new technology in West Bengal. His study indicated that in kharif season, the mean yield gap between modern and local variety seed was 651 tonnes in 1982-1983.

Umesh and Bisaliah (1987) made an econometric analysis of technical change and resource saving in paddy production. The study tried to measure the productivity differential in terms of shifts in technological parameter, and of change in the volume of per acre input level. Similarly Sharma (1987) tried to measure the contribution of HYV seeds to the output of bajra, jowar, maize and wheat. As per the study, the output growth rate of bajra and wheat had increased during 1951-78 as compared to 1961-66 which may be due to the adoption of HYV seeds.

Jain (1988) by analysing modernisation of agriculture and its impact on agricultural productivity in Madhya Pradesh estimated the correlation coefficient of agricultural productivity with irrigated area as .78 with per hectare fertiliser use as .68 and with area under HYV seeds as .48.

Sreenivasamurthy and Bisaliah (1988) in their study on 'Technical Innovation and Productivity Change in Agriculture' tried to decompose the land productivity differential between tractor operated and bullock operated farms in Karnataka. As per the study, the average per hectare ragi output differential between tractor operated farm and bullock operated farm was 516 kilograms and of this, 52 percent could be attributed to mechanisation, 37 percent to biochemical innovation and 11 percent to interaction effect.

Jain (1990) analysed HYV and correlated response of yields of wheat and rice in Uttar Pradesh. The study found that the response of yields to rainfall has become uniform across districts for wheat.

But the correlation between weather and yield variability for rice have increased in the districts of Western region.

The study on 'Effect of New Technology on Groundnut Production in Orissa' by Jlna and Mira (1990) revealed that there was a significant percentage change in area, production and productivity of the crop by 356.80, 556.27 and 54.24 respectively during 1967-68 to 1985-86 as compared to the period 1951-57 to 1966-67.

Sathya Sai (1990) reported an impact of about .95 expansion in cropping intensity corresponding to the percentage point rise in the conventional irrigation ratio during 1950-83. Alagh (1990) viewed that the annual loss of Rs.6000 crores due to pests could be averted by using 72000 tonnes pesticides.

b) Micro level studies

Singh and Singh (1967) studied the impact of new technology on agricultural production by selecting 60 adopters and non-adopters from 10 villages in Jarwa block of Azamsah district in Uttar Pradesh. The study found that the yield of paddy (14.35 quintals), maize (15.63 quintals) and wheat (15.47 quintals) were higher in adopted farms as compared to 9.82, 10.62 and 10.67 quintals for the non adopter farms.

By examining the influence of nitrogen on economics of wheat and barley, Rathore (1984) found that the use of nitrogen at the rate of

33 kilograms per hectare increased wheat yield from 2370 kilograms to 3308 kilograms and barley yield from 2850 kilograms to 3568 kilograms. Motilal (1973) studied economics of tractor cultivation by selecting 60 tractor owner farms and 60 bullock farms in Alipur block in Union Territory of Delhi for 1968-1969. As per the study, the cropping intensity for tractor owner farms (167.70) was higher than that of bullock farms (162.11).

Pandey (1974) studied institutional credit and HYV programme based on the data from 105 farms in five villages of Chakt block of Allahabad district during 1971-72. According to the study, average gross output per hectare of HYV wheat was Rs.2350.60 as compared to Rs.1124.13 for local wheat.

Gundu Rao et al. (1977) tried to formulate an econometric model for partitioning the productivity differential between farms using modern technology and those using traditional technology. The study was based on the data collected from 70 broadcasting local variety, 127 transplanting local variety, 59 local ragi variety and 62 imported ragi variety farms in Bangalore district. Through the output response function, the study found that 35 percent of the increase in output from transplanting local variety was accounted for by technical change.

The National Council of Applied Economic Research (1980) analysed implications of tractorisation on farm production and employment relating to 263 tractor owner farms, 348 tractor user farms and 203 bullock farms

for 1977-78 in Punjab, Haryana, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat. According to the study, the cropping intensity of a tractor user farm exceeded that of bullock farm by 11 percent and the yield per hectare in all States was the highest for tractor owner farms (3979) and lowest for bullock farms (2442).

Rangasamy (1980) analysed fertiliser response under dry land and irrigated lands based on experimental data for 1971-74. The study revealed that 85 percent of the variation in yield was due to the use of fertiliser. Similarly, the study on 'Optimum Allocation of Fertiliser Nutrients among Different Regions of Uttar Pradesh, and its Impact on Cropping Pattern and Production Levels' by Arora and Sharma (1981) showed that there was higher allocation of fertiliser nutrients in wheat, paddy and sugarcane crops in Western, Eastern and Central regions of Uttar Pradesh. Singh and Pandey (1982) examined crop productivity and fertiliser use efficiency in Haryana based on data collected from 20 small, medium and large farmers. As per the study, the existing level of nitrogen and phosphorus application and corresponding yield per hectare of wheat were respectively 4418 kilograms, 1015 kilograms and 27.11 quintals and this increased by 629 percent, 725 percent and 94 percent under the optimum level.

Subba Rao (1987) tried to find out the level of fertiliser use and associated yield based on 42 straight cotton growers and 72 hybrid variety cotton growers in Prakeram and Guntur districts of Andhra Pradesh. As per the study, 95 percent of variation in yield was due to fertiliser use and it estimated the marginal physical productivity of fertiliser

as .44 and .05 respectively in overall straight and hybrid variety farms.

The study on 'Impact of Irrigation on Productivity of Wheat' by Alshi and Galsalikar (1984) was related to 50 farmers in Nagpur district of Maharashtra State. They found that the higher level of input use resulted in higher per hectare yield on the irrigated farms (13.14 quintals) as compared to dry wheat farms (5.58 quintals).

'An Econometric Study of Technical Change and Efficiency Gain in Dryland Agriculture' by Gundu Rao (1986) was based on 48 local variety ragi farms and 42 transplanting improved variety farms. As per the study an average transplanting local variety farm has produced 14 percent more output per hectare than an average broadcasting local variety and transplanting improved variety farm had produced 65 percent more output per hectare than an average Broadcasting local variety farm.

The study on 'Maximisation of Returns through Farm Planning under Fertiliser Constraint' by Sirohi and Sharma (1985) was based on data collected from 14 small, 15 medium and 9 large farmers in Alipur block of the Union Territory of Delhi. They found that due to optimum use of fertiliser, returns would increase by Rs.3098.94 in small farms, by Rs.7193.70 in medium farms and Rs.9922.05 in large farms.

Sita Ram (1986) studied the technological parameters in production function by selecting 296 farms in Dorbanga district. His study showed

that 48 percent of the variation in output was explained by technological factor for large farms while for marginal, small and medium farms the variation was only by 37 percent. Technological factors respectively accounted for 48 percent, 48 percent and 30 percent variation in output of maize, wheat and potato.

Patil (1986) attempted an economic appraisal of investment in tractors based on a sample of 44 bullock farms and 90 tractor owner farmers from Ahmednagar district of Maharashtra. The study found that the yield of all crops was higher by 9 to 22 percent in tractor farms.

Trivedi and Joshi (1986) examined the impact of Green revolution on farm output based on a sample survey of 164 farmers and 118 agricultural labourers in 12 villages of Dhoraji taluk. The study revealed that the value of per acre farm output in small progressive farms was higher by 69.83 percent, while for large progressive farms, it was higher by 31.3 percent.

Gulleri and Tewari (1990) analysed the prospects of increasing farm income in tribal farms of Himachal Pradesh through new technology, relating to 102 farmers in Lahul region and 36 farmers in spiti village in Andhra Pradesh. They concluded that adoption of new technology brought about more than 40 percent increase in farm income in large farms and between 15 to 27 percent in small and medium farms.

Thus, at the macro level, Sidhu and Sankhayan (1973), Chourasia and Singh (1973), Iqbal (1974), Prakash and Rajan (1975), Bisaliah (1975), Sain (1975), Sharma and Diwakar (1980), Singh and Bokil (1980), Jain (1990) and Jlna and Mirra (1990) observed that the use of HYV seeds helped to raise the yield and farm income. Krishna (1970), Batra (1978), Shah (1979), Appa Rao (1980), Ashok and Trivedi (1982), Srivatsava (1983), Grewal and Rangi (1983) maintained that the use of fertilisers helped to raise farm yield. According to Ghodake and Jha (1981) and Alagh (1990) the use of pesticides helped to minimise the crop loss. Giles (1976), Desai (1981), Parameshwara Rao (1982) and Krishnamurthy (1984) maintained that the use of tractors helped to raise the yield by increasing cropping intensity.

At the micro level, Pandey (1974), Gundu Rao (1977) noted that the use of HYV seeds helped to raise farm output. Rathore (1984), Rangasamy (1980), Subba Rao (1987), Sirohi and Sharma (1986) maintained that the use of fertiliser helped to raise farm income. Patil (1980) and National Council of Applied Economic Research (1980) noted the favourable impact of tractorisation on farm output.

E. Studies in Indian Agriculture Relating to the Impact of Farm Technology on Employment

The macro level studies and micro level studies had controversial findings about the impact of farm technology on employment.

a) Macro level studies

At the macro level, many researchers had confirmed the favourable effect of technology on farm employment. The Ferozepur study (1970) by the National Commission of Agriculture indicated that labour employment per hectare increased steadily with the use of machinery. The study on 'Employment of Agricultural Labour in Dindugal Taluk of Madras State' by Misra and Dasgupta (1970) revealed that on an average 230.2 labourers were employed in irrigated land while only 140 labourers were employed in non irrigated land.

Ashok Rudra (1971) found no evidence of a decline in the demand for permanent workers in the farms which had shifted to tractor cultivation.

Iqbal (1972) in the study on 'Impact of New Agricultural Technology and Mechanisation on Farm Employment' found that the new technology has helped to provide regular employment to the family labourers.

Similarly, Sharma (1972) found that the introduction of tractors had increased the demand for labour by about 7 percent as compared to bullock operated farms.

Singh (1973) and Acharya (1973) noted that farm mechanisation increased human labour employment by increasing cropping intensity and farm production.

In tune with this, Mellor and Uma (1973) indicated that technical change in agriculture have created additional employment through the increased demand for inputs.

Basu (1974) in his study on 'The Impact of Mechanisation on Farm Labour Employment' revealed that per hectare labour employment was the highest (912.52) for the farms with tractors and tube wells and lowest (756.18) for the farms with bullocks and tube wells. In the study on 'Impact of Tractorisation on agriculture', Parthasarathi (1975) found that in paddy zone, paddy tobacco zone and paddy millet zones in West Godavari district of Andhra Pradesh, tractor using villages showed more employment than bullock using villages.

Mehra (1976) found that during 1966-70 in Ferozepur district, labour input per cultivated hectare increased by about 40 percent. Of this 46 percent was attributed to the expansion of irrigated and 54 percent to the introduction of new technology. Sain (1977) noted that the cultivation of HYV needs more human labour days per cropped area (109.40) as compared to local varieties (57.72). Hayami and Ruttan (1977) viewed that HYV technology and irrigation may help to increase the use of hired labour in agriculture due to the introduction of double cropping. Similarly Sadhu and Singh, Miglani and Singh (1979) opined that the introduction of tractor and intensive use of modern inputs has increased employment due to increase in cropping intensity.

Birla Institute of Scientific Research (1980) in a study on 'Impact of Technological Change in Agriculture with Specific Reference to its

Impact on Employment' found that the new technology has increased farm employment by bringing out higher labour productivity. In the study on 'Impact of Tractorisation on Income and Employment in Bhuvanagiri taluk of South Arcot District', Kubendran (1980) found that the introduction of tractors helped to increase farm employment by 60 percent and farm income by 38 percent.

The study on 'Substitution of Labour and Non-labour Inputs and Technical Change' by Singh and Pandey (1981) revealed that the impact of technology was capital using on small and large farms but it was labour using on medium farms. Singh and Saini (1981) found that improved technology increased labour utilisation for sowing by 127.72 percent, for harvesting by 34.16 percent and for threshing by 89.10 percent. Dasgupta (1981) also found that the introduction of HYV seeds has increased need for labour in transplanting and harvesting operations and had encouraged a shift to hired worker based agriculture.

As per the study of National Council of Applied Economic Research (1984) tractor farms employed 110.5 man days per cropped hectare as compared to 104.8 mandays by bullock farms.

Johl (1984) argued that the new technology created new jobs for the intensive application of modern inputs. Chavan (1984) noted that the total mandays of employment were high in irrigated holdings as compared to unirrigated holdings. Darogasingh (1988) has pointed out that a number of advances in dry farming technology have substantial

scope for labour absorption since the improved techniques involve adoption of suitable crop varieties, better land preparation, application of fertilisers and weeding the plants.

The study on 'Employment Effects of Modern Farm Technology with Special Reference to Andhra Pradesh' by Vinayak Reddy (1991) revealed that tractorisation led to increase in employment in large holdings. According to Raghuram (1991) due to adoption of improved practices, labour absorption in terms of mandays per hectare will go up from 14 to 31 percent in groundnut and 35 to 53 percent in cotton.

Swaminathan (1991) noted that bringing another two million hectares of irrigated land under HYV seeds will increase employment per hectare by 50 percent. Similarly the study on 'Structure of Agricultural Technology in India' by Sathyapaul and Rajesh (1991) found that the use of technology did not adversely change the total demand for labour.

However, a few studies at the macro level noted the adverse impact of farm technology on employment. Bal (1975) noted that when bullock operating farms switched over to farm mechanisation, it resulted in a decline of 16.5 percent of employment of human labour. Rao (1976) pointed out that the net employment in tractor use was negative since tractorisation displaced farm labour on a large scale. Verma (1978) also found that mechanisation decreased per hectare labour requirement in small and medium farms.

The analytical study of mechanisation in Punjab by Agarwal (1983) revealed that tractor ploughed farms reported labour displacement by 137 percent. Naresh Kumar (1984) also found that the introduction of agricultural technology created surplus labour. Bapna (1984) estimated the total labour days used per hectare in wheat cultivation in Kota district of Andhra Pradesh as 18.82 days for mechanised farms and 23.53 days for non mechanised farms. Similarly, Punjabi and Sadhu (1988) noted that agricultural technology tended to displace female labourers.

b) Micro studies

The micro level studies pertaining to the impact of farm technology on employment noted the favourable impact. Dixit and Singh (1970) studied the impact of HYV on human labour input and the study was undertaken in 12 randomly selected farms in Jabalpur village of Hathras block in Aligarh district of Uttar Pradesh. According to the study, the HYV wheat employed about 28 human labour days more than that of local wheat. In another study, Dixit (1975) found that HYV utilised 25 percent more of human labour than the traditional paddy.

The study on 'Impact of the Cultivation of High Yielding Variety Seeds on Employment' by Chinnappa and Silva (1977) was based on the survey of 2064 households in 11 sample villages of North Arcot in Tamil Nadu and Hanhantole district in Andhra Pradesh. According to the study, there was an overall increase of 116 percent in labour demand for HYV cultivation.

The study on 'Technology, Output and Factor Price Effects' by Bisaliah (1979) related to 131 local wheat farms and 105 Mexican wheat farms in Ferozepur district for 1967-78. It estimated per acre labour employment for Mexican wheat as 222 and local wheat as 161. Ahmed (1983) studied the implications of farm mechanisation for employment and productivity and the study related to 16 tractor farms and 134 bullock farms selected from 6 villages in Burewala tehsil of Valparai district in Rajasthan. The study revealed that the overall labour employment per cropped area was higher in tractor farms (200.77 hours) than bullock farms (161 hours) and the use of casual hired labour was higher by 80.5 percent in tractor farms.

Arulmani (1987) studied the effect of agricultural technology on employment in paddy farms in Ambasamudram taluk in Tirunelveli district of Tamil Nadu. The specific objectives of the study were to study the labour use pattern in the paddy farms, to derive the labour demand function and to compare the labour efficiency between the old technology and new technology farms. The study was based on 120 farms selected from three ayacut regions of the taluk namely Gadanadhu, Tamaraparani and Ramanadhi. The study found that new technology increased labour demand for land preparation by 5 mandays, for transplanting by nearly 3 mandays, for crop maintenance to the extent of about 10 mandays, and for harvesting by .3 mandays.

Diwakar (1988) in the study on 'Impact of Mechanisation on Labour Employment' found that for maize, indigenous and modern devices required

91 and 129 mandays per hectare respectively. Ghosh (1989) in the study on 'Effects of New Agricultural Technology upon Rural Employment' found that selective tractor use in the cultivation of rice increases labour demand by 22.22 percent to 61.11 percent in HYV paddy as compared to local variety paddy. Naidu and Selvam (1988) analysed employment effects of new agricultural technology by covering 50 farmers in Chittoor district of Andhra Pradesh. According to the study, labour input under HYV technology was 57 percent higher than under traditional technology.

To conclude, at the macro level, Iqbal (1972), Sharma (1972), Acharya (1973), Basu (1974), Singh and Pandey (1981), Johl (1984), National Council of Applied Economic Research (1984) and Vinayak Reddy (1991) observed that technical changes in agriculture have created additional employment. However, Bal (1975), Agarwal (1983) and Punjabi and Sadhu (1988) maintained that the use of tractors would displace farm labour.

At the micro level, Dixit and Singh (1970), Chinnappa and Silva (1977), Bisaliah (1979), Arulmani (1987), Diwakar (1988), Naidu and Selvam (1988) and Ghosh (1979) maintained that the use of HYV seeds and tractors would increase labour demand for farm operations. However, the investigator did not come across any studies on the impact of agricultural technology on employment at the macro level covering the entire state. This is because the data on employment at the macro level were not available on regular basis unlike the data on area, production and yield. If such studies are undertaken, they would help to identify the policy

shifts that are needed for designing / popularising technology with beneficial employment effects at the local level.

As a whole, the review of literature relating to the impact of agricultural technology on farm output and employment indicated that there were many gaps in the previous studies. They were either macro analytical or micro analytical in character. Further, they were either confined to the analysis about the diffusion of technology, or the growth of technology and the related effects. The earlier studies were restricted to the production impact of one or two crops. However, the current study tried to fill this gap by following both macro analytical and micro analytical approach to the problem. Further, the study tried to cover three food crops - paddy, cholan and maize and three commercial crops- sugarcane, cotton and groundnut.

CHAPTER III

METHODOLOGY

The methodology adopted for the study on 'Impact of Agricultural Technology on Farm Output and Employment' is discussed under the following heads :

- A. Selection of the area ;
- B. Selection of the sampling units ;
- C. Size of the sample ;
- D. Selection of the crops ;
- E. Collection of data ;
- F. Period of study ;
- G. Definition of the concepts used ;
- H. Hypotheses framed ;
- I. Quantitative tools used and
- J. Tabulation of data.

A. Selection of the Area

At the macro level, the study related to the impact of agricultural technology in the State of Tamil Nadu. Tamil Nadu is one of the southern States in the Indian sub continent. The Western Ghats in the West, the Bay of Bengal in the East and the Gulf of Mannar which separates India from Sri Lanka in the South constitute natural boundaries of the State on three sides. Tamil Nadu covers a little over 130,000 square kilometres

representing about 4 per cent of India's geographical area. (Tamil Nadu Economic Appraisal, 1992).

The topography of Tamil Nadu consists of the coastal plains in the East and with uplands and hills in the West. The plains account for a little more than half the area of the State. With a long term average rainfall of 943 millimetre per annum, the State belongs to a zone of low-to-moderate rainfall in India.

Tamil Nadu has a number of rivers, but unlike the major rivers of Northern India, they are relatively small and entirely dependant on rainfall. The major rivers of importance to irrigation in Tamil Nadu either rise in Karnataka (Cauvery, Palar, Pennaiyar) or have been diverted from their westward flow into Kerala (Periyar, Parambikulam, Aliyar). The predominant soil category is red loam which is to be found in all the districts except Kanyakumari (Kurien, 1984).

The micro analytical approach for the study was based on Coimbatore district due to easy accessibility. The economy of Coimbatore District is based on its sound agriculture, built up by its hard working agriculturists and supported by a number of irrigation projects constructed during 1960-1990.

Coimbatore District lies between 10°-00' and 12°-00' of northern latitude and 76°-40' and 78°-00' of the eastern latitude. To the North of the District lies the Nilgiris and a part of the Periyar District.

In the East, there is Periyar District, in the South lies the Dindugal District and in the West in Kerala State. The District is open with plains in the East, but is surrounded by mountains on three sides. Most of the areas in the district are sandy except for loamy soil over South-Western part, sandy loam soil over Northern part and a small patch of clay in the North. The District gets summer rains during the months of March, April and May, South West monsoon from June to September and winter rains during October, November and December. Amaravathi, Noyyal and Bhavani are the major rivers in Coimbatore district and they are the tributaries of river Cauvery. Aliyar and Palar rivers rise in the Anaimalai and flow westwards.

Figure I presents Coimbatore district which is chosen as the broad area of micro analytical study.

FIGURE- I COIMBATORE DISTRICT

100 000 & above

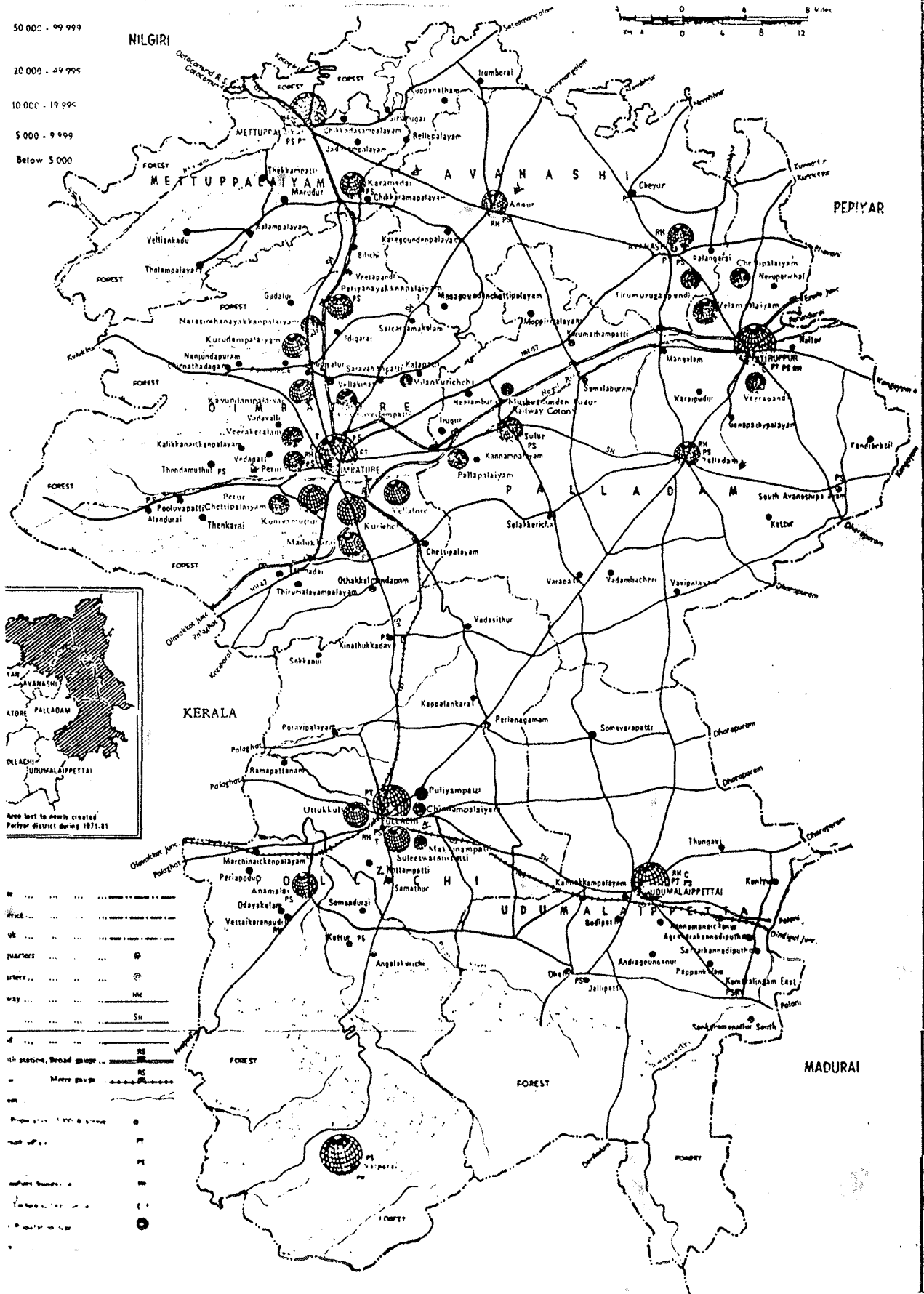
50 000 - 99 999

20 000 - 49 999

10 000 - 19 999

5 000 - 9 999

Below 5 000



B. Selection of the Sampling Units

For selecting the villages required for micro level analysis, the study adopted purposive two stage proportionate random sampling method. Coimbatore district consists of 21 blocks. Based on information in Annual Credit plan 1990-91, irrigation intensity for all the blocks, except Valparai - the hilly area was calculated. The District average irrigation intensity was also estimated.

At the first stage based on District average irrigation intensity, the blocks were divided into two groups high irrigated blocks (blocks having the irrigation intensity above the District average of 35 percent) and low irrigated blocks (blocks having the irrigation intensity lower than the District average). Table I and II gives the list of high and low irrigated blocks in Coimbatore District.

TABLE I

LIST OF HIGH IRRIGATED BLOCKS IN COIMBATORE DISTRICT

Sl.No.	Block	Net irrigated area (In hectares)	Net cultivated area	Irrigation intensity (In percent)
1	Anaimalai	12472	23773	52.46
2	Avanashi	65597	65597	100.00
3	Gudimangalam	45629	50200	90.89
4	Karamadai	9568	20185	47.40
5	Madathukulam	11605	22000	52.75
6	Perur	2118	4385	48.30
7	Pollachi North	10091	18230	55.35
8	Pollachi South	9469	13715	69.04
9	Sultanpet	9201	11201	82.14
10	Thondamuthur	7304	19021	38.39
11	Tirupur	15209	15209	100.00
12	Udumalpet	19260	28280	68.10

Source : Annual credit plan 1990-91 - Coimbatore District

TABLE II

LIST OF LOW IRRIGATED BLOCKS IN COIMBATORE DISTRICT

Sl.No.	Block	Net irrigated area (In hectares)	Net cultivated area	Irrigation intensity (In percent)
1	Annur	7091	20998	33.76
2	Kinathukadavu	2834	22994	12.37
3	Madukkarai	9875	33940	29.09
4	Palladam	13515	46038	29.35
5	Perianaicken Palayam	11335	33185	34.15
6	Pongallur	7160	53704	13.33
7	Sarkar samakulam	3000	11742	25.54
8	Sulur	5784	50136	11.53

Source : Annual credit plan - 1990-91 - Coimbatore District

Of the 20 blocks, 12 were in the first group and 8 were in the second group. Three blocks in the first group and two blocks in the second group were selected, giving a proportional representation to the blocks in both the groups. Using Tippett's Table of Random Numbers, Pollachi South, Perur and Karamadai representing high irrigated blocks and Palladam and Annur representing low irrigated blocks were selected.

At the second stage, information about the list of villages, the cropped area and irrigated area for the selected blocks were obtained from the Block Development Office. Based on the information, the irrigation intensity for the villages and the Block was worked out. The villages were classified into two groups : high irrigated villages and low irrigated villages, based on the average, block irrigation intensity.(vide Appendix I). With the help of Tippett's Table of Random Numbers again, one village from each group was selected for the study. The list of villages selected from each block is given in Table III. Figures II, III, IV, V and VI represent the study blocks and the study villages.

TABLE III**LIST OF VILLAGES SELECTED FOR THE STUDY**

Sl.No.	Block	High irrigated villages	Low irrigated villages
1	Pollachi South	Gomangalampudur	Makkinampatti
2	Perur	Vedapatti	Sundakkamuthur
3	Karamadai	Karamadai	Marudur
4	Palladam	Ayyampalayam	Ganapathi palayam
5	Annur	Pasur	Kuppanur

FIGURE- II

POLLACHI SOUTH BLOCK

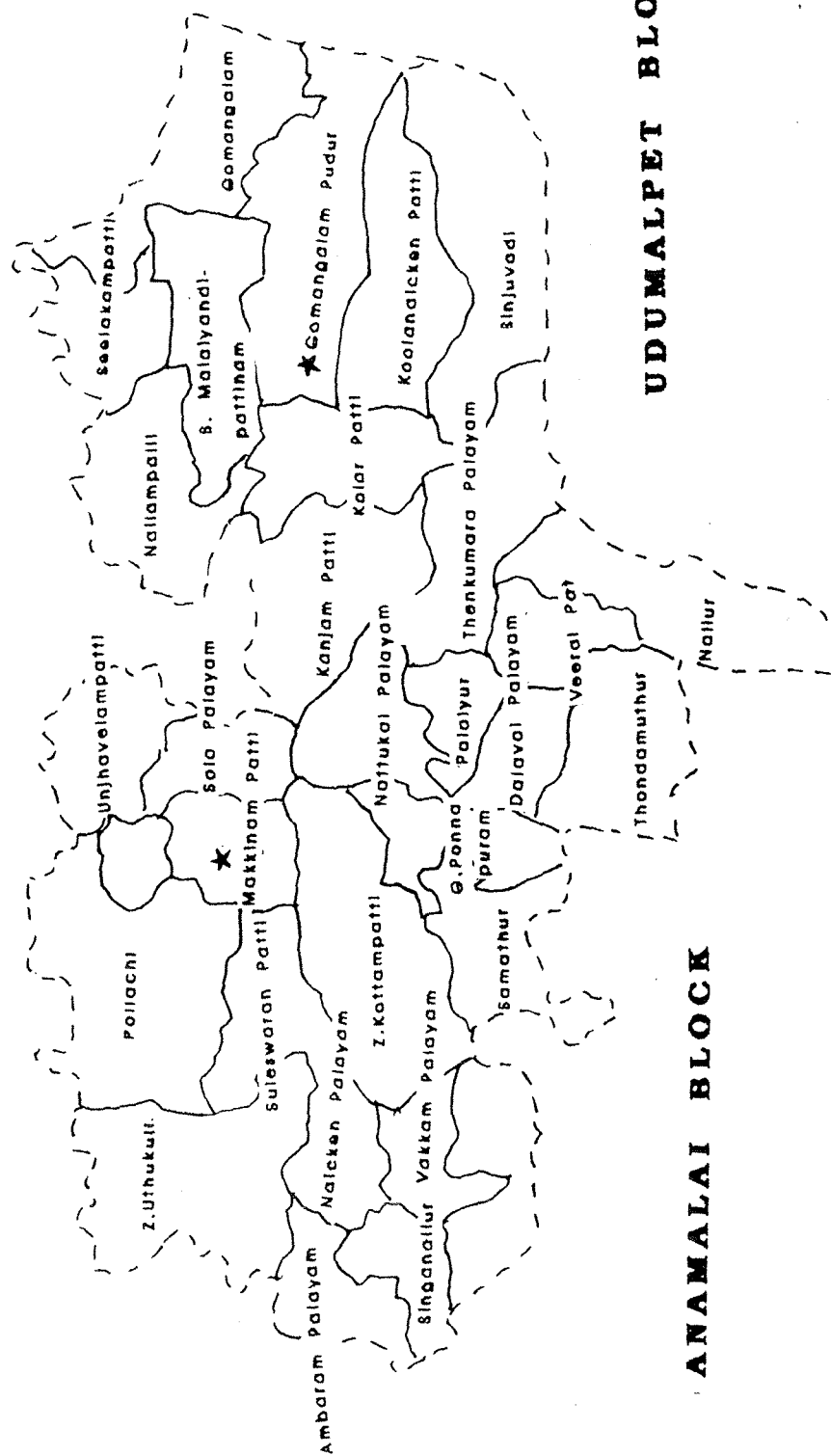


FIGURE- III

PERUR BLOCK MAP

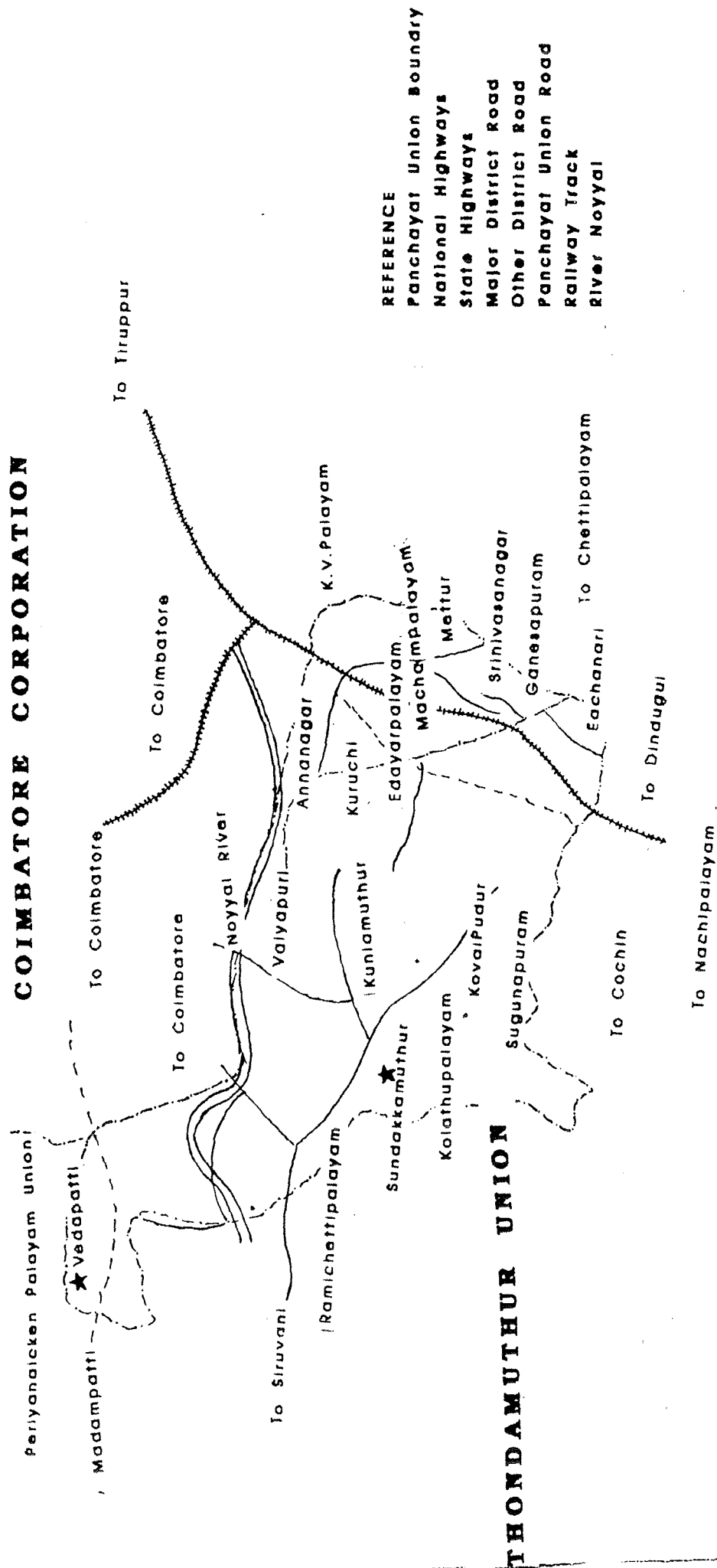


FIGURE- IV

KARAMADAI BLOCK MAP

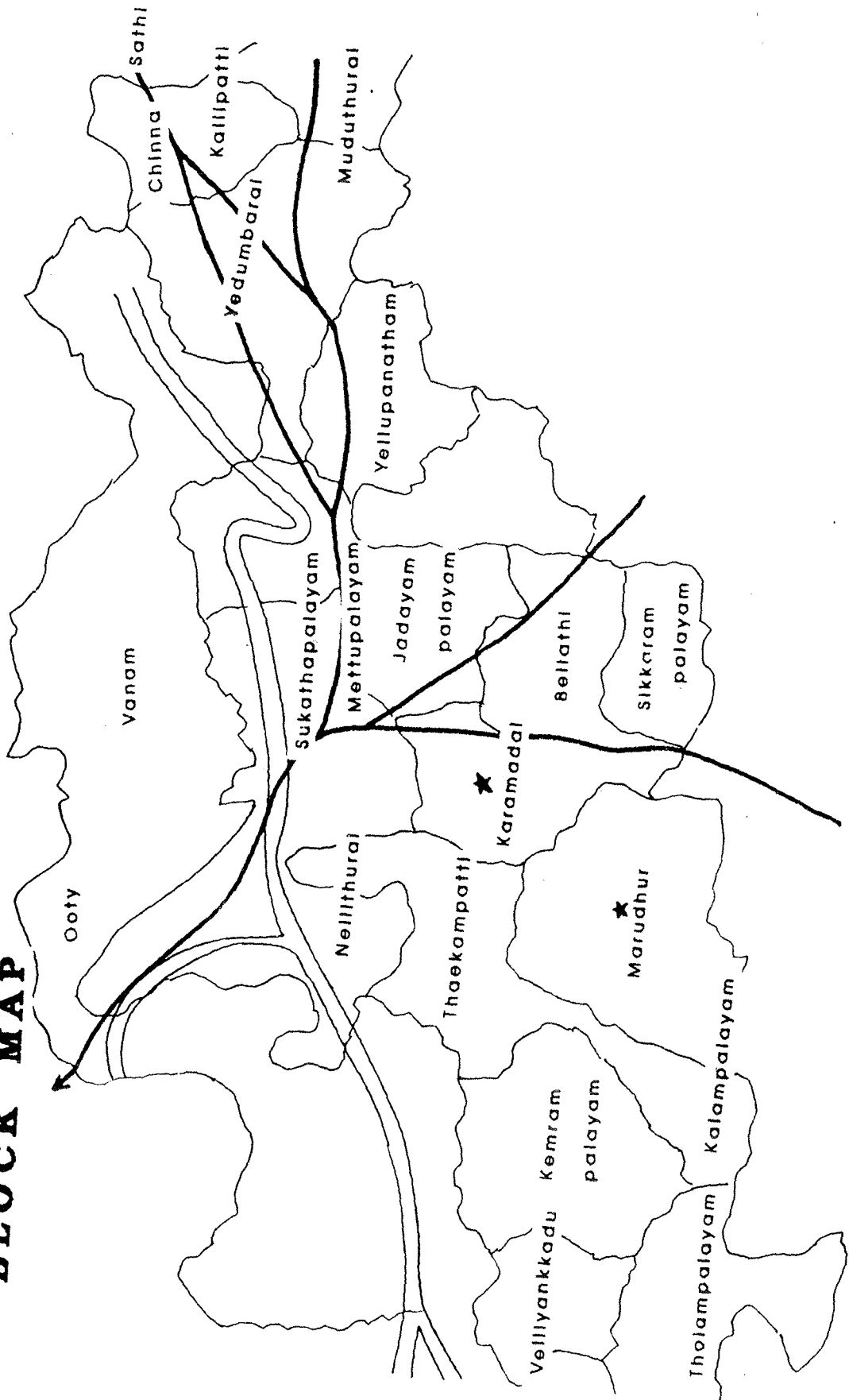


FIGURE- V

PALLADAM

BLOCK MAP

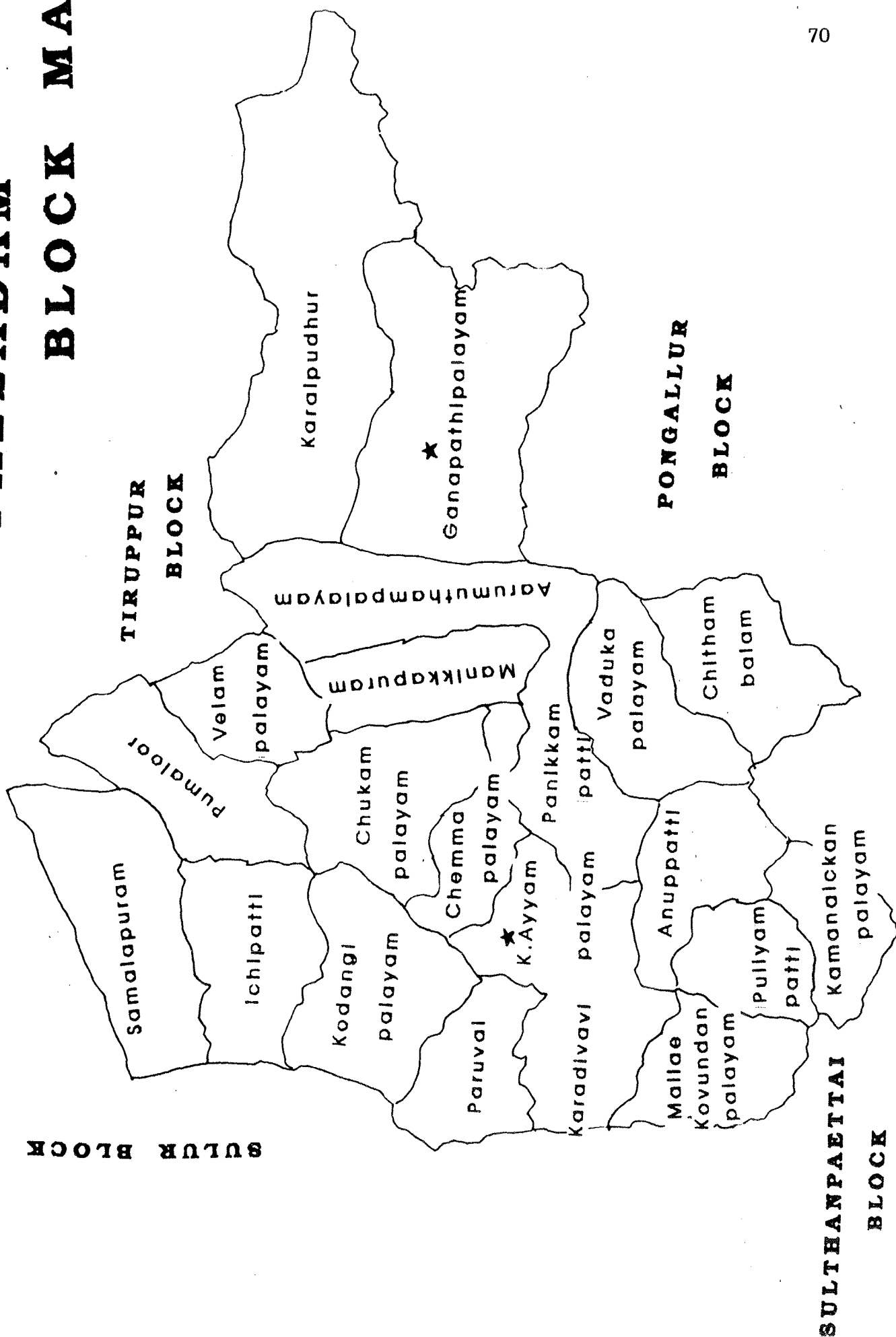
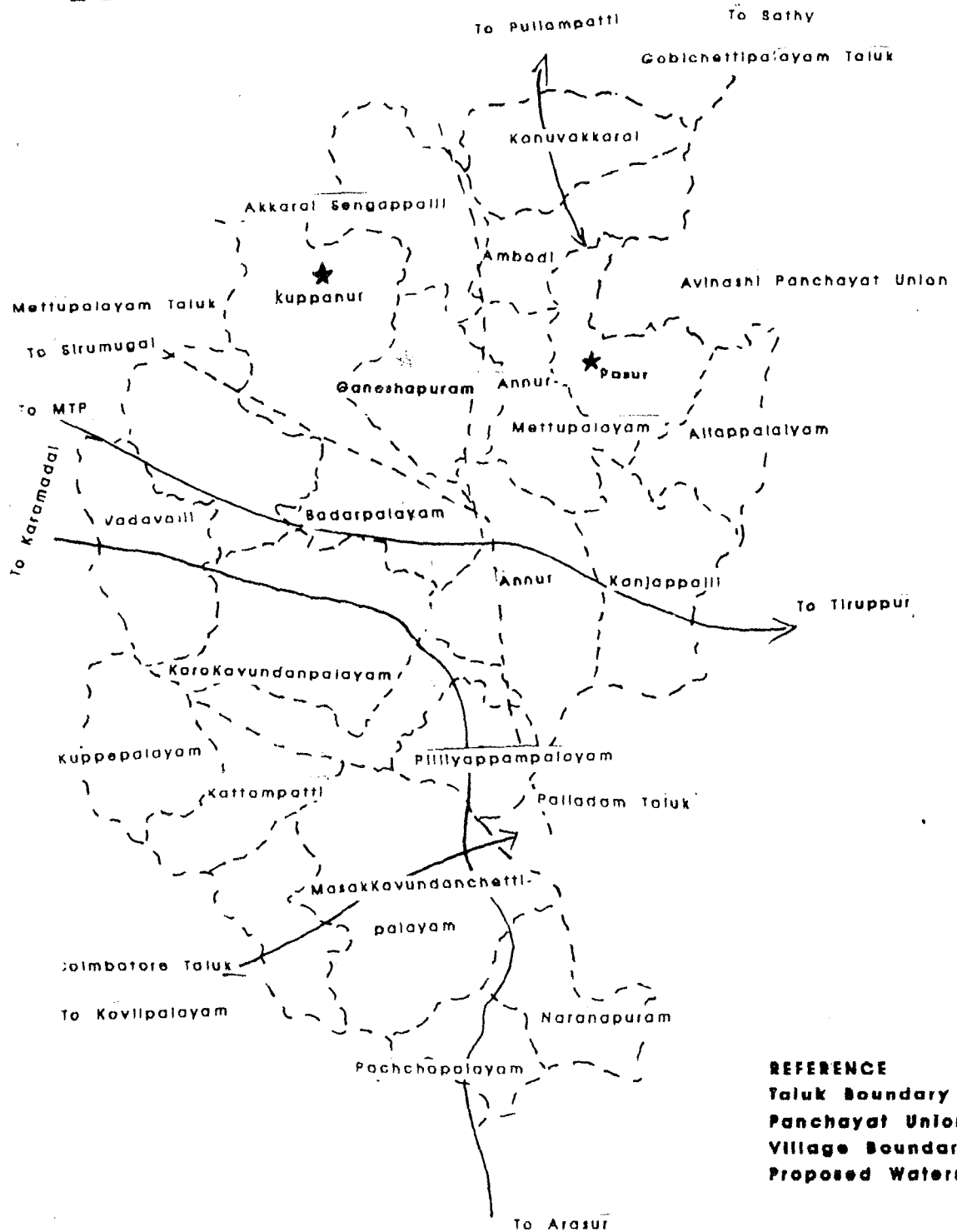


FIGURE- VI

ANNUR BLOCK MAP

LOCATION OF WATERSHED UNDER NWD PRA

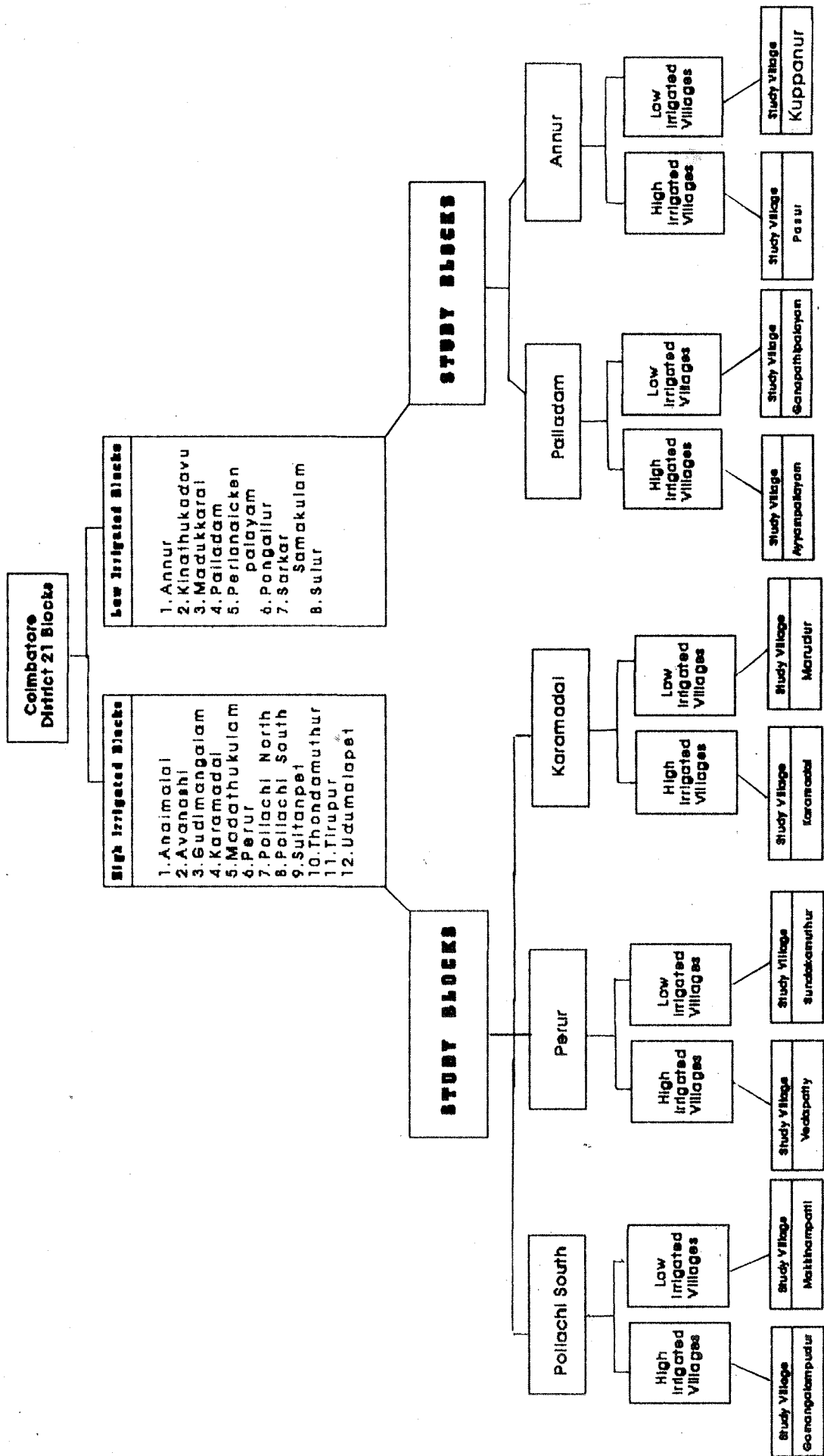


REFERENCE
 Taluk Boundary
 Panchayat Union Boundary
 Village Boundary
 Proposed Watershed

For selecting the sample farmers required for the study, from the selected Village Panchayat Union Office, the list of farmers in the village were obtained. With the help of Tippet's Table of Random Numbers the study farmers were selected. If the selected farmer was not using technology, the replaced sample farmer was included for the study purpose. Figure VII illustrates the sampling frame design used in the study.

FIGURE - VII

Flow Chart Representing the Sampling Design Used in the Study



C. Size of the Sample

From each village, 50 farmers were selected and hence the total size of the sample amounts to 500. The number of farmers in the selected village and the percentage of sample farmers covered to the total farming population is given in Table IV.

TABLE IV

PERCENTAGE OF SAMPLE FARMERS COVERED TO THE TOTAL FARMING
POPULATION IN THE SELECTED VILLAGES

Sl.No.	Village	Total Number of farmers	Number of farmers selected	Percentage of sample farmers to the total farming population
1.	Pollachi South			
a.	Gomangalampudur	120	50	41.70
b.	Makkinampatti	140	50	35.70
2.	Perur			
a.	Vedapatty	93	50	53.76
b.	Sundakkamuthur	95	50	52.63
3.	Karamadai			
a.	Karamadai	180	50	27.70
b.	Marudur	110	50	45.45
4.	Palladam			
a.	Ayyampalayam	192	50	20.20
b.	Ganapathipalayam	248	50	20.00
5.	Annur			
a.	Pasur	130	50	38.46
b.	Kuppanur	115	50	43.47
Total		1423	500	35.13

D. Selection of the Crops

The macro level analysis of the impact of technology related to foodgrains production. Food crops were chosen due to the fact that in Tamil Nadu, between 1980-81 to 1990-91, more than 70 percent of the gross cropped area in the State had been under food crops. However, per capita food grains production in the State in 1990-91 was only 136 kilograms as against the All India figure of 209 kilograms. (Tamil Nadu Economic Appraisal, 1992). As such, the current study focussed on the role of agricultural technology in increasing foodgrains production in Tamil Nadu.

The micro level study on the impact of technology on production related to three food crops : paddy, cholam and maize and three commercial crops:- sugarcane, cotton and groundnut. These crops were selected, since the Crop Manual Survey 1990-91 gave the optimum quantity of seeds, fertilisers and pesticides only for these crops, and not for others. Further, in Coimbatore District, of the total food production, paddy, cholam and maize accounted for 80 percent in 1990-91 (District statistical Handbook - 1991-92). Sugarcane, cotton and groundnut were attractive commercial crops and they fetch remunerative prices due to increasing demand for raw material in sugar mills, textile mills and oil mills.

E. Collection of Data

The data needed at the macro level were compiled from the secondary sources of published records. The data relating to rainfall, land utilisation, irrigation, production and productivity of crops, area under HYV seeds, fertiliser consumption, area under pest control and disease control and use of agricultural implements were compiled from Season and Crop Reports of Tamil Nadu and Tamil Nadu Economic Appraisal. The information on agricultural labourers and cultivators was compiled from 38th Round of the National Sample Survey Report on Employment and Unemployment and Tamil Nadu Economic Appraisal.

For micro level analysis, the study relied on primary data. Through a structured pretested interview schedule (Vide Appendix II) details regarding general information, land use pattern, labour use, capital use, cropping pattern, production, yield, cost of cultivation, profitability of farming, use of HYV seeds, use of fertilisers, agricultural implements and pesticides were collected.

F. Period of Study

The macro level study related to the period of ten years from 1980-81 to 1990-91. This period was chosen as it is the most recent period for which data were available.

The primary data were collected between May 1992 to May 1993 and the pilot study was undertaken in April 1992.

G. Definition of the Concepts Used

The study had used a number of concepts and items. Their operational definitions are given in Appendix - IIA.

H. Hypotheses Framed

The following hypotheses were formulated in the study :

- i) Adoption of crop production technology by the farmers is incomplete and has room for improvement ;
- ii) There is wide difference in adoption of technology between irrigated and rainfed farms ;
- iii) Crop production technology is resource neutral and scale neutral ;
- iv) Lack of knowledge, conviction about the benefits or scarcity of resources may limit the adoption while favourable factor product price ratio would enhance the rate of adoption ; and
- v) Adoption of technology has positive effect on resource use efficiency, income and employment in farms.

I. Quantitative Tools Used

Besides means, percentages and ratios which were used to describe and summarise the data, the methods of analysis employed in the current study were as follows :

a) **Macro Level Analysis**

i) **Coefficient of Variation**

This was used to find out the change in cropped area, foodgrains production and productivity, net irrigated area, area under HYV seeds, fertiliser consumption, use of pesticides and use of agricultural implements in the State of Tamil Nadu from 1981 - 91.

ii) **Growth Rate Analysis**

For the macro level analysis, compound growth rates were estimated for area under food crops, foodgrains production and productivity, net irrigated area, area under HYV seeds, fertiliser consumption, use of pesticides and the use of agricultural implements.

iii) **Decomposition Analysis**

This was used to find out the extent of change in foodgrains production from 1981 - 91 in Tamil Nadu due to area effect, yield effect and interaction effect. The formula used was

$$\Delta P = A_0 \times \Delta Y + Y_0 \times \Delta A \times \Delta A \Delta Y$$

where

ΔP = Change in production between the current period and base period (ie) between 1991 - 1981 ;

A_0 = Area under foodgrains in the base period (ie) 1981 ;

ΔY = Change in yield of foodgrains between the current period and the base period ;

Y_0 = Yield of foodgrains in the base period ; and

ΔA = Change in area under foodgrains between the current period and base period.

iv) Logistic curve

Rao (1986) used the logistic curve to study the pace of adoption of improved varieties of food crops in the State of Andhra Pradesh. The current study applied the logistic curve to test whether agricultural technology adoption pattern in Tamil Nadu confirms to the logistic pattern which is believed to reflect the success of an innovation.

The adoption pattern of agricultural technology at the macro level was analysed by fitting a logistic curve of the form

$$Y = \frac{K}{1 + 10^{a + bx}} \quad (1)$$

This equation was fitted by the method of selected points which requires choosing three years, X_0 , X_1 and X_2 equidistant from each other, one near the beginning of a period, one in the middle and one near the end. At each of the three points, a three year average of Y values was computed. The values were designated as Y_0 , Y_1 and Y_2 and 'n' was the number of years from X_0 to X_1 or from X_1 to X_2 . The three constants

of the logistic curve were derived as follows :

$$K = \frac{2 Y_0 Y_1 Y_2 - Y_1 (Y_0 + Y_2)}{Y_0 Y_2 - Y_1^2} \quad (2)$$

$$a = \log \frac{K - Y_0}{Y_0} \quad (3)$$

$$b = \frac{1}{n} \log \frac{Y_0 (K - Y_1)}{Y_1 (K - Y_0)} \quad (4)$$

The estimated values of K, a and b were substituted in the first equation to derive the predicted values of Y corresponding to each value of X. The predicted values were plotted in the graph and were joined to obtain the logistic curve.

(v) Correlation analysis

This was used to find out the nature and extent of relationship between foodgrains production and the use of technological variables. The formula used was

$$r = \frac{\sum xy}{[\sum x^2 \sum y^2]^{\frac{1}{2}}}$$

(vi) Multiple regression analysis

At the macro level, multiple regression equation was fitted to find out the cause and effect relationship between the yield of foodgrains

and net irrigated area, area under HYV seeds, fertiliser consumption, area under pest control, area under disease control and agricultural implements used. The estimated multiple regression equation was of the form

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + E$$

where

- Y = Yield of foodgrains in kilograms ;
- X₁ = Percentage of net irrigated area to gross cropped area ;
- X₂ = Percentage of HYV area to gross cropped area ;
- X₃ = Per hectare fertilizer consumption in quintals ;
- X₄ = Percentage of area under pest control to gross cropped area ;
- X₅ = Percentage of area under disease control to gross cropped area ;
- X₆ = Per hectare use of agricultural implements (in numbers) ;
- E = Error term ; and
- b₁...b₆ = Multiple regression coefficients.

b) Micro level analysis

(i) Chisquare analysis

At the micro level, chisquare analysis was used to find out the association between adoption of agricultural technology by the selected farmers with the attributes of educational status, years of experience in farming and socio economic status. The formula used was

$$\chi^2 = \frac{\sum (O - E)^2}{E}$$

where O = Observed values ; and
E = Expected values.

(ii) Production function

With the help of regression analysis Cobb Douglas production function was fitted to find out the nature of technological change in the selected farms. The formula used was

$$Y = A_0 L^\alpha K^\beta$$

where Y = Physical quantity of output in quintals ;
L = Number of labourers employed ;
K = Amount of capital invested ;
 α = Estimated labour efficient; and
 β = Estimated capital coefficient.

(iii) Measurement of Technical Change

Various measures of technical change have been developed by Kendrick (1961), Domar (1961), Solow (1957) and Jorgenson (1973). They have used total factor productivity measures to estimate the overall production efficiency and also for assessing technical change.

Since, the current study was based on cross section data collected at a point of time, Kendrick and Solow's measures of technical change could not be applied straightaway. However, Hicksian model of technical change was applied to measure the technical change, following Umesh and Bisaliah (1984) and Adinarayana (1986).

At the microlevel, for measuring technical change multiple regression equation was fitted for HYV and NHYV farms for different crops.

The estimated equation was of the form

$$Y = A_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7$$

where Y = Yield per acre in quintals ;

X_1 = Cropped area in acres ;

X_2 = Per acre seed expenditure in rupees ;

X_3 = Per acre pesticide expenditure in rupees ;

X_4 = Per acre fertiliser expenditure in rupees ;

X_5 = Per acre man hours employed ;

X_6 = Per acre capital invested ;

X_7 = Per acre tractor timings in hours ; and

$b_1, \dots, b_7$ = Multiple regression coefficients

In the estimated equation, technical change is denoted either by a change in intercept A_0 - efficiency parameter or change in slope coefficients-bis. A change in efficiency parameter alone denotes neutral technical change whereas change in slope coefficients only or change in both of them denotes non neutral technical change.

(iv) Determination of Change in Relative Factor Shares

To determine the change in relative factor share, Hicksian concept of bias in factor share was used. The bias was estimated by using the below equation

$$B_i = \frac{b_i \text{ (HYV)} - b_i \text{ (LV)}}{b_i \text{ (LV)}}$$

where B_i = The bias in factor share of i th factor ;

b_i = The estimated multiple regression coefficient of i th factor (ie) the relative factor share.

(v) Determination of Marginal Value Productivity of Inputs Used

The marginal value productivity of different inputs indicates the strength of technological factors in raising output. Sitaram (1984) and Rao (1987) have examined the importance of technological factors with the help of marginal value productivity analysis. The marginal value productivity of an input is calculated as

$$MVP = \hat{b}_i \frac{\hat{y}_i}{\hat{x}_i}$$

where b_i = Elasticity co-efficients of different inputs from 1, 2, 3, ... i ;

y_i = Geometric mean of output ; and

x_i = Geometric mean of i th input.

(vi) Determination of Marginal Rate of Substitution Between Factors (MRTS)

The current study calculated marginal rate of substitution of one resource X_1 for resource X_2 , by using the formula as

$$\frac{dx_2}{dx_1} = - \frac{dy}{dx_1} + \frac{dy}{dx_2}$$

By using the estimated elasticity coefficients marginal rate of substitution of one input for other is obtained

$$MRS_{X_1 X_1} = \left(\frac{\hat{b}_1}{b_1} \right) \bar{X}_1$$

where X_1 = The input for which MRTS is calculated ;

b_1 = Elasticity coefficient of the concerned input ;

b_i = Elasticity coefficient of i th inputs ; and

$\bar{X}_1$ = Geometric mean of i th input

(vii) Measurement of Resource Use Efficiency Due to Technical Change

Following Umesh and Bialiah (1984) the current study assessed the efficiency gain due to technical change by finding out the amount of complementary inputs saved and the resource loss averted by using HYV seeds. The measurement device formulated is as follows :

y_1 = Output produced by using HYV seeds ;

y = Output produced by using NHYV seeds ;

- r = Value of capital, fertiliser, plant protection chemicals and labour required for HYV output ;
 R = Value of capital, fertiliser, plant protection, chemicals and labour used to produce NHYV output ; and
 i = Varietal component of differential output (ie) $\frac{y_1 - y}{y} \times 100$

The measure of resource saved is

$$R_+ = \frac{ir}{1 + 10i} ;$$

The measure of resource loss averted is

$$R_- = \frac{iR}{100}$$

(viii) Formulation of Technology Adoption Index

The current study tried to evolve the technology adoption index - crop wise and size wise by using weighted arithmetic mean.

$$Z = \frac{\sum w_j X_j}{w_j}$$

- X_j = Percentage of actual quantity of inputs used to the optimum quantity recommended in the Crop Manual Survey ; and
 w_j = Proportion of input cost to total cost .

For this purpose, the technology adoption index in respect of seed, fertiliser and pesticides was evolved and the aggregate technology adoption index, z is obtained by adding all the three technology adoption indices. For evolving technology adoption index with regard to seed, the percentage of actual use to the optimum was found out and denoted as (X_j) . The proportion of seed expenditure to total cost was obtained and multiplied by the proportion of area used for a specific crop to the total crop and this was denoted as (w_j) . By multiplying X_j , w_j technology adoption was obtained in respect of seed. Similar procedure was obtained for fertiliser and pesticides, and finally all the three technology adoption indices were added and the aggregate technology adoption index was evolved.

(ix) 'T' Test Analysis

The 'T' test for mean difference was used to find out the significant difference in the following cases :

- a) Difference in output and yield between HYV farms and non HYV farms ;
- b) Difference in output and yield between tractor farms and non tractor farms ;
- c) Difference in employment between HYV farms and non HYV farms ;
and
- d) Difference in employment between tractor farms and non tractor farms.

The formula used was

$$T = \frac{\bar{X}_1 - \bar{X}_2}{S} \sqrt{\left[\frac{n_1 n_2}{n_1 + n_2 - 2} \right]}$$

$$S = \sqrt{\left[\frac{((X_1 - \bar{X}_1)^2 + (X_2 - \bar{X}_2)^2)}{n_1 + n_2 - 2} \right]}$$

(x) Output Decomposition Model

Following Umesh and Bisaliah (1984) from this, the current study tried to decompose the difference in farm output into varietal effect and complementary input effect through the equation as

$$\frac{Y_1}{Y_2} = \frac{A_1}{A_2} + [(a_1 - a_2) CA_2 + (b_1 - b_2) S_2 + (c_1 - c_2) P_2 + (d_1 - d_2) F_2 + (e_1 - e_2) L_2 + (f_1 - f_2) c_2 + (g_1 - g_2) T_2 + a_1 \left(\frac{c_1 A_1}{c_2 A_2}\right) + b_1 \left(\frac{S_1}{S_2}\right) + c_1 \left(\frac{P_1}{P_2}\right) + d_1 \left(\frac{F_1}{F_2}\right) + e_1 \left(\frac{L_1}{L_2}\right) + f_1 \left(\frac{c_1}{c_2}\right) + g_1 \left(\frac{T_1}{T_2}\right)]$$

where

Y_i = Yield ;

A_i = Scale parameters ;

$a_i, b_i, c_i, d_i, e_i, f_i, g_i$ expenditure = Output elasticities with respect to cropped area, fertiliser expenditure, pesticide expenditure, labour employed, capital invested and tractor timings used ;

cA_1 = Cropped area for NHYV ;

cA_2	=	Cropped area for HYV ;
s_1	=	Seed expenditure for NHYV ;
s_2	=	Seed expenditure for HYV ;
p_1	=	Pesticide expenditure for NHYV ;
p_2	=	Pesticide expenditure for HYV ;
F_1	=	Fertiliser expenditure for NHYV ;
F_2	=	Fertiliser expenditure for HYV ;
L_1	=	Man hour employed in NHYV farms ;
L_2	=	Man hour employed in HYV farms ;
C_1	=	Capital invested in NHYV farms ;
C_2	=	Capital invested in HYV farms ;
T_1	=	Tractor timings used for NHYV farms ; and
T_2	=	Tractor timings used for HYV farms.

(xi) Technology impact model

To find out the extent of impact of technology on farm income, the multiple regression analysis was used. The estimated equation was of the form

$$Y = b_0 + b_1 z + b_2 s + b_3 CI + E$$

Here

Y	=	Farm income in rupees ;
z	=	Technology adoption index ;
s	=	Cultivated area in acres ;
CI	=	Cropping intensity ;
E	=	Error term ; and
b_1, b_2, b_3	=	Estimated multiple regression coefficients

This analysis was done at three levels - overall, (aggregate), size wise and crop wise.

Besides this, to find out the impact of technology on employment, multiple regression analysis was done by relating man hours employed with technology adoption index, cultivated area and cropping intensity. The estimated multiple regression equation was of the form

$$E = a_0 + a_1 z + a_2 S + a_3 CI + E$$

where

E = Employment of labour in man hours ;

Z = Technology adoption index,

S = Cultivated area in acres ;

CI = Cropping intensity ;

E = Error term ;

a_1, a_2, a_3 = Estimated multiple regression coefficients.

(xii) Employment Decomposition Model

The major objective of employment decomposition model was to estimate employment elasticities with respect to explanatory variables and identify the sources of employment growth, to apportion the contribution of the technological parameters, market parameters and various inputs.

Following, Bisaliah and Hiremath (1982) the current study estimated labour demand equations for high technology and low technology farms in the selected villages.

The employment decomposition model using the labour demand function in log linear form for high and low technology farms is specified as

$$\begin{aligned} \text{Log } N_1 &= \text{Log } A_1 + a_1 \text{ log } W_1 + b_1 \text{ Log } L_1 + c_1 \text{ Log } F_1 + \\ &\quad d_1 \text{ Log } K_1 + U_1 \end{aligned} \quad (1)$$

$$\begin{aligned} \text{Log } N_2 &= \text{Log } A_2 + a_2 \text{ Log } W_2 + b_2 \text{ Log } L_2 + c_2 \text{ Log } F_2 + \\ &\quad d_2 \text{ Log } K_2 + U_2 \end{aligned} \quad (2)$$

Taking differences between (2) and (1) and adding some terms and subtracting some terms, the result is

$$\begin{aligned} (\text{Log } N_2 - \text{Log } N_1) &= (\text{Log } A_2 - \text{Log } A_1) + (a_2 \text{ Log } W_2 - a_1 \text{ Log } W_1) \\ &\quad + (a_2 \text{ Log } W_1 - a_2 \text{ Log } W_1) + (b_2 \text{ Log } L_2 - b_1 \text{ Log } L_1) \\ &\quad + (b_2 \text{ Log } L_1 - b_2 \text{ Log } L_1) + (c_2 \text{ Log } F_2 - c_1 \text{ Log } F_1) \\ &\quad + (c_2 \text{ Log } F_1 - c_2 \text{ Log } F_1) + (d_2 \text{ Log } K_2 - d_1 \text{ Log } K_1) \\ &\quad + (d_2 \text{ Log } K_1 - d_2 \text{ Log } K_1) - (U_2 + U_1) \end{aligned} \quad (3)$$

Rearranging

$$\begin{aligned}
 \text{Log } \left[\frac{N_2}{N_1} \right] &= \text{Log } \left[\frac{A_2}{A_1} \right] + [(a_2 - a_1) \log W_1 + (b_2 - b_1) \log L_1 \\
 &\quad + (c_2 - c_1) \log F_1 + (d_2 - d_1) \log K_1] \\
 &\quad + [a_2 \log \left(\frac{W_2}{W_1} \right)] + [(b_2 \log \left(\frac{L_2}{L_1} \right) + c_2 \log \left(\frac{F_2}{F_1} \right) \\
 &\quad + d_2 \log \left(\frac{K_2}{K_1} \right)] + (U_2 - U_1)
 \end{aligned} \tag{4}$$

In the equation,

- N_1 = Per acre employment of labour in man hours in low technology farms ;
- N_2 = Per acre employment of labour in man hours in high technology farms ;
- W_1 = Normalised wage rate for low technology farms ;
- W_2 = Normalised wage rate for high technology farms ;
- L_1 = Land input measured in acres in low technology farms ;
- L_2 = Land input measured in acres in high technology farms ;
- F_1 = The value of fertiliser and farm yard manures in rupees for low technology farms ;
- F_2 = The value of fertiliser and farm yard manures in rupees for high technology farms ;
- K_1 = The measure of capital services in rupees for low technology farms ;
- K_2 = The measure of capital services in rupees for high technology farms ;

A_1, A_2 = Scale parameters ; and

$a_1, a_2, b_1, b_2, c_1, c_2, d_1, d_2$ = Estimated employment elasticities
with respect to wage rate, land,
fertiliser and capital services.

Technology effect is captured by adding the values of first and second bracketed expression ; normalised wage rate effect is denoted by the third bracketed expression and complimentary input effect is denoted by the last bracketed expression.

(xiii) Linear Discriminant Function Analysis

In the present study, linear discriminant function analysis was used to study the relative importance of the technological variables of their power to discriminate between two groups of farms - high labour demand farms and low labour demand farms for different farm operations- land preparation, transplanting, crop maintenance and harvesting. Discriminant function used in the current study is as follows.

$$Z = l_1x_1 + l_2x_2 + l_3x_3 + l_4x_4 + l_5x_5 + l_6x_6 + l_7x_7 + l_8x_8$$

Z = Total discriminant score in employment between the high technology and low technology farms ;

x_1 = Normalised wage rate for land preparation (Rupees per man day) ;

x_2 = Normalised wage rate for transplanting (Rupees per man day);

x_3 = Normalised wage rate for crop maintenance ; (Rupees per man day)

- x_4 = Normalised wage rate for harvesting ; (Rupees per man day)
 x_5 = Fertiliser expenditure (Rupees per acre) ;
 x_6 = Pesticide expenditure (Rupees per acre) ;
 x_7 = Capital expenditure including cost of seeds ;
 organic manures, bullock labour and depreciation charges ;
 x_8 = Technology adoption index ; and
 l_i = Linear discriminant coefficients.

The l_i s are estimated by multiplying the inverse of the co variance matrix by the vector of the mean differences.

$$l = S^{-1} d$$

$$S = \begin{bmatrix} s_{11} & s_{12} & - & - & - & s_{18} \\ s_{21} & s_{22} & - & - & - & s_{28} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ s_{81} & s_{82} & - & - & - & s_{88} \end{bmatrix}$$

$$l = \begin{bmatrix} l_1 \\ l_2 \\ . \\ . \\ l_8 \end{bmatrix} \quad \text{and} \quad d = \begin{bmatrix} \bar{x}_{11} & . & . & . & \bar{x}_{21} \\ . & . & . & . & . \\ . & . & . & . & . \\ \bar{x}_{18} & . & . & . & \bar{x}_{28} \end{bmatrix}$$

The significance of an observed discriminant function z was tested using F test criterion defined by

$$F = \frac{N_1 N_2 (N_1 + N_2 - P - 1) D^2}{P(N_1 + N_2) (N_1 + N_2 - 2)}$$

in which $D^2 = d' N^{-1} d$

Where

- N_1 = Number of samples in the first group ;
- N_2 = Number of samples in the second group ;
- P = Number of factors ; and
- D^2 = Mahalanobis statistic.

If the computed 'F' value exceeds table 'F' for 'P' and $(N_1 + N_2 - P - 1)$ degrees of freedom, the function z is considered to be useful in discriminating the group.

The score value of $z^{(1)}$ and $z^{(2)}$ can be calculated as

$$z^{(1)} = \sum_{i=1}^p b_i \cdot X_{1i} \quad (\text{for group 1})$$

$$z^{(2)} = \sum_{i=1}^p b_i X_{2i} \quad (\text{for group 2})$$

The cut off point or discriminatory point $\bar{z}_e$ is calculated as

$$z_e = \frac{\bar{z}(1) + \bar{z}(2)}{2}$$

J. Tabulation of Data

The results of the study are tabulated and analysed under suitable heads and they are presented in the following chapter on 'Results and Discussion'.

RESULTS AND DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

The results and discussion of the study relating to 'Impact of Agricultural Technology on Farm Output and Employment' is organised as follows :

- I. Macro analytical study of the impact of agricultural technology on farm output and employment ; and
- II. Micro analytical study of the impact of agricultural technology on farm output and employment.

I. Macro Analytical Study of the Impact of Agricultural Technology on Farm Output and Employment

Parthasarathy (1991) noted that technologically leading states have high production and employment. In tune with this, the current study tried to analyse the impact of agricultural technology on farm output and employment based on macro level data relating to Tamil Nadu State from 1980-81 to 1990-91. The results are analysed under the following headings :

- A. Trends in land area, sources of water supply and rainfall ;
- B. Trends in area, production and productivity of foodgrains ;
- C. Trends in technology use - net irrigated area, area under high yielding variety seeds, fertilizer consumption, area under plant protection and use of agricultural implements ;

TABLE V

TRENDS IN LAND UTILISATION PATTERN IN TAMIL NADU FROM 1980-81 TO 1990-91 (IN LAKH HECTARES)

S.No.	Items	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
I.	Total Geographical Area											
1.	As per professional survey	129.82	129.82	129.82	129.94	129.94	129.87	129.93	130.41	130.24	130.20	130.19
2.	As per village papers	130.03	130.02	130.01	129.94	129.92	129.87	129.93	130.41	130.24	130.22	130.19
II.	Land Utilisation											
1.	Forest	20.22	20.24	20.30	20.30	20.50	20.66	20.91	21.22	21.64	21.66	21.57
2.	Barren land	5.77	5.83	5.90	5.75	5.68	5.53	5.46	5.88	5.13	5.14	5.09
3.	Land put to non agricultural use	17.47	17.66	17.82	17.96	17.91	17.99	18.02	18.05	18.24	18.33	18.22
4.	Culturable waste	4.43	3.35	3.30	3.16	2.99	2.95	2.99	2.89	2.89	2.91	2.89
5.	Permanent pastures	1.60	1.58	1.55	1.51	1.49	1.48	1.38	1.34	1.27	1.26	1.24
6.	Land under miscellaneous tree crops	2.13	2.19	2.01	1.83	1.84	1.89	1.87	1.49	1.19	1.83	2.34
7.	Current fallows	21.21	16.88	20.87	15.49	15.56	14.10	14.52	13.61	15.46	14.07	12.64
8.	Other fallow lands	4.59	4.87	5.68	5.48	6.10	8.35	9.36	8.45	8.95	8.48	10.48
9.	Net area sown	53.60	57.40	52.59	58.46	57.88	56.91	55.44	57.78	55.47	56.62	55.78
III.	Area sown more than once	11.10	11.69	7.71	10.99	13.00	11.28	9.64	9.50	9.04	11.60	10.54
IV.	Gross cropped area	64.70	69.09	60.30	69.45	70.88	69.19	65.08	67.29	64.51	68.22	66.32
1.	Area under food crops	49.08	53.33	45.86	53.13	53.04	50.54	48.10	46.89	44.76	47.76	46.34
2.	Area under non food crops	15.62	15.77	14.44	16.32	17.84	17.65	16.98	20.39	19.75	20.46	19.98
V.	Cropping intensity (in percentage)	120.7	120.4	114.7	118.8	122.5	119.8	117.4	116.5	116.3	120.5	118.9

Source : Season and Crop Reports of Tamil Nadu - Various issues 1981-91.

In the reference period, on an average, of the total available land, only 45 percent had been used for agricultural purpose and the remaining part was kept either as fallow land or used for non agricultural purposes. Between 1981-91, Tamil Nadu's population increased at the rate of 1.7 percent per annum resulting in decrease in percapita arable land from .1107 hectares to .0999 hectares. Further, due to urbanisation as indicated by the increase in urban population from 159.5 lakhs to 190.2 lakhs, (Census Report of Tamil Nadu, 1991) the demand for land for housing and industrial purpose had been increasing. Hence, the inelastic supply of land, rapid growth of population, urbanisation, industrialisation and housing imposed a limitation on increasing production and as an alternative the State depends on the use of agricultural technology.

b. Trends in Sources of Water Supply

Water is a critical input determining agricultural development of Tamil Nadu. Over greater part of the State, the water table is between 5 and 10 metres below the surface. The surface water resources of the State have been estimated at about 60 million cubic metres of which 83 percent had already been exploited. The ground water potential had been estimated at about 15 million cubic metres of which about 9 million cubic metres had already been harnessed (Rajalakshmi, 1987).

For promoting the efficient use of available water, the Government of Tamil Nadu had emphasised major, medium and minor irrigation project and the total expenditure on irrigation had gone up at the rate of percent per annum. Table VI presents trends in area irrigated by source wise in Tamil Nadu, from 1981 - 91.

TABLE VI

TRENDS IN SOURCES OF IRRIGATION IN TAMIL NADU FROM 1980-81 TO 1990-91

(In Lakh hectares)

S.No.	Source	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
I.	Net area irrigated by											
a.	Canals	9.88	10.00	8.63	9.65	9.96	8.73	9.19	8.20	9.8	8.9	8.69
b.	Tanks	5.90	7.38	5.17	8.07	7.15	6.72	5.10	5.10	4.79	5.22	5.30
c.	Wells	2.20	11.38	10.33	10.01	9.32	10.29	10.09	10.91	10.70	11.68	10.58
d.	Other sources of irrigation	0.24	0.25	0.15	0.20	0.21	0.25	0.17	0.15	0.14	0.14	0.13
e.	Total net area irrigated	25.7	27.11	22.54	26.28	26.40	25.01	23.56	24.38	23.75	24.96	23.73
II.	Area irrigated more than once in the same year	7.24	2.16	4.78	6.31	8.66	7.39	4.89	5.07	4.98	5.47	5.21
III.	Total gross area irrigated	32.94	34.27	27.32	32.49	35.08	32.40	28.44	29.45	28.73	30.44	28.94
IV.	Irrigation intensity (in percent)	128.2	126.4	121.2	124.1	122.8	129.5	120.8	120.8	121.0	121.5	122.1
V.	Percentage of gross irrigated area to total cropped area	50.9	49.6	45.1	46.8	49.5	47.5	43.7	43.8	44.5	44.6	43.6

Source : Season and Crop Reports of Tamil Nadu - Various Issues 1981-91.

Canals were an important source of irrigation. On an average 35 percent of area was irrigated by canals, of which the Cauvery irrigation system by itself accounted for eighty percent. Flows in the Cauvery to benefit Tamil Nadu normally depend on a fair solution of the cauvery dispute. Further, in the reference period there had been a decline in tank irrigation. Lack of comprehensive system of renovation of tanks, foreshore encroachments and unregulated release of water were the major impediments to optimum utilisation.

Eventhough, Tamil Nadu has mountains, with rivers and streams, most of them lie in the rain shadow area of the Western Ghats. Since the Cauvery river originates in and runs through Karnataka State and then through Tamil Nadu its full benefit is not available to Tamil Nadu. The flows in other rivers, the Vaigai, the Thamarabharani, the Ponnaiyar etc. are short lived and as such the State is not self sufficient in it's water requirements.

c) Trends in Rainfall

The quantum and distribution of rainfall by and large determines the quantum of water release from major reserviours. Table VII depicts the trends in rainfall in Tamil Nadu from 1981-91.

TABLE VII

TRENDS IN RAINFALL IN TAMIL NADU FROM 1980 - 81 TO 1990 - 91

(in milli meters)

Year	Winter (January - February)	Summer (March - May)	South West Monsoon (June - September)	North East Monsoon (October - December)	Total	Percentage deviation
1980 - 81	10.5	125.4	196.4	337.0	669.3	- 40.81
1981 - 82	0.2	97.4	406.1	449	952.7	1.12
1982 - 83	0.2	93.7	216.7	352.0	662.6	- 42.62
1983 - 84	169.7	170.3	398.8	483.7	1222.5	29.4
1984 - 85	93.6	66.9	330.7	300.2	791.4	- 16.3
1985 - 86	95.6	96.9	381.9	376.7	951.1	0.9
1986 - 87	8.5	90.2	271.6	330.6	700.9	- 25.8
1987 - 88	3.7	182.4	271.3	525.4	982.8	4.1
1988 - 89	2.0	112.7	376.4	217.7	708.8	- 24.9
1989 - 90	90.2	136.7	348.8	341.0	916.7	- 3.0
1990 - 91	23.3	110.3	300.2	280.7	714.5	- 31.91

Source : Season and Crop Reports of Tamil Nadu : Various issues - 1981 - 91.

In the reference period, the actual rainfall in the State was below the normal rainfall of 942.5 millimetres in all the years, but for 1981-82, 1983-84, 1985-86 and 1987-88. Due to vagaries of nature as indicated by the seasonal and uncertain nature of rainfall, the possibility of increasing production in agriculture depends on the use of agricultural technology.

B. Trends in Area, Production and Productivity of Foodgrains

Extension of area under cultivation or intensive application of modern inputs helps to bring out increase in production. Table VIII presents the trends in area, production and productivity of foodgrains.

TABLE VIII

TRENDS IN AREA, PRODUCTION AND PRODUCTIVITY OF FOODGRAINS IN TAMIL NADU FROM 1980-81 TO 1990-91

Year	Area under foodgrains (in lakh hectares)	Percentage of area under foodgrains to net area sown	Foodgrains production (in lakh tonnes)	Yield per hectare (in kilograms)
1980 - 81	42.46	79.21	56.51	1331
1981 - 82	46.61	81.20	73.75	1582
1982 - 83	39.29	74.71	49.22	1253
1983 - 84	46.78	80.02	62.60	1338
1984 - 85	46.28	79.05	68.87	1488
1985 - 86	43.58	76.46	72.70	1668
1986 - 87	41.31	74.51	71.81	1738
1987 - 88	39.96	69.15	74.80	1872
1988 - 89	37.43	67.47	73.29	1958
1989 - 90	40.2	84.35	79.17	1968
1990 - 91	38.85	83.05	74.90	1929

Source : Tamil Nadu Economic Appraisal : Various issues - 1981-91.

In Tamil Nadu, foodgrains are dominating crops, since on an average 77.28 percent of the net area sown was under foodgrains. In the reference period, there was a downward trend in area under foodgrains and it registered the compound growth rate of -0.8 percent. This implies that increase in foodgrains production was mainly due to increase in yield which in turn can be attributed to the use of technology.

Between 1981-91, there was a significant increase in foodgrains production and the compound growth rate in foodgrains production was estimated to be 1.12 percent. The yield of foodgrains also registered the positive growth rate of 1.48 percent per annum. The higher phenomenal growth in yield and production were due to the emphasis on the use of non conventional inputs - HYV seeds, fertiliser, pesticides, agricultural implements etc.

Through decomposition analysis, the current study tried to find out the extent of change in foodgrains production due to yield effect, area effect and interaction effect. Between 1981-91, the yield effect accounted for 78.48 percent of the change in production in foodgrains, while the percentage contribution of area effect and interaction effect to foodgrains production respectively were 14.85 and 6.67 percent (Appendix III). This is in conformity with the study by Prakash and Rajan (1974) revealing that the yield effect contributed more than 50 percent to foodgrains production in Madhya Pradesh.

The current study also tried to find out the crop wise yield effects in Tamil Nadu. Table IX presents the trends in area, production and productivity of foodgrains - cropwise in Tamil Nadu from 1980-81 to 1990-91.

TABLE IX

TRENDS IN AREA, PRODUCTION AND PRODUCTIVITY OF FOOD GRAINS - CROPWISE IN TAMIL NADU : 1980-81 TO 1990-91

(Area : Lakh hectares ; Production : Lakh tonnes ; Yield : Kilograms per hectare)

S.No.	Crop	1980 - 81	1981 - 82	1982 - 83	1983 - 84	1984 - 85	1985 - 86	1986 - 87	1987 - 88	1988 - 89	1989 - 90	1990 - 91
1.	Paddy											
	Area (A)	22.99	25.08	19.74	24.20	25.09	22.64	19.55	19.55	18.80	20.15	18.55
	Production (P)	42.79	56.81	36.42	46.33	53.65	53.7	53.33	56.14	57.03	62.31	57.82
	Yield (Y)	1861	2365	1845	1914	2138	2372	2728	2878	3032	3088	3116
2.	Cholam											
	Area (A)	6.75	7.03	6.73	7.75	6.87	7.33	7.30	6.89	5.61	5.86	5.41
	Production (P)	4.75	5.52	4.05	5.27	5.26	7.75	6.58	7.00	5.56	6.94	5.49
	Yield (Y)	762	785	602	680	766	1057	902	1015	991	1184	1014
3.	Cumbu											
	Area (A)	3.27	3.32	2.96	3.44	3.22	3.06	2.98	2.93	2.70	2.62	2.74
	Production (P)	2.64	3.10	2.08	3.21	3.20	3.72	2.81	3.15	3.04	2.90	2.96
	Yield (Y)	805	922	702	934	992	1215	942	1075	1125	1112	1081
4.	Maize											
	Area (A)	0.18	0.26	0.18	0.16	0.16	0.16	0.30	0.21	0.30	0.32	0.32
	Production (P)	0.20	0.26	0.41	0.40	0.28	0.29	0.41	0.32	0.38	0.51	0.44
	Yield (Y)	1074	1073	2221	2473	1750	1812	1366	1528	1266	1687	1370
5.	Ragi											
	Area (A)	1.96	2.12	1.76	2.01	2.03	1.95	1.76	1.68	1.63	1.71	1.69
	Production (P)	2.58	3.77	2.20	2.55	2.47	3.01	3.15	2.88	2.86	3.56	3.16
	Yield (Y)	1314	1778	1247	1271	1106	1542	1787	1714	1754	1995	1863
6.	Other cereals											
	Area (A)	2.57	2.63	2.97	3.19	2.74	2.61	2.54	2.35	2.11	2.2	2.2
	Production (P)	2.03	2.42	2.18	2.63	1.53	1.48	2.41	2.48	1.88	1.8	1.11
	Yield (Y)	789	920	734	824	558	567	948	1053	890	818	800
7.	Pulses											
	Area (A)	5.44	5.58	4.94	6.03	6.18	5.82	6.89	6.35	6.29	9.74	9.62
	Production (P)	1.95	1.76	1.89	2.22	2.49	2.75	3.12	2.83	2.48	3.34	3.60
	Yield (Y)	3584	3200	3825	3681	4029	4741	4528	4456	3968	4229	4150

Source : Season and Crop Reports of Tamil Nadu : Various issues - 1981-91

In the reference period, area under paddy decreased at the compound growth rate of 3.8 percent, while the yield of paddy increased at the rate of 17.3 percent. Similarly the growth rate in yield of cholam, cumbu, maize and ragi respectively were 11, 4, 4.6 and 3 percent and it was greater than the compound growth rate in area under these crops. This significant increase in yield of foodgrains might be attributed to the adoption of agricultural technology by farmers in Tamil Nadu.

Table X describes the cropwise yield effect, area effect and interaction effect.

TABLE X
CROP WISE YIELD EFFECT, AREA AFFECT AND INTERACTION EFFECT - 1981-91

S.NO.	Crop	(In Percent)		
		Yield Effect	Area Effect	Interaction Effect
1.	Paddy	79.78	10.37	9.85
2.	Cholam	74.44	18.18	7.38
3.	Cumbu	65.87	23.04	11.09
4.	Maize	31.83	43.39	24.78
5.	Ragi	90.95	6.73	2.34
6.	Pulses	16.17	71.05	12.78

For majority of the food crops, (paddy, cholam, cumbu and ragi) the yield effect was greater than area effect and interaction effect, indicating the intensive use of farm technology in the State.

C. Trends in Technology Use in Tamil Nadu

a) Trends in Net Irrigated Area, Area Under HYV Seeds, Fertiliser Consumption, Area Under Pest Control, Area Under Disease Control and Agricultural Implements Used in Tamil Nadu

Boserup (1965) viewed that per hectare yield was the highest in technologically advanced areas. The current study tried to test this proposition with respect to Tamil Nadu. Table XI presents the trends in net irrigated area, area under HYV seeds, fertiliser consumption, area under pest control, area under disease control and agricultural implements used in Tamil Nadu from 1981-91. Appendix IV describes a sample of the estimated coefficient of variation in the use of technology.

TABLE XI

TRENDS IN NET IRRIGATED AREA, AREA UNDER HIGH YIELDING VARIETY SEEDS, FERTILISER CONSUMPTION, AREA UNDER PEST CONTROL, AREA UNDER DISEASE CONTROL AND USE OF AGRICULTURAL IMPLEMENTS IN TAMIL NADU

FROM 1980-81 TO 1990-91

Year	Net irrigated area (Lakh hectares)	Percent of NIA to GCA	Area under HYV (lakh hectares)	Percent of HYV to GCA	Fertiliser consumption (lakh tonnes)	Per hectare fertiliser consumption	Area under pest control (lakh hectares)	Percent to GCA	Area under disease control (lakh hectares)	Percent to GCA	Agri-cultural implements (lakh numbers)	Per hectare use of implements
1980-81	25.71	39.73	31.70	48.99	4.79	74.8	56.47	87.27	18.09	27.96	56.23	1.15
1981-82	27.09	39.20	37.06	53.64	5.08	73.5	57.62	83.25	17.08	25.01	60.58	1.14
1982-83	22.54	37.37	28.60	47.52	4.72	78.2	49.74	82.48	16.06	26.63	62.89	0.95
1983-84	26.18	37.69	38.37	55.24	5.88	84.6	60.59	87.24	20.20	28.08	65.28	1.06
1984-85	26.40	37.24	39.91	56.30	6.91	97.4	61.15	86.27	31.63	44.62	67.76	1.04
1985-86	25.01	36.67	42.20	61.88	6.68	97.0	62.63	91.25	21.12	30.97	70.33	0.96
1986-87	23.55	36.18	27.83	42.76	6.74	103.5	57.02	87.61	20.13	30.93	73.0	0.89
1987-88	24.37	36.22	30.53	45.37	6.79	100.9	62.06	92.24	22.34	33.20	75.78	1.12
1988-89	23.74	36.80	26.40	40.92	7.68	119.0	58.9	91.31	20.49	31.76	78.66	1.21
1989-90	24.96	36.58	21.47	40.26	7.93	116.2	58.85	86.36	23.23	34.05	80.00	1.17
1990-91	23.72	35.75	28.61	41.93	8.31	125.3	61.42	92.61	22.66	34.16	72.00	1.08
$\bar{X}$	24.84	37.31	32.61	48.61	6.51	97.3	58.72	87.99	17.93	31.58	69.41	1.07
C.V.	1.33	1.21	4.98	6.88	18.27	17.22	3.45	3.31	5.11	5.01	7.21	0.20

Source : Season and Crop Reports of Tamil Nadu : Various Issues - 1981-91.

On an average, the percentage of net irrigated area to gross cropped area was 37.31 and this was above the national average of 35 percent. As Dhawan (1992) pointed out, assured supply of irrigation facilities brought out the increase in production. Since the use of HYV seeds and fertiliser initially depend on the availability of irrigation facilities, the significant increase in the use of agricultural technology might be attributed to the availability of irrigation facilities. However, during the reference period, net irrigated area decreased by .7 percent.

HYV seeds are quick yielding and hence the positive yield effect depends on the area under HYV seeds. In Tamil Nadu, in the reference period the average percentage of HYV area in relation to gross cropped area was 48.61. Since nearly half of the cropped area was sown with hybrid varieties, this helped much in bringing out the increase in yield. However, the compound growth rate in area under HYV seeds worked out to be -.4 percent.

Prasad (1991) viewed that adequate fertiliser use induces high farm output. At the State level, the average per hectare fertiliser consumption was 97 kilograms and it was above the national average of 86 kilograms (Tamil Nadu Economic Appraisal, 1991). The increase in fertiliser consumption at the compound growth rate of 5.14 percent (Appendix V) indicated that farmers in Tamil Nadu had been increasingly using fertilisers.

The sustained yield of crops depends on the application of pesticides and hence the area under plant protection is positively associated with the yield of crops. On an average, at the State level, 58.72 lakh hectares were covered under pest control and 17.93 lakh hectares were under disease control. During the reference period, area under pest control increased at the compound rate of .7 percent and area under disease control increased at the compound rate of 2.06 percent per annum. The current study conforms with the view of Ghodake and Jha (1981) that pesticide is the critical input and the use of pesticides creates a favourable impact on production.

The use of agricultural implements by speeding up the process of farm operations helped in increasing farm output. In the reference period, the use of agricultural implements increased at the compound growth rate of 2.27 percent.

b. Adoption Pattern of Agricultural Technology

The current study tried to analyse the adoption pattern of agricultural technology by fitting logistic curve. Table XII presents the adoption values for technological variables in Tamil Nadu. Appendix VI provides a sample of adoption values for technological variables in Tamil Nadu.

TABLE XII
ADOPTION VALUES FOR TECHNOLOGICAL VARIABLES IN TAMIL NADU
(ESTIMATED COEFFICIENTS OF THE LOGISTIC CURVES)

S.No.	Technological variables	K	a	b
1.	Percent of net irrigated area GCA	38.93	- 1.51	.0163
2.	Percent of area under HYV to GCA	50.69	- 1.07	- .0146
3.	Per hectare fertiliser consumption	90.66	- 1.69	.0830
4.	Percent of area under pest control to GCA	92.68	- 1.04	.0268
5.	Percent of area under disease control to GCA	32.48	- 0.64	- .0515
6.	Per hectare use of agricultural implements	1.05	- 1.50	- .0082

In Table XII, K values represent the maximum levels of adoption that can be reached and they may be regarded as the long run equilibrium levels around which the adoption would stabilise. The predicted levels indicated that about half of the gross cropped area would be under HYV seeds and more than 90 percent of the area would be under pest control.

c. Estimated Trend Values in Technology Use in Tamil Nadu

Based on the estimated coefficients of the logistic curve (K, a and b), the trend values in technology use for the State were estimated. Table XIII presents the estimated trend values in technology use in Tamil Nadu. The method of estimation of trend value in technology use in Tamil Nadu is given in Appendix VIII.

TABLE XIII

ESTIMATED TREND VALUES IN TECHNOLOGY USE IN TAMIL NADU

Year	Net irrigated area	Area under HYV	Per hectare fertiliser consumption	Area under pest control	Area under disease control	Per hectare use of agricultural implements
1981 - 82	29.74	45.41	64.41	84.07	66.31	.8012
1982 - 83	30.05	45.52	67.71	97.04	59.10	.8047
1983 - 84	30.37	45.62	70.72	103.98	52.67	.8081
1984 - 85	30.67	45.72	73.44	111.48	46.94	.8115
1985 - 86	30.97	45.85	75.86	119.40	41.84	.8149
1986 - 87	31.25	45.93	78.00	127.94	37.29	.8183
1987 - 88	31.53	46.02	79.88	137.08	33.23	.8215
1988 - 89	31.80	52.09	81.51	146.87	29.27	.8248
1989 - 90	32.07	53.01	97.13	157.45	28.92	.8281
1990 - 91	32.32	54.24	116.79	168.66	28.54	.8313

There had been deviations between the actual and trend values in the use of all technological variables. The discrepancy was found more with respect to fertiliser consumption and it was low with respect to the use of agricultural implements. Figure VIII represents the actual and trend values of technological variables in Tamil Nadu.

**FIGURE VIII A - ACTUAL AND TREND VALUES OF TECHNOLOGICAL
VARIABLES IN TAMILNADU - Net Irrigated Area**

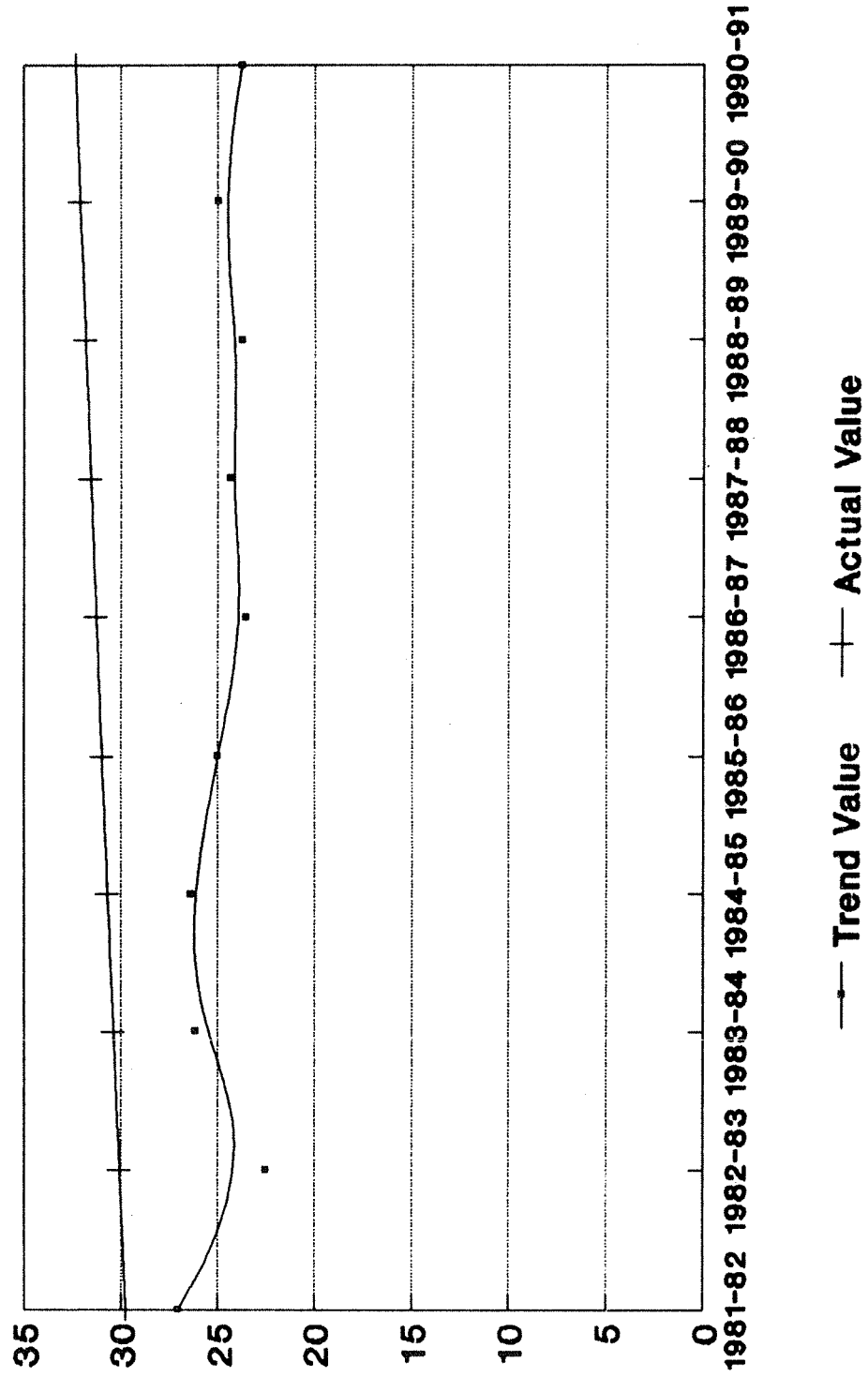


**FIGURE VIII B - ACTUAL AND TREND VALUES OF TECHNOLOGICAL
VARIABLES IN TAMILNADU - Area Under High Yielding Variety Seeds**

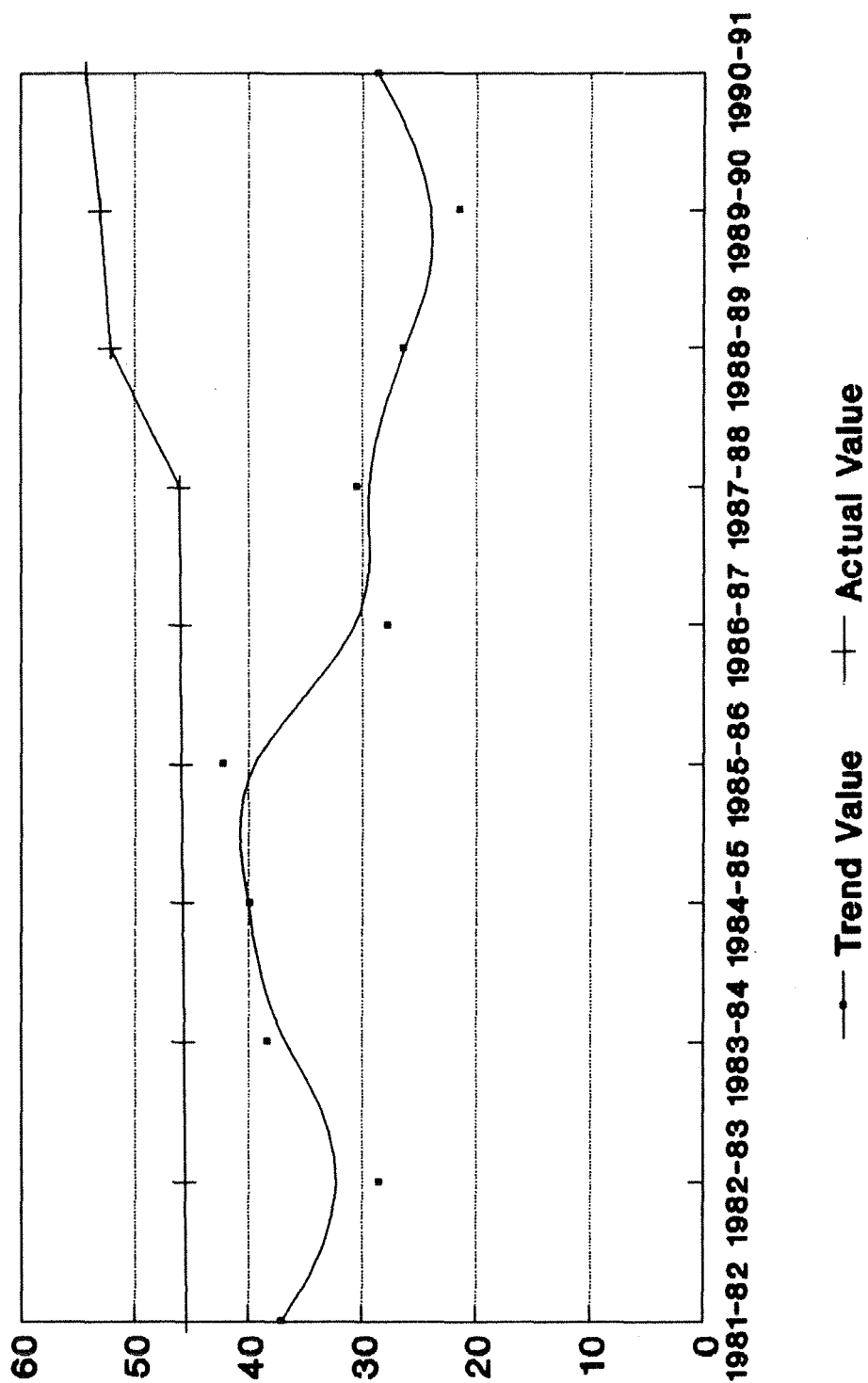


**FIGURE VIII C - ACTUAL AND TREND VALUES OF TECHNOLOGICAL
VARIABLES IN TAMILNADU - Fertilizer Consumption**

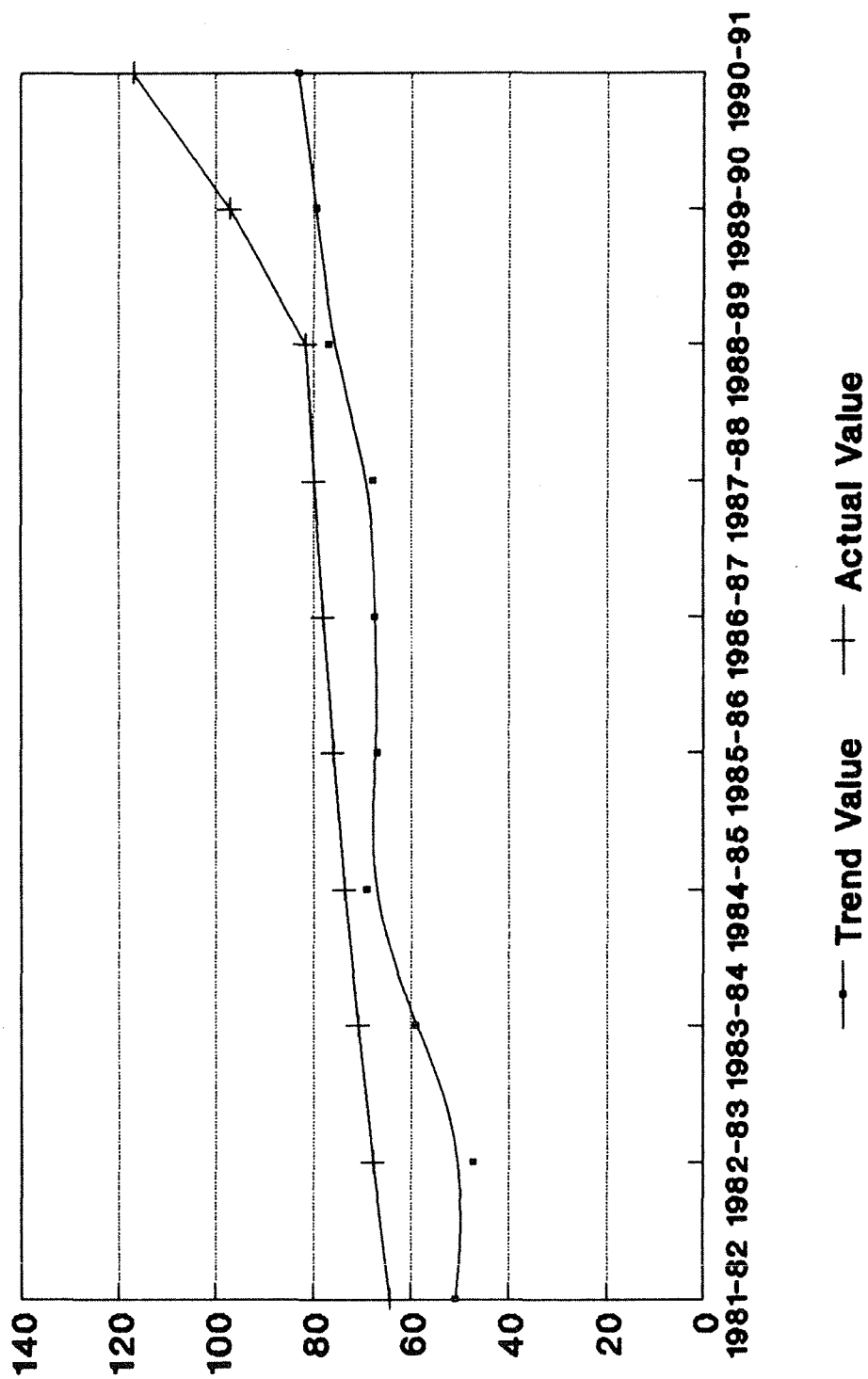


**FIGURE VIII D - ACTUAL AND TREND VALUES OF TECHNOLOGICAL
VARIABLES IN TAMILNADU - Area Under Pest Control**

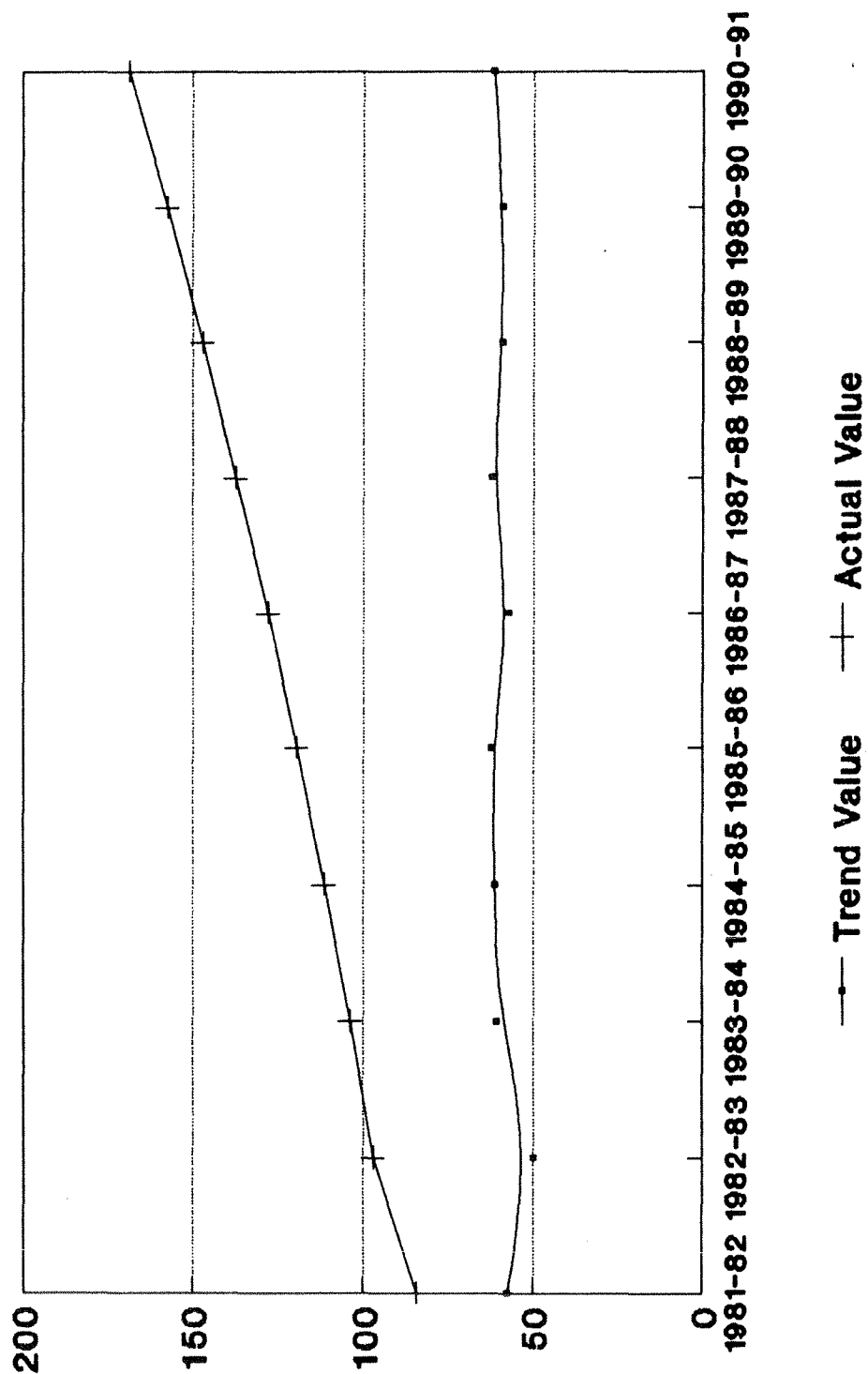


**FIGURE VIII E - ACTUAL AND TREND VALUES OF TECHNOLOGICAL
VARIABLES IN TAMILNADU - Area Under Disease Control**

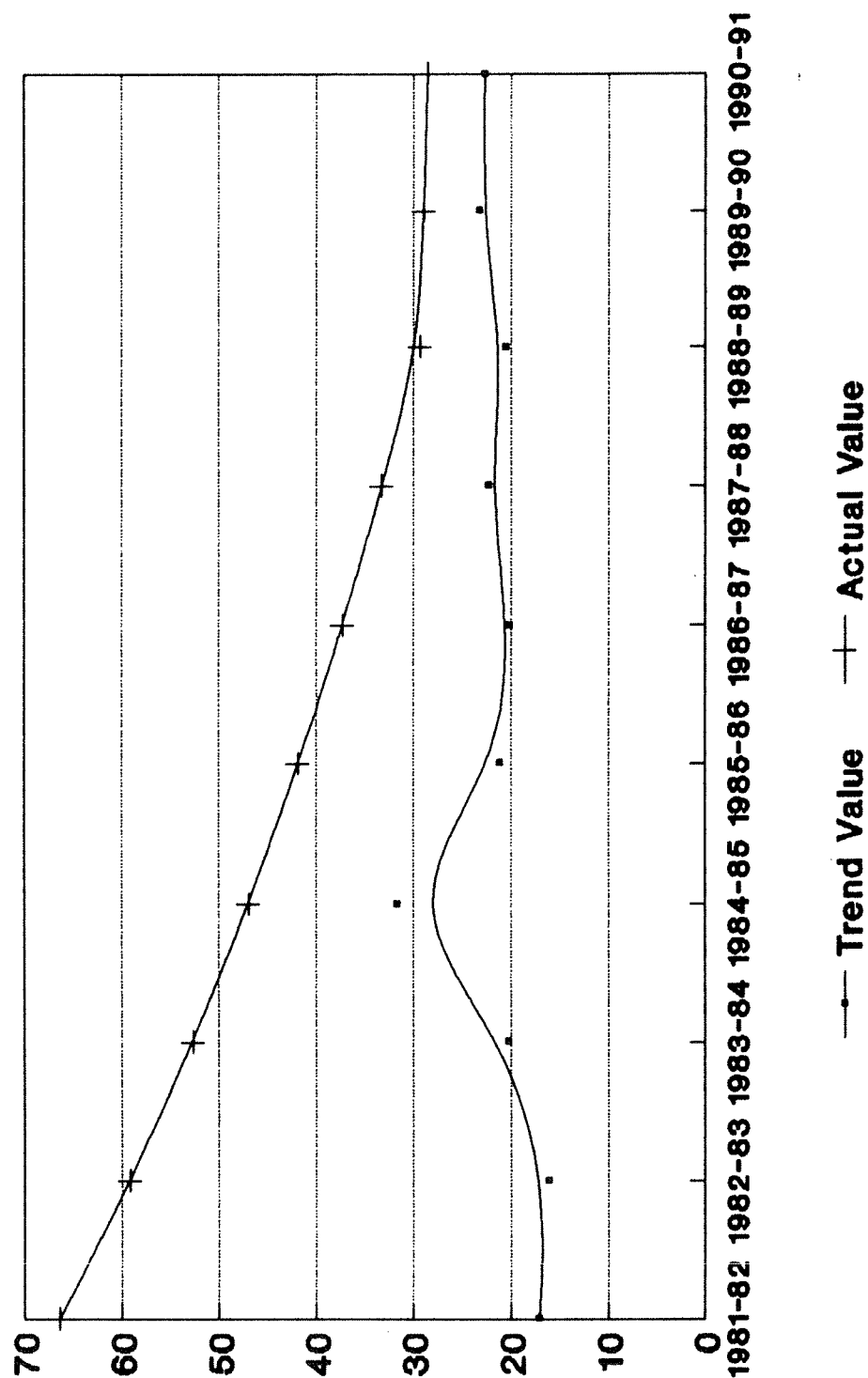
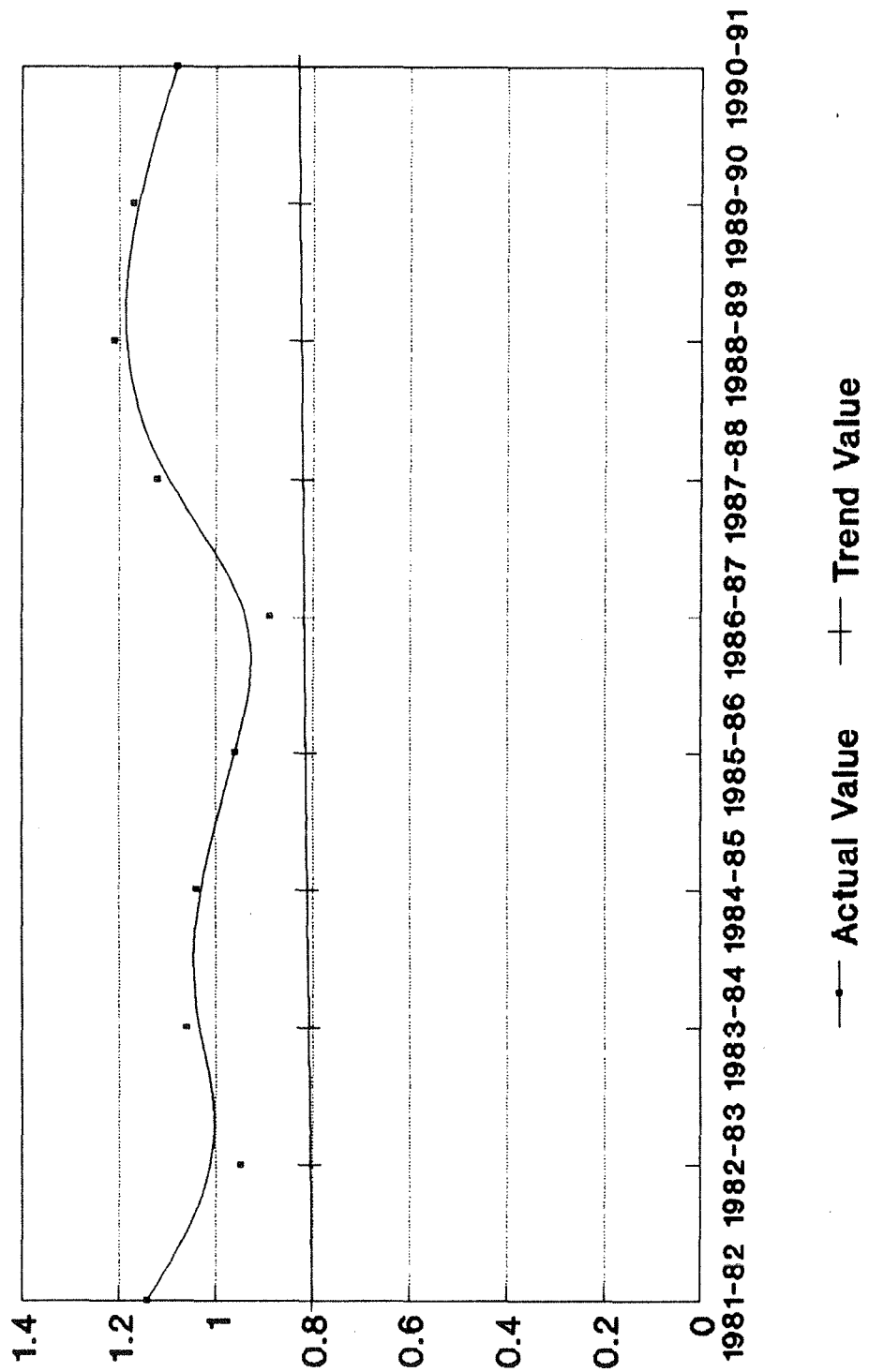


**FIGURE VIII F - ACTUAL AND TREND VALUES OF TECHNOLOGICAL
VARIABLES IN TAMILNADU - Use of Agricultural implements**



D. Technology Foodgrains Productivity Relationships**a. Nature and Extent of Relationship Between Technology - Foodgrains Productivity**

The nature and extent of relationship between technological variables and foodgrains productivity was analysed through simple correlation analysis. Table XI presents the correlation coefficient matrix of foodgrains productivity as related to technological variables.

TABLE XIV
ZERO ORDER CORRELATION COEFFICIENTS OF FOODGRAINS PRODUCTIVITY AS RELATED TO
TECHNOLOGICAL VARIABLES

Variable	Yield	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆
Yield	1.00						
X ₁	-.66	1.00					
X ₂	-.57	.36	1.00				
X ₃	.67	-.62	-.56	1.00			
X ₄	-.37	.12	.30	-.22	1.00		
X ₅	.27	-.44	-.01	.52	-.15	1.00	
X ₆	.35	.29	.31	-.17	-.03	.03	1.00

Of the technological variables, foodgrains productivity was positively related with fertiliser consumption, area under disease control and use of agricultural implements. However net irrigated area, HYV area and area under pest control have a negative association with the yield of foodgrains and this might be due to more fluctuations in these technological variables during the reference period.

b. Impact of Agricultural Technology on Foodgrains Productivity in Tamil Nadu

Studies by Umesh and Bisaliah (1981), Pandey (1986) and Reddy (1990) have emphasised that technological variables explain a major portion of productivity growth in the agricultural sector. In the current study an attempt was made to test this hypothesis. The model is as follows :-

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + E$$

where

Y = Foodgrains productivity in kilograms ;

X_1 = Percentage of net irrigated area to gross cropped area ;

X_2 = Percentage of area under HYV to gross cropped area ;

X_3 = Per hectare fertiliser consumption ;

X_4 = Percentage of area under pest control to gross cropped area ;

X_5 = Percentage of area under disease control to gross cropped area ; and

X_6 = Per hectare use of agricultural implements.

The estimated multiple regression equation of foodgrains productivity as related to technological variables is as follows :

$$Y = 3196.56 - 90.22 X_1 + 4.73 X_2 + 6.91 X_3 - .27 X_4 - 13.24 X_5 + 1097.53 X_6$$

(-91) (.56) (1.26) (-1.47) (-1.26) (1.53)

$$R^2 = .69 \quad N : 11$$

$$= 5.66 > 7(4.98) \quad (I)$$

(Appendix VIII)

The estimated equation implies that technological variables explained 69 percent of the change in foodgrains productivity in Tamil Nadu. The impact of mechanical technology on the yield of foodgrains was greater as one percent change in the use of agricultural implements is expected to bring out 1097.53 percent change in the yield. On the various components of biochemical technology, fertiliser use created more impact on the yield since one percent increase in the use of fertiliser is expected to bring out 6.91 percent change in the yield. The estimated multiple regression equation was statistically valid as indicated by the R^2 value and F value.

E. Technology - Employment Relationships

In Tamil Nadu, agriculture is the main occupation and provides employment to 65 percent of the population. The demand for agricultural

labour is a derived demand from agricultural production. Since the use of agricultural technology brings about changes in production, it also creates an impact on the demand for labour and on farm employment.

Singh (1973) and Miglani (1979) viewed that the use of agricultural technology increases farm employment by increasing cropping intensity and production. Mellor (1973) and Birla Institute of Scientific Research (1980) also noted that new technology increased the demand for inputs and created a favourable impact on employment. The current study tried to find out how far the use of agricultural technology has increased the demand for farm labour in Tamil Nadu.

Table XV presents the comparative picture of cultivators and agricultural labourers in Tamil Nadu in 1981 and 1991.

TABLE XV
TRENDS IN CULTIVATORS AND AGRICULTURAL LABOURERS IN TAMIL NADU (1981 - 91)

Year	Cultivators			Agricultural labourers		
	Male	Female	Total	Male	Female	Total
	(in lakh numbers)					
1981	39.80 (31.75)	15.79 (22.76)	55.59 (29.22)	38.70 (23.24)	21.67 (53.43)	60.37 (31.73)
1991	41.90 (26.59)	15.38 (21.33)	57.29 (24.94)	40.92 (25.98)	37.53 (52.02)	78.46 (34.16)

Source : Tamil Nadu Economic Appraisal - 1992

Figures in paranthesis indicates percentage of cultivators/agricultural labourers to main workers.

Between 1981 - 91, there was an increase in the number of both cultivators and agricultural labourers. The compound growth in cultivators and agricultural labourers were respectively estimated as 0.3 percent and 2 percent. This indicates that there was an expansion of farm employment in Tamil Nadu during the reference period. Between 1981-91, the average physical productivity of cultivators increased from 1.01 tonnes to 1.30 tonnes and that of agricultural labourers increased from 0.93 tonnes to 0.95 tonnes.

Increase in the productivity of labour and resultant increase in labour absorption might be attributed to the use of agricultural technology. As Daroga Singh (1988) pointed out, new technology has considerable scope for labour absorption since the improved technology involves adoption of suitable crop variables, better land preparation, application of fertilisers and weeding the plants.

At the State level, in the reference period, area under HYV crops registered the compound growth rate of 1.04 percent and this might be the reason for increase in farm employment. Increase in employment due to HYV is due to the fact that HYV requires more intensive ploughing and interculture and hence require more hours of human labour. This was also in tune with the views of Sain (1977) and Ruttan (1977) that HYV increased farm employment by increasing the use of hired labour in agriculture due to the introduction of double cropping.

The increase in the use of fertiliser at the rate of 5.15 percent, area under plant protection at the rate of 3.6 percent and use of

agricultural implements at the rate of 3.1 percent per annum contributed significantly for increase in farm employment. The increase in the use of these inputs created yield augmenting effect and hence more labourers were required to bring out increase in production. Besides this, the intensive application of non conventional inputs helped in increasing the efficiency of farm labour and thereby created more demand for farm labour.

II. MICRO ANALYTICAL STUDY OF THE IMPACT OF AGRICULTURAL TECHNOLOGY OF FARM OUTPUT AND EMPLOYMENT

The results of the micro analytical study on 'Impact of agricultural technology on farm output and employment' is discussed under the following headings :

- A. General profile of the sample respondents ;
- B. Resource use pattern ;
- C. Nature of technical change and measurement of technical change ;
- D. Adoption of agricultural technology ;
- E. Analysis of cost of cultivation and profitability of farming enterprise ;
- F. Determination of factor shares, factor substitution - and resource use efficiency due to technical change ;
- G. Effect of high yielding variety seeds, fertiliser, pesticides and tractors on farm output and output decomposition model ;
- H. Cropwise and sizewise variations in technology impact relating to farm output ;
- I. Effect of high yielding variety seeds and tractors on farm employment ;
- J. Technology impact model with respect to employment ;
- K. Derivation of labour demand functions and employment decomposition model ;
- L. Determination of technological factors in operation wise demand for labour - linear discriminant function analysis.

A. General Profile of the Sample Respondents

The adoption of agricultural technology is either induced or constrained by factors like literacy level of the farmers, years of experience in farming and socio economic status. Table XVI provides information about the general profile of the sample respondents.

TABLE XVI

GENERAL PROFILE OF THE SAMPLE RESPONDENTS (IN NUMBERS)

S.No.	Item	Pollachi		Perur		Karamadai		Palladam		Annur	
		Type A Village	Type B Village	Type A Village	Type B Village	Type A Village	Type B Village	Type A Village	Type B Village	Type A Village	Type B Village
1.	Age										
	a. Below 30	8	9	6	10	6	4	17	21	8	20
	b. 30 - 60	34	31	38	30	29	32	28	15	30	22
	c. Above 60	8	10	6	10	15	14	10	14	12	8
2.	Educational level										
	a. Illiterates	4	4	3	5	3	6	5	10	7	11
	b. Completed primary education	6	6	4	7	8	22	5	10	6	25
	c. Completed secondary education	34	34	35	32	31	18	33	25	32	6
	d. Completed collegiate education	6	6	8	6	8	4	7	5	5	6
3.	Type of Family										
	a. Nuclear	34	34	44	42	35	22	40	38	39	42
	b. Joint	16	16	6	8	15	28	10	12	11	8
4.	Years of experience in farming										
	a. Below 10	10	10	2	4	5	6	5	9	11	14
	b. 10 - 30	30	30	36	35	25	20	28	32	31	30
5.	Economic status										
A.	Income										
	a. Below Rs.2000	12	38	15	18	7	20	21	32	30	52
	b. Rs.2000 - 4000	24	2	25	20	30	22	20	8	12	9
	c. Above Rs.4000	14	10	10	12	13	8	9	10	8	9
B.	Property										
	a. Below Rs.50000	4	6	4	7	5	6	9	12	17	19
	b. Rs.50000 - 100000	6	6	6	10	5	12	330	28	25	22
	c. Above Rs.1,00,000	40	38	40	33	40	32	11	10	8	9
6.	Age composition of family members										
	a. Below 14	10	25	28	22	25	38	30	35	32	40
	b. 15 - 50	170	160	135	140	160	140	150	165	155	190
	c. Above 60	10	30	55	45	35	62	40	72	50	30
7.	Sex composition of family members										
	a. Male	112	120	115	118	110	132	118	160	137	150
	b. Female	88	95	103	89	100	108	102	112	100	140

In this subsequent tables, Type A village is high^{irrigated} village and Type B is low irrigated village.

By and large, there were no remarkable differences between farmers in high and low irrigated villages in respect of age, education and farming experience. There was, however, some difference in their economic status.

Since new inputs are costly, only rich farmers can afford to introduce them in their fields. The study found that in the selected high irrigated villages, 66 percent of the farmers had a monthly income of more than Rs.2000 and 84.5 percent reported property worth Rs.50,000 and above. But in the low irrigated villages only 44 percent of the farmers had a monthly income of more than Rs.2000, though 80 percent reported property worth Rs.50,000 and above.

On an average in high irrigated villages 71 percent of the population were in the workforce, while in the low irrigated villages, 65 percent of them were in the workforce category. This revealed that there was adequate supply of labour in two groups of villages.

The current study tested whether there was any significant association between technology adoption and attributes like educational status of the farmers, years of experience in farming and socio economic status. The calculated χ^2 values are given in Table XVII. A sample chi square calculation is shown in Appendix IX.

TABLE XVII

CALCULATED CHI-SQUARE VALUES OF ASSOCIATION BETWEEN TECHNOLOGY ADOPTION AND THE SELECTED CHARACTERISTICS

S.NO.	Characteristics	Pollachi Block		Perur		Karamadai		Palladam		Annur	
		Type A Village	Type B Village	Type A Village	Type B Village	Type A Village	Type B Village	Type A Village	Type B Village	Type A Village	Type B Village
1.	Educational status of the farmers	11.26*	11.26*	4.5	9.53*	7.35*	5.06	3.25	6.85*	13.43*	6.15
2.	Years of experience in farming	8.12*	14.87*	0.62	2.44	12.0*	11.10*	1.69	11.91*	11.47*	2.36
3.	Economic status	4.79	9.27*	7.92*	8.16*	8.22*	1.30	14.36*	9.06*	6.26*	4.08

* Statistically significant at 5 percent level.

In majority of the study villages (7), there was a significant association between technology adoption and educational status of the farmers and also their economic status. This implies that, irrespective of the variations in agro climatic conditions among the villages, there is scope for increasing the technology adoption by educating the farmers and also by increasing their farm and non farm income through the provision of remunerative farm price and also creation of off farm employment opportunities.

However, in high irrigated villages, economic status had a high significant association with technology adoption. This implies that since the farmers in high irrigated villages were comparatively better off than the farmers in unirrigated villages, they were able to purchase the non conventional inputs and hence they were having high mean technology adoption index.

In low irrigated villages, among the selected characteristics, educational status of the farmers had a high significant association with technology adoption by the farmers. Thus the major constraint for technology adoption by the farmers in low irrigated villages appeared to be their illiteracy.

B. Resource Use Pattern

Farming operations depend on the quantum of land labour used and capital invested. The adoption of agricultural technology might result

in saving of land or labour and it also might alter the factor proportions. Hence the current study tried to analyse the resource use pattern in terms of land use pattern, labour use and capital invested.

a. Land Use Pattern and Cropping Pattern

(i) Land Use Pattern

The significant reason for the adoption of agricultural technology is its land saving nature. With the limited supply of land the farmers depend much on intensive cultivation by applying non-conventional inputs. Table XVIII brings out the land use pattern in the selected villages.

TABLE XVIII

LAND USE PATTERN IN THE STUDY FARMS

(in acres)

S.No.	Item	Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers	Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers
I. Pollachi South											
1.	Number of farmers	9	14	8	11	8	6	11	15	7	11
2.	Land area owned	20.5	69	112	147	355	13.75	63	113	81	263
3.	Cultivated land	14.5	60	91	116	310	10.75	53	79	74	214
4.	Fallow land	6	9	21	31	45	3	10	34	7	49
5.	Cropping intensity (in percentage)	70	86	81	78	87	78	84	69	91	91
II. Perur											
1.	Number of farmers	8	12	15	7	8	11	11	9	10	9
2.	Land area owned	19	62	92	142	242	23.5	49	65	112	247
3.	Cultivated land	15.75	50.72	83.45	121	201	18.5	35	52.5	85	211
4.	Fallow land	3.25	11.28	8.55	21	41	5	14	12.5	27	36
5.	Cropping intensity	82	811	90	85	83	78	71	81	76	85
III. Karamadai											
1.	Number of farmers	11	16	7	9	7	11	12	9	10	8
2.	Land area owned	24.50	74.07	57	123	197	22.5	63	78	87	135
3.	Cultivated land	17.25	52.6	45	106	162	12.35	40.25	64	76	113.25
4.	Fallow land	7.35	21.47	12	17	35	10.65	22.75	14	11	21.75
5.	Cropping intensity	70	71	78	86	82	54	63	82	87	8.3
IV. Palladam											
1.	Number of farmers	8	7	11	7	7	10	13	9	10	8
2.	Land area owned	20	85	85	91	176	22	52.5	64	104	25.5
3.	Cultivated land	18.5	79	81	78	149	17.5	37.5	51.5	81	181
4.	Fallow land	1.5	6	4	13	27	4.5	15.05	12.5	23	74
5.	Cropping intensity	92	92	95	85	84	79	71	80	78	70
V. Annur											
1.	Number of farmers	15	11	7	9	8	16	12	7	7	8
2.	Land area owned	33.25	48	49	120	203	33.75	45.05	51	117	207
3.	Cultivated land	29.5	38	40	92	162	20.25	25.80	37	91.6	105
4.	Fallow land	3.75	10	9	28	41	13.5	19.25	11	25.4	102
5.	Cropping intensity	89	79	82	77	80	60	57	73	78	51

A comparative analysis of land use pattern in the selected villages indicated that the total land area owned in the high irrigated blocks by the farmers (2082 acres) was greater than that of low irrigated blocks (962.5) acres. The average land area owned per farmer in high irrigated blocks worked out to be 10.41 acres. However, in low irrigated blocks the corresponding figure was 9.52 acres.

In the high irrigated villages, there had been more use of land for cultivation since of the total land, 82.9 percent was cultivated and only 17.1 percent was remaining as fallow land. Comparatively in the low irrigated villages 22.4 percent was left as fallow land and 77.6 percent was cultivated. This might be either due to the poor fertility of the soil or due to the fact that the farmers in low irrigated villages could not afford to meet the cost of cultivation of entire land.

The cropping intensity was rather high in the blocks of Pollachi South, Perur and Karamadal. The average cropping intensity in high irrigated blocks was 89 percent as against 72 percent in low irrigated blocks. The high cropping intensity was an essential factor for higher farm income in these blocks which in turn might lead to high technology adoption index.

There was also a significant difference in cropping intensity between various size groups of farms. In the high irrigated blocks, the cropping intensity for large farmers exceeded that of other groups. This in turn indicated that the large farmers were effectively utilising the land

resource. However in low irrigated blocks, the cropping intensity for marginal and small farmers was greater. This might be due to the fact that cultivation was the major source of income for these farmers and hence they tried to earn their livelihood by cultivating the land at their disposal. As Ghosh (1986) stated small farmers have certain advantages over the large farmers through increase in cropping intensity.

(ii) Cropping Pattern

The farmers in the selected villages had been cultivating food crops like paddy, cholan, maize, and commercial crops like sugarcane, cotton and groundnut. Table XIX gives the information about cropping pattern in the selected villages.

TABLE XIX
CROPPING PATTERN IN THE STUDY FARMS

S. No.	Crop	(In percentage)									
		Type A					Type B				
		Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers	Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers
I. Pollachi South	N	9	14	8	11	8	8	11	6	14	11
a. Paddy		0	20	32.96	28.01	30.64	18.60	22.64	25	23.43	9.81
b. Cholam		27.58	31.66	17.58	31.89	29.03	23.25	9.43	19.44	48.43	22.89
c. Maize		-	-	-	-	-	-	-	-	-	-
d. Sugarcane		20.68	16.67	21.97	17.94	14.51	-	16.98	8.33	7.81	25.23
e. Cotton		37.95	26.67	23.07	11.20	20.96	25.58	28.30	19.44	7.81	3.8
f. Groundnut		-	-	-	-	-	18.60	12.26	22.22	12.5	18.22
g. Other crops		13.79	5	4.39	11.63	4.83	13.95	10.37	8.33	6	7
II. Perur	N	8	12	15	7	8	11	11	9	10	9
a. Paddy		44.44	39.43	41.42	38.89	33.31	-	-	-	-	-
b. Cholam		11.11	11.82	9.20	8.26	11.44	37.8	32.85	30.47	16.47	20.37
c. Maize		-	-	-	-	-	13.58	24.28	17.144	28.23	15.63
d. Sugarcane		33.33	30.99	32.22	37.19	33.33	-	-	-	-	-
e. Cotton		6.36	13.20	10.23	9.9	12.93	37.83	8.59	38.09	37.6	29.38
f. Groundnut		-	-	-	-	-	8.10	30	10	24.7	24.17
g. Other crops		4.76	4.92	6.90	9.67	4.08	2.7	4.28	-	-	-
III. Karamadai	N	5	16	12	10	7	7	10	8	10	15
a. Paddy		-	31.38	53.33	27.35	61.11	-	-	-	-	-
b. Cholam		53.62	41.82	24.44	17.95	10.49	32.38	49.68	31.25	18.42	21.19
c. Maize		-	-	-	-	-	16.19	-	7.81	27.66	24.72
d. Sugarcane		-	-	-	-	-	-	-	-	-	-
e. Cotton		40.59	22.05	13.35	47.16	22.23	16.19	24.84	31.25	31.57	14.56
f. Other crops		5.79	4.75	8.88	7.54	6.17	10.93	5.59	6.25	6.57	7.08
IV. Palladam	N	8	17	9	9	7	9	13	9	10	9
a. Paddy		-	17.74	49.38	48.71	29.53	-	-	-	-	-
b. Cholam		27.02	22.15	18.51	16.66	16.10	45.71	40.66	48.54	21.39	25.41
c. Maize		24.32	26.58	11.11	19.25	28.18	15.71	8.0	5.82	22.22	11.04
d. Sugarcane		-	-	-	-	-	-	-	-	-	-
e. Cotton		40.54	14.55	19.75	14.10	8.72	7.14	8.66	16.5	37.03	20.99
f. Groundnut		-	-	-	-	-	17.14	22.66	20.338	6.17	14.91
g. Other crops		8.12	18.98	1.24	1.28	17.37	14.28	2.0	8.73	6.17	27.62
V. Annur	N	15	11	7	9	8	16	12	7	7	8
a. Paddy		22.03	22.36	40.0	40.21	11.75	-	-	-	-	-
b. Cholam		26.27	26.35	17.5	15.25	24.38	40.74	31.0	62.16	86.24	61.91
c. Maize		18.66	22.36	17.5	18.47	27.46	49.38	65.11	32.43	-	28.57
d. Sugarcane		-	-	-	-	-	-	-	-	-	-
e. Cotton		-	-	-	-	-	-	-	-	-	-
f. Groundnut		19.49	15.78	15.0	18.47	26.85	-	-	-	-	-
g. Other crops		13.55	13.15	10.0	7.60	9.56	9.88	3.89	5.5	13.76	9.52

Farmers in high irrigated blocks were devoting a larger percentage of the area for commercial crops. On an average, the percentage of area allotted for commercial crops in high irrigated blocks was 62 percent as against 32 percent in low irrigated blocks.

Within high irrigated blocks, there was a significant difference in cropping pattern between the villages. On an average, the percentage of area allotted for food and commercial crops in high irrigated villages respectively were 43 percent and 57 percent. Comparatively, the farmers in low irrigated villages were devoting 68 percent of the area for food crops and only 32 percent for commercial crops.

Among the food crops, cholam was the most cultivated crop by the farmers in all types of villages. This might be due to the nature of the soil in these villages. However, among the commercial crops, sugarcane and cotton were cultivated to a great extent in high irrigated villages while groundnut and cotton were cultivated in low irrigated villages. The cultivation of sugarcane requires more water and there is adequate water supply only in high irrigated villages.

The cropping pattern also differed between various size groups of farmers. In all the study villages, among the food crops the small farmers were devoting high percentage of area for cholam while the large farmers were cultivating paddy in large area. Similarly among the commercial crops, while the small farmers laid more emphasis on the cultivation of cotton and groundnut, the large farmers preferred the

cultivation of sugarcane. This difference in cropping pattern might be due to the difference in their financial capacity and variations in unit cost of cultivation and return from different crops.

b. Labour Use

i. Labour Use Pattern in the Selected Villages

The farming sector provides employment to a great extent. The viability of farming operations as such depends on the proper utilisation of family and hired labour. Table XX presents the labour use pattern in the selected villages.

TABLE XI
LABOUR USE PATTERN IN THE STUDY FARMS

S.No.	Item	Type A village					Type B village				
		Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers	Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers
I. Pollachi South											
1. Per acre labour employed	T	2.62	2.28	1.16	2.16	4.08	2.14	2.01	6.91	21.31	0.74
	M	1.93	1.6	0.83	1.50	2.47	1.39	1.35	5.55	13.5	0.47
	F	0.69	0.79	0.34	4.31	1.61	0.74	0.6	1.36	7.81	0.32
2. Per acre manhours employed	T	20.96	18.4	9.34	17.31	32.69	17.16	16.15	35.33	17.05	6.31
	M	15.44	12	6.65	12.06	19.79	11.16	10.86	44.44	10.8	3.73
	F	5.52	6.27	2.69	5.24	12.9	5.95	5.28	10.88	6.25	2.58
3. Per acre family labour employed	T	1.03	0.61	0.36	0.27	0.09	0.74	0.47	1.38	2.09	0.32
	M	0.76	0.43	0.17	0.05	0.05	0.34	0.34	0.83	1.56	0.21
	F	0.28	0.18	0.09	0.10	0.03	0.27	0.13	0.55	0.53	0.91
4. Per acre family manhours employed	T	8.07	4.93	2.21	2.21	0.70	5.95	3.77	11.11	16.75	2.57
	M	6.89	3.47	1.08	1.37	0.43	3.72	2.71	6.66	12.5	1.81
	F	2.21	1.47	0.72	0.82	0.29	2.23	0.38	4.44	4.25	0.75
5. Per acre hired labour employed	T	1.58	0.18	0.94	1.91	4.00	1.39	1.54	5.52	19.22	0.47
	M	1.17	1.07	0.70	0.99	2.38	0.84	1.13	2.77	10.93	0.32
	F	0.41	0.6	0.25	0.55	1.58	0.56	0.42	2.75	8.28	0.14
6. Per acre hired labour manhours employed	T	12.68	13.33	7.55	15.24	32	11.16	12.37	44.22	153.72	3.7
	M	9.37	8.53	5.57	10.68	19.04	6.89	9.05	22.22	87.5	2.6
	F	3.10	4.8	1.97	4.41	12.68	4.46	3.32	22	66.25	1.12
II. Perur											
1. Per acre labour employed	T	2.53	7.53	4.37	9.34	12.21	6.65	6.6	4.82	5.73	2.81
	M	1.39	4.17	2.30	6.19	7.24	4.48	3.74	2.43	2.90	1.42
	F	1.14	3.35	2.07	3.14	4.97	2.70	2.85	2.38	2.82	1.38
2. Per acre manhours employed	T	20.31	60.24	34.98	74.77	97.75	53.18	52.8	38.55	45.83	22.48
	M	13.17	33.43	18.41	47.58	57.95	35.89	29.94	19.50	23.24	11.37
	F	9.14	26.81	16.57	25.19	39.801	22.85	22.85	19.04	22.58	11.10
3. Per acre family labour employed	T	.634	1.97	1.72	.41	.39	1.24	.85	.43	.43	.16
	M	.380	1.22	.92	.24	.199	.42	.24	.24	.26	.11
	F	.25	.749	.805	.165	.199	.54	.43	.19	.17	.47
4. Per acre family manhours employed	T	5.07	15.77	13.80	3.305	3.18	9.94	6.85	3.50	3.48	1.25
	M	3.04	9.77	7.36	1.98	1.59	10.62	3.42	1.98	2.07	.87
	F	2.03	5.99	6.44	1.32	1.59	4.32	3.42	1.52	1.41	.37
5. Per acre hired labour employed	T	1.90	5.55	2.64	8.93	11.82	5.40	5.74	4.19	5.29	2.65
	M	1.07	2.83	1.49	4.54	5.97	3.24	2.88	2.28	2.34	1.42
	F	.82	2.72	1.15	4.38	5.85	2.24	2.85	1.90	2.35	1.23
6. Per acre hired labour manhours employed	T	15.23	44.47	21.17	72.13	94.56	43.24	45.9	33.52	42.35	21.23
	M	8.63	22.71	11.96	36.36	47.76	25.94	23.06	18.28	23.52	11.37
	F	6.60	21.76	9.20	35.10	46.80	17.30	22.85	15.23	18.82	9.85
III. Karaikal											
1. Per acre labour employed	T	3.48	3.26	1.66	1.009	2.79	8.01	7.04	4.14	7.57	3.70
	M	2.57	2.12	1.11	.82	1.85	3.46	4.24	2.07	3.90	2.12
	F	.91	1.14	.55	.288	.93	4.53	3.15	2.06	3.67	1.56
2. Per acre manhours employed	T	27.88	26.15	13.33	8.07	22.32	64.12	59.22	33.125	60	29.66
	M	20.57	17.03	8.88	6.56	14.81	27.85	33.98	16.625	31.26	17.02
	F	7.31	9.12	4.44	1.509	7.50	36.27	25.24	16.5	29.66	12.54
3. Per acre family labour employed	T	1.14	.60	.33	.18	.185	2.26	.72	.312	.39	.229
	M	.68	.45	.02	.12	.111	1.37	.29	.171	.22	.114
	F	.45	.19	.13	.06	.07	.89	.42	.140	.171	.114
4. Per acre family manhours employed	T	9.14	4.86	2.66	1.50	1.48	18.13	5.56	2.5	3.15	1.83
	M	5.48	3.72	1.6	.98	.88	11.10	2.38	1.37	1.78	.916
	F	3.65	1.52	1.06	.528	.59	7.12	3.37	1.125	1.36	.918
5. Per acre hired labour employed	T	2.34	2.66	1.33	.82	2.60	5.74	6.68	3.92	7.65	3.40
	M	1.77	1.90	.84	.56	1.58	2.67	3.95	2.06	3.40	1.94
	F	.57	.76	.48	.25	1.02	3.86	2.73	1.85	4.01	1.57
6. Per acre hired labour employed	T	18.74	21.29	10.66	6.56	20.63	45.99	53.46	31.37	61.26	27.26
	M	14.17	15.20	6.75	4.52	12.64	21.12	31.60	16.5	29.05	15.54
	F	4.57	6.08	3.91	2.03	8.19	20.72	21.06	14.87	32.10	12.57

TABLE XX (Contd.)

S.No.	Item	Type A Village					Type B Village					
		Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers	Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers	
IV. Palladam												
1.	Per acre labour employed	T	2.64	3.01	3.03	2.48	4.27	5.82	6.61	5.14	3.22	2.94
		M	1.56	1.51	1.85	1.46	3.02	4.11	4.77	3.46	1.66	1.93
		F	1.08	1.49	1.18	1.02	1.25	1.71	1.84	1.58	1.55	1.05
2.	Per acre mahours employed	T	21.18	24.10	24.29	19.89	34.20	46.62	52.9	41.16	21.77	23.51
		M	12.52	12.15	14.81	11.69	24.16	32.91	38.18	27.96	13.3	15.46
		F	8.64	11.94	9.48	8.21	10.04	13.71	14.72	13.2	12.44	8.04
3.	Per acre family labour employed	T	0.81	.48	.61	.84	.29	.91	1.32	.85	.48	.16
		M	0.48	.25	.37	.51	.16	.57	0.96	.66	.22	.09
		F	0.32	.22	.24	.33	.12	.34	0.66	.19	.23	.07
4.	Per acre family manhours employed	T	6.81	.48	.61	.84	.29	7.31	10.66	6.83	8.38	1.32
		M	.48	.25	.37	.51	.16	4.51	7.46	5.28	1.98	0.75
		F	.32	.22	.24	.33	.12	2.74	5.33	1.55	1.87	0.57
5.	Per acre hired labour employed	T	1.83	2.53	2.42	1.69	3.97	2.91	5.28	4.29	2.74	2.77
		M	1.08	1.26	1.48	.94	2.86	3.41	3.32	2.07	2.01	0.76
		F	.75	1.26	.94	.69	1.13	2.05	1.86	1.58	.66	
6.	Per acre hired labour employed	T	14.7	20.25	19.35	13.12	31.3	39.31	42.24	34.33	21.93	22.18
		M	8.64	10.12	11.85	7.58	22.8	22.85	27.3	26.56	16.59	16.08
		F	6.05	10.12	7.5	5.53	9.01	16.45	14.93	8.36	5.33	6.09
V. Annur												
1.	Per acre labour employed	T	2.62	2.61	1.60	1.27	1.57	1.96	3.42	2.29	1.37	1.76
		M	1.40	1.34	0.85	0.70	0.91	1.28	2.10	1.21	0.80	0.93
		F	1.22	1.27	0.75	0.57	0.61	0.67	1.31	1.07	0.58	0.77
2.	Per acre manhours employed	T	21.05	20.93	12.8	10.21	12.22	15.72	27.36	18.34	10.96	13.61
		M	11.22	10.74	6.8	5.60	7.31	10.30	16.84	9.75	6.40	7.45
		F	9.82	10.20	6.0	4.59	4.90	5.42	10.52	8.58	4.56	6.16
3.	Per acre family labour employed	T	0.87	1.27	0.60	0.25	0.24	0.88	1.18	0.90	0.29	0.13
		M	0.52	0.67	0.35	0.13	0.12	0.50	0.73	0.66	0.19	0.07
		F	0.35	0.60	0.25	0.13	0.12	0.37	0.44	0.24	0.10	0.05
4.	Per acre family labour manhours employed	T	7.05	9.47	7.21	2.32	0.99	7.01	10.20	4.80	2.02	1.91
		M	4.06	5.89	3.26	1.52	0.59	4.21	5.36	2.80	1.01	0.98
		F	2.98	3.57	1.95	0.80	0.39	2.8	4.83	2.00	1.01	0.93
5.	Per acre hired labour	T	1.06	2.23	1.39	1.08	1.57	1.75	1.34	1.00	1.02	1.28
		M	0.77	1.36	0.56	0.61	0.85	0.87	0.67	0.50	0.57	0.79
		F	0.31	0.86	0.82	0.47	0.72	0.87	0.34	0.50	0.45	0.50
6.	Per acre hired labour employed	T	8.67	17.89	11.12	8.64	12.62	14.03	10.73	8.00	8.18	10.31
		M	6.23	10.90	4.48	4.88	6.85	7.07	5.36	4.00	4.59	6.33
		F	2.44	6.90	6.63	3.76	5.76	7.01	2.68	4.00	3.58	3.91

T - Total ; M - Male and F - Female.

In relative terms, more labour absorption was observed in high irrigated blocks. On an average, per acre labour use in high irrigated blocks was 53.32 for a year. The corresponding figure for the low irrigated blocks was 39.16. The average per acre man hours employed in high irrigated blocks was 427 and this was greater than that of the low irrigated blocks 313. The differences in labour use might be due to differences in cropping pattern between two groups of blocks. In high irrigated blocks, there was more cultivation of paddy and this in turn required the employment of more labour.

However, in low irrigated blocks, the average per acre family labour man hours employed was greater. While, on an average in an acre, 392 family labour man hours were employed in low irrigated blocks, the corresponding figure for the high irrigated blocks was 192.

The high irrigated blocks had more labour absorption with regard to hired labour. On an average, the farmers in these blocks were employing 680 hired labour manhours per acre. While in low irrigated blocks, the employment of hired labour manhours per acre was only 208. Hence the high irrigated blocks which are technically advanced had high employment potential of hired labour. This is in conformity with the view of Daroga Singh (1986) that the use of technical inputs shifts the demand for hired labour.

However, there were no sex wise differences in employment of farm labour between high and low irrigated blocks. On an average, in high

irrigated blocks, of the total labour employed, 65.31 percent were males and 34.69 percent were females. In low irrigated blocks, the corresponding figures were 64.17 percent and 35.83 percent.

ii. Cropwise and Operationwise Use of Labour

The major agricultural operations are divided into four categories - land preparation, transplanting, crop maintenance and harvesting. Table XXI brings out the cropwise and operation wise use of labour in the selected villages.

TABLE XXI

CROPWISE AND OPERATION WISE USE OF LABOUR IN THE SELECTED VILLAGES

(man hours per acre)											
S.No.	Crop	Type A Village					Type B Village				
		Land Preparation	Transplanting	Crop maintenance	Harvesting	Per acre total man hours	Land preparation	Transplanting	Crop maintenance	Harvesting	Per acre total man hours
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I. Pollachi South											
1.	Paddy	13.71	16.71	19.42	18.71	68.55	15.83	19.72	26.60	23.88	86.03
2.	Cholam	12.73	4.29	3.89	6.99	27.9	19.85	8.17	8.86	10.83	37.71
3.	Sugarcane	17.5	13.0	18.25	9.75	58.5	12.16	4.05	17.56	10.81	44.58
4.	Cotton	4.87	6.44	8.03	16.86	36.2	7.79	5.57	12.25	17.79	43.4
5.	Groundnut	-	-	-	-	-	7.39	9.10	7.32	20.21	44.02
II. Perur											
1.	Paddy	11.81	11.21	13.33	12.72	49.07	-	-	-	-	-
2.	Cholam	6.03	3.57	3.35	7.15	20.1	6.09	5.81	5.81	6.63	24.34
3.	Maize	-	-	-	-	-	5.03	5.64	5.90	6.29	22.86
4.	Sugarcane	4.36	4.36	12.72	12.04	33.48	-	-	-	-	-

TABLE XXI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
5.	Cotton	-	-	-	-	-	4.81	7.17	11.62	12.90	36.5
6.	Groundnut	4.29	7.98	10.58	12.07	34.92	5.97	6.56	6.78	8.11	27.42
III. Karamadai											
1.	Paddy	12.19	13.28	16.02	14.93	56.42	-	-	-	-	-
2.	Cholam	17.43	3.71	1.68	8.66	31.48	12.81	10.36	5.9	16.72	45.75
3.	Maize	-	-	-	-	-	15.35	3.57	1.78	7.14	27.84
4.	Sugarcane	-	-	-	-	-	-	-	-	-	-
5.	Cotton	4.59	3.67	10.61	15.43	34.32	9.6	7.42	15.0	13.2	45.22
6.	Groundnut	-	-	-	-	-	8.37	8.37	10.04	14.7	41.49
IV. Palladam											
1.	Paddy	14.41	15.14	18.82	17.35	65.72	-	-	-	-	-
2.	Cholam	8.18	3.28	4.29	8.38	24.13	10.23	4.26	6.82	12.79	34.1
3.	Maize	4.91	3.33	3.77	5.46	17.47	10.69	7.48	9.62	12.83	40.62
4.	Cotton	8.37	9.25	12.03	20.33	49.98	6.17	8.64	12.34	19.87	47.02
5.	Groundnut	-	-	-	-	-	8.33	13.22	7.40	14.81	43.78

TABLE XXI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
V.	Annur										
1.	Paddy	5.04	5.68	7.20	10.39	30.41	-	-	-	-	-
2.	Cholam	4.63	4.51	4.25	4.52	17.9	4.37	4.27	4.21	4.32	17.17
3.	Maize	4.76	4.30	4.42	4.31	17.79	5.58	4.87	5.43	5.93	21.81
4.	Groundnut	5.44	5.40	5.86	5.37	22.07	-	-	-	-	-

In the study villages, the cultivation of paddy required the employment of more man hours. For paddy cultivation, per acre man hours employed ranged from 30.41 to 68.55. However, cholam and maize required only less man hours per acre. Man hours employed for cholam ranged from 17.71 to 37.41.

There was difference in per acre crop wise manhours employed between high and low irrigated blocks. In high irrigated blocks, highest manhours employed was found with regard to paddy. But in low irrigated blocks, cotton or groundnut required the employment of more manhours.

The requirement of labour varied by the nature of farm operations. In all the study villages, the cultivation of paddy, sugarcane and cotton required more manhours for crop maintenance. However, the cultivation of cholam and groundnut required more manhours for harvesting.

C. Capital Invested

The amount of capital invested in the farm decides to a great extent crop production. Table XXII presents the information on capital invested by the selected farmers.

TABLE XXII

CAPITAL INVESTED BY THE SELECTED FARMERS

(in Rupees)

S.No.	Item	Type A Village					Type B Village						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I. Pollachi South													
	1. Per acre investment			12740	22155	33203	86065	136573	12558	12020	34375	73047	917897
	2. Proportion of owned funds to total funds			35	32	40	60	70	25	30	35	50	60
	3. Proportion of borrowed funds to total funds			65	68	60	40	30	75	70	65	50	40
	4. Proportion of bank credit to borrowed funds			30	35	40	50	70	25	330	35	40	50
	5. Bank credit as a proportion of total funds			20	24	24	20	52	19	21	23	25	20
II. Perur													
	1. Per acre investment			10517	12636	42693	84631	949500	9405	11843	32000	62995	71493
	2. Proportion of owned funds to total investment			42	45	48	50	55	40	42	45	47	50
	3. Proportion of borrowed funds to total funds			58	55	52	50	45	60	58	55	53	50
	4. Proportion of land to borrowed funds			35	38	40	45	48	30	32	35	38	40
	5. Bank credit as a proportion of total funds			36	41	25	42	13	28	42	54	56	20
III. Karamadai													
	1. Per acre investment			8493	9477	29778	40236	48858	8316	9031	12813	23387	27417
	2. Proportion of owned funds to total funds			30	35	37	40	42	25	30	32	35	40

TABLE XXII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	3. Proportion of borrowed funds to total funds	70	65	63	60	58	75	70	68	65	60
	4. Proportion of bank credit to borrowed funds	40	45	50	55	60	30	35	38	40	45
	5. Bank credit as a proportion of total funds	49	30	32	14	35	23	25	30	28	27
IV.	Palladam										
	1. Per acre investment	1243	1342	1926	2154	10201	677	1133	1592	1790	6740
	2. Proportion of owned funds to total funds	20	25	30	36	45	15	20	25	30	35
	3. Proportion of borrowed funds to total funds	80	75	70	64	55	85	80	75	70	65
	4. Proportion of bank credit borrowed funds	25	30	35	40	42	20	22	27	30	35
	5. Bank credit as a proportion of total funds	20	23	25	26	14	14	41	32	21	23
V.	Annur										
	1. Per acre investment	964	1842	2038	3571	5369	1849	1034	571	644	498
	2. Proportion of owned funds to total funds	15	20	25	28	30	10	15	20	22	25
	3. Proportion of borrowed funds to total funds	85	80	75	72	70	90	85	80	78	76
	4. Percentage of bank credit to total borrowed funds	28	30	35	40	45	25	28	30	32	35
	5. Bank credit as a proportion of total funds	24	24	26	29	32	32	33	31	27	14

On an average per acre investment in high irrigated villages was greater (Rs.85000) as compared to low irrigated villages (Rs.28000). This might be due to high farm income in these villages enabling the farmers to invest more.

On an average, the percentage of owned funds by the farmers in high irrigated village was 54 as against 40 in low irrigated villages. Due to inadequacy of owned funds, the farmers had been depending on borrowed funds and the average percentage of borrowed funds was 60 in low irrigated villages as against 40 in high irrigated villages.

Credit is an essential input in farm business and the availability of bank credit helps the farmers to purchase new inputs. In the high irrigated villages, the average percentage of bank credit to total borrowed fund was 45 and this was greater than that of low irrigated villages (36 percent). The proportion of bank credit to total funds invested ranged from 14 to 56 percent. As Pandey (1984) stated, the availability of institutional credit facilitated the farmers in high irrigated villages to purchase non conventional inputs and use them in their fields.

C. Nature of Technical Change and Measurement of Technical Change

a. Nature of Technical Change

Technical change, the key source of productivity growth depends on the use of resources like labour and capital. There is more use of labour intensive technology if the labour coefficient is greater than capital coefficient and vice versa.

Jodha (1986) suggested that for finding out the nature of technical change in high and low irrigated areas, two production functions can be fitted as

$$Y_1 = A_0 L^{\alpha_1} K^{\beta_1}$$

$$Y_2 = A_0 L^{\alpha_2} K^{\beta_2}$$

Where Y_1 and Y_2 represent agricultural production in two areas α_1 , β_1 , α_2 , β_2 represent the corresponding labour and capital coefficients.

The existence of common technology in high and low irrigated areas implies that $\alpha_1 = \alpha_2$ and $\beta_1 = \beta_2$. The significant difference in α_1 and α_2 and β_1 , β_2 might imply the change in production process in two areas.

Following this, the current study tried to find out whether there was any difference in the nature of technical change in high and low irrigated areas through the empirical estimates of agricultural production function as given in Table XXIII. The actual procedure used for estimating the agricultural production function is given in Appendix X.

TABLE XXIII
EMPIRICAL ESTIMATES OF THE AGRICULTURAL PRODUCTION FUNCTION

S.No.	Item	Type A Village	Type B Village
1.	Constant	61.46	46.23
2.	Labour coefficient	1.03 (9.32) **	0.06 (0.21)
3.	Capital coefficient	0.01 (8.96) **	0.03 (8.63) **
4.	R ² Value	.49	.25
5.	Number of observations	250	250
6.	D.W. Test	1.67	1.07

* Figures in paranthesis indicates t values.

* Significant at 5 percent level

** Significant at 1 percent level

In the highly irrigated villages, there was more use of labour intensive technology. The estimated labour coefficient (1.03) was greater than capital coefficient (0.01). There had been increasing returns to scale since $\alpha + \beta$ was greater than one. In the low irrigated villages also, the farmers were applying more of labour intensive technology. The estimated labour coefficient (.06) was greater than capital coefficient (.03). However, in these villages, there was decreasing returns to scale since the estimated $\alpha + \beta$ was less than one. As such, in both the villages, technical change was labour augmenting in nature.

The current study attempted to find out the nature of technology for various size groups of farms. Table XXIV provides empirical estimates of size wise agricultural production function.

TABLE XXIV
EMPIRICAL ESTIMATES OF THE AGRICULTURAL PRODUCTION FUNCTION - SIZEWISE

S.No.	Item	Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers
1.	Constant	- 10.73	84.27	84.27 *	53.09	151.97
2.	Labour coefficient	3.35 (5.16) **	1.18 (.32)	.18 (.32)	1.21 (4.45) **	.48 (.12)
3.	Capital coefficient	0.0036 (5.99) **	- .0054 (-.75)	- .0054 (-.75)	.0165 (5.08) **	.0104 (.003)
4.	R ² Value	.35	.008	.008	.35	.33
5.	Number of observations	105	111	91	109	84
6.	D.W. Test	2.11	1.38	1.38	1.31	1.02

Figures in paranthesis indicates t values

* Significant at 5 percent level

** Significant at 1 percent level

Size wise analysis of the estimated agricultural production function indicated that all categories of farmers were using more of labour intensive technology than capital intensive technology. The estimated labour coefficient for all types of farmers was greater than capital coefficient. The estimated coefficients were statistically significant as indicated by t value and R^2 value.

The current study estimated the agricultural production function for the various study blocks. Table XXV presents the block wise estimates of the agricultural production function.

TABLE XXV

BLOCK WISE EMPIRICAL ESTIMATES OF THE AGRICULTURAL PRODUCTION FUNCTIONS

S.No.	Item	Farms in Type A Village					Farms in Type B Village				
		Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers	Marginal farmers	Small farmers	Semi medium farmers	Medium farmers	Large farmers
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I. Pollachi South											
1.	Constant	.23 (.26)	-.82 (1.33)	-.40 (-.28)	.40 (.33)	.059 (.58)	-.12 (.55)	2.02 (.68)	6.56 (.89)	11.97 (10.96)	30.17 (13.49)
2.	Labour coefficient	.25 (.07)	-.21 (-3.16)	-.93 (-1.11)	-.27 (.39)	.071 (.031)	-1.09 (-1.08)	.03 (.003)	-.18 (-.46)	.1617 (.05)	-.58 (-.54)
3.	Capital coefficient	.03 (.05)	5.66 (-.85)	4.53 (-.47)	.33 (-.07)	20.9 (.116)	2.20 (-.0096)	.02 (.0016)	-.928 (-2.78)	-.05 (-.03)	-.20 (-.46)
4.	R ² Value	.20	.85	.44	.95	.05	.04	.0021	.46	.02	.20
5.	Number of observations	9	14	8	11	8	6	11	15	7	11
II. Perur											
1.	Constant	1.40 (.39)	-4.61 (-1.16)	-.41 (-.09)	1.83 (2.5)	2.55 (.38)	-.13 (.07)	.60 (.24)	1.11 (.08)	.04 (.007)	17.25 (4.89)

TABLE XXV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2. Labour coefficient		-.08 (-.14)	1.66 (.63)	-1.34 (-1.98)	.131 (.23)	.82 (.07)	-.0462 (-.019)	-.17 (-.34)	.009 (.007)	-.48 (-.16)	.11 (.44)
3. Capital coefficient		-.082 (-.0027)	.10 (3.96)	-.44 (-.38)	-.17 (-1.7)	-.018 (-5.88)	.37 (.11)	.17 (-1.01)	.004 (.003)	.55 (.15)	.18 (1.30)
4. R^2 Value		.012	.84	.41	.03	.007	.16	.11	.005	.50	.19
5. Number of observations		8	12	15	7	8	11	11	9	10	9
III. Karamadai											
1. Constant		-.14 (-.05)	.65 (.23)	1.116 (.81)	.04 (.206)	17.25 (4.89)	-.69	-.47	1.47	.54	17.41
2. Labour coefficient		.38 (.11)	.16 (.07)	.004 (.005)	.55 (.09)	.18 (.90)	.75 (.19)	.39 (.14)	-.005 (-.001)	.59 (.27)	.28 (.027)
3. Capital coefficient		-.05 (-.02)	-.18 (-.36)	.009 (.001)	-.48 (-.11)	.14 (.35)	-.47 (-.04)	-.06 (.015)	.011 (.0002)	.07 (-.03)	.16 (.06)
4. R^2 Value		.16	.10	.001	.51	.19	.72	.35	.008	.37	.32
5. Number of observations		11	16	7	9	7	11	12	9	10	8
IV. Palladam											
1. Constant		.0091 (.012)	0.74 (-.38)	-.0927 (-.025)	-.0025 (.51)	.037 (5.14)	.2405 (.118)	3.26 (.902)	-1.53 (-.42)	1.45 (1.023)	16.20 (4.015)

TABLE XXV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2.	Labour coefficient	.0356 (.0004)	-.14 (4.82)	.0442 (.0494)	-.328 (-.0506)	.044 (.421)	.2805 (.099)	-.57 (-.012)	.071 (.04)	.0093 (.10)	-.149 (-.125)
3.	Capital coefficient	.2095 (-.0003)	-1.01 (.9303)	2.2609 (.0325)	2.444 (-.0436)	15.417 (.072)	-.1627 (.053)	-.05 (.003)	.004 (.01)	-.040 (.006)	-.233 (-.671)
4.	R ² Value	.0002	0.88	.0102	.0007	.033	.18	.22	.008	.0005	.072
5.	Number of farmers	8	7	11	7	7	10	13	9	10	8
V. Annur											
1.	Constant	.04	.006 (.005)	.03 (.04)	-.56 (-.04)	.004 (.008)	1.06	.99 (.94)	1.22	.29	15.53 (2.27)
2.	Labour coefficient	-3.74 (.0056)	.043 (.032)	.02 (.03)	3.10 (.29)	-.092 (-.087)	-.0091 (.02)	-.15 (-.31)	.03 (.02)	1.15 (.028)	.282 (.21)
3.	Capital coefficient	3.26 (.6453)	1.007 (.698)	1.50 (1.00)	.39 (.02)	18.76 (1.22)	.0028 (.003)	.07 (.082)	-.58 (-.08)	-.03 (-.001)	.018 (.052)
4.	R ² Value	.04	.002	.01	.25	.002	.0002	.01	.016	.002	.0220
5.	Number of observations	15	11	7	9	8	16	12	7	7	8

Figures in paranthesis indicates t values ;

* Significant at 5 percent level ;

** Significant at 1 percent level.

In Pollachi South block, in the highly irrigated village, there was more emphasis on the use of capital intensive technology since on an average, capital coefficient was greater than labour coefficient. The marginal farmers were using labour intensive technology to a great extent while the other groups of farmers were largely using capital intensive technology. In the low irrigated village, there was more use of capital intensive technology, since the estimated capital coefficients were greater than labour coefficients.

In Perur block, in the high irrigated village, all groups of farmers were using labour intensive technology to a great extent since the estimated labour coefficients were greater than capital coefficients. However, in low irrigated village, there was more use of capital intensive technology.

In Karamadai and Annur blocks, in both high and low irrigated villages, all groups of farmers were largely using labour intensive technology.

In Palladam block, in the high irrigated village, all groups of farmers were largely using capital intensive technology. But in low irrigated villages, for all groups of farmers, the estimated labour coefficients were greater than capital coefficients implying that there was more use of capital intensive technology.

(ii) Measurement of Technical Change

Hicksian model of technical change was applied following Umesh and Bisaliah (1984) and Adinarayana (1986) to measure the nature of technical change. In the Cobb Douglas production function, technical change is denoted either by a change in intercept, ' A_0 ' - efficiency parameter or change in slope coefficients - ' b_1 's. A change in efficiency parameter alone denotes neutral technical change whereas change in slope coefficients only or change in both of them denotes non neutral technical change.

The current study, fitted the following equation for different crops of HYV and non HYV farms to find out whether the switch over to HYV had brought about neutral or non-neutral technical change :

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + E$$

where

- Y = Yield in quintals ;
- X_1 = Cropped area in acres ;
- X_2 = Per acre seed expenditure in rupees ;
- X_3 = Per acre pesticide expenditure in rupees ;
- X_4 = Per acre fertiliser expenditure in rupees ;
- X_5 = Per acre manhours employed ;
- X_6 = Per acre capital invested ; and
- X_7 = Tractor timings employed (Hours).

Table XXVI presents the estimated cropwise efficiency parameters and slope coefficients due to technical change. A sample of the estimated cropwise efficiency parameters and slope coefficients is given in Appendix XI.

TABLE XXVI

ESTIMATED CROP WISE EFFICIENCY PARAMETER AND SLOPE COEFFICIENTS DUE TO TECHNICAL CHANGE

S.No.	Item	Paddy			Cholam			Maize			Sugarcane			Cotton			Groundnut		
		HYV	NHYV	HYV	HYV	NHYV	NHYV	HYV	NHYV	HYV	HYV	NHYV	NHYV	HYV	NHYV	HYV	HYV	NHYV	NHYV
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
I. Pollachi South																			
Type A Village																			
1.	A ₀	-1.13	36.48	-69.96	-3.21	-	-	-120.8	-7.34	-60.83	166.88	-	-	-	-	-	-	-	-
2.	b ₁	26.00 (0.39)	-3.36 (-1.3)	2.78 (.19)	-3.18 (-4.9)**	-	-	-16.74 (-.27)	-56 (-16.4)**	-4.38 (-1.27)	24.99 (1.83)	-	-	-	-	-	-	-	-
3.	b ₂	-.031 (-.003)	-.04 (-.001)	.19 (.11)	.006 (.002)	-	-	.13 (.02)	.007 (.001)	.006 (.01)	.16 (.12)	-	-	-	-	-	-	-	-
4.	b ₃	.003 (.15)	.02 (.52)	-.14 (-.16)*	.025 (5.02)**	-	-	-.03 (-.64)	.0097 (.83)	-.004 (-5.46)	-.115 (-.97)	-	-	-	-	-	-	-	-
5.	b ₄	-.0096 (-.37)	.01 (.02)	.0015 (.0016)	.028 (3.35)**	-	-	-.09 (-.66)	-.004 (-79.2)**	.03 (34.13)**	-.35 (-2.2)	-	-	-	-	-	-	-	-
6.	b ₅	-.018 (-.61)	-.07 (-.64)	-.33 (-.72)	-.007 (-.35)	-	-	.38 (2.53)	.002 (1.9)	.013 (21.83)	-.36 (-1.27)	-	-	-	-	-	-	-	-

TABLE XXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
7.	b ₆	.0048 (.24)	.0025 (.56)	.0036 (.32)	.0016 (.53)	-	-	.0074 (-.46)	.0015 (22.38)**	.006 (69.00)**	.001 (1.45)	-	-
8.	b ₇	2.39 (1.53)	-1.01 (-.05)	23.44 (-1.00)	5.85 (3.56)**	-	-	28.66 (1.33)	7.31 (206.25)**	-.006 (28.07)	23.87 (2.63)**	-	-
	R ²	.76	.62	.66	.98	-	-	.98	.99	.99	.99	-	-
	N	29	21	13	28	-	-	28	20	29	20	-	-
Type B Village													
1.	A ₀	61.55	10.88	9.29	-4.81	-	-	196.62	336.68	19.25	2.47	-48.5	-7.65
2.	b ₁	-9.32 (-.66)	2.28 (.41)	-.036 (-.30)	-.22 (2.95)**	-	-	21.82 (-.49)	-21.52 (-464.29)**	7.44 (3.015)**	0.13 (.73)	18.24 (.65)	3.22 (5.22)
3.	b ₂	.16 (.12)	.0017 (.003)	.015 (.041)	-.003 (-.02)	-	-	.001 (.015)	.19 (.17)	-.033 (-.012)	-.004 (-.021)	-.014 (-.01)	-1.19 (1.12)
4.	b ₃	-.115 (-.97)	-.004 (-.21)	-.013 (1.52)	-.0067 (4.23)**	-	-	-.0102 (5.3)**	-.0167 (-.68)	-.07 (-.306)	-.006 (-2.43)	.006 (.74)	.103 (.45)
5.	b ₄	-.35 (-2.2)	-.016 (-.59)	.072 (1.82)	-.006 (-7.71)**	-	-	-.088 (-5.15)**	.012 (.23)	.046 (236.27)**	.006 (1.58)	.019 (.01)	1.20 (1.88)

TABLE XXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
6.	b ₅	-.336 (-1.27)	.0016 (-.57)	-.067 (-1.41)	.0076 (6.09)**	-	-	.006 (3.69)	1.32 (.58)	.006 (47.24)	.06 (2.61)	.06 (-1.01)	-.001 (2.02)
7.	b ₆	.001 (1.45)	.0016 (.16)	-.0024 (-1.12)	-.005 (-.59)	-	-	.002 (2.87)**	-.001 (-.24)	.002 (485.34)	.005 (-2.43)	.082 (.71)	.009 (.78)
8.	b ₇	23.07 (2.63)	-4.33 (-.21)	-4.43 (-.19)	-4.3 (-.21)	-	-	1.08 (11.61)**	2.65 (.27)	2.33 (48.39)**	.44 (.41)	.57 (2.9)**	2.26 (.90)
	R ²	.99	.95	.97	.99	-	-	.89	.99	.96	.96	.97	.98
N	27	25	28	25	29	-	-	20	25	22	25	20	
II. Perur													
Type A Village													
1.	A ₀	-84.11	25.46	-30.21	-17.05	-	-	82.74	6.98	5.17	3.05	-	-
2.	b ₁	-4.25 (-2.83)**	-3.38 (-.71)	1.50 (2.28)	-.96 (-1.13)	-	-	-23.72 (-5.63)**	-1.57 (-.15)	-.40 (-23.43)**	-1.61 (-1.63)	-	-
3.	b ₂	-.006 (-.015)	-.005 (-2.8)**	-.05 (-15.54)**	-.03 (-.006)	-	-	-.0012 (3.74)**	.0012 (.04)	.0059 (.13)	-.002 (.70)	-	-
4.	b ₃	-.025 (-1.4)	-.004 (-1.68)	-.07 (-1.38)	-.08 (-.018)	-	-	-.13 (-7.04)	.002 (.96)	.0069 (18.42)	-.007 (-.69)	-	-
5.	b ₄	.028 (.62)	.005 (3.47)	.005 (18.11)	.075 (.65)	-	-	.033 (1.95)	-.029 (-.32)	-.0029 (-1.95)	3.00 (.37)	-	-

TABLE XXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
6.	b ₅	-.015 (-1.66)	.008 (1.74)	-.68 (.83)	.01 (.23)	-	-	.01 (4.74)**	.028 (.15)	.007 (1.59)	.002 (.54)	-	-
7.	b ₆	-.004 (-1.22)	.0032 (.96)	-.0013 (-1.4)	-.01 (-1.62)	-	-	.009 (.088)	.009 (20.58)	.007 (1.54)	.009 (4.82)	-	-
8.	b ₇	.033 (1.92)**	2.61 (1.86)	-.21 (.58)	13.12 (1.04)	-	-	.72 (16.40)**	.31 (4.3)	1.1 (50.3)**	2.91 (3.98)	-	-
	R ²	.86	.98	.99	.86	-	-	.99	.97	.99	.81	-	-
	N	28	27	26	29	-	-	29	28	29	24	-	-
Type B Village													
1.	A ₀	-	-	2.77	1.08	1.65	13.25	-	-	4.06	3.86	5.30	6.17
2.	b ₁	-	-	-.87 (-1.63)	-.44 (-1.94)	-1.49 (-14.72)	-6.36 (-8.36)	-	-	-.13 (-0.31)	-.36 (-6.31)	-1.02 (-.87)	-.08 (-.25)
3.	b ₂	-	-	.007 (.7)	.01 (12.88)	.60 (.10)	.01 (4.93)	-	-	.01 (6.45)	-.01 (6.49)	.81 (1.31)	-.0053 (-.74)
4.	b ₃	-	-	-.004 (-.69)	-.0013 (-.018)	-.006 (-4.2)	-.002 (-1.82)	-	-	-.03 (-6.92)	-.03 (-2.98)	-.01 (1.31)	-.07 (-.28)
5.	b ₄	-	-	-.003 (-.37)	-.008 (-7.66)	-.0079 (-1.95)	-.008 (-3.8)	-	-	.001 (1.37)	.001 (1.48)	-.01 (-1.0)	.0049 (.68)

TABLE XXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
6.	b_5	-.05 (-3.4)	.39 (-.99)	1.009 (.33)	.078 (-.87)	-	-	-	-	1.02 (-.55)	.023 (3.85)**	-	-
7.	b_6	-.001 (-1.58)	.002 (.79)	-.003 (.06)	.003 (.84)	-	-	-	-	-.001 (-.58)	-.002 (-2.99)*	-	-
8.	b_7	-.45 (-1.13)	5.79 (2.03)	2.85 (2.6)**	-.52 (-.25)	-	-	-	-	21.71 (3.43)*	.35 (2.28)	-	-
	R^2	.98	.88	.96	.85	-	-	-	-	.94	.99	-	-
	N	28	22	25	20	-	-	-	-	22	29	-	-
III. Karamadai													
Type A Village													
1.	A_0	-	-	4.03	6.11	57.47	18.00	-	-	2.75	18.35	6.64	-8.42
2.	b_1	-	-	-.54 (-1.71)	-1.13 (-.93)	11.67 (.80)	-1.1 (-.73)	-	-	-.50 (1.43)	2.29 (-.84)	-1.36 (1.29)	6.33 (1.29)
3.	b_2	-	-	.004 (2.4)**	.004 (.81)	-.15 (-1.21)	-.86 (-1.12)	-	-	.002 (-1.48)	-.012 (1.26)	.005 (-.67)	-.005 (-.27)
4.	b_3	-	-	.001 (.36)	.0075 (.86)	-.005 (-.057)	.03 (1.83)	-	-	-.003 (.67)	-.001 (2.52)	.0048 (.65)	.002 (.55)

TABLE XXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
6.	b ₅	-	-	.002 (.54)	.007 (2.43)	.0264 (14.24)	.01 (5.06)	-	-	.006 (7.74)	.004 (.10)	-.004 (-.38)	-.005 (1.17)
7.	b ₆	-	-	.007 (-1.54)	-.009 (-4.82)	-.0069 (-1.08)	.0013 (4.87)	-	-	-.004 (-5.08)	-.001 (-3.38)	.012 (-.10)	.0028 (.74)
8.	b ₇	-	-	2.91 (3.98)	1.12 (6.16)	.81 (5.02)	-.47 (-1.4)	-	-	.85 (3.31)	.87 (1.79)	38.5 (1.77)	1.8 (2.98)
	R ²	-	-	.81	.99	.99	.93	-	-	.99	.95	.93	.99
	N	-	-	26	29	27	21	-	-	24	25	22	21
III. Karamadai													
Type A Village													
1.	A ₀	38.00	55.93	9.71	5.27	-	-	-	-	-3.41	1.63	-	-
2.	b ₁	-2.66 (-1.13)	.54 (.63)	-.84 (-2.1)	-1.7 (-.79)	-	-	-	-	2.08 (8.34)**	-.07 (-2.34)	-	-
3.	b ₂	.0016 (.89)	-.005 (-.57)	-.05 (-12.8)	-.002 (-.48)	-	-	-	-	.11 (.59)	-.004 (-.037)	-	-
4.	b ₃	.003 (.09)	-.007 (-.17)	.002 (.57)	.008 (.76)	-	-	-	-	.33 (.74)	.001 (.65)	-	-
5.	b ₄	-.006 (-.03)	.011 (1.04)	.003 (1.45)	.005 (.97)	-	-	-	-	-.27 (-.75)	.003 (4.23)**	-	-

TABLE XXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
5.	b_4	-	-	.002 (12.8)	.002 (21)	.10 (1.24)	.003 (.23)	-	-	.001 (1.73)	.009 (-.13)	-.009 (1.03)	.00 (1.13)
6.	b_5	-	-	-.014 (-1.27)	-.016 (.35)	.027 (.31)	-.19 (-1.12)	-	-	.0015 (-1.7)	-.79 (-1.14)	-.0096 (-.11)	-.001 (-.15)
7.	b_6	-	-	-.005 (-1.59)	-.008 (.99)	.004 (-.95)	.0054 (1.31)	-	-	.0082 (2.1)	.0014 (-.01)	-.0051 (-3.82)	-.0029 (-3.15)**
8.	b_7	-	-	1.08 (7.71)	-.17 (-.16)	3.84 (1.52)	8.5 (3.23)	-	-	1.07 (9.18)**	1.36 (1.88)	1.38 (2.25)	5.75 (2.75)**
	R^2	-	-	.99	.43	.88	.99	-	-	.99	.99	.99	.99
	N	-	-	27	23	25	28	-	-	27	21	28	26
IV. Palladam													
Type A Village													
1.	A_0	16.02	34.56	-4.93	-3.85	4.00	27.99	-	-	1.75	2.04	-	-
2.	b_1	-.05 (-.03)	-4.33 (-.80)	-.57 (-1.7)	-.60 (-5.44)**	-.08 (-.31)	6.61 (-9.75)**	-	-	-.47 (-.14)	-.62 (-13.82)**	-	-
3.	b_2	.024 (1.38)	.012 (.416)	.012 (2.25)	-.025 (-.81)	-.006 (-.33)	-.007 (-16.39)**	-	-	.01 (1.01)	-.001 (-3.27)**	-	-

TABLE XXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
4.	b ₃	-.02 (-1.81)	-.01 (-.35)	.002 (34.34)**	.0043 (9.45)**	.003 (.10)	.006 (5.79)	-	-	.007 (.64)	.004 (11.75)	-	-
5.	b ₄	.0014 (.27)	.0013 (.113)	-.003 (-10.5)**	.014 (-6.5)**	.08 (.13)	.006 (8.94)	-	-	-.007 (-.72)	.0025 (1.56)	-	-
6.	b ₅	-.37 (-.87)	.48 (.24)	-.008 (-.71)	.116 (5.39)**	.067 (.60)	-.004 (-7.26)**	-	-	-.345 (-.82)	-.97 (3.75)	-	-
7.	b ₆	.0029 (.86)	.0066 (.38)	-.0012 (-1.17)	-.0056 (-.28)	.004 (.29)	.005 (5.5)	-	-	.008 (.33)	.003 (1.3)	-	-
8.	b ₇	10.29 (4.48)	1.52 (.10)	3.83 (4.2)**	2.58 (1.38)	3.62 (2.85)	-1.94 (-2.91)**	-	-	2.36 (.86)	2.01 (.81)	-	-
	R ²	.97	.50	.96	.98	.99	.99	-	-	.91	.99	-	-
	N	27	25	29	28	22	20	-	-	25	28	-	-
Type B Village													
1.	A ₀	-	-	3.79	-.97	-1.37	.32	-	-	11.64	-.65	.059	2.96
2.	b ₁	-	-	-.58 (-1.99)	-.16 (-.18)	.71 (7.48)**	-.38 (-.78)	-	-	-.47 (-4.83)**	.25 (2.18)	-.0326 (-.37)	-.02 (-.05)

TABLE XXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(5)	(5)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
3.	b ₂	-	-	.01 (2.86)**	-.03 (-2.13)	-.008 (3.99)**	-.009 (-1.16)	-	-	-	-.01 (-6.88)**	-.008 (-11.4)**	-.0019 (-.001)	-.001 (-.005)
4.	b ₃	-	-	.004 (2.09)	-.0062 (-.99)	.0062 (.28)	.007 (6.9)	-	-	-	.002 (5.4)**	.002 (5.4)	.0010 (.007)	.0010 (.005)
5.	b ₄	-	-	.014 (2.59)	.0045 (1.9)	.0087 (2.02)	-.007 (-2.7)	-	-	-	.002 (4.95)**	.002 (3.95)**	-.004 (-.012)	.001 (.001)
6.	b ₅	-	-	.11 (1.33)	-.008 (-1.22)	-.003 (-1.6)	-.345 (-2.24)	-	-	-	.023 (.19)	.0075 (4.08)**	-.0032 (-.019)	-.001 (-.001)
7.	b ₆	-	-	-.0056 (-1.66)	-.0047 (-1.95)	.0097 (.98)	.008 (.001)	-	-	-	-.007 (-.4)	.008 (-1.2)	.0024 (.0015)	-.002 (-.017)
8.	b ₇	-	-	2.59 (-1.66)	2.10 (-1.95)	1.26 (.98)	2.36 (.001)	-	-	-	-.008 (-.4)	-.004 (-1.2)	1.67 (.0015)	.0017 (-.017)
	R ²	-	-	.99	.99	.95	.97	-	-	-	.99	.99	.96	.99
	N	-	-	22	28	20	25	-	-	-	25	27	23	29
V. Annur														
Type A Village														
1.	A ₀	5.26	-6.10	4.22	2.52	5.65	125.21	-	-	-	-	-	8.74	.65
2.	b ₁	-.97 (-3.58)**	-.24 (-11.9)**	-.45 (-7.2)**	.70 (1.25)	48 (5.18)**	-10.2 (-2.55)	-	-	-	-	-	2.75 (1.11)	-.002 (-3.3)

TABLE XXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
3.	b ₂	.009 (1.87)	.0018 (11.42)**	.002 (.61)	.002 (.33)	.01 (3.87)**	-.13 (-1.63)	-	-	-	-	-.01 (-3.61)**	-.03 (10.46)**
4.	b ₃	.0019 (3.99)**	.002 (4.69)**	.009 (9.79)**	-.001 (-.43)	.04 (3.96)**	.0114 (1.78)	-	-	-	-	-.04 (-.46)	-.011 (14.02)*
5.	b ₄	.002 (.311)	.002 (39.9)**	.005 (6.66)**	.003 (2.84)**	.006 (.18)	-.030 (-2.83)**	-	-	-	-	-.008 (-0.74)	-.0018 (-4.26)
6.	b ₅	.055 (2.16)*	.065 (5.04)**	.095 (7.25)	-.048 (-8.58)	.041 (4.71)	.0713 (1.97)	-	-	-	-	.037 (.59)	.0136 (16.68)
7.	b ₆	-.0071 (-2.54)	-.002 (-36.65)**	.005 (1.77)	-.009 (-.43)	-.06 (-4.33)**	.001 (.17)	-	-	-	-	.004 (.06)	.0042 (5.16)
8.	b ₇	.21 (1.61)	2.43 (12.06)**	.51 (1.83)	3.86 (6.58)**	-1.32 (-2.37)	.86 (2.46)	-	-	-	-	-.047 (-.017)	4.82 (11.93)
	R ²	.99	.96	.99	.98	.99	.93	-	-	-	-	.99	.99
	N	22	25	29	27	28	29	-	-	-	-	24	29
Type B Village													
1.	A ₀	-	-	4.20	3.27	4.44	3.25	-	-	-	-	-	-

TABLE XXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
2.	b_1	-	-	-.62 (-2.55)	-1.61 (-4.66)**	-.15 (-1.98)	-.83 (-13.73)**	-	-	-	-	-	-
3.	b_2	-	-	-.002 (-1.68)	-.001 (-.04)	-.001 (-.08)	.009 (13.67)	-	-	-	-	-	-
4.	b_3	-	-	-.001 (-3.03)	.002 (8.74)**	.006 (2.01)	-.001 (-2.38)*	-	-	-	-	-	-
5.	b_4	-	-	.0013 (3.18)	.002 (2.36)	.009 (.096)	-.0026 (-14.15)**	-	-	-	-	-	-
6.	b_5	-	-	.019 (1.94)	-.28 (-2.53)	.061 (1.92)	-.19 (-7.00)**	-	-	-	-	-	-
7.	b_6	-	-	.0021 (2.02)	.001 (7.58)**	.002 (.31)	.0013 (9.48)**	-	-	-	-	-	-
8.	b_7	-	-	.30 (4.68)	1.09 (5.16)**	.51 (2.55)	.53 (10.07)**	-	-	-	-	-	-
	R^2	-	-	.99	.99	.97	.99	-	-	-	-	-	-
	N	-	-	25	28	27	.25	-	-	-	-	-	-

Figures in paranthesis indicates t values

* Statistically significant at 5 percent level

** Statistically significant at 1 percent level

In the highly irrigated village of Pollachi South block negative technical change had taken place due to switch over from NHYV to HYV. This might be due to the efficient use of resources among NHYV farms while the HYV farms must have wasted some resources. However, in low irrigated village, for paddy and cholam, there had been positive technical change, while for sugarcane, cotton and groundnut slope coefficients decreased depicting negative technical change.

In Perur block, in the high irrigated village, there had been positive technical change for sugarcane and cotton as compared to food crops. However, in the low irrigated village, for cholam, maize, cotton and groundnut crops, the slope coefficients increased depicting positive technical change.

However, in Karamadai block, in the high irrigated village for cholam, there was positive technical change. In low irrigated village, the farmers experienced positive technical change in maize and groundnut cultivation.

In Palladam block in both high and low irrigated villages the highest positive technical change was found with regard to cotton. This might be due to high technology adoption index for cotton as compared to other crops. In Annur block in the high irrigated village, positive technical change was found with regard to paddy, cholam and groundnut. In the low irrigated village of Annur block switch over from NHYV to HYV created positive change as represented by positive slope coefficients.

The above analysis indicates that there had been significant technical change in the selected villages since the estimated R^2 and 't' values were significant. In all the study villages there was non neutral technical change, since there had been change in both efficiency parameters (A_0) and slope coefficients (b_1 s).

D. Adoption of Agricultural Technology

a. Extent of Discrepancy Between the Optimal and Actual Use of Inputs

Agricultural technology is aimed at bridging the gap between the potential yield and actual yield obtained from farms. The yield gap is considered to be minimal if the discrepancy between optimum quantity of inputs recommended in Crop Manual Survey and the actual quantity of inputs used by the farmers is low. Table XXVII gives the extent of discrepancy between optimal and actual use of inputs.

TABLE XXVII

EXTENT OF DISCREPANCY BETWEEN OPTIMAL AND ACTUAL USE OF INPUTS IN THE SELECTED VILLAGES

S.No.	Crop	Seeds			Fertiliser			Pesticides		
		Optimum quantity	Actual quantity	Percentage of actual to optimum	Optimum quantity	Actual quantity	Percentage of actual to optimum	Optimum quantity	Actual quantity	Percentage of actual to optimum
I. Pollachi South										
Type A Village										
1.	Paddy	60	51.42	85.70	200	90.21	45.10	30	16.21	54.03
2.	Cholam	40	36.65	91.62	120	33.84	28.20	5	1.45	29.0
3.	Sugarcane	75000	74333	99.11	450	276.66	61.48	12.5	10.50	84.00
4.	Cotton	15	12.5	83.33	160	128.33	80.20	4.5	1.61	35.77
5.	Groundnut	-	-	-	-	-	-	-	-	-
Type B Village										
1.	Paddy	60	30.42	50.70	200	99.21	49.6	30	1.90	6.33
2.	Cholam	40	19.63	49.07	120	66.47	55.39	5	0.37	7.40
3.	Sugarcane	75000	70000	93.33	450	236.56	52.56	12.5	2.52	20.16
4.	Cotton	15	9.88	65.86	160	93.52	58.45	45	0.71	15.77
5.	Groundnut	40	20.68	51.70	200	135	48.21	25	0.62	2.08

TABLE XXVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
II. Perur										
Type A Village										
1.	Paddy	60	54.52	90.86	200	441	220.5	30	1.78	5.93
2.	Cholam	40	33.18	82.95	120	71.88	59.9	5	2.13	4.26
3.	Maize	-	-	-	-	-	-	-	-	-
4.	Sugarcane	75000	73235	97.64	450	392.64	87.25	125	2.88	2.30
5.	Cotton	15	13.92	92.8	160	88.71	55.44	4.5	4.07	90.44
6.	Groundnut	-	-	-	-	-	-	-	-	-
Type B Village										
1.	Paddy	-	-	-	-	-	-	-	-	-
2.	Cholam	40	193	48.25	120	29.8	24.83	5	.7	14.0
3.	Maize	20	8.1	40.5	240	120	50.0	50	1.8	3.6
4.	Sugarcane	-	-	-	-	-	-	-	-	-
5.	Cotton	15	5.6	37.3	160	63.5	39.68	45	.7	1.55
6.	Groundnut	40	186	46.5	280	56	20.0	25	1.1	4.4

TABLE XXVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
III. Karamadai										
Type A Village										
1.	Paddy	60	58.6	97.60	200	107.5	53.75	30	11.35	37.83
2.	Cholam	40	39.7	99.25	120	68.5	57.08	5	2.75	55.0
3.	Maize	20	-	-	240	-	-	50	-	-
4.	Cotton	15	14.25	95.0	160	82.5	51.5	45	2.65	58.8
5.	Groundnut	-	-	-	-	-	-	-	-	-
Type B Village										
1.	Paddy	-	-	-	-	-	-	-	-	-
2.	Cholam	40	17.88	44.7	120	36.66	30.55	5	0.02	.40
3.	Maize	20	7.82	3.91	240	94.00	49.14	50	1.79	3.58
4.	Cotton	15	5.27	35.13	160	39.11	24.44	4.5	0.72	16.0
5.	Groundnut	40	17.63	44.07	280	84.38	30.13	25	1.59	6.16

TABLE XXVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IV. Palladam									
	Type A Village								
1.	Paddy	60	40.00	66.66	200	120.00	60	3.0	10.0
2.	Cholam	40	20.10	50.25	120	57.93	48.27	5	0.46
3.	Maize	20	13.58	67.90	240	119.70	49.87	50	1.97
4.	Cotton	15	14.2	94.60	160	105.60	66.0	4.5	1.61
5.	Groundnut	-	-	-	-	-	-	-	-
	Type B Village								
1.	Paddy	-	-	-	-	-	-	-	-
2.	Cholam	40	26.84	67.1	120	19.36	16.13	5	0.61
3.	Maize	20	5.47	27.35	240	115.52	48.133	50	1.58
4.	Cotton	15	13.22	88.133	160	93.61	58.5	45	1.27
5.	Groundnut	40	22.11	55.27	280	121.11	43.25	25	1.33

TABLE XXVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
V. Annur										
Type A Village										
1.	Paddy	60	36.37	60.61	200	114.6	57.3	30	4.03	13.43
2.	Cholam	40	25.10	62.77	120	55.78	46.6	5	0.44	8.8
3.	Maize	20	15.38	76.9	240	135.71	58.49	50	1.26	2.52
4.	Cotton	15	-	-	160	-	-	4.5	-	-
5.	Groundnut	40	27.38	68.45	280	173.3	61.89	25	2.02	8.08
Type B Village										
1.	Paddy	-	-	-	-	-	-	-	-	-
2.	Cholam	40	30.68	76.7	120	29.21	24.34	5	2.58	51.6
3.	Maize	20	16.9	33.8	240	64.5	25.8	50	1.16	2.32
4.	Cotton	-	-	-	-	-	-	-	-	-
5.	Groundnut	40	-	-	250	-	-	25	-	-

There was a difference in the adoption of agricultural technology use of HYV seeds, fertiliser and pesticides between high and low irrigated villages. The farmers in high irrigated villages were aware of the recommended doses of seed, fertilizer and pesticides and hence there was low discrepancy between the optimum and actual use of technology. As a case, on an average, in Pollachi South block, the farmers in high irrigated villages were using 90 percent, 54 percent and 51 percent respectively of the recommended quantum of seed, fertiliser and pesticides. However, the farmers in low irrigated village of Pollachi South block were using only 62 percent, 54 percent and 10 percent of the optimum quantity of seed, fertiliser and pesticides.

The extent of discrepancy between the optimum and actual quantity of seeds, fertiliser and pesticides also differed between various crops. For the commercial crops there was low discrepancy as compared to food crops. To illustrate, in Pollachi South block, the farmers had been using 99.11 percent, 61.48 percent and 84 percent of the recommended quantity of seed, fertiliser and pesticides. As against this, for food crops - cholam, the farmers were using 92.62 percent, 33.84 percent and 29 percent of the recommended quantity of seed, fertiliser and pesticides.

b. Technology Adoption Index - Size wise and Crop wise

i. Size wise Technology Adoption Index

Technology adoption index was defined as the weighted arithmetic mean of use of inputs.

The current study formulated technology adoption index as

$$z = \frac{\sum w_j \cdot X_j}{\sum w_j}$$

X_j = Percentage of actual quantity of inputs used to the optimum recommended ; and

w_j = Proportion of input cost to total cost.

The technology adoption index in respect of seed, fertiliser and pesticides were obtained. The aggregate technology adoption index z is obtained by adding all these three values. Table XXVIII presents the formulated size wise technology adoption index in the study villages.

TABLE XXVIII

SIZE WISE TECHNOLOGY ADOPTION INDEX IN THE SELECTED VILLAGES

S.No.	Category of farm	Pollachi South		Perur		Karamadai		Palladam		Annur	
		Type A Village	Type B Village	Type A Village	Type B Village	Type A Village	Type B Village	Type A Village	Type B Village	Type A Village	Type B Village
1.	Marginal	50.05	19.08	37.6	18.2	26.96	22.0	52.29	26.49	35.90	24.64
2.	Small	39.10	38.58	39.2	28.3	40.86	12.13	28.14	7.12	39.85	11.08
3.	Semi medium	33.96	36.00	31.2	34.0	45.16	10.16	23.62	11.10	38.93	19.29
4.	Medium	41.13	16.95	45.6	12.5	45.79	29.57	51.36	21.38	32.77	9.23
5.	Large	90.79	20.81	81.2	16.8	74.86	29.43	43.78	23.80	31.87	21.30
6.	Overall	51.01	26.28	46.90	21.90	46.66	18.66	39.84	17.98	35.87	17.11

The technology adoption index for various size groups of farms differed between the selected villages. In Pollachi South, Perur and Karamadai blocks, in high irrigated villages the medium and large farmers had exhibited a high technology adoption index. But in low irrigated villages of the same blocks, the marginal and small farmers were having high technology adoption index as compared to other groups.

In the low irrigated blocks of Palladam and Annur, both in high and low irrigated villages, high technology adoption index was found in the case of marginal farmers. This implies that the marginal and small farmers in dry blocks were using technology with the hope of raising farm income.

From the above analysis it can be inferred that the adoption of technology is scale neutral. This is in conformity with the findings of Rao (1976) and Sain (1986).

ii. Crop wise Technology Adoption Index

The current study also tried to analyse the difference in technology adoption index for various crops. Table XXIX presents crop wise technology adoption index in the selected villages. A sample of the estimated crop wise technology adoption index is given in Appendix XII.

TABLE XXIX

CROPWISE TECHNOLOGY ADOPTION INDEX IN THE SELECTED VILLAGES

S.No.	Crop	Pollachi South		Perur		Karamadai		Palladam		Annur	
		Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B
		Village	Village	Village	Village	Village	Village	Village	Village	Village	Village
1.	Paddy	30.51	38.38	42.11	-	40.60	-	32.11	-	20.04	-
2.	Cholam	19.73	6.37	38.2	31.5	38.08	8.73	29.86	23.22	22.88	22.12
3.	Maize	-	-	-	26.2	-	25.36	-	16.35	26.74	26.42
4.	Sugarcane	28.62	23.91	46.2	-	-	-	-	-	-	-
5.	Cotton	34.13	22.98	45.8	42.3	49.80	9.11	22.98	16.63	-	-
6.	Groundnut	-	22.44	-	38.2	-	8.55	22.44	16.09	19.69	-

By and large, if a crop is cultivated in both high irrigated and low irrigated villages the technology adoption index for the crop in high irrigated villages was greater than that of low irrigated villages. This implies that irrigation is the basic factor affecting technology adoption and hence there is need for providing irrigation facilities in all the villages.

Among the food crops, in all the villages, the technology adoption index was the highest for paddy and lowest for cholam. This is due to the fact that the farmers cultivating cholam were getting low price and hence they were not able to use the non conventional inputs for cholam. Among the commercial crops the technology adoption index was high for sugarcane and cotton as compared to groundnut. This in turn might be attributed to the fact that the crop like cotton is more susceptible to pests and hence there was more application of pesticides and fertiliser for these crops.

c. Factors Inducing the Adoption of Agricultural Technology

The selected farmers had stated the reasons for the use of HYV seeds, fertiliser, pesticides and farm implements. Table XXX provides the information on factors inducing the adoption of agricultural technology as stated by the selected farmers.

TABLE XXX

FACTORS INDUCING THE ADOPTION OF AGRICULTURAL TECHNOLOGY AS STATED BY THE SELECTED FARMERS
(Number stating)

S.No.	Item	Type A Village					Type B Village					Grand Total		
		a	b	c	d	e	Total	a	b	c	d		e	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
I.	Pollachi South													
	N	9	14	11	8	8	50	6	11	14	6	11	50	100
1.	HYV Seeds													
	a. More Production	7	10	8	6	6	37	3	6	9	5	6	29	66
	b. Quick yielding	7	10	8	5	6	36	3	6	8	5	6	28	64
	c. Improved quality	2	3	5	3	3	16	4	5	6	4	5	24	40
	d. Pest resistant	2	7	5	3	4	21	3	4	5	2	4	21	42
2.	Fertiliser													
	a. High output	9	10	8	6	6	39	3	6	9	5	5	28	67
	b. Quick return	7	8	7	5	6	33	3	5	9	5	6	28	61
	c. More profit	8	10	8	6	6	38	2	6	8	4	5	25	63
3.	Agricultural Implements													
	a. High output	8	7	5	4	4	28	3	6	9	5	6	29	57
	b. More profit	7	9	6	3	5	30	2	5	8	5	5	25	55
	c. Non available of labour	7	10	8	6	6	37	3	5	9	4	6	27	64
	d. High labour cost	8	10	8	5	5	36	4	2	9	4	6	25	61
4.	Pesticide													
	a. To avoid damage	6	8	7	5	3	29	2	4	7	4	4	21	50
	b. To increase yield	6	7	6	4	3	26	2	5	8	3	3	21	47

TABLE XXX (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
II.	Perur													
1.	HYV Seeds	8	12	15	7	8	50	11	11	9	10	9	50	100
	a. More production	5	10	12	5	6	36	9	9	7	8	8	41	77
	b. Quick yielding	3	10	12	5	6	35	9	8	6	7	7	37	72
	c. Improved quality	4	8	10	4	5	34	7	6	5	6	6	30	64
	d. Pest resistant	2	9	10	3	5	29	6	6	5	6	6	29	58
2.	Fertiliser													
	a. High output	6	10	12	5	6	39	9	10	8	9	8	44	83
	b. Quick return	6	10	12	5	6	39	9	9	7	8	8	41	80
	c. More profit	5	9	10	4	5	33	6	8	5	6	7	32	65
3.	Agricultural Implements													
	a. High output	4	8	10	4	6	35	8	9	6	8	8	39	74
	b. More profit	6	9	9	4	5	33	7	8	5	7	7	34	67
	c. Non availability of labour	4	8	10	2	5	29	6	7	5	6	8	32	61
	d. High labour cost	5	7	8	2	4	26	6	5	3	7	5	26	52
4.	Pesticides													
	a. To avoid damage	5	7	10	4	4	30	5	6	5	7	7	30	60
	b. To increase yield	4	6	9	5	5	29	6	4	4	5	6	25	54

TABLE XXX (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
III. Karamadai														
1.	HYV Seeds	6	16	12	10	7	50	7	10	8	10	15	50	100
	a. More production	3	12	8	6	5	34	3	5	4	8	9	29	63
	b. Quick yielding	3	10	7	7	4	31	4	6	3	7	9	29	60
	c. Improved quality	3	11	7	5	3	29	1	3	2	7	8	21	50
	d. Pest resistant	2	10	6	5	5	28	1	3	2	6	7	19	47
2.	Fertiliser													
	a. High output	5	9	10	9	6	39	3	6	5	8	10	32	71
	b. Quick returns	4	7	8	7	5	31	3	4	3	8	8	26	67
	c. More profit	5	9	9	10	5	38	2	2	3	7	10	24	62
3.	Agricultural Implements													
	a. High output	3	10	6	8	4	31	1	3	4	6	10	24	55
	b. More profit	2	8	4	6	3	23	1	3	3	6	8	21	44
	c. Non availability of labour	4	12	10	9	5	40	2	4	3	5	7	21	61
	d. High labour cost	4	12	9	8	4	37	2	4	4	4	8	22	59
4.	Pesticides													
	a. To avoid damage	3	9	8	6	3	29	2	5	4	5	4	25	54
	b. To increase yield	3	9	6	5	4	27	2	5	6	5	9	27	54

TABLE XXX (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
IV.	Palladam													
1.	HYV Seeds	8	17	9	9	7	50	9	13	9	10	9	50	100
	a. More production	6	12	6	5	5	34	5	7	5	6	5	28	62
	b. Quick yield	6	12	6	5	5	34	4	6	4	4	4	22	56
	c. Improved quality	2	8	3	2	1	16	3	6	5	4	3	21	37
	d. Pest resistant	2	5	3	3	2	15	1	5	4	5	5	20	35
2.	Fertiliser													
	a. High output	6	12	6	6	5	35	5	7	5	6	7	30	65
	b. Quick return	5	9	5	4	4	27	5	6	4	6	6	27	54
	c. More profit	6	12	3	6	5	32	4	7	5	3	4	23	55
3.	Agricultural Implements													
	a. High output	3	12	7	6	3	31	4	5	3	5	3	20	51
	b. More profit	2	9	6	5	3	25	2	3	4	3	3	15	40
	c. Non availability of labour	4	8	7	4	4	27	2	2	2	3	2	11	38
	d. High labour cost	4	8	2	3	4	21	4	2	3	4	3	16	37
4.	Pesticide													
	a. To avoid damage	6	10	5	4	5	30	5	6	4	6	5	26	56
	b. To increase yield	6	10	5	3	5	29	5	6	5	6	5	27	56

TABLE XXX (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
V.	Annur													
1.	HYV Seeds	15	11	7	9	8	50	16	12	7	7	8	50	100
	a. More production	8	6	3	5	6	28	7	5	4	5	5	26	54
	b. Quick yielding	8	6	3	3	6	29	7	5	4	5	4	25	54
	c. Improved quality	6	5	2	4	5	22	6	5	3	4	5	23	45
	d. Pest resistant	6	5	2	4	6	26	6	4	4	44	4	22	48
2.	Fertiliser													
	a. High output	6	4	3	4	6	23	5	4	5	5	4	23	46
	b. Quick return	6	5	2	4	5	22	4	5	4	5	4	22	44
	c. More profit	5	4	2	4	5	20	4	4	4	4	5	21	41
3.	Agricultural Implements													
	a. High output	5	4	3	4	5	21	4	5	3	4	4	20	41
	b. More profit	4	3	3	3	4	17	3	4	3	4	4	18	35
	c. Non availability of labour	3	2	2	2	3	12	3	3	2	3	3	14	26
	d. High labour cost	3	3	2	2	3	13	3	3	2	3	3	14	27
4.	Pesticides													
	a. To avoid damage	4	4	2	3	3	16	4	2	2	3	3	14	30
	b. To increase yield	5	4	2	3	2	16	3	2	2	3	2	12	28

There existed difference between the high and low irrigated villages with regard to factors influencing the adoption of agricultural technology by the farmers. In high irrigated villages, on an average, more than 70 percent of the farmers were using HYV seeds as they promised more production and were quick yielding.

Regarding the use of fertiliser, the major reasons stated by the respondents in both high and low irrigated villages were high output and more profit. But, while on an average, 65 percent of the farmers in high irrigated villages were aware of the benefits of fertiliser use as high output and more profit, the corresponding response by the farmers in low irrigated villages was only 53 percent.

The basic factors behind the use of agricultural implements were high output, more profit and non availability of labour. In the high irrigated villages, on an average, 64 percent of the farmers were using tractors with a view to get high output, more profit and also due to high labour cost. But in low irrigated villages, on an average, only 55 percent of the farmers were aware of the benefits of agricultural implements.

Regarding the use of pesticides, while on an average 53 percent of the farmers in high irrigated villages have stated the reasons as avoiding damage and increasing yield, the corresponding percentage of respondents in low irrigated village was only 45.

To sum up, there was a technology gap in low irrigated villages and farmers awareness about technology is rather limited. It may be improved by spreading information about HYV seeds, fertilisers, agricultural implements and pesticides through extension agencies and mass media. As such, the current study accepts the hypothesis that there is a technology gap and there is scope for improvement in technology adoption.

d. Factors Constraining the Adoption of Agricultural Technology

The major factors limiting the use of agricultural technology were high cost, non availability of inputs and lack of credit. Table XXXI provides the information on factors constraining the adoption of agricultural technology as stated by the selected farmers.

TABLE XXXI

FACTORS CONSTRAINING THE ADOPTION OF AGRICULTURAL TECHNOLOGY AS STATED BY THE SELECTED FARMERS
(Number stating)

S.No.	Item	Type A Village					Type B Village					Grand Total		
		a	b	c	d	e	Total	a	b	c	d		e	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
I.	Pollachi South													
	N	9	14	11	8	8	50	6	11	14	6	11	50	100
1.	HYV Seeds													
	a. High cost	2	4	3	2	2	13	3	5	6	5	4	23	36
	b. Non availability	1	2	1	1	1	6	1	2	3	1	1	8	14
	c. Lack of storage facilities	1	1	3	1	1	7	1	3	2	2	2	10	17
2.	Fertiliser													
	a. High price	2	4	3	2	2	13	3	6	5	4	4	22	35
	b. Non availability	-	-	-	-	-	-	-	-	-	-	-	-	-
	c. Inadequate credit facilities	2	4	4	2	1	12	2	6	5	3	3	19	31
	d. Lack of subsidy	1	2	4	1	2	10	2	2	3	1	1	9	19
3.	Agricultural Implements													
	a. High price	2	4	2	2	2	12	3	6	5	4	4	22	34
	b. Inadequate credit facilities	2	4	2	1	1	10	3	6	4	3	3	19	29
	c. Lack of subsidy	2	1	3	1	1	8	1	2	3	2	1	9	17

TABLE XXXI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
4.	Pesticides													
	a. Inadequate supply	2	4	2	1	1	10	2	3	2	1	4	12	22
	b. Non availability	1	2	1	1	1	6	1	2	2	1	2	8	14
	c. Lack of credit facilities	2	4	3	2	1	11	2	6	5	3	3	19	30
	d. Lack of subsidy	2	3	3	2	1	11	2	5	4	2	2	15	26
II.	Perur													
	N	8	12	15	7	8	50	11	11	9	10	9	50	100
1.	HYV Seeds													
	a. High cost	4	7	2	4	3	20	8	7	5	7	6	33	53
	b. Non availability	4	4	3	5	2	18	7	6	3	6	5	27	45
	c. Lack of storage facilities	4	4	5	5	2	20	5	5	2	6	5	24	44
2.	Fertiliser													
	a. High price	3	9	10	4	4	30	9	9	6	5	6	34	64
	b. Non availability	4	8	12	3	3	30	5	6	4	4	4	23	53
	c. Inadequate credit facilities	3	8	10	2	2	25	8	7	3	3	3	24	49
	d. Lack of subsidy	4	8	10	1	1	24	7	6	2	2	2	19	43
3.	Agricultural Implements													
	a. High price	5	9	12	5	4	35	6	6	5	6	5	28	63
	b. Inadequate credit facilities	4	8	10	3	3	28	5	5	4	5	4	23	51
	c. Lack of subsidy	9	9	10	2	2	28	3	2	3	4	3	15	43

TABLE XXXI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
4.	Pesticides													
	a. Inadequate supply	4	8	10	3	2	27	7	6	4	3	4	24	51
	b. Non availability	4	9	10	2	2	27	4	3	2	2	2	13	40
	c. Lack of credit facilities	3	8	9	2	2	24	5	4	2	2	2	15	39
	d. Lack of subsidy	3	8	8	2	2	23	3	2	2	2	2	11	34
III.	Karamadai													
	N	5	16	12	11	7	50	10	10	8	10	15	50	100
1.	HVV Seeds													
	a. High Cost	2	4	4	5	2	17	3	6	4	2	6	21	38
	b. Non availability	-	1	1	2	1	5	1	2	1	2	3	9	14
	c. Lack of storage facilities	-	1	2	2	1	6	1	2	3	1	5	12	18
2.	Fertiliser													
	a. High price	2	4	4	5	2	17	3	6	4	2	8	23	40
	b. Non availability	-	-	-	-	-	-	-	-	-	-	-	-	-
	c. Inadequate credit facilities	2	3	4	5	2	16	3	5	4	2	7	21	37
	d. Lack of subsidy	2	3	4	3	-	12	3	3	2	2	3	13	25
3.	Agricultural Implements													
	a. High price	2	4	4	3	2	15	5	7	4	4	5	25	40
	b. Inadequate credit facilities	2	3	4	3	2	14	5	7	4	4	4	24	38
	c. Lack of subsidy	1	1	1	1	1	5	1	2	1	2	1	7	12

TABLE XXXI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
4.	Pesticides													
	a. Inadequate supply	-	2	1	1	1	5	1	2	1	1	1	6	11
	b. Non availability	-	1	-	1	1	3	1	2	1	1	1	6	9
	c. Lack of credit facilities	2	4	3	5	1	15	4	5	4	5	6	24	39
	d. Lack of subsidy	2	3	3	5	1	14	5	5	3	4	5	22	36
IV.	Palladam													
	N	8	17	9	9	7	50	9	13	9	10	9	50	100
1.	HYV Seeds													
	a. High cost	2	5	3	4	2	16	4	6	4	4	4	22	38
	b. Non availability	1	2	1	2	1	7	3	4	2	3	2	15	22
	c. Lack of storage facilities	1	2	-	-	-	-	2	3	2	2	5	14	20
2.	Fertiliser													
	a. High price	2	5	3	4	2	16	4	6	4	4	3	21	37
	b. Non availability	-	-	-	-	-	-	-	-	-	-	-	-	-
	c. Inadequate credit facilities	2	5	3	4	1	15	4	5	3	4	2	18	33
	d. Lack of subsidy	1	2	1	1	1	6	3	2	2	3	1	11	17
3.	Agricultural Implements													
	a. High price	2	5	3	4	3	17	6	5	3	4	2	23	37
	b. Inadequate credit facilities	2	4	3	4	2	15	5	4	3	4	4	20	35
	c. Lack of subsidy	2	1	1	1	1	6	2	5	3	3	1	14	20
4.	Pesticides													
	a. Inadequate supply	1	1	1	2	1	6	2	1	2	2	1	8	14
	b. Non availability	1	2	1	1	1	6	1	2	2	1	1	7	13
	c. Lack of credit facilities	2	5	3	2	2	14	4	6	4	2	2	18	32
	d. Lack of subsidy	2	5	3	2	2	14	4	5	3	2	1	15	29

TABLE XXXI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
V.	Annur													
	N	15	11	7	9	8	50	16	12	7	7	8	50	100
1.	HYV Seeds													
	a. High cost	10	8	4	6	5	33	12	8	5	4	5	34	67
	b. Non availability	8	7	2	3	3	23	10	6	4	3	3	26	49
	c. Lack of storage facilities	6	5	2	3	3	19	8	6	3	2	2	21	40
2.	Fertilisers													
	a. High price	10	8	5	6	5	34	12	8	5	4	5	34	68
	b. Non availability	8	6	2	3	3	22	7	5	4	33	3	22	44
	c. Inadequate credit facilities	8	6	3	5	5	27	10	8	4	4	5	31	58
	d. Lack of subsidy	5	5	3	3	3	19	10	7	3	3	3	26	45
3.	Agricultural Implements													
	a. High price	11	8	5	6	5	35	10	8	4	3	4	29	64
	b. Inadequate credit facilities	10	6	4	4	4	28	12	9	4	4	5	34	62
	c. Lack of subsidy	7	5	3	3	3	21	8	5	3	3	3	22	43
4.	Pesticides													
	a. Inadequate supply	10	7	3	5	4	29	10	5	4	3	3	25	54
	b. Non availability	8	5	2	2	3	20	8	4	2	2	3	19	39
	c. Lack of credit facilities	5	4	5	4	5	23	7	5	5	4	4	25	48
	d. Lack of subsidy	5	3	2	2	2	14	6	3	2	3	2	16	30

Farmers' perception of the constraints inhibiting them from adopting technology varied by their farm size. In both high irrigated and low irrigated villages, on an average, 45 percent of the marginal farmers have stated that high cost of HYV seeds was the major limitation. But only 35 percent of the large farmers have stated this response. This calls for provision of improved seeds at reduced price to marginal and small farmers.

Irrespective of the size of holdings, on an average, 40 percent of the sample farmers considered high fertiliser price as the essential constraint hindering the use of fertiliser. However, on an average 25 percent of the marginal farmers and 20 percent of the large farmers stated inadequate credit facilities as a constraint in the use of fertilisers.

Regarding the use of agricultural implements, 30 percent of the marginal and 25 percent of the large farmers considered high price of implements as the essential constraint. But 36 percent of the marginal farmers were not able to use any agricultural implement due to inadequate credit facilities and due to lack of subsidy. But only 25 percent of the large farmers were facing this problem.

Regarding the use of pesticides, on an average 35 percent of the marginal farmers and 25 percent of the large farmers were facing the constraints as lack of credit facilities and lack of subsidy.

To sum up, the current study is in conformity with the view of Salik Ram (1981) that high input price hinders technology adoption by the farmers.

E. Analysis of Cost of Cultivation and Profitability of Farming Enterprise

a. Analysis of Cost of Cultivation

Traditionally, cost of cultivation have been important in farm management. In the market for farm products, numerous producers compete to sell their products to a few organised buyers. Since the market power remains with the buyers and the farmers are price takers, their goal of profit maximisation required cost reduction.

In farm management studies, total cost of cultivation comprise paid out costs and imputed costs. Imputed costs comprise rental value of owned land, interest on own fixed capital and the value of family labour. The significant concepts of cost of cultivation used in the study were :

Cost A_1 = All actual expenses in cash and kind incurred in production of crops by owner - operator ;

Cost A_2 = Cost A_1 + rent paid for leased in land ;

Cost B_1 = Cost A_1 + interest on value of owned capital assets (excluding land) ;

Cost B_2 = Cost B_1 + rental value of owned land ;

Cost C_1 = Cost B_1 + imputed value of family labour ;

Cost C_2 = Cost B_2 + imputed value of family labour ;

Table XXXII gives data on per acre cost of cultivation and components of per acre cost of cultivation in the selected farms.

TABLE XXXII

COMPONENTS OF PER ACRE COST OF CULTIVATION IN THE STUDY FARMS

		(in rupees)								
S.No.	Crop	Per acre cost	WC	BC	MC	SC	FC	P	I	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
I. Pollachi South										
1.	Paddy	2871	335 (11.66)	51 (1.77)	69 (2.40)	443 (15.43)	508 (17.69)	752 (26.19)	713 (24.86)	
	NHYV	2532	318 (12.55)	79 (3.12)	62 (2.44)	286 (11.29)	361 (11.25)	968 (38.25)	458 (18.08)	
2.	Cholam	1493	319 (21.36)	59 (3.95)	46 (3.08)	109 (7.30)	89 (5.96)	118 (7.90)	753 (50.45)	
	NHYV	1613	464 (28.48)	121 (7.90)	40 (2.47)	107 (6.63)	73 (4.52)	94 (5.82)	714 (44.26)	
3.	Sugarcane	3768	513 (13.81)	97 (2.57)	131 (3.47)	710 (18.84)	597 (15.84)	915 (24.28)	807 (21.19)	
	NHYV	3753	533 (14.20)	117 (3.11)	38 (1.01)	529 (14.09)	588 (18.33)	1283 (34.18)	565 (15.08)	
4.	Cotton	2667	260 (9.78)	69 (2.58)	57 (2.13)	640 (23.99)	463 (17.36)	885 (33.18)	293 (10.98)	
	NHYV	2224	665 (29.90)	181 (8.13)	97 (4.36)	247 (11.1)	189 (8.49)	233 (10.47)	612 (27.55)	
5.	Groundnut	-	-	-	-	-	-	-	-	
	NHYV	-	-	-	-	-	-	-	-	

205

TABLE XXXII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Type B Village										
1.	Paddy	HYV	6123	1064 (17.37)	210 (3.42)	92 (1.5)	1410 (23.02)	826 (13.49)	726 (11.85)	1795 (29.31)
		NHYV	3346	695 (20.77)	195 (5.82)	32 (0.95)	455 (13.59)	328 (9.8)	278 (8.30)	1363 (40.71)
2.	Cholam	HYV	1550	404 (26.06)	138 (8.90)	70 (4.51)	157 (10.12)	83 (5.35)	38 (2.4)	660 (42.58)
		NHYV	1481	370 (24.98)	193 (13.21)	28 (1.89)	100 (6.79)	107 (7.2)	50 (3.30)	637 (42.53)
3.	Sugarcane	HYV	4136	542 (13.10)	135 (3.26)	56 (1.35)	1179 (22.5)	872 (21.08)	698 (16.87)	654 (15.84)
		NHYV	3032	419 (13.81)	115 (3.79)	45 (1.48)	896 (29.5)	604 (19.98)	472 (15.56)	481 (15.86)
4.	Cotton	HYV	2862	530 (18.51)	108 (3.77)	48 (1.67)	600 (20.98)	576 (20.12)	400 (13.97)	600 (20.98)
		NHYV	1227	437 (35.61)	109 (8.8)	33 (2.68)	82 (6.68)	82 (6.68)	21 (1.71)	463 (37.84)
5.	Groundnut	HYV	2515	511 (20.31)	120 (4.77)	90 (3.57)	375 (14.95)	344 (13.67)	275 (10.93)	800 (31.8)
		NHYV	1229	315 (25.63)	96 (7.85)	22 (1.79)	130 (10.57)	79 (6.42)	69 (5.61)	518 (4.21)

TABLE XXXII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
II.	Perur									
	Type A Village									
1.	Paddy	HYV	3440	504 (14.65)	110 (3.19)	60 (1.74)	630 (17.44)	750 (21.80)	1000 (29.06)	415 (12.06)
		NHYV	2655	450 (16.94)	132 (4.97)	48 (1.80)	400 (15.06)	640 (24.10)	1140 (42.93)	245 (9.22)
2.	Cholam	HYV	1999	839 (43.96)	180 (9.00)	133 (6.65)	208 (10.40)	277 (13.89)	62 (3.10)	260 (13.00)
		NHYV	2078	765 (36.61)	278 (13.37)	141 (6.78)	245 (11.79)	333 (18.02)	49 (2.39)	265 (11.00)
3.	Sugarcane	HYV	9238	1204 (13.52)	140 (1.97)	115 (1.29)	2586 (29.04)	2490 (27.97)	2107 (23.66)	258 (2.89)
		NHYV	8895	1761 (19.79)	186 (2.09)	54 (0.66)	2421 (27.21)	2027 (22.78)	1761 (19.79)	701 (7.91)
4.	Cotton	HYV	7495	348 (4.64)	98 (1.30)	115 (1.53)	2260 (30.15)	2212 (29.51)	2260 (30.15)	202 (2.69)
		NHYV	6030	378 (6.26)	92 (1.52)	53 (4.87)	1618 (26.83)	1765 (29.27)	1728 (28.65)	396 (6.56)

TABLE XXXII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Type B Village									
1.	Paddy	-	-	-	-	-	-	-	-
	HYV	-	-	-	-	-	-	-	-
2.	Cholam	2177	715	178	74	208	362	47	827
	HYV		(32.84)	(8.17)	(3.33)	(9.55)	(16.62)	(2.15)	(37.98)
3.	Sugarcane	2456	797	170	450	135	270	168	871
	HYV		(32.45)	(6.92)	(18.32)	(5.49)	(10.99)	(6.84)	(35.46)
4.	Maize	4003	760	164	111	683	461	385	1442
	HYV		(18.98)	(4.09)	(2.77)	(17.06)	(11.51)	(9.61)	(36.02)
5.	Cotton	2609	388	127	50	416	416	277	935
	HYV		(14.87)	(4.86)	(1.91)	(15.94)	(15.94)	(10.61)	(35.83)
6.	Maize	1604	478	294	76	198	130	118	510
	HYV		(29.80)	(18.32)	(4.73)	(12.34)	(8.10)	(7.35)	(31.79)
7.	Cotton	1922	297	75	29	148	95	95	1183
	HYV		(15.46)	(3.90)	(1.50)	(7.70)	(4.94)	(4.94)	(61.55)
8.	Cotton	3429	1180	104	79	219	136	90	1610
	HYV		(34.41)	(3.03)	(2.30)	(6.38)	(3.96)	(2.62)	(46.95)
9.	Cotton	2154	371	101	79	219	136	90	1610
	HYV		(17.22)	(4.68)	(1.62)	(8.26)	(5.06)	(5.06)	(63.81)

TABLE XXXII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
III. Karamadai										
Type A Village										
1.	Paddy	HYV	5249	845 (16.09)	111 (2.11)	44 (0.83)	1271 (24.21)	1235 (23.52)	1404 (26.74)	339 (6.45)
		NHYV	2242	366 (16.32)	90 (4.01)	11 (0.49)	579 (25.82)	530 (23.63)	530 (23.63)	136 (6.06)
2.	Cholam	HYV	1692	361 (21.33)	162 (9.57)	41 (2.42)	376 (22.2)	215 (12.7)	279 (16.48)	258 (15.24)
		NHYV	1616	567 (35.08)	155 (9.59)	24 (1.48)	200 (12.37)	213 (13.18)	305 (18.87)	152 (9.4)
3.	Maize	HYV	-	-	-	-	-	-	-	-
		NHYV	-	-	-	-	-	-	-	-
4.	Cotton	HYV	10148	558 (5.49)	97 (0.95)	27 (.26)	3320 (32.71)	2938 (28.95)	2961 (29.17)	247 (2.43)
		NHYV	4926	125 (2.53)	55 (1.11)	11 (0.22)	1624 (32.96)	1503 (30.51)	1510 (30.65)	98 (1.98)

TABLE XXXII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Type B Village									
1.	Paddy	HYV	451 (11.46)	83 (2.10)	32 (.81)	1332 (33.85)	990 (25.15)	940 (23.88)	107 (2.71)
		NHYV	3582 335 (9.35)	94 (2.62)	21 (.58)	1275 (35.59)	894 (24.95)	884 (24.67)	79 (2.20)
2.	Cholam	HYV	1325 296 (22.33)	120 (9.05)	32 (2.41)	291 (20.86)	253 (19.06)	240 (18.11)	93 (7.01)
		NHYV	1008 354 (35.11)	103 (10.21)	16 (1.58)	112 (11.11)	121 (11.2)	201 (19.94)	101 (10.01)
3.	Maize	HYV	1724 357 (20.7)	140 (8.12)	37 (2.14)	415 (24.07)	360 (20.88)	290 (16.82)	125 (7.25)
		NHYV	1353 354 (26.13)	114 (8.42)	15 (1.10)	291 (21.5)	282 (20.84)	208 (15.34)	89 (6.57)
4.	Cotton	HYV	4150 557 (13.42)	122 (2.93)	104 (2.5)	1159 (27.92)	1063 (25.63)	1625 (24.69)	120 (2.89)
		NHYV	3018 325 (10.76)	93 (3.08)	48 (1.59)	956 (31.67)	729 (24.15)	792 (26.24)	75 (2.48)

TABLE XXXII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IV. Palladam									
Type A Village									
1. Paddy	HYV	2041	344 (16.85)	37 (1.81)	33 (1.61)	185 (9.06)	568 (27.82)	341 (16.70)	533 (26.15)
	NHYV	1787	274 (15.33)	70 (3.91)	14 (.78)	236 (13.20)	573 (32.06)	385 (21.54)	235 (13.15)
2. Cholan	HYV	950	205 (21.57)	30 (3.15)	14 (1.47)	125 (13.15)	216 (22.73)	192 (20.25)	168 (17.68)
	NHYV	719	229 (31.84)	40 (5.56)	8 (1.11)	32 (4.40)	142 (19.74)	143 (19.88)	125 (17.38)
3. Maize	HYV	1344	55 (4.09)	13 (0.96)	24 (1.78)	122 (9.07)	454 (33.77)	220 (16.36)	456 (33.97)
	NHYV	862	733 (8.46)	35 (4.06)	16 (1.85)	77 (8.93)	194 (22.50)	147 (17.05)	320 (37.15)
4. Cotton	HYV	2578	829 (32.15)	86 (3.33)	97 (3.76)	240 (9.34)	468 (18.15)	326 (12.64)	532 (20.63)
	NHYV	2054	624 (30.37)	108 (5.25)	28 (1.36)	172 (8.37)	302 (14.74)	279 (13.58)	541 (26.33)
5. Groundnut	HYV	-	-	-	-	-	-	-	-
	NHYV	-	-	-	-	-	-	-	-

TABLE XXXII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Type B Village									
1.	Paddy	-	-	-	-	-	-	-	-
	HYV	-	-	-	-	-	-	-	-
	NHYV	-	-	-	-	-	-	-	-
2.	Cholam	1744	327 (18.75)	41 (2.35)	14 (0.80)	123 (7.05)	272 (15.59)	140 (8.05)	827 (47.41)
	HYV	1289	329 (25.52)	65 (5.04)	9 (0.69)	59 (4.57)	164 (12.72)	43 (3.3)	620 (48.09)
	NHYV								
3.	Maize	1527	172 (11.26)	40 (2.61)	23 (1.50)	118 (7.72)	321 (21.42)	136 (8.90)	718 (47.02)
	HYV								
	NHYV	1280	177 (13.82)	62 (4.84)	19 (1.48)	109 (8.51)	202 (15.78)	76 (5.93)	635 (49.60)
4.	Cotton	1201	244 (20.31)	35 (2.91)	22 (1.83)	99 (8.28)	151 (12.57)	122 (10.15)	528 (43.96)
	HYV								
	NHYV	1506	381 (25.29)	82 (5.44)	21 (1.39)	153 (10.15)	291 (19.32)	214 (14.25)	364 (24.16)
5.	Groundnut	1397	337 (24.12)	46 (3.29)	22 (1.57)	32 (2.22)	88 (6.29)	70 (5.90)	802 (57.4)
	HYV								
	NHYV	1004	329 (32.76)	70 (6.97)	20 (1.99)	25 (2.49)	182 (18.12)	117 (11.65)	261 (25.99)

TABLE XXXII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
V.	Annur								
	Type A Village								
1.	Paddy	3545	530 (14.95)	163 (4.31)	71 (2.00)	333 (9.39)	1340 (37.79)	926 (26.12)	181 (5.10)
		854	130 (15.22)	65 (7.61)	13 (1.52)	111 (12.99)	252 (29.5)	223 (26.11)	61 (7.14)
2.	Cholam	402	75 (18.65)	26 (6.46)	10 (2.48)	53 (13.18)	169 (42.03)	21 (5.22)	48 (11.94)
		345	97 (28.11)	18 (5.21)	67 (19.42)	32 (9.27)	113 (32.75)	38 (11.01)	40 (11.59)
3.	Maize	1429	141 (9.86)	758 (53.04)	18 (1.25)	811 (5.66)	330 (23.09)	18 (1.25)	83 (5.80)
		1773	337 (19.00)	170 (9.58)	19 (1.07)	160 (9.02)	562 (31.69)	209 (11.78)	316 (17.82)
4.	Groundnut	1691	278 (16.43)	132 (7.8)	44 (2.60)	218 (12.89)	402 (37.17)	156 (9.22)	235 (13.89)
		767	147 (19.16)	70 (9.12)	13 (1.69)	85 (11.08)	282 (36.76)	24 (3.12)	145 (18.90)

TABLE XXXII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Type B Village									
1.	Paddy	-	-	-	-	-	-	-	-
	NHYV	-	-	-	-	-	-	-	-
2.	Cholam	1298	356 (27.42)	94 (7.24)	77 (5.93)	192 (14.79)	386 (29.73)	0	193
	NHYV	800	205 (25.63)	45 (5.62)	15 (7.31)	102 (12.75)	270 (33.75)	71 (8.88)	92 (11.5)
3.	Maize	1892	383 (20.24)	192 (10.14)	50 (2.64)	346 (18.28)	417 (22.04)	271 (14.32)	233 (12.34)
	NHYV	1250	368 (29.44)	153 (12.24)	16 (1.28)	211 (16.88)	237 (18.96)	145 (11.6)	120 (9.60)
4.	Groundnut	-	-	-	-	-	-	-	-
	NHYV	-	-	-	-	-	-	-	-

WC = Wage Cost ; BC = Bullock Cost ; MC = Machinery Cost ; SC = Seed Cost ; FC = Fertiliser Cost ;

P = Pesticide Cost ; I = Interest Cost

* Figures in parantheses indicate percentage to per acre cost of cultivation.

The analysis of per acre cost of cultivation indicates that in Pollachi South block, in high irrigated village, for all the crops, except for cholam, the cost was higher in HYV farms than the NHYV farms. The high cost of cultivation in HYV farms was due to the fact that the farmers were spending more for the purchase of quality seeds, fertilisers and pesticides. The exceptional case for cholam might be attributed to the fact that they were spending more on hiring bullocks to improve soil fertility. In low irrigated village of Pollachi South block, for all crops, per acre cost of cultivation in HYV farms was greater than that of NHYV farms. If a HYV crop is cultivated in both high and low irrigated villages the cost incurred was high in the second group as compared to the first group. This was due to the fact that in the low irrigated village the farmers were using overdose of fertiliser and pesticides.

The component wise analysis of per acre cost of cultivation revealed that interest cost and wage cost were the primary items of cost of cultivation. In high irrigated village, the interest cost ranged from 15 to 44 percent, and the wage cost was ranging from 10 to 30 percent. Similarly, in low irrigated village, the interest cost was ranging from 16 to 43 percent and wage cost was ranging from 16 to 36 percent. In Pollachi South block, the farmers had to pay high wage rate as there was acute scarcity of labour due to migration of labour from the farms to town for employment in textile mills or house construction.

In Perur block, in the high irrigated village, the cost of cultivation per acre for sugarcane was the highest. This might be due to the fact

that the cultivation of sugarcane requires more fertiliser. Of the various components of per acre cost, wage cost ranged from 14 to 35 percent and interest cost ranged from 15 to 45 percent. In the low irrigated village, for cultivating HYV sugarcane the farmers were spending more money per acre (Rs.4008) as compared to other crops. In this village, wage cost and interest cost were the dominant items.

In the high irrigated village of Karamadai block, the farmers were spending more amount for cotton cultivation and wage cost was the predominant item. But in the low irrigated village, the cost of cultivation per acre for groundnut was exceeding that of others.

In Palladam block, in the high irrigated village, cotton cultivation required higher cost. Of the different components, for all the crops, wage cost and interest cost, were predominant. The wage cost ranged from 4 to 32 percent and interest cost ranged from 13 to 33 percent. In the low irrigated village also, the cost of cultivation per acre for cotton was the highest.

In the high irrigated village of Annur block, the cost of cultivation per acre for paddy was the highest. Of the different components, machinery cost was the lowest and it ranged from only 1 to 26 percent. In the low irrigated village, the cost of cultivation per acre for cholam was greater than that of maize.

To sum up, the cost of cultivation per acre differed from crop to crop. Of the food crops cultivated, HYV paddy and among the

commercial crops, HYV sugarcane cultivation required high cost. Regarding the components of cost of cultivation, wage cost and interest cost were dominant. This implies that to attract labour into farm operations the farmers offered high wages. Further due to scarcity of owned funds, they were borrowing money and hence part of the expenses were related to paying interest. Figure IX represents the components of per acre cost of cultivation in HYV and NHYV farms.

FIGURE - IX A

PIE DIAGRAM TO REPRESENT THE COMPONENTS OF PER ACRE COST OF CULTIVATION IN HYV AND NHYV FARMS

Pollachi South - Type-A Village

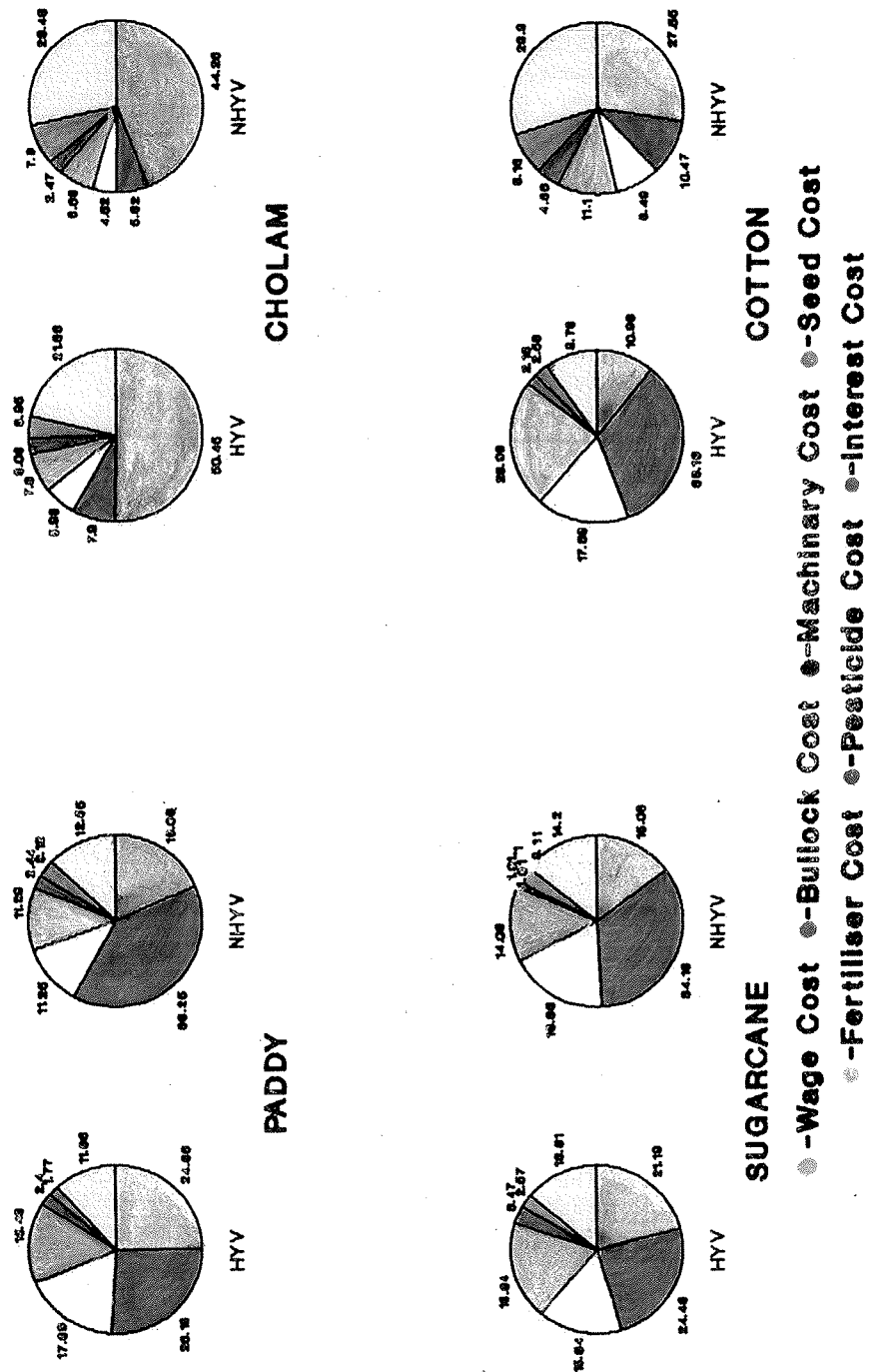


Figure - IX A

PIE DIAGRAM TO REPRESENT THE COMPONENTS OF PER ACRE COST OF CULTIVATION IN HYV AND NHYV FARMS

Pollachi South - Type-B Village

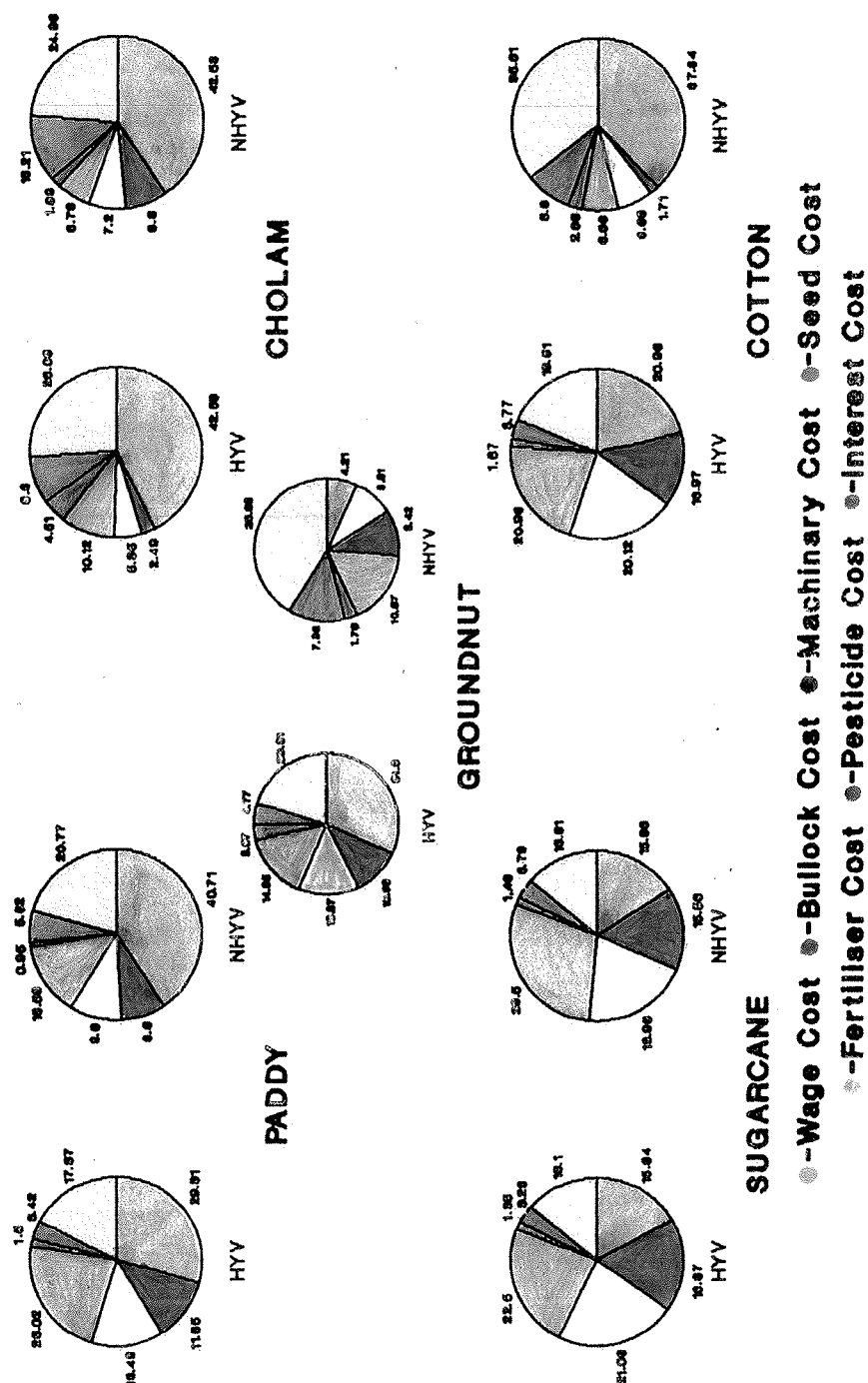
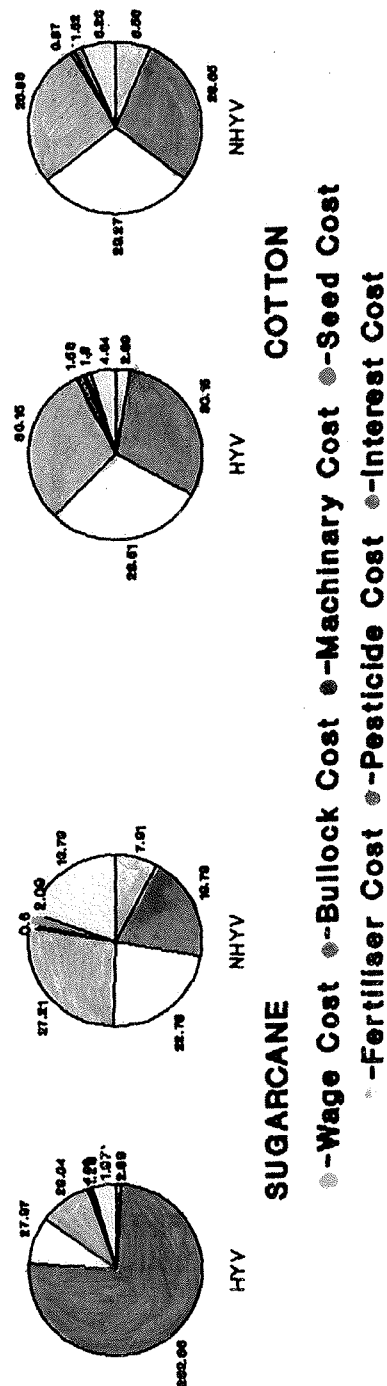
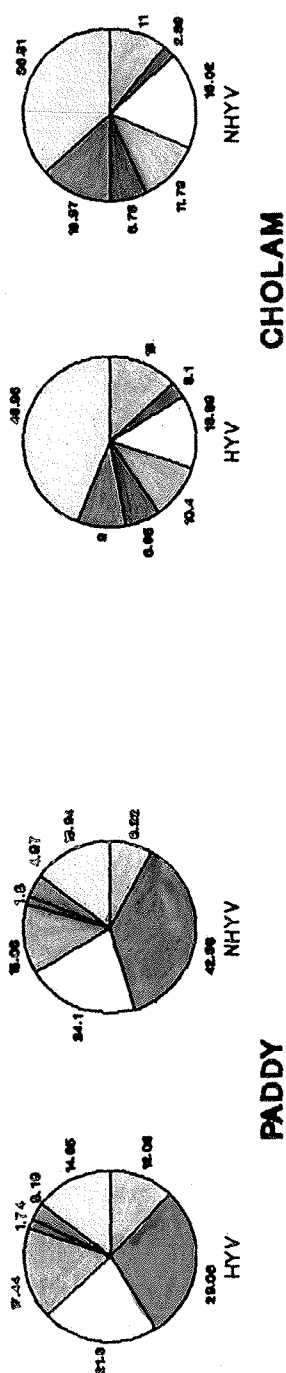


FIGURE - IX B

PIE DIAGRAM TO REPRESENT THE COMPONENTS OF PER ACRE COST OF CULTIVATION IN HYV AND NHYV FARMS

Perur - Type-A Village

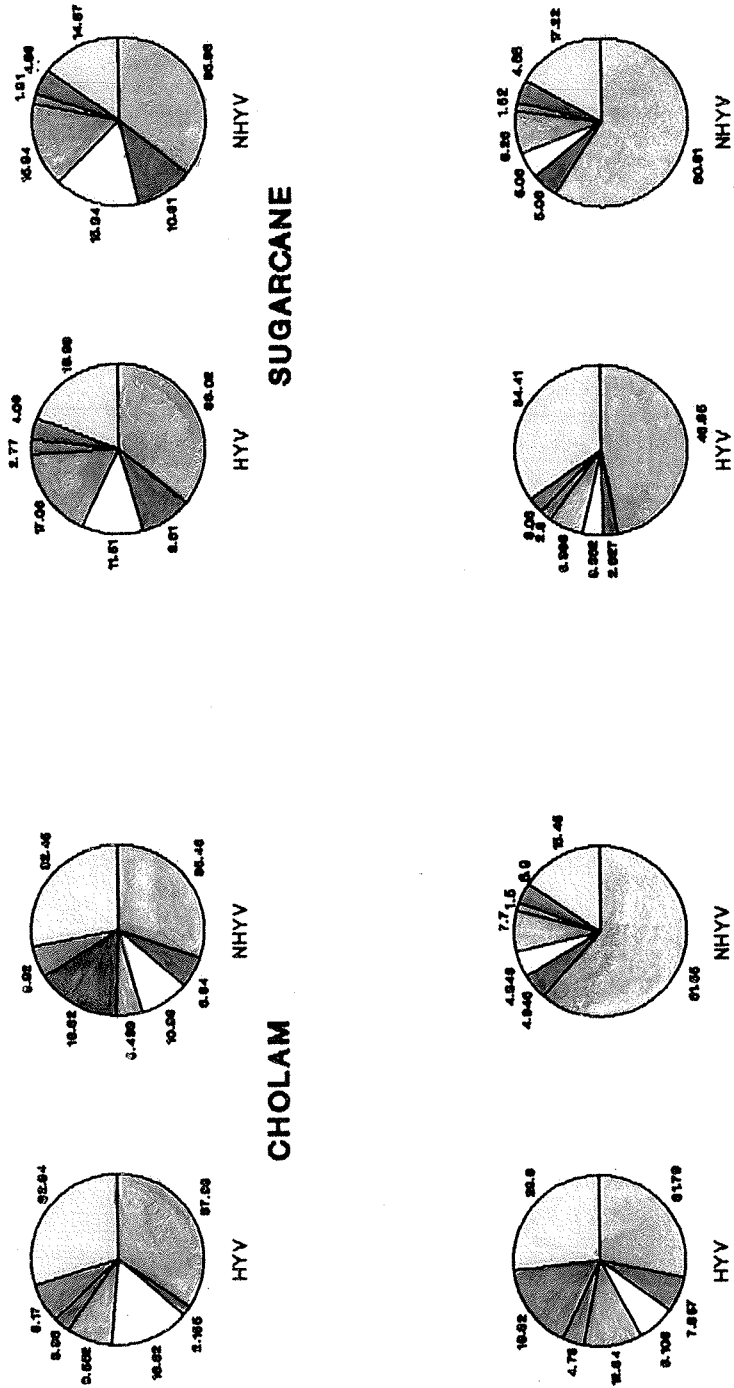


● -Wage Cost ● -Bullock Cost ● -Machinery Cost ● -Seed Cost
 ● -Fertiliser Cost ● -Pesticide Cost ● -Interest Cost

FIGURE - IX B

PIE DIAGRAM TO REPRESENT THE COMPONENTS OF PER ACRE COST OF CULTIVATION IN HYV AND NHYV FARMS

Perur - Type-B Village



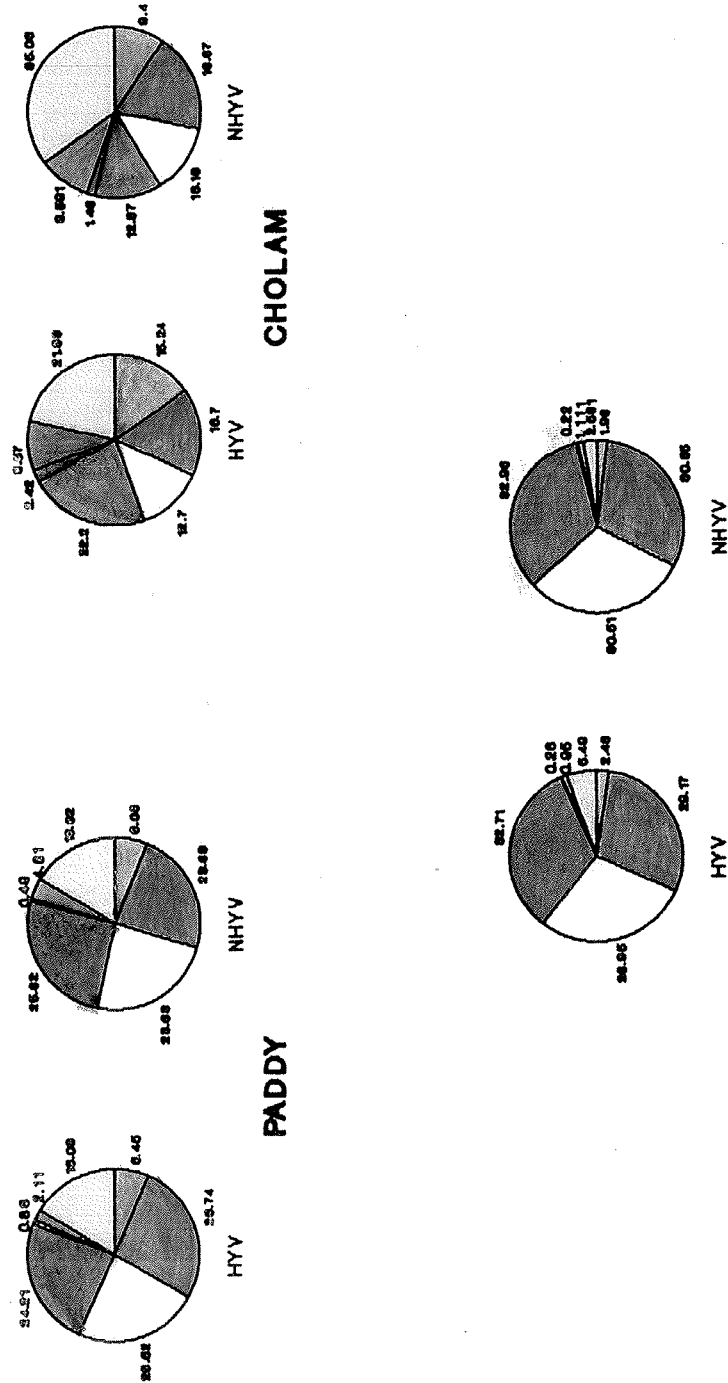
MAIZE

● -Wage Cost ●-Bullock Cost ●-Machinery Cost ●-Seed Cost
●-Fertiliser Cost ●-Pesticide Cost ●-Interest Cost

FIGURE - IX C

PIE DIAGRAM TO REPRESENT THE COMPONENTS OF PER ACRE COST OF CULTIVATION IN HYV AND NHYV FARMS

Karamadai - Type-A Village



● -Wage Cost ●-Bullock Cost ●-Machinery Cost ●-Seed Cost
●-Fertiliser Cost ●-Pesticide Cost ●-Interest Cost

FIGURE - IX C

PIE DIAGRAM TO REPRESENT THE COMPONENTS OF PER ACRE COST OF CULTIVATION IN HYV AND NHYV FARMS

Karamadai - Type-B Village

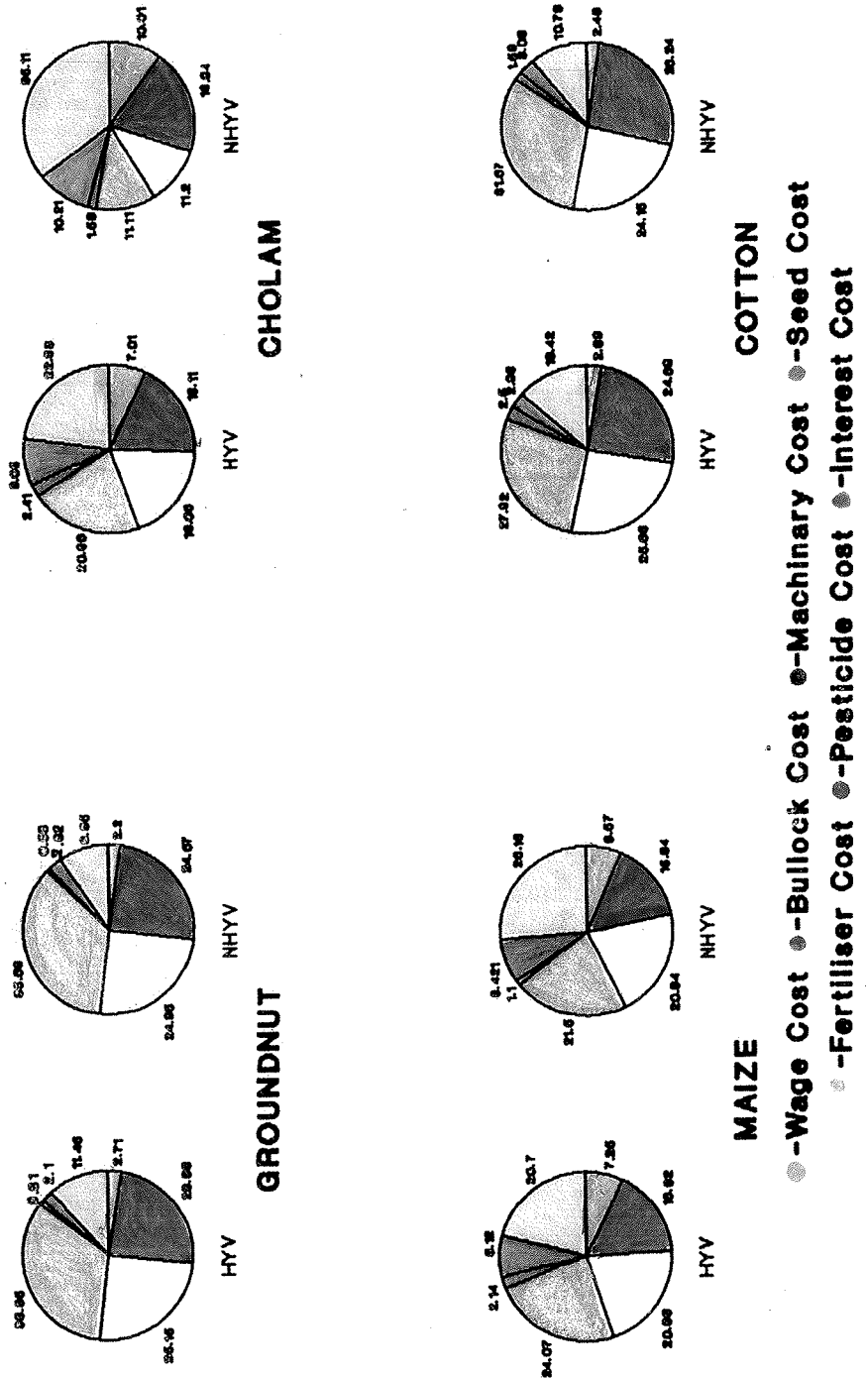


FIGURE - IX D

PIE DIAGRAM TO REPRESENT THE COMPONENTS OF PER ACRE COST OF CULTIVATION IN HYV AND NHYV FARMS

Palladam - Type-A Village

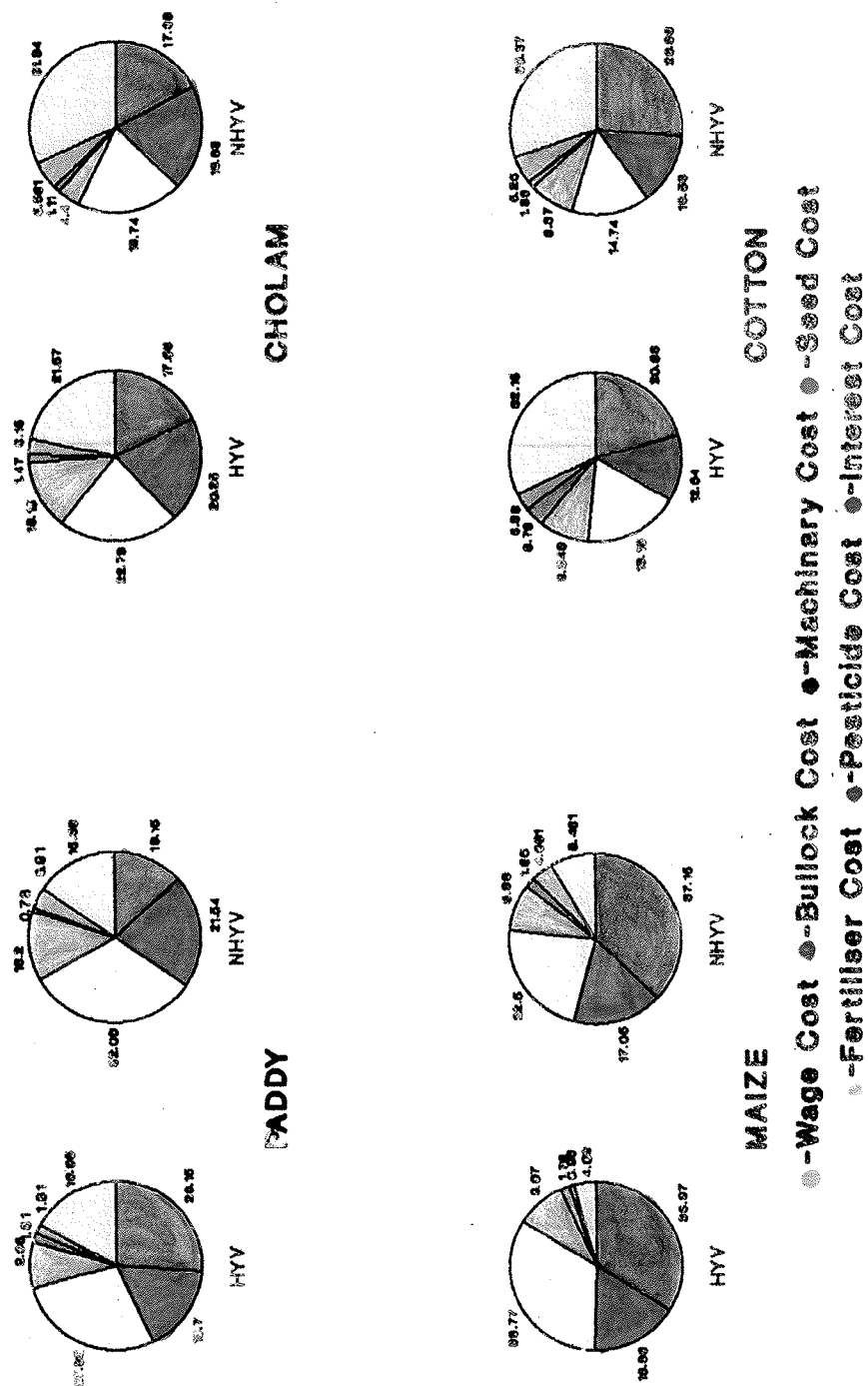


FIGURE - IX D

PIE DIAGRAM TO REPRESENT THE COMPONENTS OF PER ACRE COST OF CULTIVATION IN HYV AND NHYV FARMS

Palladam - Type-B Village

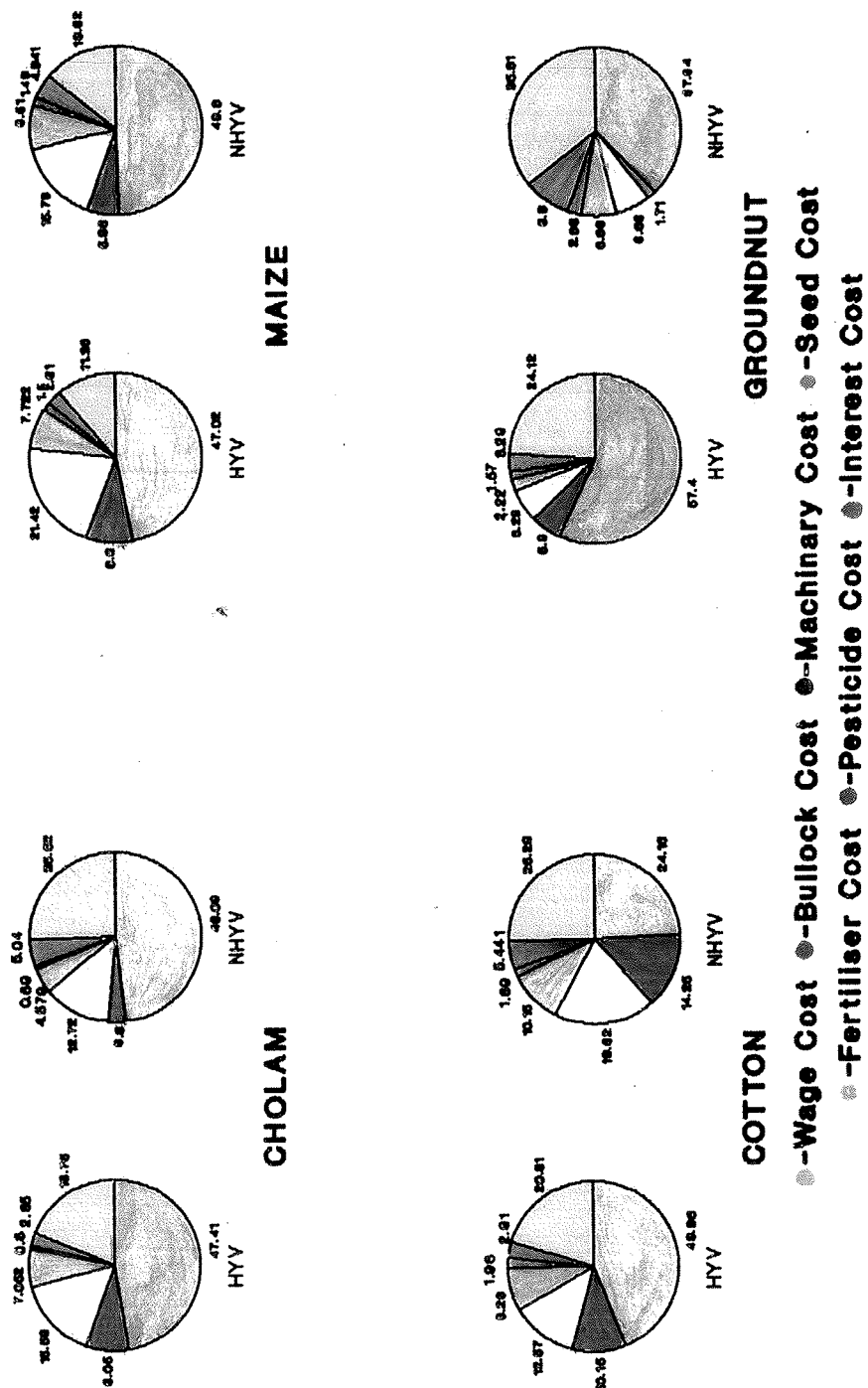


FIGURE - IX E

PIE DIAGRAM TO REPRESENT THE COMPONENTS OF PER ACRE COST OF CULTIVATION IN HYV AND NHYV FARMS

Annur - Type-A Village

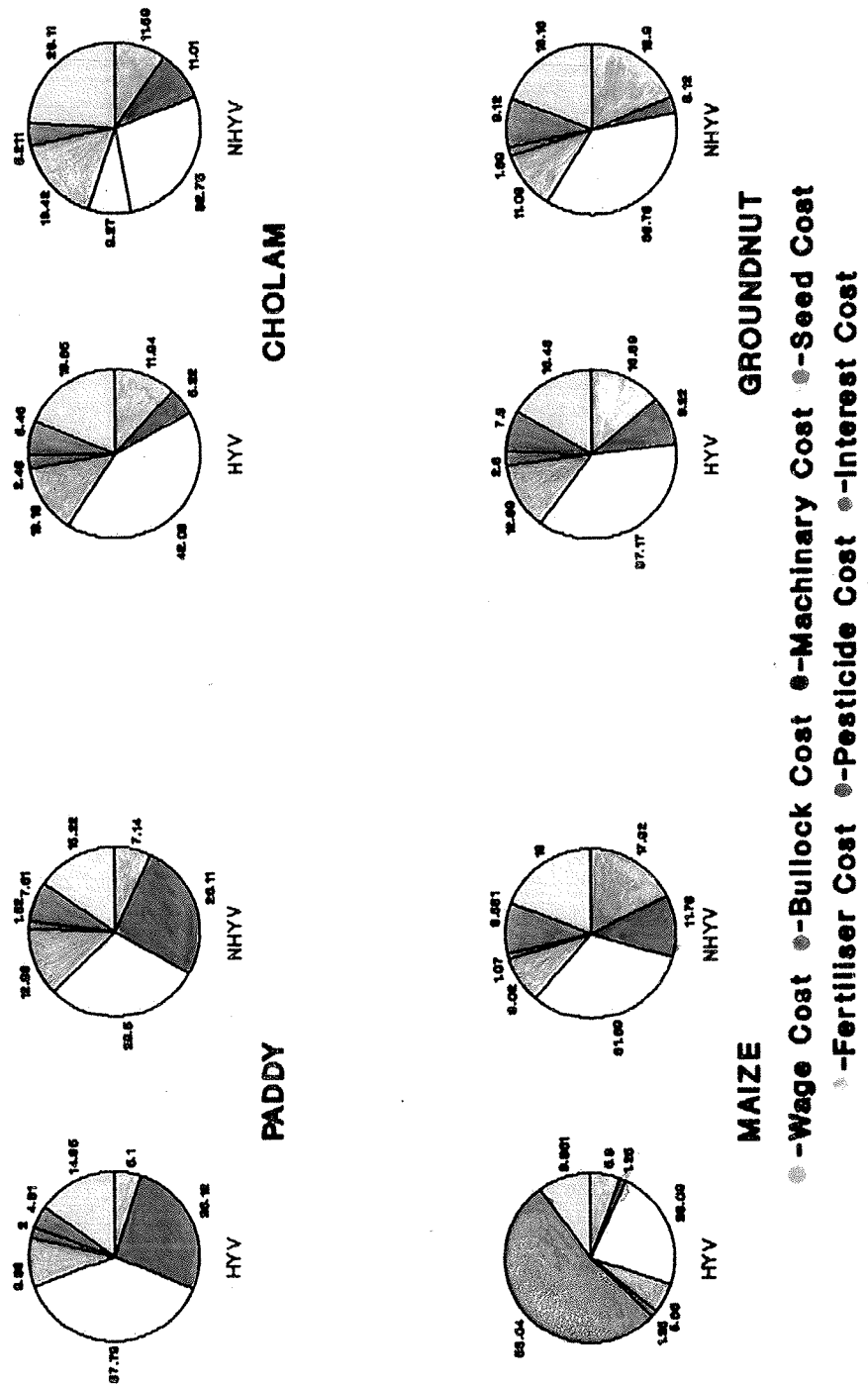
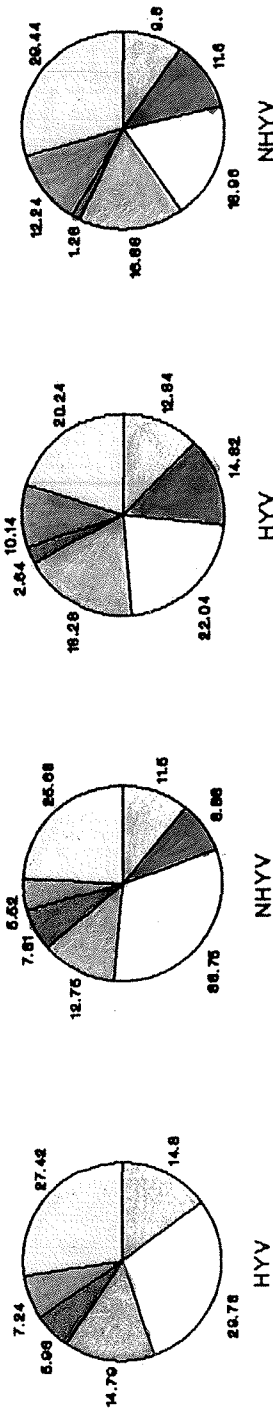


FIGURE - IX E

PIE DIAGRAM TO REPRESENT THE COMPONENTS OF PER ACRE COST OF CULTIVATION IN HYV AND NHYV FARMS

Annur - Type-B Village



● -Wage Cost ● -Bullock Cost ● -Machinery Cost ● -Seed Cost
 -Fertiliser Cost ● -Pesticide Cost ● -Interest Cost

b. Profitability of Farming Enterprise

Profit is an essential inducement for farm business and agricultural technology is used with a view to get more profit. Table XXXIII brings out this information.

TABLE XXXIII

PER ACRE NET RETURN IN THE SELECTED FARMS

(in Rupees)

S.No.	Item	Paddy		Cholam		Maize		Sugarcane		Cotton		Groundnut	
		HYV	NHYV	HYV	NHYV	HYV	NHYV	HYV	NHYV	HYV	NHYV	HYV	NHYV
I. Pollachi South													
Type A Village													
1.	Revenue	5497	4526	3492	2116	-	-	16840	9984	11941	6756	-	-
2.	Cost	2871	2532	1493	1613	-	-	3768	3753	2667	2224	-	-
3.	Net return	2626	1994	1999	503	-	-	13072	6231	9274	4532	-	-
Type B Village													
1.	Revenue	7231	4082	3065	1916	-	-	16909	9070	8081	2713	7435	3183
2.	Cost	6123	3546	1550	1481	-	-	4136	3032	2862	1227	2515	1229
3.	Net return	1108	736	1515	435	-	-	12773	6038	5119	1486	4920	1954

TABLE XXXIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(12)	(13)	(14)	(15)
II. Perur													
Type A Village													
1.	Revenue	5955	4505	3504	2578	-	-	21853	14910	16610	7498	-	-
2.	Cost	3440	2655	1999	2078	-	-	9238	8895	7495	6030	-	-
3.	Net return	2511	1850	1505	500	-	-	12515	6015	9115	1468	-	-
Type B Village													
1.	Revenue	-	-	3637	2876	5403	3234	-	-	6709	3347	8269	3939
2.	Cost	-	-	2177	2456	4003	2659	-	-	1604	1922	3429	2154
3.	Net return	-	-	1460	420	1400	625	-	-	5105	1425	4840	1785
III. Karamadai													
Type A Village													
1.	Revenue	7649	3965	3175	2089	-	-	-	-	19153	6315	-	-
2.	Cost	5249	2242	1692	1616	-	-	-	-	10148	4926	-	-
3.	Net return	2400	1723	1483	473	-	-	-	-	9005	1389	-	-

TABLE XXXIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Type B Village													
1.	Revenue	-	-	2675	1488	3099	1942	-	-	9155	4639	7959	5293
2.	Cost	-	-	1325	1008	1724	1353	-	-	4150	3018	3935	3582
3.	Net return	-	-	1350	480	13375	589	-	-	5005	1621	4024	1711
IV. Palladam													
Type A Village													
1.	Revenue	4241	3372	2307	1175	2544	1512	-	-	11153	3569	-	-
2.	Cost	2041	1787	950	719	1344	862	-	-	2578	2054	-	-
3.	Net return	2200	1585	1357	456	1200	650	-	-	8575	1515	-	-
Type B Village													
1.	Revenue	-	-	3019	1739	2832	1905	-	-	6181	3017	5397	2709
2.	Cost	-	-	1744	1289	1527	1280	-	-	1201	1506	1397	1004
3.	Net return	-	-	1275	450	1305	625	-	-	4980	1511	4000	1705

TABLE XXXIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
V.	Annur												
	Type A Village												
1.	Revenue	5345	2272	1347	731	2544	2348	-	-	-	-	3877	2462
2.	Cost	3545	854	402	345	1429	1773	-	-	-	-	1671	767
3.	Net return	1800	1418	945	386	1115	575	-	-	-	-	2186	1695
	Type B Village												
1.	Revenue	-	-	2223	1145	2897	2120	-	-	-	-	-	-
2.	Cost	-	-	1298	800	1892	1250	-	-	-	-	-	-
3.	Net return	-	-	925	345	1005	870	-	-	-	-	-	-

(Rs.2186). But in the low irrigated village, of the two crops cultivated (cholan and maize) the farmers were getting high net return (Rs.1005) by cultivating HYV maize.

The above analysis indicated that, in all the study villages, for all the crops, the net return per unit of land for HYV farms was greater than NHYV farms. This is in conformity with Pandey (1981) and Agarwal (1984) that HYV cultivation was more profitable than NHYV. The reason for this might be attributed to high yield and high price for HYV variety.

It can also be inferred that of the food crops cultivated, paddy cultivation was more profitable and among the commercial crops, sugarcane and cotton gave the highest net return. However, if a crop is cultivated in both high and low irrigated villages, net return in the first group was greater than the second group. This might be due to higher output obtained in high irrigated villages as compared to the low irrigated villages.

F. Determination of Factor Shares, Factor Substitution and Resource Use Efficiency Due to Technical Change

a. Determination of Factor Shares

The share of different factors in total output specifies the relative contribution of individual inputs to total outputs. Following Sitaram (1984) and Rao (1987), the current study analysed the determination of factor shares with the help of marginal value productivity analysis. The marginal

value productivity of an input is calculated as

$$MVP = b_i^{\wedge} \frac{Y_1^{\wedge}}{X_i^{\wedge}}$$

where

- $b_i^{\wedge}$ = Elasticity coefficients of different inputs ;
- $Y_1^{\wedge}$ = Geometric mean of output ; and
- $X_i^{\wedge}$ = Geometric mean of ith input.

The current study estimated the marginal value productivity of inputs of cropped area, seeds, fertilisers, pesticides, labour, capital and tractor timings by using the above method. Table XXXIV presents the crop wise estimated geometric mean of output and inputs in the selected farms. A sample of estimated geometric mean of output and input is given in Appendix XIII.

TABLE XXXIV

ESTIMATED GEOMETRIC MEAN OF OUTPUT AND INPUT IN THE SELECTED FARMS

S.No.	Item	Paddy		Cholam		Maize		Sugarcane		Cotton		Groundnut	
		HYV	NHYV	HYV	NHYV	HYV	NHYV	HYV	NHYV	HYV	NHYV	HYV	NHYV
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
I. Pollachi South													
Type A Village													
1.	Output	79.80	64.79	50.58	11.14	-	-	315.8	30.28	14.00	5.29	-	-
2.	Cropped area	6.74	5.95	4.39	1.93	-	-	3.53	4.26	6.39	4.48	-	-
3.	Seed expenditure	42.37	285.5	555.25	647	-	-	310.2	287.2	453.9	266.2	-	-
4.	Pesticide expenditure	549.2	279.5	798	898	-	-	359.0	360.0	714.5	267.9	-	-
5.	Fertiliser expenditure	308.9	284.7	260.2	231	-	-	257.5	270.0	385.0	260.0	-	-
6.	Manhours employed	159.5	189.36	46.99	289	-	-	60.94	59.25	170.5	168.3	-	-
7.	Capital invested	4237	4848	685.5	439.6	-	-	10100	12750	23420	39792	-	-
8.	Tractor timings	5.01	465	2.16	1.58	-	-	4.18	3.15	2.96	3.38	-	-

TABLE XXXIV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Type B Village													
1.	Output	68.15	59.12	11.05	10.75	-	-	11.28	76.26	12.15	6.15	68.14	58.8
2.	Cropped area	5.12	4.85	5.48	3.25	-	-	4.24	4.56	5.89	4.82	3.37	4.72
3.	Seed expenditure	41.00	32.95	798.5	657.8	-	-	518.6	457.1	25.71	398.5	291.3	171.2
4.	Pesticide expenditure	48.95	35.00	700	850	-	-	303.7	257.8	248.5	390.0	204.0	109.2
5.	Fertiliser expenditure	301.10	270.0	250	215	-	-	349.9	345.0	242.5	210.0	425.0	145.9
6.	Man hours employed	112.8	115.5	30.29	29.75	-	-	42.39	66.48	115.8	100.5	48.46	46.15
7.	Capital invested	7200	8250	5795	6200	-	-	60770	76630	10750	18450	60420	15740
8.	Tractor timings	4.38	5.02	4.05	3.98	-	-	3.40	2.22	4.38	3.21	2.27	1.42
II. Perur													
Type A Village													
1.	Output	64.28	59.45	7.63	5.09	-	-	72.35	53.40	5.89	304	-	-
2.	Cropped area	6.25	5.48	3.58	2.03	-	-	5.03	356	1.07	2.06	-	-
3.	Seed expenditure	3975	2752	567.15	441.77	-	-	2759.94	1269.4	850.46	1016.01	-	-
4.	Pesticide expenditure	5415	2600	120.44	87.37	-	-	956.31	1903.7	1065.61	1136.57	-	-
5.	Fertiliser expenditure	3015	2700	1094.96	768.42	-	-	2657.05	7302.9	1323.89	1304.66	-	-
6.	Manhours employed	100.8	95.26	66.34	58.33	-	-	35.01	17.16	63.97	63.48	-	-

TABLE XXXIV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
7.	Capital invested	5616	5725	2746.62	1715.14	-	-	7661.25	7159.78	1139.46	7082.71	-	-
8.	Tractor timings	408	395	3.01	1.95	-	-	3.38	2.08	2.67	2.30	-	-
Type B Village													
1.	Output	-	-	5.14	4.44	4.45	8.03	-	-	1.29	3.66	5.17	7.35
2.	Cropped area	-	-	284	240	3355	267	-	-	6.56	4.41	4.14	3.69
3.	Seed expenditure	-	-	616.3	378.8	624	1852	-	-	1037	861.6	436.7	913.8
4.	Pesticide expenditure	-	-	923.2	610.2	314.5	541.3	-	-	604.5	119	615.3	853.3
5.	Fertiliser expenditure	-	-	1801	914.1	8403	1209	-	-	949.9	171.8	446.7	994.7
6.	Manhours employed	-	-	90.69	95.94	65.35	31.99	-	-	124.6	81.49	63.12	58.18
7.	Capital invested	-	-	6713	6884	8149	7389	-	-	36.65	7727	16250	18670
8.	Tractor timings	-	-	1.47	1.61	3.19	1.61	-	-	1.76	1.62	1.92	1.70
III. Karamadai													
Type A Village													
1.	Output	59.15	52.71	13.5	7.84	-	-	-	-	35.14	38.93	-	-
2.	Cropped area	5.98	5.41	2.58	2.93	-	-	-	-	8.02	12.32	-	-
3.	Seed expenditure	3945	3150	835.2	524.6	-	-	-	-	678.7	2787	-	-
4.	Pesticide expenditure	5100	3500	648.2	531.4	-	-	-	-	544.9	265.3	-	-
5.	Fertiliser expenditure	3010	2955	579.3	526.9	-	-	-	-	867.6	227.6	-	238

TABLE XXXIV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
6.	Manhours employed	115.5	156.5	50.79	45.09	-	-	-	-	125.8	67.47	-	-
7.	Capital invested	4500	4952	3815	3906	-	-	-	-	38160	18420	-	-
8.	Tractor timings	4.98	4.54	1.43	1.07	-	-	-	-	1.36	1.26	-	-
Type B Village													
1.	Output	-	-	4.29	5.68	16.41	10.8	-	-	4.94	685	7.89	10.90
2.	Cropped area	-	-	2.5	2.97	2.58	2.19	-	-	2.72	3.12	3.32	3.48
3.	Seed expenditure	-	-	381.5	614.2	739.8	615.4	-	-	462.48	1069.05	650.12	75042
4.	Pesticide expenditure	-	-	199.7	294.9	324.8	215.4	-	-	135.4	68.75	101.5	73.72
5.	Fertiliser expenditure	-	-	501.4	319.6	483.4	387.2	-	-	391.6	764.18	154.63	87.13
6.	Manhours employed	-	-	100.5	109.7	85.39	66.95	-	-	61.36	56.81	61.81	101.82
7.	Capital invested	-	-	8746	8410	22970	117890	-	-	8584	5977	14461	15991
8.	Tractor timings	-	-	1.43	2.40	1.67	1.16	-	-	2.17	2.16	2.17	2.39
IV. Palladam													
Type A Village													
1.	Output	13.05	21.69	8.42	478	8.77	6.69	-	-	4.86	3.91	-	-
2.	Cropped area	10.01	1.54	3.74	372	7.88	4.66	-	-	4.66	3.22	-	-
3.	Seed expenditure	1774	1543	534.3	4130	962.7	446.6	-	-	795.4	842.2	-	-
4.	Pesticide expenditure	2864	2592	824.9	658.6	2117	771.2	-	-	1096	178.8	-	-

TABLE XXXIV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
5.	Fertiliser expenditure	4897	3461	908.4	852.3	3414	873.0	-	-	1508	3091	-	-
6.	Manhours employed	255.4	145.1	78.88	40.40	164.4	83.62	-	-	114.9	95.57	-	-
7.	Capital invested	28710	9407	2332	2190	18660	5327	-	-	5117	7463	-	-
8.	Tractors employed	2.08	1.19	1.09	1.19	1.48	1.09	-	-	2.07	1.19	-	-
Type B Village													
1.	Output	-	-	4.14	3.05	4.10	2.86	-	-	3.39	2.09	48.14	40.26
2.	Cropped area	-	-	2.68	2.89	2.86	2.76	-	-	5.71	3.46	326	342
3.	Seed expenditure	-	-	431.1	225.8	398.71	300.0	-	-	446.7	526	1025	980
4.	Pesticides expenditure	-	-	536.3	759	583.7	200.1	-	-	828.8	454.6	856.2	798.7
5.	Fertilizer expenditure	-	-	969	617	959.5	1033.4	-	-	1086	1227	905.2	1046.2
6.	Manhours employed	-	-	68.10	95.40	71.25	73.69	-	-	162.6	162.5	67.15	65.20
7.	Capital invested	-	-	4002	5899	5816	4430	-	-	11460	17300	15430	17355
8.	Tractors employed	-	-	1.22	1.04	1.09	1.09	-	-	1.60	1.08	1.36	1.42
V. Annur													
Type A Village													
1.	Output	10.00	8.60	11.24	11.09	4.94	4.42	-	-	-	-	10.57	8.62
2.	Cropped area	3.02	5.68	2.83	5.93	1.64	1.36	-	-	-	-	29.13	5.97

TABLE XXIV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
3.	Seed expenditure	973.86	123.05	549.3	430.4	455.8	635.9	-	-	-	-	527	515.9
4.	Pesticide expenditure	1898.45	3064.07	464.1	1476	406	518.3	-	-	-	-	219	459.8
5.	Fertiliser expenditure	31188	4538.37	2165	1461	407.9	1579	-	-	-	-	1497	1888
6.	Manhours employed	5700	113.18	25.61	69.28	48.91	1148.6	-	-	-	-	56.49	60.84
7.	Capital invested	2703	8546.73	3781	4413	2757	7280	-	-	-	-	3056	6033
8.	Tractor timings	2.21	1.48	1.36	1.46	1.16	1.13	-	-	-	-	13.78	11.90
Type B Village													
1.	Output	-	-	7.2	6.00	5.50	3.86	-	-	-	-	-	-
2.	Cropped area	-	-	1.36	1.95	1.95	2.22	-	-	-	-	-	-
3.	Seed expenditure	-	-	503.82	505.24	505.24	393.10	-	-	-	-	-	-
4.	Pesticide expenditure	-	-	358.2	233.02	233.02	190.05	-	-	-	-	-	-
5.	Fertiliser expenditure	-	-	115.0	109.2	1092	743.81	-	-	-	-	-	-
6.	Manhours employed	-	-	44.28	45.25	45.25	43.77	-	-	-	-	-	-
7.	Capital invested	-	-	2770	2320	2320	3101	-	-	-	-	-	-
8.	Tractor timings	-	-	1.42	1.28	1.28	1.73	-	-	-	-	-	-

Based on the estimated elasticity coefficients of inputs (vide Table XXVI) and geometric means of output and inputs given in Table XXXIV, marginal value productivity of inputs was estimated. Table XXXV presents the estimated crop wise marginal value productivity of inputs. Appendix XIV describes a sample estimation of marginal value productivity of output and inputs.

TABLE XXXV
ESTIMATED CROPPWISE MARGINAL VALUE PRODUCTIVITIES OF INPUTS IN THE STUDY FARMS

S.No.	Input	Paddy			Cholam			Maize			Sugarcane			Cotton			Groundnut		
		HYV	NHYV	(3)	HYV	NHYV	(4)	HYV	NHYV	(5)	HYV	NHYV	(6)	HYV	NHYV	(7)	HYV	NHYV	(8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
I. Pollachi South																			
Type A Village																			
1.	Cropped area	3.07	3.84	32.03	-8.41	-	-	-51.26	-1.57	3.42	10.74	-	-	-	-	-	-	-	-
2.	Seeds	-.00005	-.00014	.0112	.0047	-	-	1.32	.031	-.000021	.00068	-	-	-	-	-	-	-	-
3.	Pesticides	.00034	.00008	-.0088	.000014	-	-	-.00026	.000029	-.0031	-.00061	-	-	-	-	-	-	-	-
4.	Fertiliser	-.00024	.000036	.0029	.607	-	-	-.0011	-.000021	.00003	-.0017	-	-	-	-	-	-	-	-
5.	Labour	-.0093	-.0028	-3.55	-.068	-	-	.1969	.03045	.00004	-.0188	-	-	-	-	-	-	-	-
6.	Capital	.000075	.000001	.0026	.0000019	-	-	.00002	.000026	.0123	.0000001	-	-	-	-	-	-	-	-
7.	Tractor timings	38.06	-1.61	546.61	189.22	-	-	216.11	49.35	.4894	37.64	-	-	-	-	-	-	-	-
8.	Y	29	21	13	28	-	-	28	20	21	20	-	-	-	-	-	-	-	-
Type B Village																			
1.	Cropped area	.4495	9.10	3.46	5.28	-	-	-558.42	51.63	3.42	.27	5.99	368.36	-	-	-	-	-	-
2.	Seeds	-.000008	-.00042	.0018	-.18	-	-	.00041	-.13	-.00002	-.00004	.00003	-.278	-	-	-	-	-	-

TABLE XXXV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
3.	Pesticides	-.000024	.00035	-.0018	-.0005	-	-	-.0021	-.00002	-.00331	.000028	.00096	3.44
4.	Fertiliser	-.000069	.00089	.0015	.003	-	-	.00038	.0002	.00089	.00003	.000064	-.00001
5.	Labour	-.4945	-.0189	-.061	.0012	-	-	-.0532	.0011	.000004	-.00096	.0106	-1.25
6.	Capital	.0000008	-.00002	.0004	.00009	-	-	.00010	.0000005	-.0123	.000007	.0000016	.0000032
7.	Tractor timings	-34.57	-46.63	4.68	-.0004	-	-	-.000006	15.73	.4939	3.10	46.89	.3787
N		27	25	25	20	-	-	25	22	28	25	29	20
II. Perur													
Type A Village													
1.	Cropped area	-22.97	-18.63	3.19	-1.5	-	-	-341.42	-2.35	-24.03	36.74	-	-
2.	Seeds	-.00004	-.00009	.0006	-.0008	-	-	.00003	-.00005	.00004	.00047	-	-
3.	Pesticides	-.00029	.000018	-.004	-.006	-	-	.0009	-.000056	-.00002	-.0004	-	-
4.	Fertilisers	.000097	.000034	.0003	.0005	-	-	.0009	.000002	.00054	-.0008	-	-
5.	Labour	-.0011	.00099	-.0007	.0008	-	-	.0040	.00089	.0025	-.0081	-	-
6.	Capital	-.000013	.000015	.00002	-.00001	-	-	-.0001	-.00001	-.00003	.000004	-	-
7.	Tractor timings	.311	23.12	9.98	-.49	-	-	28.74	4.40	-.0132	30.39	-	-
N		28	27	26	29	-	-	29	28	29	24	-	-
Type B Village													
1.	Cropped area	-	-	-1.63	-1.73	-1.86	-19.14	-	-	-1.57	.000058	-1.27	-.16
2.	Seeds	-	-	.00008	-.00037	.000035	.00001	-	-	.000058	.00011	.00011	-.00004
3.	Pesticides	-	-	-.0029	-.045	-.00005	-.00003	-	-	-.0022	-.0022	-.00084	.00066

TABLE XXXV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
4.	Fertiliser	-	-	-.004	-.0214	-.00013	-.000053	-	-	-.00011	-.0038	-.0004	.00036
5.	Labour	-	-	.000092	.0005	.0023	.0080	-	-	.0011	.00032	-.0001	-.00032
6.	Capital	-	-	-.000005	-.000001	.000003	.000004	-	-	.00005	-.000006	.00004	.0000008
7.	Tractor timings	-	-	7.99	-7.33	.0011	-2.34	-	-	-10.16	4.28	10.85	4.32
	N	-	-	25	29	27	21	-	-	24	25	22	21
III. Karamadai													
Type A Village													
1.	Cropped area	-4.01	1.63	-.43	-4.53	-	-	-	-	-4.01	1.63	-	-
2.	Seeds	.00009	-.0006	-.000005	-.00003	-	-	-	-	.00009	-.0006	-	-
3.	Pesticides	.000013	-.00009	.000004	.0001	-	-	-	-	.00001	.00009	-	-
4.	Fertilisers	-.00002	.00018	.00007	.00007	-	-	-	-	-.00002	.00018	-	-
5.	Labour	.0423	-2.16	.0002	-.0135	-	-	-	-	.0423	-2.16	-	-
6.	Capital	-.00002	.00004	-.00001	.00006	-	-	-	-	-.000002	.00004	-	-
7.	Tractor timings	-1.05	15.87	1.92	-3.80	-	-	-	-	-1.05	15.87	-	-
	N	28	22	25	20	-	-	-	-	22	29	-	-
Type B Village													
1.	Cropped area	-	-	-.93	-1.63	73.70	-3.33	-	-	-.90	5.01	-3.22	19.77
2.	Seeds	-	-	.00004	.00002	-.026	-.0047	-	-	.00002	-.00007	.00006	-.0008

TABLE XXXV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
3.	Pesticides	-	-	.0002	.01909	-.0002	.0028	-	-	-.00013	-.0001	.00037	.00029
4.	Fertilisers	-	-	.00017	.0002	.0036	.00006	-	-	.000012	.00008	-.00049	.00027
5.	Labour	-	-	-.0031	-.0006	3.21	-.92	-	-	.00004	-.0204	-.0006	-.0007
6.	Capital	-	-	.000027	-.00005	31.76	-.0003	-	-	-.00005	.00004	.00002	-.00002
7.	Tractor timings	-	-	3.23	-.3035	-47.0	49.65	-	-	2.43	4.30	5.01	36.08
N		-	-	27	23	25	28	-	-	27	21	28	26
IV. Palladam													
Type A Village													
1.	Cropped area	-72.5	-60.9	-1.28	-.20	-.08	-9.47	-	-	-.70	-.62	-	-
2.	Seeds	-.00013	.00017	.0008	-.00028	-.00005	-.00010	-	-	.00034	-.0010	-	-
3.	Pesticides	-.00001	-.0008	.0002	.00003	.00012	.00059	-	-	.000042	.00065	-	-
4.	Fertilisers	-.00002	.00007	-.00028	.00021	.00020	.0004	-	-	-.000031	.00051	-	-
5.	Labour	-1.78	.071	-.009	.0001	.0003	-.0003	-	-	.02009	.0080	-	-
6.	Capital	.00007	.00001	-.00004	-.00002	.000002	.000059	-	-	.00010	.0052	-	-
7.	Tractor timings	-27.71	27.63	29.61	10.59	21.31	11.91	-	-	7.60	7.01	-	-
N		27	15	29	18	22	20	-	-	25	28	-	-
Type B Village													
1.	Cropped area	-	-	-.89	-.16	1.03	-.39	-	-	-.46	.15	-.01	-.02
2.	Seeds	-	-	.0009	-.004	.0008	-.00086	-	-	-.00006	-.00002	-.00003	-.0001

TABLE XXXV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
3.	Pesticides	-	-	.0015	.0016	-.0004	.0008	-	-	.00005	.00009	.003	.001
4.	Fertilisers	-	-	-.00017	.0006	.0001	.0074	-	-	-.00001	.00003	-.0003	-.0011
5.	Labour	-	-	-.0048	.0035	-.0004	.00012	-	-	-.0072	.00029	-.0003	-.0023
6.	Capital	-	-	-.000001	-.00003	.00003	.00063	-	-	.00001	-.00001	.00002	.0017
7.	Tractor timings	-	-	12.94	7.26	7.90	3.31	-	-	7.42	-.01	3.40	1.20
N		-	-	22	28	20	25	-	-	25	27	23	29
V. Annur													
Type A Village													
1.	Cropped area	-.320	-3.65	-1.78	1.30	2.06	-16.82	-	-	-	-	.99	-.0028
2.	Seeds	.00019	.00006	.0004	.0005	.0002	-.002	-	-	-	-	-.0002	.0005
3.	Pesticides	.0001	.00005	.2179	-.0007	-.0240	.0002	-	-	-	-	-.0019	-.0002
4.	Fertilisers	.00006	.0004	.0002	.00002	.0004	-.0002	-	-	-	-	-.00005	-.00003
5.	Labour	.0096	.0004	.25	-.0076	.0093	.118	-	-	-	-	.0069	.0208
6.	Capital	-.0002	-.00002	.0283	-.0002	-.0002	.000002	-	-	-	-	-.00001	.0008
7.	Tractor timings	.95	14.06	4.21	23.21	-.10	70.78	-	-	-	-	-.03	29.13
N		22	25	29	27	28	29	-	-	-	-	24	21

TABLE XXXV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Type B Village													
1.	Cropped area	-	-	-3.42	-3.56	-.48	-2.49	-	-	-	-	-	-
2.	Seeds	-	-	.0001	-.00012	.00007	.00097	-	-	-	-	-	-
3.	Pesticides	-	-	.0079	.0005	.00005	.0012	-	-	-	-	-	-
4.	Fertilisers	-	-	.00008	.00001	.00026	-.000	-	-	-	-	-	-
5.	Labour	-	-	-.0228	-.0374	.0001	-.0191	-	-	-	-	-	-
6.	Capital	-	-	.000002	.00004	.00005	.00002	-	-	-	-	-	-
7.	Tractor timings	-	-	2.48	5.10	2.22	2.24	-	-	-	-	-	-
N		-	-	25	28	27	25	-	-	-	-	-	-

In the high irrigated village of Pollachi South block, for paddy, and maize, the marginal value productivity of tractor timings had been high implying that tractor use had contributed significantly for increase in production of these crops. However, for the commercial crops - sugarcane and cotton, the marginal value productivity of fertiliser and pesticides were positive indicating that these resources were efficiently utilised. In the low irrigated village of Pollachi South block, for paddy and groundnut, the contribution of bio chemical inputs were positive as indicated by the estimated marginal value productivities.

In Perur block, in the high irrigated village, for all HYV farms cultivating paddy, cholam, sugarcane or cotton, the marginal value productivity of seeds and fertilisers were positive. This implies that if there is adequate supply of water, greater benefit can be obtained by using bio chemical inputs. In the low irrigated village of Perur block, for the HYV farms cultivating cholam, maize or cotton or groundnut, the estimated marginal value productivity of tractor timings had been the highest. For instance one rupee spent on hiring tractors for groundnut cultivation would increase the output of groundnut by Rs. 10.85.

In Karamadai block also, there had been a differential in marginal value productivity between HYV and NHYV farms. In the high irrigated village, for paddy, cholam and cotton, for HYV farms, the marginal value productivity of pesticides was positive. This implies that pesticides was the crucial input in these farms. But for NHYV farms, the contribution of tractor timings was positive. In the low irrigated village, for HYV

farms cultivating cholam, cotton and groundnut, the use of tractors have made a positive contribution to total output. For maize, the conventional input - labour contributed more since one rupee spent on labour increased the output by Rs.31.76.

In Palladam block, in both high and low irrigated villages, for all the crops, except for NHYV cotton, the contribution of tractor timings was positive. This implies that, though Palladam is a low irrigated block, the farmers were benefited by using tractors.

Similarly, in Annur block, in both high and low irrigated villages, for all the crops, except for HYV maize and groundnut, the tractor use was contributing more to total output. For maize and groundnut, the marginal value productivity of labour and capital were positive implying the role of conventional inputs in production.

As a whole, the analysis about marginal value productivity indicates that in high irrigated villages, the role of technological factors was primary while in low irrigated villages, there was only secondary role of technological factors. Further, the spread of technology was selective since paddy, sugarcane, cotton and groundnut were more affected by technological factors as compared to cholam and maize. Wherever technology was an important variable, tractor use seemed relatively more important. In all the crops, where it was used its marginal value productivity significantly differed from zero.

This is not in conformity with the findings of Prakash and Rajan (1976) and Sitaram (1984) that of the technological variables, chemical fertiliser was the essential factor in bringing about higher output for the selected farmers in Madhyapradesh.

b. Determination of Factor Substitution

The current study estimated marginal rate of substitution between factors by using the method as

$$MRS X_1 X_i = \frac{\hat{b}_1}{\hat{b}_i} X_i$$

where

- $\hat{b}_1$ = Elasticity coefficient of the factor for which MRS is estimated ;
- $\hat{b}_i$ = Elasticity coefficient of ith factor ; and
- X_i = Geometric mean of ith input.

Table XXXVI presents the estimated marginal rate of substitution between factors in the selected farms. A sample of the estimated marginal rate of substitution between factors is given in Appendix XV.

TABLE XXXVI

ESTIMATED MARGINAL RATE OF SUBSTITUTION BETWEEN FACTORS IN THE SELECTED FARMS

S.No.	Crop	Marginal rate of substitution of land for			Marginal rate of substitution of fertiliser for			Marginal rate of substitution of labour for			Marginal rate of substitution of tractor for labour
		Labour	Fertiliser	Other working expenses	Land	Labour	Other working expenses	Land	Tractor	Fertiliser	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I. Pollachi South											
1.	Paddy										
	HYV	54.07	395.13	260.15	.53	.45	2.03	.02	.012	115.83	67.4
	NHYV	25.96	303.68	783.08	.57	.26	7.34	.04	.008	221.35	108.8
2.	Cholam										
	HYV	48.96	287.68	240.6	.59	.46	2.05	.03	.011	97.63	4.28
	NHYV	22.38	215.14	650.38	.52	.34	4.32	.06	.026	86.48	36.1
3.	Sugarcane										
	HYV	52.18	482.68	290.25	.65	.41	2.08	.09	.015	100.45	56.12
	NHYV	24.86	353.15	778.15	.52	.31	4.15	.03	.004	147.26	60.15
4.	Cotton										
	HYV	49.16	381.16	270.5	.58	.49	2.18	.05	.013	120.46	60.2
	NHYV	32.15	290.15	650.7	.46	.55	4.35	.06	.004	200.45	72.1

TABLE XXXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Type B Village											
1.	Paddy										
	HYV	48.05	381.18	270.15	.65	.42	2.65	.06	.015	100.8	62.5
	NHYV	35.16	292.65	726.15	.58	.31	6.95	.03	.009	150.5	76.2
2.	Cholam										
	HYV	34.16	200.15	220.6	.65	.42	2.15	.04	.012	87.15	46.2
	NHYV	20.18	195.78	460.5	.47	.38	4.28	.09	.036	92.0	38.2
3.	Sugarcane										
	HYV	59.15	412.60	187.56	.58	.46	3.15	.08	.019	126.4	50.2
	NHYV	26.18	300.68	782.5	.52	.35	3.68	.07	.007	160.8	48.5
4.	Cotton										
	HYV	48.12	320.5	200.5	.72	.36	2.91	.07	.015	160.5	40.5
	NHYV	36.15	280.6	400.6	.41	.35	5.25	.09	.008	205.2	36.2
5.	Groundnut										
	HYV	42.15	280.2	180.2	.69	.32	3.15	.05	.022	150.2	38.6
	NHYV	32.60	200.6	290.5	.58	.36	4.68	.08	.009	175.6	31.2
II. Perur											
Type A Village											
1.	Paddy										
	HYV	51.15	357.61	250.68	.48	.42	2.15	.05	.015	141.53	58.16
	NHYV	32.16	315.28	650.15	.47	.36	6.18	.09	.007	200.85	72.60

TABLE XXXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2.	Cholam										
	HYV	46.64	215.42	260.6	.51	.42	2.15	.05	.015	96.15	46.1
	NHYV	32.15	260.98	450.5	.46	.38	3.68	.06	.036	81.6	32.6
3.	Sugarcane										
	HYV	48.16	400.65	260.72	.69	.39	2.16	.07	.014	110.5	55.6
	NHYV	38.65	397.15	650.16	.49	.28	4.68	.04	.003	135.2	52.1
4.	Cotton										
	HYV	48.15	360.5	260.5	.59	.37	2.12	.07	.014	160.5	58.4
	NHYV	30.16	280.2	425.5	.46	.32	4.39	.08	.005	180.4	60.2
Type B Village											
1.	Cholam										
	HYV	57.16	300.98	260.15	.46	.41	2.46	.06	.016	150.2	38.2
	NHYV	48.15	312.65	460.5	.49	.39	4.18	.07	.009	160.6	65.4
2.	Maize										
	HYV	42.16	214.65	250.4	.52	.40	2.18	.04	.012	92.16	42.6
	NHYV	30.82	240.68	380.6	.49	.36	3.62	.02	.046	82.8	36.5
3.	Cotton										
	HYV	46.15	350.4	248.6	.62	.39	2.16	.05	.015	150.2	56.2
	NHYV	32.16	260.4	400.8	.48	.35	4.26	.09	.002	160.6	48.2
4.	Groundnut										
	HYV	42.16	250.8	215.4	.58	.36	2.12	.04	.014	160.5	54.6
	NHYV	36.5	260.2	300.4	.44	.32	3.68	.08	.005	140.2	44.8

TABLE XXXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
III. Karamadai											
Type A Village											
1.	Paddy	HYV NHYV	48.68 36.15	300.68 312.41	260.65 620.18	.49 .48	.46 .38	2.65 4.18	.04 .08	146.2 200.8	48.14 58.16
2.	Cholam	HYV NHYV	42.14 36.12	200.15 250.64	240.9 380.6	.55 .47	.49 .37	2.65 3.12	.04 .02	92.65 82.26	42.1 30.6
3.	Cotton	HYV NHYV	46.12 30.15	300.18 240.6	240.4 400.8	.58 .46	.32 .36	2.64 3.48	.06 .09	150.4 160.5	54.2 58.4
Type B Village											
1.	Cholam	HYV NHYV	41.15 32.16	280.16 240.6	200.08 315.04	.52 .46	.48 .38	2.54 3.15	.09 .07	96.15 81.58	40.15 32.68
2.	Maize	HYV NHYV	38.18 40.14	195.25 186.60	250.5 295.6	.58 .42	.59 .31	2.65 3.12	.08 .03	86.15 78.15	38.16 36.65
3.	Cotton	HYV NHYV	40.15 39.64	200.64 220.65	180.05 300.15	.46 .38	.42 .39	2.68 3.15	.08 .06	94.25 86.61	38.16 32.15
4.	Groundnut	HYV NHYV	38.15 36.65	180.6 250.4	300.6 280.4	.42 .39	.46 .38	2.45 3.12	.04 .05	90.2 84.6	30.6 28.4
IV. Palladam											
Type A Village											
1.	Paddy	HYV NHYV	44.15 38.12	354.64 300.12	240.42 516.68	.48 .44	.42 .36	2.54 3.68	.06 .09	144.6 215.2	46.68 38.12
2.	Cholam	HYV NHYV	40.14 39.64	250.42 260.64	200.8 324.2	.59 .48	.46 .38	2.48 3.14	.06 .04	96.15 80.15	46.5 32.4

TABLE XXXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
3.	Maize	HYV NHV	186.24 190.40	260.4 282.4	.56 .42	.48 .32	2.54 3.16	.07 .04	.014 .012	74.65 72.15	34.65 32.15
4.	Cotton	HYV NHV	280.15 220.65	190.05 320.62	.44 .32	.46 .38	2.54 4.62	.07 .05	.014 .015	92.62 84.15	34.12 36.65
Type B Village											
1.	Cholam	HYV NHV	300.18 380.4	260.5 415.2	.44 .48	.46 .38	2.48 3.16	.04 .08	.012 .003	140.5 200.6	44.44 36.5
2.	Maize	HYV NHV	200.6 250.15	205.4 320.6	.52 .46	.42 .36	2.64 3.12	.05 .03	.012 .003	92.16 80.15	42.5 36.2
3.	Cotton	HYV NHV	240.62 260.4	180.14 290.42	.48 .39	.42 .36	2.98 3.62	.05 .04	.012 .014	96.12 82.65	36.12 32.60
4.	Groundnut	HYV NHV	280.4 220.6	190.4 280.4	.46 .42	.38 .29	2.54 3.28	.09 .07	.015 .016	84.65 78.20	34.15 32.30
V. Annur											
Type A Village											
1.	Paddy	HYV NHV	200.14 250.22	260.54 315.25	.49 .38	.44 .32	4.36 1.38	.03 .04	.05 .013	160.2 250.4	46.4 38.2
2.	Cholam	HYV NHV	180.4 200.6	300.5 280.4	.52 .46	.42 .31	2.58 3.15	.04 .01	.015 .004	84.64 92.65	46.2 38.9
3.	Maize	HYV NHV	240.5 215.2	200.2 190.4	.42 .39	.41 .36	1.96 2.56	.09 .04	.022 .003	71.64 82.42	44.1 36.5

TABLE XXXVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
4.	Groundnut	HYV NHV	42.9 44.6	220.4 260.4	270.4 250.6	.46 .42	1.88 2.15	.08 .07	.024 .006	78.15 82.16	38.15 40.16
Type B Village											
1.	Cholam	HYV NHV	52.6 42.5	180.18 200.64	250.5 300.4	.49 .48	2.64 3.15	.06 .04	.012 .003	78.2 96.4	44.2 36.9
2.	Maize	HYV NHV	46.2 44.2	260.4 250.2	200.8 190.4	.46 .38	2.15 2.95	.04 .02	.016 .004	74.2 76.4	46.2 38.4

In the high irrigated village of Pollachi South, an additional dose of fertiliser by Rs. 215.14 to Rs. 482.68 would substitute an acre of land. The use of fertilisers by one kilogram can save land to the extent of .46 to .53 acres. In the low irrigated village, an additional dose of fertiliser by Rs. 196.78 to Rs. 412.6 would save one acre of land.

In Perur block, in the high irrigated village, the marginal rate of substitution of land for fertiliser was ranging from Rs. 215.42 to Rs. 400.65. The corresponding figure in the low irrigated village was from Rs. 214.65 to Rs. 350.4. Per unit of fertiliser use can save land to the extent of .46 to .69 acres in high irrigated villages and .44 to .62 acres in low irrigated villages.

In the high irrigated village of Karamadal block, an additional dose of fertiliser by Rs. 200.15 to Rs. 300.68 would substitute an acre of land. The application of fertiliser by one unit would save land to the extent of .46 to .58 acres. In the low irrigated village, the marginal rate of substitution of land in respect of fertiliser was ranging from Rs. 180.6 to Rs. 280.6.

In Palladam block in the high irrigated village, the marginal rate of substitution of land in respect of fertiliser was ranging from Rs. 186.24 to Rs. 354.64. In the low irrigated village, the figure was from Rs. 200.6 to Rs. 380.4. The use of fertiliser by one unit would save land to the extent of .32 to .59 acres in the high irrigated village and .39 to .52 acres in the low irrigated village.

In Annur block, in the high irrigated village, an additional dose of fertiliser by Rs.180.4 to Rs.260.4 would save an area of land. The corresponding figure in the low irrigated village was Rs.180.18 to Rs.260.4.

As a whole, in all the study villages, the use of technology - specifically fertiliser was a better substitute for land. The use of fertiliser helped to obtain more output by saving land resource. Hence the current study is in conformity with the general proposition that biochemical inputs are land saving in character.

e. Impact of Technical Change on Share of Different Factors in Total Production

To determine the change in relative factor shares, the current study had used the Hicksian concept of bias in factor shares. The bias was estimated as follows :

$$B_i = \frac{b_i (HYV) - b_i (LV)}{b_i (LV)}$$

where B_i is the bias in factor share of i th factor and b_i 's are relative factor shares. Table XXXVII gives the estimated bias in factor shares. Appendix XVI describes the method of estimation of bias in factor shares.

TABLE XXXVII

ESTIMATED BIAS IN SHARE OF DIFFERENT FACTORS IN TOTAL PRODUCTION

S.No.	Crop	Land	Seeds	Pesticides	Fertilisers	Labour	Capital	Tractor timings
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
I. Pollachi South								
Type A Village								
1.	Paddy	-1.07	-.92	-.89	.04	-1.31	0.80	3.38
2.	Cholam	-1.87	3.08	-8.8	-.94	-4.8	1.29	3.0
3.	Sugarcane	9.29	1.75	-4.09	21.9	1.89	-9.933	2.92
4.	Cotton	-1.17	-.98	-.97	-1.03	-1.03	9.0	-1.01
	$\bar{X}$	1.29	2.93	-3.68	4.99	-1.31	.29	2.07
Type B Village								
1.	Paddy	-5.23	-1.03	-1.3	-1.13	-.47	1.88	-.005
2.	Cholam	-.83	-4.0	-.44	0.16	.26	.52	-4.98
3.	Sugarcane	-.02	-1.57	.18	-.73	2.19	-1.35	.13
4.	Cotton	56.23	-.71	-2.0	-.68	-0.9	1.26	-.22
5.	Groundnut	4.66	-1.99	7.58	-.81	-2.93	-3.83	-.7
	$\bar{X}$	10.96	-1.86	.80	-16.67	42.99	.30	-1.15

TABLE XXXVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
II.	Perur							
	Type A Village							
1.	Paddy	.25	.13	-18.85	4.6	-2.8	-2.25	-.98
2.	Cholam	-2.56	.66	-.12	-.26	-7.8	7.15	-19.8
3.	Maize	-	-	-	-	-	-	-
4.	Sugarcane	14.10	-2.0	-7.3	-2.13	-.32	-8.69	17.22
5.	Cotton	-.75	3.95	-1.98	-1.00	-.83	-1.10	-.71
6.	Groundnut	-	-	-	-	-	-	-
	$\bar{X}$	2.76	.68	-7.06	.30	2.93	1.22	-1.08
	Type B Village							
1.	Paddy	-	-	-	-	-	-	-
2.	Cholam	.97	-.3	-.75	-.63	-.71	-2.3	1.59
3.	Maize	-.76	-.5	1	-.01	-.73	4.3	-2.72
4.	Sugarcane	-	-	-	-	-	-	-
5.	Cotton	-.63	-1.98	-1.2	2.0	-1.5	-.7	-.79
6.	Groundnut	11.75	-2.88	.42	-.18	0	-1.6	2.85
	$\bar{X}$	2.83	-1.41	-.13	.29	-.73	-.0075	.23

TABLE XXXVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
III. Karamadai								
Type A Village								
1.	Paddy	-5.92	1.32	-1.42	-1.54	-1.12	-1.15	-1.07
2.	Cholam	-.5	1.5	-.98	-1.01	45.34	0.6	-.67
3.	Maize	-	-	-	-	-	-	-
4.	Cotton	-30.71	-28.5	3.29	-91	-45.34	1.5	61.02
5.	Groundnut	-	-	-	-	-	-	-
	$\bar{X}$	-12.37	-8.56	108.8	-31.18	-30.6	.2	19.76
Type B Village								
1.	Paddy	-	-	-	-	-	-	-
2.	Cholam	-.52	0	-86	0	-1.2	1.7	-7.3
3.	Maize	-11.6	-1.5	-1.1	35	-1.14	-.25	-.54
4.	Cotton	-1.21	-1.16	2.0	-.88	-1.0	4.85	-.21
5.	Groundnut	-1.21	-1.91	1.4	-4.2	8.6	.75	-0.76
	$\bar{X}$	3.63	1.14	.36	8.42	1.58	1.76	-2.2

TABLE XXXVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
IV.	Palladam							
	Type A Village							
1.	Paddy	-.98	1.0	-1.0	.76	-1.77	-.56	5.76
2.	Cholam	-.05	-1.48	-.53	-1.21	-1.06	-.78	.48
3.	Maize	-.98	-.14	-.99	.99	-17.75	-0.2	-2.86
4.	Cotton	-	-	-	-	-	-	-
5.	Groundnut	-	-	-	-	-	-	-
	$\bar{X}$	.56	-2.9	-.44	-.81	-6.27	-.08	.88
	Type B Village							
1.	Paddy	-	-	-	-	-	-	-
2.	Cholam	4.2	-4.0	-.99	-1.28	-1.07	.73	.47
3.	Maize	-2.86	-1.8	-.01	-.48	-3.36	-.51	.66
4.	Cotton	2.88	1.0	2.5	-4.5	-16.0	-2.1	-20.36
5.	Groundnut	.63	18.0	1.2	3.0	.39	.58	.39
	$\bar{X}$	1.21	3.3	.67	.82	-5.01	-.69	-.16

TABLE XXXVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
V.	Annur							
	Type A Village							
1.	Paddy	-.59	.05	-.05	0	-.15	2.47	-.91
2.	Cholam	-7.42	0	-10	-.99	-2.97	-1.5	-.83
3.	Maize	-1.47	-1.07	-3.85	2.75	-.95	-6.1	-1.14
4.	Groundnut	-3.75	-1.3	.63	3.44	-.72	-.04	-1.01
	$\bar{X}$	-3.3	.61	-3.31	1.3	1.19	-1.29	-.97
	Type B Village							
1.	Paddy	-	-	-	-	-	-	-
2.	Cholam	-.61	1.0	.5	-.35	-1.68	1.1	-.72
3.	Maize	-.81	-1.1	-7.0	-4.69	-1.32	.84	-.03
4.	Groundnut	-	-	-	-	-	-	-
	$\bar{X}$	-.71	-1.05	.6	-2.52	1.5	.92	.38

In Pollachi South block, there existed differences in factor shares between high and low irrigated villages. The relative share of seeds, fertilisers and tractor use for the high irrigated villages (2.93, 4.99 and 2.07) exceeded that of low irrigated villages (-1.86, -16.67 and -1.15). This implies that due to the advent of HYV technology, the actual factor share of seeds, fertiliser and tractor timings have significantly increased. However, the share of land, fertiliser, labour and capital in low irrigated villages (10.96, 80, 42.99 and .30) was greater than that of the high irrigated villages (1.29, -3.68, -1.31 and .29). The cropwise analysis of bias in factor shares indicated that in high irrigated village, for paddy and sugarcane cultivation, the share of tractor use and fertiliser use had increased due to the use of technology. But, for cholam, the bias in factor share was the highest with regard to seeds. However in low irrigated village, for the cultivation of food crops, capital had the greatest share while for commercial crops, the share of labour and land were significant.

In the high irrigated village of Perur block, the adoption of technology had created bias in factor share in respect of labour. This result do not support the hypothesis that labourer's share in increased output has decreased with the adoption of HYV seeds. On the other hand it implies modern technology creates additional demand for labour. However, in the low irrigated village of Perur block, there had been high factor share for land implying that in the concerned village, with the use of technology, the farmers were not saving their land resource. Cropwise analysis of bias in factor shares indicated that for paddy,

chulam and cotton the factor share for seeds were significant, while for sugarcane, tractor use was the essential factor.

In Karamadai block, in the high irrigated village, there had been more bias in favour of pesticides (108.8). This might be due to the dominance of cotton cultivation in the area, which in turn requires the application of more pesticides. However, in the low irrigated village, the factor share in respect of fertiliser had been significant (8.42), which implies that in the concerned village, with the use of technology, there had been upward shift in demand for fertiliser. A comparative estimate of factor shares for different crops revealed that in high irrigated village, for paddy and chulam, seeds accounted for the greater share, while for cotton, the factor share in relation to pesticides was significant. However, in low irrigated village, for chulam there had been no bias with regard to the share of seeds and fertilisers implying that the adoption of technology had not created additional demand for seeds and fertilisers.

In the low irrigated block - Palladam, the factor share in respect of land had been significant in both high and low irrigated villages. This implies that the use of agricultural technology in this block, was not land saving in character. In the high irrigated village, for paddy and chulam, the factor share in respect of tractor use had been significant. For cotton, the factor share in respect of pesticides had been significant. Similarly in low irrigated village, for paddy and chulam cultivation, there had been more bias in respect of tractor use. For cotton, land and seeds respectively accounted for a greater share.

- Y = Output produced by using NHYV seeds ;
- r = Value of capital fertiliser, plant protection chemicals and labour required for HYV output ;
- R = Value of capital fertiliser, plant protection chemicals and labour required to produce NHYV output.

Table XXXVIII presents the empirical results of resource saved and resource loss averted per acre by the selected farmers due to technical change. A sample calculation of resource saved and resource loss averted due to technical change is given in Appendix XVII .

TABLE XXXVIII

ESTIMATED VALUE OF RESOURCE SAVED AND RESOURCE LOSS AVERTED PER ACRE BY THE SELECTED FARMERS

DUE TO TECHNICAL CHANGE

(in Rupees)

S.No.	Crop	r	R	y	y ₁	i	R ₊	R ₋
I. Pollachi South								
Type A Village								
1.	Paddy	63455	33853	117.62	130.11	10.61	10.59	3591.80
2.	Cholam	11279	17789	51.55	129.53	251.00	248.79	44650.39
3.	Sugarcane	45592	36406	128.50	235.25	183.07	182.66	66648.20
4.	Cotton	26318	16681	117.93	156.25	3249	31.22	5419.00
5.	Groundnut	-	-	-	-	-	-	-
Type B Village								
1.	Paddy	58400	28700	80.37	85.33	6.17	6.05	30550
2.	Cholam	9300	15650	5.88	10.15	7.26	7.11	17200
3.	Sugarcane	42675	34992	273.37	430	5.72	5.35	39500
4.	Cotton	22340	14295	10.13	49.5	388.64	380.25	25625
5.	Groundnut	20480	12600	50.75	288	467.48	459.20	14200

TABLE XXXVIII (CONTD.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
II.	Perur							
	Type A Village							
1.	Paddy	62700	32700	104.5	144.38	38.07	36.25	34670
2.	Cholam	10580	9390	13.85	33.88	146.00	144.28	14480
3.	Maize	-	-	-	-	-	-	-
4.	Sugarcane	44675	34285	17.11	332.5	1845.70	1842.30	36290
5.	Cotton	23550	15780	7.63	8.63	13.10	12.65	16240
6.	Groundnut	-	-	-	-	-	-	-
	Type B Village							
1.	Paddy	-	-	-	-	-	-	-
2.	Cholam	9800	8600	26.00	17.36	-32.15	-31.25	10100
3.	Maize	8750	7800	34.22	29.77	-12.97	-11.88	10150
4.	Sugarcane	-	-	-	-	-	-	-
5.	Cotton	22780	14900	13.88	20.87	5.02	4.85	16280
6.	Groundnut	18700	11500	31.13	42.46	3.83	3.05	12675

TABLE XXXVIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
III. Karamadai								
Type A Village								
1.	Paddy	58900	30650	158.62	188.56	18.87	17.25	31775
2.	Cholam	9700	81680	16.60	23.88	43.85	42.12	10211
3.	Maize	-	-	-	-	-	-	-
4.	Cotton	22850	14655	14.50	44.88	209.5	200.8	15700
5.	Groundnut	-	-	-	-	-	-	-
Type B Village								
1.	Paddy	-	-	-	-	-	-	-
2.	Cholam	8800	6710	18.94	35.22	16.27	15.02	8650
3.	Maize	7900	6675	30.55	43.25	12.50	11.8	9200
4.	Cotton	-	-	-	-	-	-	-
5.	Groundnut	17595	10928	46.6	45.11	-.03	-.01	11100

TABLE XXXVIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
IV. Palladam								
Type A Village								
1.	Paddy	47600	28495	124.0	193.0	55.64	52.11	30700
2.	Cholam	8900	7750	15.5	23.5	51.61	49.73	9600
3.	Maize	8200	6980	26.0	79.9	178.39	175.01	10200
4.	Cotton	22800	14200	17.3	24.1	39.3	36.25	15750
5.	Groundnut	-	-	-	-	-	-	-
Type B Village								
1.	Paddy	-	-	-	-	-	-	-
2.	Cholam	7650	6800	9.88	17.50	77.12	74.38	10290
3.	Maize	6900	7750	9.13	14.75	61.55	58.42	12100
4.	Cotton	21900	13800	11.38	25.01	119.60	112.4	16750
5.	Groundnut	17680	10490	9.37	15.18	620.00	55.45	12600

TABLE XXXVIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
V. Amur								
Type A Village								
1.	Paddy	45200	25650	45.22	28.77	-36.35	-34.32	26400
2.	Cholam	7200	6705	37.77	72.37	91.58	85.62	8400
3.	Maize	6800	5950	72.33	47.00	-35.02	-32.15	6200
4.	Groundnut	14280	12650	48.50	58.00	19.80	17.65	14110
Type B Village								
1.	Paddy	-	-	-	-	-	-	-
2.	Cholam	6400	5875	9.75	10.87	11.48	9.67	7200
3.	Maize	5200	4552	57	17.00	-70.17	-68.13	4900
4.	Groundnut	-	-	-	-	-	-	-

In high irrigated village of Pollachi South block, HYV led productivity has contributed for saving of resources per acre to the tune of about Rs.249 for cholam, Rs.183 for sugarcane, Rs.31 for cotton and Rs.11 for paddy. The resource loss averted due to the use of technology was the highest for sugarcane Rs.66658 and lowest for paddy (Rs.3592). But in the low irrigated village, resource saving was the highest for groundnut cultivators (Rs.459) and the resource loss avoided by using technology was the highest for sugarcane (Rs.39,500).

In Perur block, in high irrigated village, the adoption of agricultural technology helped to minimise the use of resources and for sugarcane to the extent of Rs.1842 and avoid resource loss of Rs.36290. But in the low irrigated village resource saving effect and resource loss avoiding effect was greater in respect of cotton (Rs.5) and Rs.16280 respectively.

However, in Karamadai block, in high irrigated village, cotton cultivators were able to save resources to a remarkable extent (Rs.200) but the resource loss avoidance was greater in respect of paddy (Rs.31775). In the low irrigated village, resource saving effect was the highest in respect of cholam (Rs.15.02).

In Palladam block, highest resource saving (Rs.178.39) was found in respect of maize and highest resource loss avoidance (Rs.30700) was in respect of paddy in high irrigated village. Comparatively in low irrigated village, the use of agricultural technology helped to save resources to a great extent for cotton (Rs.112.4).

In Annur block, in both high and low irrigated villages, the cultivators of cholam were able to save the use of resources to a great extent (Rs.86 and Rs.10 respectively).

The above analysis indicates that by and large, resource saving effect of technology was noticeable in high irrigated villages, as compared to low irrigated villages. If a crop is cultivated in both the villages, the farmers in the first group were able to turn out output with the minimum use of resources. Hence, irrigation is complementary to the resource saving effect of agricultural technology.

G. Effect of High Yielding Variety Seeds, Fertiliser, Pesticides and Tractors on Farm Output and Output Decomposition Model

The use of high yielding variety seeds, fertilisers, pesticides and farm implements comprise an input package that has led to phenomenal rate of growth of output. The current study tried to find out the effect of these inputs by finding out the differences in output and yield between the farms adopting agricultural technology and not adopting the technology.

a. Effect of High Yielding Variety Seeds on Farm Output and Yield

High yielding variety seeds have a high reproductive potential and short maturity span. Rao (1980) observed that in the areas with high level of fertilisation and controlled irrigation, HYV seeds are able to increase production by stepping up the cropping intensity.

Table XXXIX describes the difference in output and yield between HYV and NHYV farms in the selected villages. A sample 't' test for difference in output and yield between HYV and NHYV farms is given in Appendix XVIII.

TABLE XXXIX

DIFFERENTIALS IN OUTPUT AND YIELD BETWEEN HIGH YIELDING VARIETY AND NON HIGH YIELDING
VARIETY FARMS IN THE SELECTED VILLAGES

S.No.	Crop	Type A Village				Type B Village			
		HYV	NHYV	Percentage difference	t value	HYV	NHYV	Percentage difference	t value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I. Pollachi South									
1.	Paddy								
	Output	130.11	117.62	10.61	0.63	85.33	80.37	61.70	0.19
	Yield	10.43	6.97	49.64	1.24	26.11	20.22	14.76	0.33
2.	Cholam								
	Output	130.331	53.38	144.11	1.39	10.15	5.88	7.26	2.95**
	Yield	38.94	13.53	187.80	0.98	3.00	2.38	11.68	0.37
3.	Sugarcane								
	Output	235.25	128.50	183.50	1.16	430.0	273.37	5.72	1.64
	Yield	46.33	22.13	109.35	1.23	83.60	69.65	2.00	0.61
4.	Cotton								
	Output	156.25	117.93	32.49	3.23**	49.50	10.13	388.64	9.89**
	Yield	27.96	6.96	301.72	2.87**	11.40	2.25	406.60	4.71**
5.	Groundnut								
	Output	-	-	-	-	288.00	507.50	467.48	9.31**
	Yield	-	-	-	-	116.27	11.95	948.36	2.53*

TABLE XXXIX (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
II. Perur									
1. Paddy									
Output		144.38	104.58	39.25	1.02	-	-	-	-
Yield		24.68	20.21	21.82	0.80	-	-	-	-
2. Cholam									
Output		33.87	13.50	115.23	2.60**	26.00	17.63	33.3	4.07**
Yield		11.70	7.66	38.31	0.93	6.72	6.52	0.45	0.26
3. Maize									
Output		-	-	-	-	34.22	29.77	22.72	0.29
Yield		-	-	-	-	8.33	5.85	49.25	1.11
4. Sugarcane									
Output		332.50	117.11	125.80	12.83**	-	-	-	-
Yield		82.08	42.66	95.23	0.35	-	-	-	-
5. Cotton									
Output		8.63	7.63	6.95	5.15**	20.87	13.88	48.61	1.19
Yield		7.42	3.46	100.25	5.75**	3.85	1.96	97.21	3.39**
6. Groundnut									
Output		-	-	-	-	42.66	31.33	45.23	0.93
Yield		-	-	-	-	11.63	5.89	95.24	1.49

TABLE XXXIX (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
III. Karamadai									
1.	Paddy	188.56 38.34	158.62 17.68	18.87 116.85	0.29 1.93	- -	- -	- -	- -
2.	Cholam	23.88 9.03	16.60 4.95	43.85 82.42	0.88 0.62	35.22 9.89	18.94 6.70	16.27 3.18	1.00 0.74
3.	Maize	- -	- -	- -	- -	43.05 15.80	30.55 13.60	12.50 2.01	0.81 0.34
4.	Cotton	44.88 7.61	14.50 3.88	209.50 96.13	0.38 0.59	40.50 6.50	12.68 2.75	215.65 140.32	4.2** 1.7
5.	Groundnut	- -	- -	- -	- -	45.11 13.33	46.60 9.93	- .03 3.39	- .28 2.94*
IV. Palladam									
1.	Paddy	193.00 23.90	124.00 21.20	55.64 12.73	1.29 0.45	- -	- -	- -	- -
2.	Cholam	23.50 4.77	15.50 4.05	51.61 17.77	2.01* 0.47	17.50 5.10	9.88 2.73	77.12 86.81	1.71 3.05**

TABLE XXXIX (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
3. Maize									
Output		79.90	26.00	178.29	1.65	14.75	9.13	61.55	.36
Yield		5.70	4.30	21.27	0.46	5.05	2.99	68.89	1.80
4. Cotton									
Output		24.10	17.30	39.30	0.92	25.00	11.38	119.6	2.71**
Yield		8.60	3.20	168.70	1.36	3.61	2.99	20.73	0.76
5. Groundnut									
Output		-	-	-	-	15.18	9.37	62.00	1.88
Yield		-	-	-	-	3.11	2.56	21.48	0.80
V. Annur									
1. Paddy									
Output		28.77	45.22	-36.35	-2.53**	-	-	-	-
Yield		9.12	7.98	14.28	.84	-	-	-	-
2. Cholan									
Output		72.37	37.77	91.58	2.91**	10.87	9.75	11.48	1.01
Yield		11.82	11.73	.74	.05	6.15	4.46	37.89	3.14**
3. Maize									
Output		47.00	72.33	-35.02	-2.05*	17.00	57.00	-70.17	-4.6**
Yield		11.94	11.93	0.08	.008	3.61	.56	1.40	.09
4. Groundnut									
Output		58.00	48.50	19.58	.53	-	-	-	-
Yield		10.99	8.99	22.24	1.39	-	-	-	-

* Significant at 5 percent level.

** Significant at 1 percent level

A comparison of the impact of HYV on output and yield between high and low irrigated villages indicated that there was more percentage difference in output and yield in high irrigated villages as compared to low irrigated villages. As a case in the high irrigated village of Pollachi South block, switch over of one acre from NHYV to HYV will increase the yield of paddy by 49.64 percent, cholam by 187.8 percent, sugarcane by 109.35 percent and cotton by 301.72 percent. However, in the low irrigated village of Pollachi South block, a farmer by cultivating one acre under HYV will get the additional yield of paddy by 14.76 percent, cholam by 11.68 percent and cotton by 406.6 percent. This implies that irrigation is complementary to the use of HYV seeds and hence there is a need for expanding irrigation facilities.

For all the crops, except for groundnut in the low irrigated village of Karamadai and paddy and maize in the high and low irrigated villages of Annur block, the use of HYV helped to obtain more output. Hence, it can be inferred that the use of HYV had a positive effect on output and yield. This is in conformity with the findings of Sain (1979) and Vidyasagar (1991).

However, the extent of positive impact of HYV differed from crop to crop. Among the food crops, the percentage difference in yield was the highest for cholam. Among the commercial crops, sugarcane and groundnut have got high percentage difference.

b. Output Decomposition Model

Following Umesh and Bisaliah (1984), the current study tried to decompose the differences in farm output into varietal effect and complementary input effect through the equation as

$$\begin{aligned} \frac{Y_1}{Y_2} = & \frac{A_1}{A_2} + [a_1 - a_2] cA_2 + (b_1 - b_2) S_2 + (c_1 - c_2) P_2 + (d_1 - d_2) F_2 \\ & + (e_1 - e_2) L_2 + (f_1 - f_2) C_2 + (g_1 - g_2) T_2 + a_1 \left(\frac{cA_1}{cA_2} \right) \\ & + b_1 \left(\frac{S_1}{S_2} \right) + c_1 \left(\frac{P_1}{P_2} \right) + d_1 \left(\frac{F_1}{F_2} \right) + e_1 \left(\frac{L_1}{L_2} \right) + f_1 \left(\frac{C_1}{C_2} \right) + g_1 \left(\frac{T_1}{T_2} \right) \end{aligned}$$

where

Y_i = yield ;

A_1 = Scale parameters ;

$a_1, b_1, c_1, d_1, e_1, f_1, g_1$ = Output elasticities with respect to cropped area, seed expenditure, fertiliser expenditure, pesticide expenditure, labour employed, capital invested and tractor timings used ;

cA_1, cA_2 = Cropped area for NHYV and HYV farms ;

s_1, s_2 = Seed expenditure for NHYV and HYV farms ;

P_1, P_2 = Pesticide expenditure for NHYV and HYV farms ;

F_1, F_2 = Fertiliser expenditure for NHYV and HYV farms ;

L_1, L_2 = Manhours employed for NHYV and HYV farms ;

C_1, C_2 = Capital invested in NHYV and HYV farms ;

T_1, T_2 = Tractor timings used for NHYV and HYV farms ;

Table XL presents partitioning of per acre differential output into components of variety effect and complementary inputs effect. Appendix XIX describes as sample estimation of output decomposition.

TABLE XL

PARTITIONING OF PER ACRE DIFFERENTIAL OUTPUT INTO COMPONENTS OF VARIETY EFFECT AND COMPLEMENTARY INPUTS EFFECT
(In percent)

S.No.	Item	Type A Village					Type B Village						
		Paddy	Cholam	Maize	Sugarcane	Cotton	Groundnut	Paddy	Cholam	Maize	Sugarcane	Cotton	Groundnut
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
I. Pollachi South													
1.	Total change in output	10.61	144.11	-	183.5	32.49	-	6.17	7.26	-	5.72	388.6	467.48
2.	Source of change												
a.	Variety effect	-0.03	21.57	-	163.4	-36	-	5.65	-1.93	-	0.58	7.79	6.34
b.	Complementary input effect	10.64	122.54	-	-348.93	32.85	-	0.52	9.19	-	5.14	380.81	461.14
II. Perur													
1.	Total change	38.07	146.0	-	1845.7	13.10	-	-	-32.15	-12.97	-	5.02	3.83
2.	Source of change												
a.	Variety effect	-3.30	1.77	-	11.85	1.69	-	-	2.56	0.12	-	1.32	0.85
b.	Complementary input effect	41.37	144.23	-	1833.85	11.41	-	-	-34.71	-13.09	-	3.70	2.98
III. Karamadai													
1.	Total change	18.87	43.85	-	-	209.5	-	-	16.27	12.5	-	215.65	-0.03
2.	Source of change												
a.	Variety effect	0.68	1.84	-	-	-2.09	-	-	0.65	3.19	-	26.60	-78
b.	Complementary input effect	18.19	42.01	-	-	211.59	-	-	15.62	9.49	-	189.05	.81

ESTIMATED FERTILISER YIELD RESPONSE CO-EFFICIENTS IN THE SELECTED FARMS

287

TABLE XLI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
4.	Cotton	HYV	30	.33	.07 (.29)	.04	25	6.28	.331 (3.26)**	.68
		NHYV	20	2.1	.33 (3.59)	.68	20	4.31	.15 (1.91)	.59
5.	Groundnut	HYV	-	-	-	-	25	-18.31	2.06 (5.18)**	.048
		NHYV	-	-	-	-	22	.99	.0053 (.0003)	.059
II. Perur										
1.	Paddy	HYV	38	6.5	1.58 (4.31)**	.82	-	-	-	-
		NHYV	27	4.2	.41 (2.69)**	.45	-	-	-	-
2.	Cholam	HYV	36	2.1	.71 (3.69)**	.65	36	1.5	.65 (2.09)**	.81
		NHYV	29	1.8	.29 (2.78)**	.50	29	2.1	.33 (2.38)*	.65
3.	Maize	HYV	-	-	-	-	37	1.3	.71 (4.9)**	.69
		NHYV	-	-	-	-	31	2.6	.45 (3.3)**	.71

TABLE XLI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4.	Sugarcane	HYV	39	-6.2	1.09	.79	-	-	-
		NHYV	28	2.3	.65	.56	-	-	-
5.	Cotton	HYV	29	4.3	1.01 (5.3)**	.81	2.6	1.69 (1.98)*	.80
		NHYV	24	1.2	.62 (2.1)*	.76	1.5	.73 (1.64)	.64
6.	Groundnut	HYV	-	-	-	-	2.9	1.31 (4.69)**	.73
		NHYV	-	-	-	-	1.7	.72 (3.2)**	.61
III. Karamadai									
1.	Paddy	HYV	30	4.2	1.5 (2.96)*	.54	-	-	-
		NHYV	22	1.6	0.7 (3.2)*	.42	-	-	-
2.	Cholam	HYV	35	6.4	.09 (.68)	.55	2.6	.91 (1.5)	.45
		NHYV	30	-.8	0.4 (1.5)	.33	1.2	.63 (1.2)	.59
3.	Maize	HYV	-	-	-	-	1.5	.65 (2.7)**	.62
		NHYV	-	-	-	-	.9	.33 (1.6)	.335

TABLE XLI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
4.	Cotton	HYV	32	1.9	3.2 (4.58)**	.85	27	2.9	2.6 (4.6)**	.83
		NHYV	29	1.2	1.2 (2.6)	.64	21	0.8	1.2 (2.7)	.71
5.	Groundnut	HYV	-	-	-	-	28	1.4	1.7 (4.2)**	.82
		NHYV	-	-	-	-	26	.65	.82 (1.3)	.62
IV. Palladam										
1.	Paddy	HYV	31	1.20	.71 (3.9)**	.81	-	-	-	-
		NHYV	25	.69	.42 (2.6)**	.65	-	-	-	-
2.	Cholam	HYV	30	2.10	.35 (1.58)	.62	32	1.7	.43 (1.9)	.65
		NHYV	28	1.78	.29 (1.6)	.59	28	1.3	.21 (2.6)**	.59
3.	Maize	HYV	32	0.83	.46 (2.13)**	.52	30	0.93	.36 (1.3)	.54
		NHYV	30	1.31	.21 (1.57)	.43	25	1.4	.31 (.65)	.41

TABLE XLI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
4.	Cotton	HYV	30	.65	.61 (3.2)**	.75	35	2.2	.89 (4.61)**	.81
		NHYV	28	1.41	.45 (2.64)**	.69	27	1.6	.26 (2.6)*	.59
5.	Groundnut	HYV	-	-	-	-	33	1.5	.54 (2.58)*	.75
		NHYV	-	-	-	-	29	1.2	.23 (1.6)	.56
V.	Annur									
1.	Paddy	HYV	22	1.2	.54 (2.61)**	.61	-	-	-	-
		NHYV	25	1.7	-.61 (-.71)	.51	-	-	-	-
2.	Cholam	HYV	29	1.3	-.21 (-1.2)	.45	35	0.71	-.53 (-.91)	.59
		NHYV	27	1.2	-.65 (-1.6)	.51	38	0.83	-.03 (-.72)	.45
3.	Maize	HYV	38	0.91	-.34 (-.72)	.62	31	1.41	-.65 (-.65)	.55
		NHYV	29	0.83	-.41 (-.65)	.41	30	1.26	-.21 (-.23)	.26

TABLE XLI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4.	Groundnut	HYV	24	1.71	-.65 (-.53)	.43	-	-	-
		NHYV	21	1.26	-.28 (-.71)	.35	-	-	-

Figures in paranthesis indicates t values.

* Statistically significant at 5 percent level

** Statistically significant at 1 percent level

In Pollachi South block, in the high irrigated village, the fertiliser yield response was the highest for HYV sugarcane since one percent increase in the use of fertiliser might increase the yield by 93 percent. In low irrigated village, the use of fertiliser helped in bringing out more increase in yield of groundnut, since the estimated fertiliser response coefficient for groundnut was the highest.

In Perur block, in high irrigated village, fertiliser use was more helpful in bringing out higher yield of HYV paddy as evident from the highest fertiliser yield response coefficients for paddy. In low irrigated village, the use of fertiliser for HYV cotton had highest response on yield.

In Karamadai block, in both high and low irrigated villages, the application of fertiliser for cotton had the highest impact on yield.

In Palladam block in the highly irrigated village, the fertiliser response coefficient was the highest for HYV paddy. In the low irrigated village fertiliser yield response coefficient was the highest with regard to cotton.

In Annur block, in high irrigated village, for all the HYV crops, except for paddy, the fertiliser yield response coefficients were negative. This implies that the farmers in Annur block were not able to obtain more output, even though they were applying fertiliser.

Summing up, the impact of fertiliser on output was noticeable for HYV crops, as compared to NHYV crops. This was due to the complementary nature of fertiliser and HYVs. Further there existed difference in crop wise fertiliser yield response coefficients. Among the food crops, paddy had the highest impact of fertiliser and among the commercial crops, sugarcane was more benefitted by the use of fertiliser.

d. Effect of Pesticides on Farm Output and Yield

The use of pesticides helps to reduce the damage to pests and obtain the sustained yield. With the help of pesticide yield response functions, the current study tried to analyse the effect of pesticides on farm output and yield. Table XLII presents the estimated pesticide yield response coefficients in the selected farms and a sample estimation is given in Appendix XXI.

TABLE XLII

ESTIMATED PESTICIDE YIELD RESPONSE CO-EFFICIENTS IN THE SELECTED FARMS

S.No.	Crop	Type A Village				Type B Village			
		N	a	b	R ²	N	a	b	R ²
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I. Pollachi South									
1.	Paddy	HYV	29	1.9	0.63 (1.7)*	27	1.3	0.83 (2.9)**	.45
		NHYV	21	0.8	0.42 (1.2)	25	0.8	0.41 (1.7)	.33
2.	Cholam	HYV	13	1.72	0.52 (3.62)**	28	3.2	1.08 (4.68)**	.75
		NHYV	28	1.65	0.11 (1.5)	25	1.4	.71 (3.5)**	.61
3.	Sugarcane	HYV	28	1.6	.93 (3.2)**	29	1.9	0.79 (1.7)	.69
		NHYV	20	1.2	0.55 (1.98)**	20	0.4	0.54 (1.2)	.57
4.	Cotton	HYV	29	0.84	0.64 (2.78)*	25	1.2	0.26 (1.3)	.58
		NHYV	20	1.2	0.62 (2.57)*	22	0.8	0.12 (0.96)	.61

TABLE XLII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
5.	Groundnut	HYV	-	-	-	25	5.3	0.91 (2.5)	.72
		NHYV	-	-	-	20	1.2	0.42 (3.61)**	.65
II. Perur									
1.	Paddy	HYV	2.7	0.91 (1.9)*	.85	-	-	-	-
		NHYV	1.2	0.62 (1.2)	.69	-	-	-	-
2.	Cholam	HYV	1.9	0.83 (2.5)*	.75	26	4.2	0.97 (4.3)**	.87
		NHYV	0.9	0.72 (1.6)	.63	29	3.9	0.62 (2.6)*	.67
3.	Maize	HYV	-	-	-	27	5.4	0.65 (3.5)**	.80
		NHYV	-	-	-	21	3.7	0.59 (2.6)*	.57
4.	Sugarcane	HYV	1.72	0.95 (4.2)**	.86	-	-	-	-
		NHYV	1.08	0.42 (0.42)	.72	-	-	-	-

TABLE XLII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
5.	Cotton	HYV	29	2.37	1.15 (6.4)**	.91	27	2.9	0.87 (2.7)**	.84
		NHYV	24	1.68	0.62 (5.8)**	.65	25	1.3	0.52 (1.2)	.72
6.	Groundnut	HYV	-	-	-	-	22	6.4	0.69 (4.7)**	.74
		NHYV	-	-	-	-	21	4.2	0.57 (3.2)**	.69
III. Karamadai										
1.	Paddy	HYV	28	2.7	1.7 (3.49)	.84	-	-	-	-
		NHYV	22	1.2	1.2 (2.7)	.72	-	-	-	-
2.	Cholam	HYV	26	4.2	0.9 (1.68)	.65	27	2.21	1.4 (4.6)*	.81
		NHYV	20	3.6	10.8 (0.97)	.54	23	1.11	0.9 (3.2)	.75
3.	Maize	HYV	-	-	-	-	25	5.2	0.8 (5.4)*	.72
		NHYV	-	-	-	-	28	2.7	0.4 (4.2)	.65

TABLE XLII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
4.	Cotton	HYV	22	3.1	0.8 (2.73)	.67	27	4.3	1.2 (3.58)*	.84
		NHYV	29	2.6	0.4 (2.2)	.52	21	2.6	0.97 (2.69)*	.60
5.	Groundnut	HYV	-	-	-	-	28	1.9	0.83 (4.3)*	.71
		NHYV	-	-	-	-	26	1.2	0.42 (1.68)	.64
IV. Palladam										
1.	Paddy	HYV	27	0.86	1.2 (3.42)**	.79	-	-	-	-
		NHYV	25	0.21	0.5 (2.91)**	.61	-	-	-	-
2.	Cholam	HYV	29	1.01	0.95 (5.2)**	.75	22	2.05	1.00 (2.97)**	.91
		NHYV	28	0.97	0.62 (4.1)**	0.62	28	1.98	0.87 (1.63)	.62
3.	Maize	HYV	22	0.62	0.45 (3.01)**	.83	20	5.08	0.53 (5.61)**	.86
		NHYV	20	0.54	0.31 (1.69)	.21	25	4.61	0.42 (2.68)**	.45

TABLE XLII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
4.	Cotton	HYV	25	1.78	3.2 (4.91)**	.91	25	1.42	2.68 (4.53)**	.87
		NHYV	28	1.20	2.1 (2.61)**	.72	27	1.02	1.02 (2.68)**	.72
5.	Groundnut	HYV	-	-	-	-	23	4.20	0.65 (3.62)**	.80
		NHYV	-	-	-	-	29	3.11	0.52 (1.91)	.65
V. Annur										
1.	Paddy	HYV	22	2.7	0.52 (2.01)*	.69	-	-	-	-
		NHYV	25	1.3	0.31 (2.13)	.62	-	-	-	-
2.	Cholam	HYV	29	3.1	0.91 (2.71)**	.71	25	3.5	0.89 (1.6)	.74
		NHYV	27	1.9	0.62 (1.6)	.52	28	4.2	0.63 (1.4)	.62
3.	Maize	HYV	28	4.2	0.11 (1.97)*	.70	27	1.69	0.54 (2.7)**	.65
		NHYV	29	2.7	0.09 (0.81)	.65	25	1.54	0.42 (1.8)	.57
4.	Groundnut	HYV	24	5.1	0.41 (4.2)*	.51	-	-	-	-
		NHYV	21	4.9	0.32 (2.9)*	.44	-	-	-	-
										299

* Statistically significant at 5 percent level ;

** Statistically significant at 1 percent level.

In Pollachi South block, in high irrigated village, the use of pesticides helped to obtain more yield of cotton since the estimated pesticide yield response coefficient for cotton was the highest. In the low irrigated village, the use of pesticides was having more impact on the yield of cholam.

In the high irrigated village of Perur block, cotton was more benefitted by the use of pesticides and in low irrigated village highest impact was found with regard to cholam.

In Karamadai block, in both high and low irrigated villages, highest pesticide response coefficient was found with regard to cholam. This implies that, cholam was more susceptible to pests, and hence the farmers had to apply pesticides for obtaining sustained yield.

In Palladam blok, in both high and low irrigated villages, there was great damage to cotton due to pests and hence the application of pesticides for cotton helped to increase the yield of cotton to a great extent.

In Annur block, in both high and low irrigated villages, the highest pesticide yield response coefficient was found with regard to cholam.

To sum up, there were differences in pesticides response coefficients between the high and low irrigated village. The impact of pesticides on output was found to be more in the first group of villages as compared to the second group. Further the pesticide yield response coefficients

differed from crop to crop. Among the food crops, impact of pesticides on the yield of cholam was more and among the commercial crops, cotton was more benefitted by the use of pesticides.

e. Effect of Tractors on Farm Output and Yield

The use of mechanical technology, particularly the use of tractors helped the farmers to obtain more output by speedening the process of farm operations. The current study tried to find out whether there was any significant difference in output and yield between tractor and non tractor farms (vide Table XLIII).

TABLE XLIII
DIFFERENTIALS IN OUTPUT AND YIELD BETWEEN TRACTOR AND NON TRACTOR FARMS IN THE SELECTED VILLAGES

S.No.	Crop	Type A Village				Type B Village			
		Tractor farms	Non tractor farms	Percentage difference	't' value	Tractor farms	Non tractor farms	Percentage difference	't' Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I. Pollachi South									
1.	Paddy								
	Output	68.57	54.52	25.77	2.6**	93.63	56.57	65.51	1.57
	Yield	10.44	6.97	49.78	11.21**	26.10	23.55	10.85	2.18
2.	Cholam								
	Output	126.20	124.68	1.22	1.8	22.1	20.18	1.91	.73
	Yield	38.99	12.46	212.9	.21	3.83	1.41	171.83	2.11
3.	Sugarcane								
	Output	163.52	126.50	29.31	7.58**	165.2	122.8	34.52	4.96**
	Yield	72.66	22.88	217.56	.82	126	90.36	39.44	3.52**
4.	Cotton								
	Output	82.65	42.71	93.54	2.68**	62.15	48.07	29.29	1.58
	Yield	25.75	6.08	323.94	-1.42	11.06	2.24	393.75	1.47

TABLE XLIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
5.	Groundnut								
	Output	-	-	-	-	205.6	91.82	123.91	2.06*
	Yield	-	-	-	-	116.27	11.95	872.42	2.34*
II.	Perur								
1.	Paddy								
	Output	209.28	97.66	111.61	2.54*	-	-	-	-
	Yield	33.69	22.05	11.63	.0642	-	-	-	-
2.	Cholam								
	Output	5.50	38.83	33.33	-2.03	100.25	96.58	1.01	1.81
	Yield	1.65	14.73	-13.03	-1.81	6.62	6.52	1.45	3.22**
3.	Maize								
	Output	-	-	-	-	141.65	124.21	6.20	1.20
	Yield	-	-	-	-	10.18	6.85	48.61	2.27
4.	Sugarcane								
	Output	64.90	385.00	-320.01	-2.26	-	-	-	-
	Yield	10.21	101.11	-90.89	-1.93	-	-	-	-
5.	Cotton								
	Output	4.20	8.00	-3.80	-1.29	6.20	4.80	10.50	1.50
	Yield	2.48	7.205	-4.71	-2.17	3.85	1.85	10.80	-4.53**
6.	Groundnut								
	Output	-	-	-	-	55.70	46.30	13.70	1.90
	Yield	-	-	-	-	11.63	5.89	97.45	4.02**

TABLE XLIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
III. Karamadai									
1. Paddy		145.62 38.33	121.45 17.18	61.28 123.1	2.91** 1.58	- -	- -	- -	- -
2. Cholan		46.01 9.03	33.25 4.95	15.21 8.20	1.91 2.77**	42.05 8.90	31.65 6.70	125.00 32.00	1.80 33.77**
3. Maize									
Output		-	-	-	-	654.00	400.00	954.00	6.40**
Yield		-	-	-	-	506.63	41.97	1170.85	.25
4. Cotton									
Output		64.28	54.28	10.68	1.71	15.80	11.40	6.50	1.70
Yield		39.58	3.76	95.10	1.72	7.83	5.87	33.39	1.85
5. Groundnut									
Output		-	-	-	-	120.4	100.6	10.93	1.65
Yield		-	-	-	-	13.34	9.93	34.34	3.00
IV. Palladam									
1. Paddy		115.00 22.21	102.00 11.00	31.56 101.93	1.80 2.41	- -	- -	- -	- -
2. Cholan									
Output		110.00	92.00	42.00	1.87	90.00	72.00	28.00	0.91
Yield		16.23	4.43	265.77	10.36**	5.46	3.83	42.00	-7.79**

TABLE XLIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
3.	Maize								
	Output	50.00	42.00	6.20	1.64	47.00	32.00	14.20	0.56
	Yield	10.31	8.15	26.00	5.42**	5.13	2.98	71.00	3.08**
4.	Cotton								
	Output	70.40	50.60	18.20	5.20**	65.20	42.60	8.30	2.90**
	Yield	6.96	4.92	41.45	3.78**	3.72	2.65	40.00	6.82**
5.	Groundnut								
	Output	-	-	-	-	45.20	30.60	11.10	4.20**
	Yield	-	-	-	-	3.11	2.56	21.00	10.45**
V.	Annur								
1.	Paddy								
	Output	39.25	44.13	-11.33	-0.75	-	-	-	-
	Yield	11.77	7.49	59.36	2.76*	-	-	-	-
2.	Cholam								
	Output	71.20	47.00	51.48	1.81	9.57	10.08	-5.05	-0.42
	Yield	14.59	10.60	37.64	2.03*	6.57	4.37	50.34	4.07**
3.	Maize								
	Output	74.43	44.40	67.61	2.35*	4.00	4.93	-18.80	-0.05
	Yield	14.95	9.83	51.98	3.77**	6.02	4.22	42.41	2.09*
4.	Groundnut								
	Output	62.20	53.70	15.68	0.33	-	-	-	-
	Yield	12.09	10.04	20.31	1.69*	-	-	-	-

* Statistically significant at 5 percent level

** Statistically significant at 1 percent level

In all the selected villages, the tractor farms were able to give more output and yield as compared to non tractor farms. The percentage difference in yield was the highest in high irrigated village of Pollachi South block and it was the lowest in low irrigated village of Annur block. This might be due to the fact that tractors were used to a great extent for the cultivation of commercial crops which were cultivated in a large scale in high irrigated villages. The difference in yield was statistically significant as evident by the estimated 't' values. This implies that a farmer by using tractor can bring out substantial increase in yield. This is in conformity with the findings of Bina Agarwal (1976) that the tractor farms have high potential for farm output.

H. Crop wise and Size wise Variation in Technology Impact Relating to Farm Output

The farmers irrespective of the size of their holdings, have been using technology with a view to maximising the output and farm income. The study tried to find out the elasticity of farm income as related to technology adoption index through the functional form as given below.

$$Y = a + b_1 z + b_2 S + b_3 CI$$

where Y is the income, z is technology adoption index, S is cultivated area and CI is cropping intensity.

a. Overall Effect of Technology Adoption Index on Farm Income

The estimated regression coefficients of farm income as related to technology adoption index, cultivated area and cropping intensity for the overall village are given in Table XLIV. A sample estimation is given in Appendix XXII.

TABLE XLIV

ESTIMATED MULTIPLE REGRESSION COEFFICIENTS OF FARM INCOME AS RELATED TO TECHNOLOGY ADOPTION INDEX,
CULTIVATED AREA AND CROPPING INTENSITY

S.No.	Village	N	$\hat{a}_0$	$\hat{b}_1$	$\hat{b}_2$	$\hat{b}_3$	R^2
I. Pollachi South							
a.	High irrigated village	50	- 55.48	1.49 (0.26)	17.48 (2.59)**	3.08 (0.72)	.17
b.	Low irrigated village	50	- 800.18	3.07 (1.39)	10.15 (4.38)**	10.56 (1.78)	.42
II. Perur							
a.	High irrigated village	50	- 208.32	5.9 (1.69)	12.87 (1.27)	- 3.85 (-.54)	.19
b.	Low irrigated village	50	- 13.39	.02 (.39)	1.63 (6.30)**	.21 (1.88)	.52
III. Karamadai							
a.	High irrigated village	50	- 167.26	.0023 (.39)	1.23 (.35)	3.65 (1.54)	.08
b.	Low irrigated village	50	1.54	.0193 (1.19)	1.92 (2.72)*	.0919 (.096)	.25

TABLE XLIV (Contd.)

S.No.	Village	N	$\hat{a}$	$\hat{b}_1$	$\hat{b}_2$	$\hat{b}_3$	R^2
IV. Palladam							
a.	High irrigated village	50	- 65.47	.004 (.82)	3.91 (1.97)*	2.17 (1.45)	.11
b.	Low irrigated village	50	- 23.5	.0003 (.97)	1.03 (4.31)**	.65 (1.76)	.32
V. Annur							
a.	High irrigated village	50	29.54	.007 (1.83)	2.93 (9.89)**	-.11 (-.68)	.73
b.	Low irrigated village	50	- 5.27	.001 (.41)	.91 (29.58)**	.07 (3.57)	.96
Overall		500	- 6.28	2.61 (1.58)	3.01 (4.26)	1.05 (.96)	.82

Figures in paranthesis indicates t values ;

* Significant at 5 percent level ;

** Significant at 1 percent level.

From the estimated regression coefficients, it is evident that the extent of impact of technology on output differed between the various blocks. In the high and low irrigated villages of Pollachi South block, the technology adoption index, cropped area and cropping intensity had a positive impact on farm income. In the high irrigated village of Pollachi South block, an increase in technology adoption index by one percent was expected to increase the farm income by 1.49 percent, while in low irrigated village South, the extent of increase was 3.07 percent. The essential factor affecting farm income in Pollachi South block was cropped area as indicated by 't' value. This might be due to the dominance of medium and large farmers owning 71 percent of the total operational holdings. As they were having more land at their disposal, they preferred extensive cultivation rather than the application of technology.

In the high irrigated village of Perur block, the use of agricultural technology exercised a positive impact on farm income. An increase in technology adoption by one percent brought out the increase in farm income by 5.9 percent. But the cropping intensity had a negative influence on farm income. The reason for this might be attributed to the fact that in the selected village, of the total available land, only 75 percent was cultivated and the remaining part was fallow land.

However, in both high and low irrigated villages of Karamadai block, technology had a positive impact on farm income but the extent of impact was to a lesser degree. While in the high irrigated village

of Karamadai block, the use of technology was expected to increase the farm income by .0023 percent, in the low irrigated village the extent of increase was .0193 percent. In Karamadai block, all the three factors-technology adoption index, cultivated area and cropping intensity exercised positive impact on farm income. This implies that in Karamadai block, the farmers benefitted from extensive as well as intensive cultivation.

In the low irrigated block - Palladam, technology exercised only low positive impact on farm income. In the high irrigated village of Palladam block, an increase in technology adoption by one percent increased the farm income by .004 percent and in low irrigated village the extent of increase was .0003 percent. But the significant factor influencing farm income in this block were cultivated area and the cropping intensity. The reason for this might be due to the fact that it was a dry block having irrigation intensity of only 30 percent. Since the technology adoption index was low it did not have significant impact on farm income.

In the high irrigated village of Annur block, technology adoption exercised a positive impact on farm income and the increase in technology adoption by one percent tended to increase the farm income by .007 percent. The significant factor influencing farm income in this area was cultivated area which might be due to the dominance of large farmers in this area. However, in the low irrigated village of Annur block, technology adoption index, cultivated area and cropping intensity exercised a positive impact on farm income. But the extent of influence of technology

adoption on farm income was meagre since one percent increase in the adoption of technology was expected to increase the farm income only by .001 percent. The estimated multiple regression equation was statistically significant as indicated by 't' value and high R^2 value.

Summing up, in all the study villages, technology adoption index had a positive impact on farm income. Hence the current study accepts the hypothesis that technology had a favourable impact on farm output. However, the extent of positive impact was more in high irrigated villages as compared to low irrigated villages. This implies that irrigation is the essential factor for the farmers to benefit from agricultural technology.

b. Cropwise Technology Impact Model

The impact of technology on farm income was not uniform for all the crops. The impact of technology on farm income from commercial crops was higher as compared to foodcrops. The current study tried to test this hypothesis.

The estimated multiple regression coefficients explaining the crop wise technology impact are given in Table XLV and a sample estimation is given in Appendix XXIII.

TABLE XLV

ESTIMATED CROPWISE REGRESSION COEFFICIENTS OF FARM INCOME AS RELATED TO TECHNOLOGY
ADOPTION INDEX, CULTIVATED AREA AND CROPPING INTENSITY

S.No.	Crop	Type A Village				Type B Village					
		$\hat{a}_0$	$\hat{b}_1$	$\hat{b}_2$	$\hat{b}_3$	R^2	$\hat{a}_0$	$\hat{b}_1$	$\hat{b}_2$	$\hat{b}_3$	R^2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I. Pollachi South											
1.	Paddy	-162.31	.94 (.38)	7.57 (2.82)**	2.85 (1.74)	.58	28.38	.63 (2.59)**	.53 (.28)	.49 (.62)	.33
2.	Cholam	13.82	.19 (.38)	.013 (.03)	-.09 (-.48)	.02	152.85	9.33 (2.52)	3.68 (-.65)	-4.81 (-1.85)	.34
3.	Sugarcane	-363.29	10.44 (.83)	28.25 (3.28**)	18.92 (1.83)	.47	26.82	10.58 (6.41**)	2.65 (3.52**)	.42 (1.6)	.59
4.	Cotton	179.58	3.36 (.66)	-1.73 (-.42)	.66 (.25)	.05	-46.17	.27 (.31)	1.11 (.38)	1.82 (1.38)	.14
5.	Groundnut	-	-	-	-	-	266.11	2.98 (.86)	4.53 (.68)	-3.13 (-1.34)	.18

TABLE XLV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
II. Perur											
1.	Paddy	16.41	.54 (2.11*)	-.61 (-.14)	.42 (.65)	.45	-	-	-	-	-
2.	Cholam	15.41	2.31 (2.65**)	-1.72 (-.21)	4.2 (1.96)	.65	-1.48	.13 (1.68)	.35 (2.83**)	.07 (1.41)	.32
3.	Maize	-	-	-	-	-	-5.19	.03 (1.13)	.63 (2.89**)	.11 (1.33)	.40
4.	Sugarcane	-12.61	4.52 (4.98**)	-1.9 (1.6)	3.2 (2.1*)	.71	-	-	-	-	-
5.	Cotton	-10.61	.61 (2.1*)	-.58 (-1.8)	1.1 (1.8)	.64	-7.54	.13 (.21)	1.49 (2.06*)	.19 (.50)	.33
6.	Groundnut	-	-	-	-	-	.85	.0021 (.001)	.23 (2.38*)	-.0085 (-.018)	.40
III. Karamadai											
1.	Paddy	16.41	.51 (.90)	-.41 (-.7)	.63 (.20)	.54	-	-	-	-	-
2.	Cholam	6.2	.18 (.03)	.19 (.05)	-.12 (-.01)	.45	.94	.16 (.97)	2.26 (5.62)	.13 (2.14)	.11
3.	Maize	-	-	-	-	-	2.98	0.03 (.26)	1.25 (1.72)	-.11 (-1.37)	.19

TABLE XLV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
4.	Cotton	4.5	.64 (.65)	-.61 (-.27)	.54 (.41)	.65	22.31	1.75 (1.89)	7.14 (4.06)	-.11 (-.55)	.65
5.	Groundnut	-	-	-	-	-	-2.32	.011 (.23)	.58 (3.02)	.01 (1.21)	.40
IV. Palladam											
1.	Paddy	24.06	0.68 (2.35)	11.87 (2.72)	4.49 (2.15)	.49	-	-	-	-	-
2.	Cholam	-39.01	.65 (.11)	-1.55 (-.49)	1.06 (.29)	.22	-1.48	.13 (1.68)	.35 (2.83)	.07 (1.4)	.32
3.	Maize	10.77	.39 (.66)	2.44 (2.12)	-.27 (-.65)	.32	-5.19	.03 (1.13)	.64 (2.89)	.11 (1.33)	.40
4.	Cotton	18.42	1.11 (1.21)	1.42 (1.48)	-.74 (-1.21)	.27	7.54	.13 (.21)	1.49 (2.05)	.19 (.49)	.33
5.	Groundnut	-	-	-	-	-	.85	.0021 (.0012)	.23 (2.38)	-.0085 (-.02)	.40
V. Annur											
1.	Paddy	18.41	.45 (.84)	1.42 (1.91)	.29 (1.25)	.40	-	-	-	-	-
2.	Cholam	.93	.09 (.55)	.96 (4.81)	.09 (.99)	.83	.78	.04 (2.22)	.05 (1.56)	.01 (1.31)	.50

TABLE XLV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
3.	Maize	18.9	.06 (.45)	.42 (1.99)	-.10 (-1.23)	.76	-.81	.003 (.72)	.94 (12.32)	.06 (1.39)	.93
4.	Groundnut	23.94	.51 (1.62)	1.76 (.22)	.01 (.11)	.48	-	-	-	-	-

Figures in paranthesis indicates t values ;

* Significant at 5 percent level ;

** Significant at 1 percent level.

In the high irrigated village of Pollachi South block, the impact of technology was more on sugarcane since the increase in the adoption of technology by one percent helped to increase the farm income by 10.44 percent. In the low irrigated village, technology had more positive impact on groundnut as the increase in technology adoption for groundnut by one percent helped to increase the farm income by 2.98 percent. However, in Pollachi South block, for majority of the crops, the farmers were more benefitted by extending the area under cultivation since the estimated regression coefficients of cultivated area in relation to farm income was of higher magnitude. This might be due to the dominance of medium and large farmers in this block.

In Perur block, in the high irrigated village, the highest positive impact of technology on farm income was found with regard to sugarcane. An increase in technology adoption for sugarcane by one percent would increase the farm income by 4.52 percent. In the low irrigated village, highest impact of technology was found with regard to cotton since one percent increase in technology adoption for cotton would bring out an increase in farm income by 1.49 percent.

In Karamadai block, in high irrigated village, technology adoption had the highest positive impact on farm income from cotton. In the low irrigated village, more positive impact of technology was found with regard to cotton. The insignificant positive impact of technology on farm income from cholam, maize and groundnut was due to the fact that in this area, only 40 percent of the farmers were cultivating these crops and the technology adoption index for these crops was also low.

In Palladam block, in both high and low irrigated villages, the positive impact of technology on farm income was more for cotton as compared to other crops. This might be due to high mean technology adoption index for cotton (37.52) as compared to other crops.

In the high irrigated village of Annur block, technology adoption had the highest positive impact on farm income from groundnut since one percent increase in technology adoption would bring out the increase in farm income by .51 percent. But in the low irrigated village, as compared to maize, cholam had more positive impact on farm income since one percent increase in technology adoption could increase the farm income by .04 percent.

To sum up, among the food crops the impact of technology was of larger magnitude for paddy, and among commercial crops, sugarcane and cotton cultivation were more benefitted by using technology.

c. Size Wise Technology Impact Model

The impact of technology on farm income differed between various size group of farms. Rao (1976) opined that the adoption of agricultural technology benefits the large farmers more as compared to marginal and small farmers. The current study tried to test this hypothesis through the estimated multiple regression equations.

The estimated size wise regression coefficients of farm income as related to technology adoption index, cultivated area and cropping intensity are presented in Table XLVI.

TABLE XLVI

ESTIMATED SIZEWISE REGRESSION COEFFICIENTS OF FARM INCOME AS RELATED TO TECHNOLOGY ADOPTION INDEX,
CULTIVATED AREA AND CROPPING INTENSITY

S.No.	Group of farmers	Type A Village					Type B Village				
		$\hat{a}_0$	$\hat{b}_1$	$\hat{b}_2$	$\hat{b}_3$	R^2	$\hat{a}_0$	$\hat{b}_1$	$\hat{b}_2$	$\hat{b}_3$	R^2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I. Pollachi South											
1.	Marginal farmers	150.87	1.71 (1.73)	-1.29 (-.73)	-.15 (-.83)	.72	102.61	.98 (2.38)	-32.86 (-.71)	1.29 (2.68)	.77
2.	Small farmers	16.28	10.81 (3.32)	36.94 (.94)	-5.30 (-1.52)	.36	54.04	.25 (.55)	3.35 (.31)	.19 (.14)	.11
3.	Semi-medium farmers	238.73	3.56 (.73)	-23.53 (-.54)	-.15 (-.04)	.09	-15.75	.48 (.37)	278.83 (1.63)	-4.29 (-.76)	.23 .1
4.	Medium farmers	-894.15	12.25 (1.87)	39.46 (1.62)	-1.95 (-.47)	.50	-333.21	1.03 (.18)	96.81 (1.48)	.91 (.09)	.64
5.	Large farmers	4839.35	21.77 (1.04)	58.44 (1.43)	-59.25 (-1.33)	.46	221.09	.0083 (1.28)	4.34 (1.18)	-2.35 (-3.91)	.74

TABLE XLVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
II. Perur											
1.	Marginal farmers	10.21	.12 (1.01)	1.5 (2.1)	-3.1 (2.5)	.45	4.51	.18 (3.39)	-4.11 (4.15)	.09 (1.96)	.91
2.	Small farmers	15.26	.65 (.05)	.43 (.21)	1.1 (.19)	.61	6.81	.36 (.88)	.11 (.78)	.04 (.39)	.18
3.	Semi-medium farmers	71.21	.71 (.41)	-.64 (-.50)	1.72 (.11)	.59	-12.61	.02	-1.78 (-.37)	.54 (2.25)	.18
4.	Medium farmers	50.61	.61 (.54)	-.52 (-.43)	2.8 (1.9)	.69	-101.69	.66 (.52)	6.36 (.90)	.72 (1.8)	.53
5.	Large farmers	26.72	3.08 (2.7)	-1.91 (-1.6)	.65 (.54)	.81	-138.47	.007 (.02)	8.03 (2.66)	-.45 (-.67)	.69
III. Karamadai											
1.	Marginal farmers	158.21	4.71 (2.32)	29.28 (.88)	-1.51 (-1.83)	.73	-16.48	5.2 (1.8)	1.8 (.69)	-.64 (.11)	.44
2.	Small farmers	-470.23	7.83 (1.09)	-100.33 (-1.18)	9.65 (1.31)	.55	15.22	.24 (.11)	.65 (.52)	-.25 (-.05)	.51
3.	Semi medium farmers	-321.20	1.76 (.34)	22.63 (.63)	3.73 (.42)	.67	10.51	.11 (.02)	.20 (.04)	1.01 (.91)	.65

TABLE XLVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
4.	Medium farmers	-1142.36	3.84 (.75)	36.69 (2.40)	6.25 (.52)	.61	16.2	1.6 (.54)	-.15 (-.01)	.54 (.19)	.70
5.	Large farmers	159.99	14.98 (3.09)	7.44 (3.44)	-3.14 (-1.36)	.98	12.78	1.9 (.71)	-.11 (-.003)	.48 (.21)	.72
IV. Palladam											
1.	Marginal farmers	-53.29	.53 (41.45)	10.26 (3.17)	11.91 (1.31)	.79	10824.19	.75 (.83)	2.28 (.84)	-5.58 (-.24)	.31
2.	Small farmers	16.82	.74 (1.6)	-1.34 (-.03)	-.88 (-.35)	.23	12608.31	.98 (.46)	3.07 (1.3)	-556.45 (-5.8)	.11
3.	Semi-medium farmers	21.0	0.19 (.25)	2.54 (.39)	-.39 (-.47)	.07	-23366.79	.69 (1.5)	2.53 (7.35)	1229.3 (1.34)	.96
4.	Medium farmers	229.9	1.4 (1.01)	13.56 (1.38)	.42 (.20)	.33	-34200.12	1.2 (.24)	3.56 (.77)	326.73 (.28)	.33
5.	Large farmers	200.06	.59 (1.63)	-160.84 (-1.02)	38.95 (2.2)	.42	-.1615	1.08 (.92)	2.28 (.86)	3.26 (.54)	.55
V. Annur											
1.	Marginal farmers	-45.15	.27 (1.58)	11.78 (1.75)	.42 (2.11)	.50	-1.50	.05 (2.17)	.98 (1.57)	.01 (.73)	.83

TABLE XLVI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2.	Small farmers	6.88	.08 (.12)	-7.58 (-.52)	.61 (1.13)	.28	-4.81	.01 (.31)	1.07 (3.93)	.06 (3.06)	.85
3.	Semi-medium farmers	81.71	.56 (.49)	-4.73 (-.58)	.12 (.19)	.19	-14.85	.09 (.36)	2.38 (2.36)	.08 (1.03)	.97
4.	Medium farmers	5.0	1.15 (1.49)	4.65 (1.53)	.13 (.06)	.56	7.97	.04 (1.31)	.85 (4.39)	-.18 (-1.24)	.94
5.	Large farmers	249.24	.59 (.90)	-13.83 (-2.39)	2.62 (3.08)	.84	-21.99	.02 (1.34)	1.20 (4.10)	.50 (2.72)	.95

Figures in paranthesis indicates t values ;

* Statistically significant at 5 percent level ;

** Statistically significant at 1 percent level.

In Pollachi South block, in the high irrigated village the large farmers benefitted more with the adoption of agricultural technology. An increase in technology adoption by one percent could bring out the increase in farm income by 21.77 percent. In the low irrigated village, there had been more favourable impact of technology on farm income for the medium farmers since the estimated multiple regression coefficient was the highest (1.03) for medium farmers.

In Perur block, in the high irrigated village, technology adoption had the highest positive impact on farm income for large farmers. If large farmers are increasing the technology adoption by one percent they could increase their farm income by 3.08 percent. However in low irrigated village, the estimated multiple regression coefficient of farm income as related to technology adoption index was high for medium farmers (.66).

In Karamadai block, in both high and low irrigated villages, technology adoption created more positive impact on farm income for large farmers. In the high irrigated village, an increase in technology adoption by one percent could increase the farm income for large farmers by 14.98 percent. In the low irrigated village, the increase in technology adoption by one percent could increase the farm income by 1.9 percent for large farmers.

In the high irrigated village of Palladam block medium farmers benefitted more with the adoption of agricultural technology. An increase in technology adoption by one percent could increase the farm income

by 1.4 percent. In the low irrigated village, an increase in technology adoption by one percent by medium farmers could bring out the highest increase in farm income by 1.2 percent (Appendix XXIV).

In Annur block, in the high irrigated village, technology adoption benefitted the semimedium farmers to a great extent. An increase in technology adoption by one percent could bring out the increase in farm income for semi medium farmers by 56 percent. In the low irrigated village, an increase in technology adoption by one percent helped to increase the farm income for the semi medium farmers by .09 percent.

To sum up, the adoption of agricultural technology, created more favourable impact for semi medium, medium and large farmers as compared to marginal and small farmers. Hence, though the adoption of agricultural technology is scale neutral, the benefits of agricultural technology were not scale neutral. These findings are in conformity with the view of Mohammed Ali (1984) and Singh (1986) that agricultural technology had widened economic inequality among the farmers.

I. Effect of High Yielding Variety Seeds and Tractors on Farm Employment

Ishikawa (1978) and Vaidynathan (1980) observed that there is a positive association between output per unit of land and labour use per unit of land. Technical changes, comprising of HYV seeds, fertiliser and pesticides increases employment by bringing out notable change in

the output per unit of land. At the same time, mechanisation in the form of tractors, harvestors, threshers etc. help the timely completion of certain operations but also displace some labour in their respective operations in a given crop. The current study tried to find out whether technology had created favourable impact on employment by comparing the manhours employed between HYV and NHYV farms and between tractor and non tractor farms.

a. Effect of High Yielding Variety Seeds on Employment

The use of HYV seeds requires more labour for manuring, fertiliser application, interculture, transplanting and harvesting. Table XLVII brings out the difference in employment between HYV and NHYV farms.

TABLE XLVII

DIFFERENTIALS IN MANHOURS EMPLOYED BETWEEN HIGH YIELDING VARIETY AND NON HIGH YIELDING VARIETY FARMS

S.No.	Crop	Type A Village				Type B Village			
		HYV	NHYV	Percentage difference	t Value	HYV	NHYV	Percentage difference	t Value
I. Pollachi South									
1.	Paddy								
	a. Per acre man hours	62.60	35.17	77.99	4.60**	49.71	21.96	126.36	3.60**
	b. Per acre family labour man hours	14.90	12.30	22.87	3.20**	12.5	8.53	46.54	2.18*
	c. Per acre hired labour man hours	47.70	22.87	108.50	0.73	37.21	13.43	177.06	1.01
2.	Cholam								
	a. Per acre man hours	13.27	11.81	12.36	1.20	11.79	9.77	22.27	0.65
	b. Per acre family labour man hours	4.68	3.62	2.92	2.40*	4.31	3.20	34.68	1.20
	c. Per acre hired labour man hours	8.59	8.29	3.61	1.82	7.42	6.57	12.93	0.83
3.	Sugarcane								
	a. Per acre man hours	61.52	24.86	147.26	5.95**	31.00	48.00	61.45	1.20
	b. Per acre family labour man hours	12.9	10.68	20.78	1.08	10.00	19.20	20.48	1.36
	c. Per acre hired labour man hours	48.62	14.18	242.87	6.71**	21.00	8.30	92.66	1.98*
4.	Cotton								
	a. Per acre man hours	25.71	20.10	28.55	4.30*	34.08	15.40	121.29	1.68
	b. Per acre family labour man hours	10.32	7.65	34.10	1.70	10.11	6.20	63.06	1.97*
	c. Per acre hired labour man hours	15.39	12.45	23.61	5.70**	23.97	9.20	160.54	0.55
5.	Groundnut								
	a. Per acre man hours	-	-	-	-	20.90	12.00	199.00	1.63
	b. Per acre family labour man hours	-	-	-	-	5.70	5.00	14.00	0.31
	c. Per acre hired labour man hours	-	-	-	-	15.20	7.00	117.14	2.71**

TABLE XLVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
II. Perur									
1.	Paddy								
	a. Per acre man hours	59.64	43.70	36.47	1.20	-	-	-	-
	b. Per acre family labour man hours	10.21	9.50	7.47	8.30	-	-	-	-
	c. Per acre hired labour man hours	49.41	44.20	11.78	2.16*	-	-	-	-
2.	Cholam								
	a. Per acre man hours	34.75	20.20	72.02	0.32	32.00	30.44	5.12	0.11
	b. Per acre family labour man hours	9.68	8.30	16.62	0.11	8.70	7.20	20.83	0.16
	c. Per acre hired labour man hours	25.07	11.90	110.67	1.3	23.30	23.24	0.25	0.03
3.	Maize								
	a. Per acre man hours	-	-	-	-	27.60	12.00	130.00	4.31
	b. Per acre family labour man hours	-	-	-	-	8.30	4.40	88.63	2.81
	c. Per acre hired labour man hours	-	-	-	-	19.50	7.60	22.36	0.93
4.	Sugarcane								
	a. Per acre man hours	56.13	50.8	10.49	0.63	-	-	-	-
	b. Per acre family labour man hours	1.20	10.6	5.66	0.21	-	-	-	-
	c. Per acre hired labour man hours	44.93	40.2	11.76	1.73	-	-	-	-
5.	Cotton								
	a. Per acre man hours	35.20	22.80	54.38	0.98	-	-	-	-
	b. Per acre family labour man hours	8.60	7.10	21.12	0.73	-	-	-	-
	c. Per acre hired labour man hours	26.60	15.70	69.42	1.11	-	-	-	-
6.	Groundnut								
	a. Per acre man hours	-	-	-	-	25.12	12.76	96.86	0.81
	b. Per acre family labour man hours	-	-	-	-	9.70	4.30	125.58	2.95
	c. Per acre hired labour man hours	-	-	-	-	15.42	8.46	82.26	1.61

TABLE XLVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
III. Karamadai									
1.	Paddy								
	a. Per acre man hours	56.91	31.31	81.73	1.92	-	-	-	-
	b. Per acre family labour man hours	12.18	9.41	29.43	0.83	-	-	-	-
	c. Per acre hired labour man hours	44.73	21.9	104.24	1.53	-	-	-	-
2.	Cholam								
	a. Per acre man hours	18.80	18.66	0.75	0.40	31.10	17.12	81.65	2.63**
	b. Per acre family labour man hours	6.00	5.90	1.60	0.50	7.20	5.80	24.13	1.93
	c. Per acre hired labour man hours	12.80	12.76	0.31	0.70	23.90	11.32	111.11	1.61
3.	Maize								
	a. Per acre man hours	-	-	-	-	28.60	16.12	77.41	1.05
	b. Per acre family labour man hours	-	-	-	-	8.20	4.80	70.83	2.58
	c. Per acre hired labour man hours	-	-	-	-	20.40	11.32	97.87	2.95
4.	Cotton								
	a. Per acre man hours	37.10	27.90	32.97	0.93	35.60	21.60	62.50	1.31
	b. Per acre family labour man hours	9.20	8.40	9.52	0.40	8.60	7.20	19.44	0.41
	c. Per acre hired labour man hours	27.90	19.50	43.07	0.61	26.50	14.40	84.02	0.96
5.	Groundnut								
	a. Per acre man hours	-	-	-	-	34.64	26.80	29.25	0.93
	b. Per acre family labour man hours	-	-	-	-	9.20	8.40	13.03	0.41
	c. Per acre hired labour man hours	-	-	-	-	25.44	8.40	38.04	0.26

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TABLE XLVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IV. Palladam									
1. Palladam									
a. Per acre man hours		60.22	29.71	102.61	5.78**	-	-	-	-
b. Per acre family labour man hours		15.65	10.30	51.94	2.90**	-	-	-	-
c. Per acre hired labour man hours		44.57	19.41	129.62	6.73**	-	-	-	-
2. Cholam									
a. Per acre man hours		22.85	13.77	65.94	3.92**	30.51	22.34	34.15	4.18**
b. Per acre family labour man hours		10.11	4.68	116.02	6.71**	12.68	10.51	20.64	3.23**
c. Per acre hired labour man hours		12.74	9.09	40.15	2.83**	27.83	12.23	126.74	7.2**
3. Maize									
a. Per acre man hours		38.71	14.96	158.75	5.65**	29.71	20.64	43.94	2.22
b. Per acre family labour man hours		10.42	5.61	85.73	3.98**	10.42	8.72	19.49	1.73
c. Per acre hired labour man hours		28.29	9.35	202.56	4.64**	19.29	11.92	61.82	4.68**
4. Cotton									
a. Per acre man hours		48.11	11.55	316.53	6.73**	29.35	36.46	-19.5	-1.08
b. Per acre family labour man hours		15.32	12.72	224.57	5.48**	11.28	13.11	-13.95	-2.12*
c. Per acre hired labour man hours		32.79	6.83	380.08	7.21**	18.07	23.35	-22.65	-3.23**
5. Groundnut									
a. Per acre man hours		-	-	-	-	15.22	21.9	-30.5	-1.91
b. Per acre family labour man hours		-	-	-	-	4.93	3.81	29.8	2.6*
c. Per acre hired labour man hours		-	-	-	-	10.29	18.1	-43.14	-3.2*

TABLE XLVII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
V. Annur									
1.	Paddy								
	a. Per acre man hours	58.27	28.12	107.21	4.69**	-	-	-	-
	b. Per acre family labour man hours	14.15	12.30	15.04	2.61**	-	-	-	-
	c. Per acre hired labour man hours	44.12	15.82	180.52	5.95**	-	-	-	-
2.	Cholam								
	a. Per acre man hours	20.80	18.15	14.6	3.57**	18.17	16.20	12.16	3.25**
	b. Per acre family labour man hours	10.17	3.95	157.64	5.18**	9.95	2.98	233.89	4.69**
	c. Per acre hired labour man hours	10.63	14.20	105.46	1.95	8.22	14.22	76.08	0.98
3.	Maize								
	a. Per acre man hours	36.55	15.75	132.06	4.69**	35.25	14.68	140.12	3.65**
	b. Per acre family labour man hours	11.15	4.38	154.56	3.97**	10.95	4.02	112.38	0.97
	c. Per acre hired labour man hours	25.40	11.37	317.61	4.12**	24.30	10.66	303.84	1.12
4.	Groundnut								
	a. Per acre man hours	46.72	10.19	358.48	5.98**	-	-	-	-
	b. Per acre family labour man hours	14.16	4.35	24.75	4.69**	-	-	-	-
	c. Per acre hired labour man hours	32.56	5.84	425.46	6.15**	-	-	-	-

* Significant at 5 percent level ;

** Significant at 1 percent level.

In Pollachi South block, in the high irrigated village, for all the crops cultivated, per acre manhours employed in HYV farms was greater than NHYV farms. Both per acre family labour and hired labour manhours in HYV farms exceeded that of NHYV farms. For instance, switching over of one acre from NHYV to HYV paddy would provide jobs for additional manhours by 131.27 percent. In the low irrigated village the percentage difference in employment was the highest with regard to paddy. This implies that in Pollachi South block, HYV technology had got more favourable impact on employment in paddy farms as compared to other farms.

In Perur block, in both the high and low irrigated villages highest impact of HYV technology was found with regard to cotton. In high irrigated village by switching over of one acre from NHYV to HYV cotton would increase employment by 125.64 percent and in low irrigated village the percentage difference was 47.57.

In Karamadai block, in high irrigated village, HYV paddy farms were able to absorb more manhours as against other farms. The percentage difference in employment between HYV and NHYV farms was the highest with regard to paddy. In the low irrigated village, the percentage difference in man hours employed between HYV and NHYV farms was the highest with regard to cholam. This might be due to the fact that, in the concerned village HYV cholam cultivators were applying pesticides to a great extent which in turn required the employment of more labour.

In Palladam block, in the high irrigated village, the highest percentage difference in employment between HYV and NHYV farms was found with regard to cholam. In the low irrigated village, cotton growers were able to provide employment for additional manhours to a great extent. This also might be attributed to the application of fertilisers and pesticides on a large scale in the concerned block.

In Annur block, in both high and low irrigated villages, more percentage difference in employment was found with regard to cholam. This implies that there is scope for additional employment of agricultural labour in Annur block, by motivating the cultivators of cholam to use HYV seeds.

In general in all the study vilages, HYV farms were able to create employment for additional manhours as compared to NHYV farms. Both the family labour and hired labour manhours employed in HYV farms was greater than NHYV farms and the percentage difference was statistically significant as indicated by the estimated t values. However, the extent of difference varied based on the irrigated intensity. If a crop is cultivated in both high and low irrigated villages highest percentage difference in employment was found in the first group as compared to the second group. Further, the extent of difference also varied between different crops. Among the foodcrops, paddy and cholam HYV farms were able to attract additional manhours as compared to the corresponding NHYV farms. Among the commercial farms, HYV cotton farms, were having more employment prospect as compared to other farms.

Hence these findings are in conformity with the findings of Acharya (1984) and Kahlon (1986) that HYV farms had favourable impact on employment. It also supports the view of Sivanappan (1984) that irrigation is an essential factor for creating additional employment through HYV.

b. Effect of Tractors on Employment

The current study tried to find out the effect of tractors on farm employment by comparing the manhours employed between tractor and non tractor farms. Table XLVIII brings out this information.

TABLE XLVIII

DIFFERENTIALS IN MAN HOURS EMPLOYED BETWEEN TRACTOR AND NON TRACTOR FARMS

S.No.	Crop	Type A Village				Type B Village			
		Tractor farms	Non tractor farms	Percentage difference	't' value	Tractor farms	Non tractor farms	Percentage difference	't' value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I. Pollachi South									
1.	Paddy								
	a. Per acre man hours	50.33	43.33	16.15	0.93	50.61	28.22	79.34	1.21
	b. Per acre family labour man hours	6.28	5.41	16.08	3.18	10.28	9.51	8.09	- .51
	c. Per acre hired labour man hours	44.05	37.92	10.16	4.26	40.33	18.71	115.55	2.57
2.	Cholan								
	a. Per acre man hours	27.56	11.84	132.77	4.28**	-	-	-	-
	b. Per acre family labour man hours	10.61	4.98	113.65	2.51	-	-	-	-
	c. Per acre hired labour man hours	16.95	6.86	147.08	6.53**	-	-	-	-
3.	Sugarcane								
	a. Per acre man hours	64	31.82	101.13	5.62**	51	37	37.83	0.91
	b. Per acre family labour man hours	15	12.00	25.00	1.71	12	10	20.0	0.58
	c. Per acre hired labour man hours	49	19.82	147.22	6.28	39	27	44.44	1.31
4.	Cotton								
	a. Per acre man hours	38.77	14.09	175.15	4.9**	33.1	25.27	30.98	0.81
	b. Per acre family labour man hours	10.61	7.52	41.09	0.91	9.2	7.60	21.05	0.65
	c. Per acre hired labour man hours	28.16	6.57	328.61	6.57	23.9	17.67	9.93	0.16

TABLE XLVIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
5.	Groundnut								
	a. Per acre man hours	-	-	-	-	21	17.75	18.30	1.01
	b. Per acre family labour man hours	-	-	-	-	9	7.00	28.57	.43
	c. Per acre hired labour man hours	-	-	-	-	12	10.75	11.62	1.28
II.	Perur								
1.	Paddy								
	a. Per acre man hours	50.66	424	19.48	1.96	-	-	-	-
	b. Per acre family labours man hours	9.71	9.2	5.54	0.81	-	-	-	-
	c. Per acre hired labour man hours	40.95	332.0	23.34	3.31	-	-	-	-
2.	Cholam								
	a. Per acre man hours	25.64	23.4	9.57	0.81	22.85	20.9	9.33	.81
	b. Per acre family labours man hours	8.72	7.3	19.45	2.73**	9.21	8.2	12.31	2.91**
	c. Per acre hired labour man hours	16.92	16.10	5.09	0.41	13.64	11.7	16.58	3.50**
3.	Maize								
	a. Per acre man hours	-	-	-	-	22.5	20.36	10.51	1.03
	b. Per acre family labours man hours	-	-	-	-	9.2	8.60	6.97	2.96**
	c. Per acre hired labour man hours	-	-	-	-	13.3	11.76	13.09	1.71
4.	Sugarcane								
	a. Per acre man hours	45.33	32.72	38.53	0.43	-	-	-	-
	b. Per acre family labour man hours	9.5	8.91	6.74	1.21	-	-	-	-
	c. Per acre hired labour man hours	35.83	23.81	50.48	2.93**	-	-	-	-

TABLE XLVIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
5.	Cotton								
	a. Per acre man hours	23.2	18.66	24.73	2.3	21.7	20.6	5.33	0.85
	b. Per acre family labour man hours	8.5	7.90	7.59	0.86	8.3	8.1	2.46	1.61
	c. Per acre hired labour man hours	14.7	10.76	36.61	4.32	13.4	12.5	7.20	4.28
6.	Groundnut								
	a. Per acre man hours	-	-	-	-	25.62	15.60	24.62	2.68
	b. Per acre family labour man hours	-	-	-	-	9.40	7.10	32.39	3.12
	c. Per acre hired labour man hours	-	-	-	-	16.22	8.50	90.82	4.15
III.	Karamadai								
1.	Paddy								
	a. Per acre man hours	55.85	34.2	63.3	1.61	-	-	-	-
	b. Per acre family labour man hours	10.21	8.3	23.01	0.83	-	-	-	-
	c. Per acre hired labour man hours	45.64	25.9	76.21	5.98	-	-	-	-
2.	Cholam								
	a. Per acre man hours	19	16	18.75	1.98	20.68	17.7	16.83	2.93
	b. Per acre family labour man hours	7	6	16.66	0.41	7.20	6.9	4.34	3.41
	c. Per acre hired labour man hours	12	10	20.0	4.23	13.48	10.8	24.81	0.81
3.	Maize								
	a. Per acre man hours	-	-	-	-	19.50	16.78	16.20	0.85
	b. Per acre family labour man hours	-	-	-	-	7.1	6.90	42.09	4.11
	c. Per acre hired labour man hours	-	-	-	-	12.40	9.88	25.50	3.76

TABLE XLVIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4.	Cotton								
	a. Per acre man hours	31.5	24.2	30.16	1.91	31.11	27.0	15.22	.65
	b. Per acre family labour man hours	8.2	7.6	7.89	0.11	7.69	7.2	6.80	1.28
	c. Per acre hired labour man hours	23.3	16.6	40.36	4.26	23.42	19.8	22.42	.11
5.	Groundnut								
	a. Per acre man hours	-	-	-	-	23.85	21.66	10.11	2.68
	b. Per acre family labour man hours	-	-	-	-	7.51	7.40	7.48	4.01
	c. Per acre hired labour man hours	-	-	-	-	16.34	14.26	14.58	3.11
IV.	Palladam								
1.	Paddy								
	a. Per acre man hours	46.7	31.4	48.72	1.11	-	-	-	-
	b. Per acre family labour man hours	10.3	8.9	15.73	.63	-	-	-	-
	c. Per acre hired labour man hours	36.4	22.5	61.77	2.91	-	-	-	-
2.	Cholam								
	a. Per acre man hours	17.6	11.75	49.78	2.11	16.6	11.58	43.35	0.91
	b. Per acre family labour man hours	7.2	5.2	38.46	0.81	6.5	5.90	27.45	.86
	c. Per acre hired labour man hours	10.4	6.55	58.77	1.02	10.1	5.48	84.30	1.69
3.	Maize								
	a. Per acre man hours	14.73	11.0	33.90	.61	14.3	13.2	8.33	1.11
	b. Per acre family labour man hours	6.15	5.00	23.00	0.08	6.1	5.9	3.38	0.68
	c. Per acre hired labour man hours	8.58	60	43.0	1.1	8.2	7.3	12.32	0.59

TABLE XLVIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4.	Cotton								
	a. Per acre man hours	33.6	27.33	22.94	.65	39.20	30.6	5.52	.18
	b. Per acre family labour man hours	9.6	8.11	18.37	.71	9.20	8.7	5.74	1.65
	c. Per acre hired labour man hours	24.0	19.22	24.86	1.97	23.09	21.9	5.43	2.31
5.	Groundnut								
	a. Per acre man hours	-	-	-	-	26.4	20.4	29.41	1.18
	b. Per acre family labour man hours	-	-	-	-	9.1	8.6	5.81	.81
	c. Per acre hired labour man hours	-	-	-	-	17.3	11.8	4.66	.65
V.	Annur								
1.	Paddy								
	a. Per acre man hours	36.3	25	4.52	1.68*	-	-	-	-
	b. Per acre family labour man hours	10.5	92	14.13	.69	-	-	-	-
	c. Per acre hired labour man hours	25.8	158	59.36	1.73	-	-	-	-
2.	Cholam								
	a. Per acre man hours	13.1	12	9.16	.51	11.50	9.14	25.82	.58
	b. Per acre family labour man hours	5.1	4.8	6.25	.62	4.90	4.15	18.07	.91
	c. Per acre hired labour man hours	8.0	7.2	11.11	.45	6.60	4.99	34.69	.11
3.	Maize								
	a. Per acre man hours	10.57	10.3	2.62	.41	10.12	9.8	3.26	1.96
	b. Per acre family labour man hours	5.20	5.0	4.0	1.91	4.80	4.6	4.34	.71
	c. Per acre hired labour man hours	5.37	5.3	1.32	.65	5.32	5.2	23.07	.68
4.	Groundnut								
	a. Per acre man hours	20	15.4	29.87	.61	-	-	-	-
	b. Per acre family labour man hours	6	5.0	20.0	.23	-	-	-	-
	c. Per acre hired labour man hours	14	10.4	34.61	.97	-	-	-	-

* Significant at 5 percent level ;

** Significant at 1 percent level

In Pollachi South block, in the high irrigated village the percentage difference in employment between tractors and non tractor farms was the highest relating to cotton. This is indicated by the fact that by using tractor for one acre under cotton would create additional employment opportunities by 242.35 percent. In the low irrigated village, highest percentage difference was found with regard to paddy. This might be due to the fact that in the concerned village, paddy growers were employing tractors for longer hours as compared to other farmers.

In the high irrigated village of Perur block sugarcane cultivators benefitted more by the use of tractors in terms of employment. By using tractor for sugarcane in an acre would increase employment by 107.77 percent. But in the low irrigated village, highest percentage difference in employment between tractor and non tractor farms was found with regard to groundnut.

In Karamadai block, in the high irrigated village, highest percentage difference in employment between tractor farms and non tractor farms was found with respect to paddy. This also would be attributed to more use of tractors in paddy farms as against other farms. In the low irrigated village, cotton had the highest percentage difference in employment between tractor and non tractor farms. By using tractor for one hour in cotton farm would create employment for additional manhours by 31.68 percent.

In Palladam block, in the high irrigated village, highest percentage difference in employment was found with regard to paddy. In the low

irrigated village cholam cultivators using tractors were more benefitted in terms of employment.

In Annur block, in the high irrigated village, highest percentage difference in employment was found with regard to paddy. In the low irrigated village, using tractor for one hour for maize cultivation would increase employment by 23.97 percent and this was greater than the other crop (cholam) cultivated in this village.

To sum up, the use of mechanical technology, specifically the use of tractors did not displace labour use. In fact, it increased labour use through it's yield augmenting effect. This is not in conformity with the view of Rao (1973), and Bina Agarwal (1974) that the use of tractors would create unemployment. A comparison of the percentage difference of per acre family manhours and hired labour man hours indicated that there was favourable impact of tractors on the use of hired labour. This is in conformity with the findings of Darogasingh (1981) that tractor use shifts the demand for hired labour. The crop wise comparison of the impact of tractors revealed that tractors used in paddy and cotton farms would create more employment opportunities.

J. Technology Impact Model with Respect to Employment

The impact of technology on employment was analysed by fitting multiple regression equation relating employment of labour in man hours with technology adoption index (X_1) cultivated area (X_2) and cropping intensity (X_3). The estimated multiple regression coefficients of employment as related to technology adoption index, cultivated area and cropping intensity are represented in Table XLIX.

TABLE XLIX

ESTIMATED MULTIPLE REGRESSION COEFFICIENTS OF EMPLOYMENT AS RELATED TO TECHNOLOGY ADOPTION INDEX,
CULTIVATED AREA AND CROPPING INTENSITY

S.No.	Village	N	$\hat{a}_0$	$\hat{b}_1$	$\hat{b}_2$	$\hat{b}_3$	R^2
I. Pollachi South							
a.	High irrigated village	50	- 252.25	.88 (.33)	27.2 (8.68)	1.56 (.79)	.71
b.	Low irrigated village	50	199.22	.58 (.51)	2.23 (.33)	.78 (.27)	.41
II. Perur							
a.	High irrigated village	50	125.61	.45 (.41)	3.2 (.65)	.11 (.05)	.70
b.	Low irrigated village	50	124.83	.39 (.51)	15.95 (4.24)	-.31 (-.2)	.31
III. Karamadai							
a.	High irrigated village	50	217.65	1.33 (.40)	15.28 (8.23)	2.81 (2.21)	.65
b.	Low irrigated village	50	115.02	.69 (.40)	1.2 (.82)	1.61 (.20)	.58

TABLE XLIX (Contd.)

S.No.	Village	N	$\hat{a}_0$	$\hat{b}_1$	$\hat{b}_2$	$\hat{b}_3$	R^2
IV. Palladam							
a.	High irrigated village	50	224.93	2.25 (.98)	28.52 (10.78)	.72 (.36)	.73
b.	Low irrigated village	50	229.19	2.16 (.76)	7.54 (3.58)	- 2.44 (- 2.8)	.19
V. Annur							
a.	High irrigated village	50	56.68	.79 (.88)	5.99 (4.96)	- .35 (- .56)	.42
b.	Low irrigated village	50	6.96	.03 (.05)	6.59 (17.22)	.28 (1.66)	.90
	Overall	500	76.12	1.28 (.71)	4.35 (6.28)	.41 (1.05)	.82

Figures in paranthesis indicates t values ;

* Statistically significant at 5 percent level ;

** Statistically significant at 1 percent level.

In Pollachi South block, in both high and low irrigated villages, technology adoption had a positive impact on employment. But the extent of impact was more in the first group as compared to the second group. The increase in technology adoption by one percent would increase employment by .88 percent in high irrigated village and by .58 percent in low irrigated village.

In Perur block, in the high irrigated village, the extent of increase in technology adoption by one per cent would increase employment by .45 percent in high irrigated village and by .39 percent in low irrigated village.

In Karamadai block, the adoption of agricultural technology had created positive impact on employment. In the high irrigated village, an increase in technology adoption by one percent tended to increase employment by 1.3 percent. In the low irrigated village, the extent of change in employment in response to technology adoption was estimated to be .69 percent.

In Palladam block, an increase in technology adoption by one percent would increase employment by 2.25 percent in high irrigated village and 2.16 percent in low irrigated village. The estimated regression coefficients were the highest as compared to other blocks. This might be due to the fact that in Palladam block, per acre man hours employed was higher as compared to other blocks.

In Annur block, the extent of increase in employment due to technology adoption was estimated to be .79 and .03 respectively in high and low irrigated villages (Appendix XXV).

In all the study villages, technology had a favourable impact on employment. A comparison of the extent of change between high and low irrigated village in a block revealed that, the use of technology had created more positive impact on employment in the high irrigated village. However, a comparison of the change in employment due to technology adoption, cultivated area and cropping intensity indicated that in all the study villages, more change in employment was found due to change in farm size.

K. Derivation of Labour Demand Functions for High Technology and Low Technology Farms and Employment Decomposition Model

a. Derivation of Labour Demand Functions

One of the major shifts in the area of development economics is that output growth does not necessarily lead to considerable growth in employment. Provision of employment opportunities has been treated as one of the major instruments for effecting the implementation of equity goal of development. Technical change may generate additional employment by facilitating multiple cropping as it may also contribute to employment by creating a dynamic environment for farm diversification. In addition to these on farm employment effects, technical change may also generate employment through backward and forward linkages in input and output markets (Mellor and Uma, 1973).

Following Bisaliah and Hiremath (1982) the current study derived the labour demand function as

$$N = f(W, L, F, K)$$

where

N = Per acre man hours of labour ;

W = Normalised wage rate ;

L = Land input measured in acres ;

F = The current value of fertiliser and farm yard manures in rupees ; and

K = A measure of flow of capital services per farm. This includes rental value of bullock service, value of seed irrigation charges, depreciation charges, interest and miscellaneous charges.

The estimated employment elasticities are presented in Table L. A sample estimation is given in Appendix XXVI.

TABLE L
ESTIMATED EMPLOYMENT ELASTICITIES IN THE STUDY FARMS

S.No.	Item	Paddy		Cholam		Maize		Sugarcane		Cotton		Groundnut	
		HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
I. Pollachi South													
Type A Village													
1.	Constant	2.31	4.03	66.31	1.8	-	-	.21	.45	2.43	1.26	-	-
2.	Wage rate	-.79 (2.16)*	-.61 (-.92)	-.58 (-1.59)	-.41 (-.38)	-	-	-.62 (-.58)	-.45 (-.25)	-.72 (-1.05)	-.55 (-1.06)	-	-
3.	Land	.41 (2.01)*	.60 (1.2)	.58 (21.09)*	.45 (4.98)	-	-	.35 (.42)	.38 (.76)	.36 (2.02)*	.42 (1.58)	-	-
4.	Fertiliser	.15 (3.28)**	.12 (2.46)*	.11 (1.98)*	.09 (2.26)*	-	-	.62 (2.15)*	.54 (3.16)**	.43 (1.52)	.339 (1.18)	-	-
5.	Capital Services	.31 (1.92)	.19 (.65)	.29 (96.84)	.18 (.26)	-	-	.43 (.28)	.28 (1.05)	.37 (2.26)	.18 (1.98)	-	-
	R^2	.68	.72	.96	.49	-	-	.74	.69	.71	.65	-	-
	N	26	24	26	23	-	-	28	20	28	22	-	-

TABLE L (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Type B Village													
1.	Constant	.62	3.43	1.6	2.3	-	-	.41	1.6	1.1	.96	.11	.62
2.	Wage rate	-.81 (-1.8)	-.90 (-.41)	-.74 (-.28)	-.48 (-.26)	-	-	-.72 (-3.2)	-.74 (-.18)	-.81 (-.15)	-.72 (-2.26)	-.64 (.58)	-.62
3.	Land	.54 (.11)	.65 (.16)	.61 (.18)	.70 (.24)	-	-	.32 (1.02)	.36 (1.28)	.38 (2.41)	.44 (1.6)	.38 (1.05)	.40 (.42)
4.	Fertiliser	.11 (2.18)*	.10 (1.96)	.07 (.42)	.03 (.46)	-	-	.58 (3.21)**	.43 (2.96)**	.31 (1.05)	.26 (.82)	.26 (.76)	.24 (.31)
5.	Capital services	.29 (.31)	.17 (1.08)	.27 (1.51)	.16 (2.98)**	-	-	.41 (1.06)	.22 (3.51)	.31 (1.86)	.28 (.51)	.21 (.26)	.26 (.31)
	R ²	.81	.28	.67	.51	-	-	.72	.74	.21	.46	.56	.43
	N	26	24	29	21	-	-	26	17	29	21	28	21
II. Perur													
Type A Village													
1.	Constant	3.28	4.11	.52	.14	-	-	6.26	4.35	2.18	.23	-	-
2.	Wage rate	-.81 (-.08)	-.84 (-.15)	-.65 (-.16)	-.64 (-1.2)	-	-	-.68 (-.24)	-.71 (-.35)	-.61 (-.39)	-.42 (-1.58)	-	-

TABLE L (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
3.	Land	.52 (1.96)	.65 (1.58)	.54 (1.05)	.69 (1.02)	-	-	.56 (2.01)	.59 (1.96)	.31 (1.58)	.40 (2.1)	-	-
4.	Fertiliser	.33 (1.84)	.21 (1.05)	.31 (2.12)	.28 (1.96)	-	-	.21 (3.26)**	.26 (3.41)**	.32 (1.02)	.25 (3.21)**	-	-
5.	Capital services	.33 (2.16)	.21 (1.98)	.31 (1.44)	.28 (1.26)	-	-	.21 (1.21)	.26 (.84)	.32 (.96)	.25 (.94)	-	-
	R ²	.69	.71	.74	.76	-	-	.49	.56	.80	.69	-	-
	N	28	20	28	20	-	-	27	23	26	24	-	-
Type B Village													
1.	Constant	-	-	1.2	1.7	1.4	1.6	-	-	.62	.59	.119	.16
2.	Wage rate	-	-	-.82 (-.12)	-.87 (-.86)	-.72 (-1.01)	-.36 (-1.52)	-	-	-.82 (-.91)	-.46 (-.86)	-.62 (-.81)	-.53 (-.42)
3.	Land	-	-	.56 (.32)	.68 (.36)	.62 (1.92)	.64 (1.96)	-	-	.25 (2.08)*	.28 (2.51)*	.41 (3.16)	.46 (3.12)
4.	Fertiliser	-	-	.21 (.48)	.15 (.46)	.62 (1.02)	.56 (1.92)	-	-	.28 (2.52)*	.30 (1.52)	.20 (1.96)	.18 (2.01)

TABLE L (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
5.	Capital services	-	-	.21 (1.52)	.15 (1.16)	.62 (1.02)	.56 (1.92)	-	-	.28 (2.52)*	.30 (1.52)	.20 (1.96)	.18 (2.01)
	R ²	-	-	.68	.64	.58	.59	-	-	.44	.65	.71	.50
	N	-	-	29	18	27	20	-	-	28	22	28	20
III. Karamadai													
Type A Village													
1.	Constant	.48	.11	2.2	2.3	-	-	-	-	8.7	3.2	-	-
2.	Wage rate	-.84 (-1.46)	-.80 (-1.82)	-.79 (-1.05)	-.65 (-2.12)	-	-	-	-	-.59 (-1.34)	-.56 (-1.38)	-	-
3.	Land	.65 (1.92)	.61 (1.26)	.66 (3.4)	.72 (4.2)	-	-	-	-	.62 (.26)	.58 (.15)	-	-
4.	Fertiliser	.11 (1.05)	.09 (1.36)	.12 (1.92)	.11 (2.16)	-	-	-	-	.90 (3.46)	.50 (4.2)	-	-
5.	Capital Services	.40 (1.92)	.22 (1.86)	.38 (1.35)	.20 (1.32)	-	-	-	-	.20 (1.82)	.18 (1.96)	-	-
	R ²	.58	.65	.74	.31	-	-	-	-	.49	.57	-	-
	N	26	20	28	22	-	-	-	-	21	19	-	-

TABLE I (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Type B Village													
1.	Constant	-	-	1.2	5.4	4.9	3.2	-	-	3.6	4.2	.65	3.1
2.	Wage rate	-	-	-.46 (-.82)	-.61 (-1.16)	-.54 (-1.12)	-.46 (1.92)	-	-	-.81 (-1.82)	-.86 (-2.01)	-.48 (.84)	-.61 (-1.64)
3.	Land	-	-	.54 (3.92)	.52 (2.56)	.71 (4.2)	.65 (3.1)	-	-	.62 (1.96)	.66 (1.58)	.71 (3.2)	.72 (1.6)
4.	Fertiliser	-	-	.80 (3.01)	.53 (2.01)	.72 (2.91)	.81 (3.26)	-	-	.87 (42)	.54 (3.52)	.13 (2.26)	.11 (1.52)
5.	Capital services	-	-	.33 (4.22)	.17 (1.52)	.22 (3.12)	.18 (4.16)	-	-	.12 (3.12)	.10 (2.16)	.80 (1.52)	.60 (2.12)
	R ²	-	-	.69	.71	.74	.65	-	-	.76	.74	.65	.64
	N	-	-	20	20	28	22	-	-	29	21	28	22
IV. Palladam													
Type A Village													
1.	Constant	4.3	1.2	4.6	3.2	1.7	.8	-	-	-	-	5.9	4.2

TABLE L (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
2.	Wage rate	-.76 (-.52)	-.71 (-.16)	-.58 (-.12)	-.61 (-1.01)	-.41 (-1.96)	-.65 (-1.05)	-	-	-.54 (-2.11)	-.52 (-2.16)	-	-
3.	Land	.63 (.31)	.64 (.24)	.58 (1.92)	.62 (1.06)	.58 (1.51)	.51 (1.92)	-	-	.60 (2.05)*	.52 (2.16)*	-	-
4.	Fertiliser	.23 (3.24)**	.11 (4.26)**	.10 (3.21)**	.93 (4.21)**	.81 (.18)	.42 (.12)	-	-	.80 (.16)	.71 (1.92)	-	-
5.	Capital Services	.38 (2.16)*	.24 (1.92)	.31 (3.12)	.34 (4.96)**	.54 (3.21)**	.42 (2.05)	-	-	.40 (4.2)**	.61 (5.2)**	-	-
	R ²	.71	.65	.74	.76	.61	.64	-	-	.59	.48	-	-
	N	26	25	26	20	24	19	-	-	25	20	-	-
Type B Village													
1.	Constant	-	-	5.8	4.6	.51	.42	-	-	3.9	2.8	4.6	3.1
2.	Wage rate	-	-	-.42 (-.05)	-.44 (-.12)	-.31 (-.16)	-.26 (-.12)	-	-	-.44 (-1.05)	-.59 (-1.26)	-.28 (-.41)	-.40 (-.36)
3.	Land	-	-	.52 (3.16)**	.60 (4.28)**	.64 (3.21)**	.63 (1.92)	-	-	.65 (4.12)**	.72 (3.26)**	.49 (4.92)**	.26 (3.26)**

TABLE L (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
4.	Fertiliser	-	-	.30 (.41)	.25 (.26)	.38 (1.2)	.25 (.28)	-	-	.65 (.42)	.59 (.21)	.72 (.28)	.61 (.52)
5.	Capital services	-	-	.28 (4.2)**	.24 (3.2)**	.21 (1.96)	.20 (2.51)*	-	-	.30 (1.58)	.11 (2.16)	.22 (1.52)	.19 (1.81)
	R ²	-	-	.61	.58	.71	.49	-	-	.65	.58	.71	.85
	N	-	-	23	20	28	22	-	-	29	21	28	22
V. Annur													
Type A Village													
1.	Constant	2.6	1.8	3.8	2.2	1.2	.61	-	-	-	-	4.8	3.6
2.	Wage rate	-.81 (-1.12)	-.16 (-.05)	-.55 (-1.08)	-.65 (-1.92)	-.81 (-1.42)	.42 (-.16)	-	-	-	-	-.52 (-1.16)	-.50 (-1.16)
3.	Land	.56 (1.18)	.52 (1.06)	.56 (2.92)**	.62 (2.08)	.66 (3.56)**	.49 (.42)	-	-	-	-	.70 (4.92)	.55 (1.55)
4.	Fertiliser	.21 (3.28)**	.10 (.36)	.12 (1.58)	.95 (2.96)	.13 (1.52)	.21 (3.26)	-	-	-	-	.86 (.92)	.75 (.82)
5.	Capital Services	.36 (1.68)	.22 (1.96)	.33 (3.58)**	.35 (4.36)**	.26 (5.2)	.51 (.92)	-	-	-	-	.42 (.96)	.60 (.18)

TABLE L (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
		R^2	.65	.56	.72	.74	.62	.65	-	-	-	.65	.46
		N	22	25	28	22	26	20	-	-	-	26	24
Type B Village													
1.	Constant	-	-	5.2	4.5	.52	.46	-	-	-	-	-	-
2.	Wage rate	-	-	-.40 (-.18)	-.42 (-.26)	-.35 (-.18)	-.28 (-1.05)	-	-	-	-	-	-
3.	Land	-	-	.56 (2.92)	.52 (1.58)	.65 (.96)	.62 (.68)	-	-	-	-	-	-
4.	Fertiliser	-	-	.31 (1.92)	.28 (4.56)**	.36 (1.38)	.26 (2.82)	-	-	-	-	-	-
5.	Capital Services	-	-	.26 (.12)	.22 (4.32)	.22 (3.12)	.18 (2.52)	-	-	-	-	-	-
	R^2	-	-	.65	.59	.55	.52	-	-	-	-	-	-
	N	-	-	26	20	28	22	-	-	-	-	-	-

HT = High Technology Farms ; LT = Low Technology Farms

Figures in paranthesis indicates t values ;

* Statistically significant at 5 percent level ;

** Statistically significant at 1 percent level.

In all the study villages, the estimated employment elasticity with regard to wage rate was negative, while the employment elasticities in respect of land, fertiliser and the flow of capital services were positive. Hence the current study is in conformity with the general proposition that labour demand is a negative function of the wage rate.

b. Employment Decomposition Model

The current study formulated employment decomposition model using the labour demand function in log linear form for high and low technology farms. The function was specified as

$$\text{Log } N_1 = \log A_1 + a_1 \log W_1 + b_1 \log L_1 + c_1 \log F_1 + d_1 \log K_1 + U_1$$

$$\text{Log } N_2 = \log A_2 + a_2 \log W_2 + b_2 \log L_2 + c_2 \log F_2 + d_2 \log K_2 + U_2$$

Taking differences between 2 and 1 and adding some terms subtracting same terms and rearranging terms,

$$\begin{aligned} \text{Log } \left(\frac{N_2}{N_1} \right) &= \text{Log } \left(\frac{A_2}{A_1} \right) + [(a_2 - a_1) \log W_1 + (b_2 - b_1) \log L_1 \\ &\quad + (c_2 - c_1) \log F_1 + (d_2 - d_1) \log K_1] + [a_2 \log \left(\frac{W_2}{W_1} \right) \\ &\quad + b_2 \log \left(\frac{L_2}{L_1} \right) + c_2 \log \left(\frac{F_2}{F_1} \right) + d_2 \log \left(\frac{K_2}{K_1} \right) + (U_2 - U_1)] \end{aligned}$$

Technology effect is captured by adding the values of the first and bracketed expression, normalised wage rate effect is denoted by the third bracketed expression and complimentary input effect is denoted by the last bracketed expression. The estimated results are presented in Table LI and Appendix XXVII describes the method.

TABLE LI

DECOMPOSITION ANALYSIS OF TOTAL CHANGE IN PER ACRE EMPLOYMENT BETWEEN HIGH AND LOW TECHNOLOGY FARMS
(IN PERCENT)

S.No.	Item	Type A Village						Type B Village					
		Paddy	Cholam	Maize	Sugarcane	Cotton	Groundnut	Paddy	Cholam	Maize	Sugarcane	Cotton	Groundnut
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
I. Pollachi South													
1.	Total change in employment	36.5	10.1	-	20.6	19.7	-	32.3	9.8	-	18.5	16.2	15.5
2.	Source of change in employment												
	A. Technology effect	10.2	2.2	-	6.5	6.0	-	6.1	2.1	-	6.3	5.8	4.2
	B. Normalised wage rate effect	9.8	4.13	-	3.6	3.9	-	11.4	4.2	-	2.6	1.5	4.8
	C. Complementary input effect	16.5	3.7	-	10.5	9.8	-	14.8	3.5	-	9.6	8.9	6.5
II. Perur													
1.	Total change in employment	34.2	9.2	-	18.8	16.2	-	31.2	8.9	-	-	15.2	14.8
2.	Source of change in employment												
	A. Technology effect	9.9	2.1	-	6.3	5.8	-	5.9	1.9	-	-	5.4	5.2
	B. Normalised wage rate effect	12.3	4.1	-	2.3	1.9	-	11.8	4.1	-	-	1.6	2.3
	C. Complementary input effect	15.7	3.0	-	10.2	8.9	-	13.5	2.9	-	-	8.2	6.3

TABLE LI (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
III. Karamadai													
1.	Total change in employment	32.7	8.9	-	-	15.7	-	-	8.1	8.0	-	14.8	13.7
2.	Source of change in employment												
	A. Technology effect	8.7	1.9	-	-	3.6	-	-	1.7	1.6	-	3.2	2.9
	B. Normalised wage rate effect	9.0	5.0	-	-	4.9	-	-	3.8	3.9	-	4.8	4.8
	C. Complementary input effect	15.0	2.00	-	-	7.6	-	-	2.6	2.5	-	6.8	6.0
IV. Palladam													
1.	Total change in employment	31.8	8.0	7.9	-	15.2	-	-	7.8	7.6	-	14.0	13.0
2.	Source of change in employment												
	A. Technology effect	8.0	1.7	1.6	-	3.4	-	-	1.5	1.4	-	3.0	2.7
	B. Normalised wage rate effect	9.8	4.5	4.7	-	4.4	-	-	3.9	4.0	-	4.6	4.5
	C. Complementary input effect	14.0	1.8	1.6	-	7.4	-	-	2.4	2.2	-	6.4	5.8
V. Annur													
1.	Total change in employment	28.7	7.2	7.0	-	-	12.0	-	6.8	6.4	-	-	-
2.	Source of change in employment												
	A. Technology effect	6.0	1.2	1.0	-	-	2.5	-	1.3	1.1	-	-	-
	B. Normalised wage rate effect	12.7	4.7	4.8	-	-	6.9	-	3.6	3.8	-	-	-
	C. Complementary input effect	10.0	1.3	1.2	-	-	2.6	-	1.9	1.5	-	-	-

In Pollachi South block, in the high irrigated village the highest percentage change in employment between high and low technology farms was found with regard to paddy cultivation. It can be observed that new technology had increased employment by about 365 percent in paddy farms. Of the increased employment, 10.2 percent was attributed to technology effect. This is due to the fact that technical change that shifts production function upwards also shifts profit function upwards. This upward shift in profit function, shifts the demand for labour. The negative employment effect of the difference in normalised wage rate was estimated as 9.8 percent. This follows from the fact that the hourly normalised wage rate paid by high technology farms is slightly higher than the one paid by low technology farms. The total positive employment effect of increased use of complementary inputs was estimated to be 16.5 percent. This positive employment effect results from the increased marginal product of labour with the use of more fertiliser. In the low irrigated village of Pollachi South block the highest change in employment was noticed with regard to paddy farms. Of 32.3 percent change in employment, technology alone had the effect of increasing employment by 6.1 percent and the use of complementary inputs increased the employment yield by 14.8 percent.

In Perur block, in both high and low irrigated villages the highest change in employment was found in paddy farms. In the high irrigated village in paddy farms, of 34.2 percent increase in employment, 9.9 percent was contributed to technological factor and 15.7 percent was due to the use of complementary inputs. In the low irrigated village,

of 31.2 percent increase in employment in paddy farms, the use of technology alone had the effect of increase in employment by 5.8 percent, but the use of complementary inputs increased the employment by 8.9 percent.

In the high irrigated village of Karamadai block, highest increase in employment was found in paddy farms. The percentage change in employment between high and low technology farms was estimated to be 32.7 percent. Of this, 8.7 percent was attributed to technological factor and 15 percent to the use of complementary inputs. However, in low irrigated village highest increase in employment was found in cotton farms. Of 14.8 percent increase in employment, 3.2 percent was due to technological factor and 6.8 percent was due to the use of complementary inputs.

Similarly, in Palladam block, in the high irrigated village, highest difference in employment between high and low technology farms was found with regard to paddy. In paddy farms the percentage change in employment was estimated to be 31.8 percent. Of this, 8 percent was due to technological factor and 14 percent was due to the use of complementary inputs. In the low irrigated village, cotton farms benefitted more in terms of employment since the percentage change in employment was the highest. Of 14 percent increase in employment, 3 percent was due to technological factor and 6.4 percent was due to the use of complementary inputs.

However, in Annur block, in the high irrigated village, highest change in employment was found in paddy farms. Of 28.7 percent increase in paddy farms, 6 percent was due to technological factor and 10 percent was due to the use of complementary inputs. But in the low irrigated village, more increase in employment was found in cholam farms as compared to other farms. In cholam farms, of 6.8 percent increase in employment, 1.3 percent was due to technology effect and 1.9 percent was due to the use of complementary inputs.

Thus the percentage change in employment between high and low technology farms differed from crop to crop. Among the food crops, paddy growing farms benefitted more in terms of employment. Among the commercial crops, cotton cultivators were able to provide employment by adopting agricultural technology. Further, the percentage change in employment due to technical effect and complementary inputs also differed based on the irrigation intensity. If a crop is cultivated in both high and low irrigated villages, more percentage change in employment due to technical factor and complimentary inputs was found in the first group of villages. Hence technology had more favourable impact on employment in irrigated farms. This is in conformity with the views of Sivanappan (1981) and Dasgupta (1984) that irrigation is the critical input in agriculture.

L. Determination of Technological Factors in Operation-wise Demand For Labour - Linear Discriminant Function Analysis

It is argued that the adoption of agricultural technology had created operation wise differences in demand for labour. Singh (1971) viewed that manhours employed for crop maintenance was high in HYV farms as compared to NHYV farms. Arulmani (1981) argued that for paddy, the use of technology had increased the demand for labour for fertiliser application. Following this, the current study tried to identify the role of technological factors in different farm operations.

The current study had used linear discriminant function analysis for finding out operation wise differences in labour demand. The formulated linear discriminant function is as follows :

$$Z = b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8$$

Z = Total discriminant score for two groups (High and low labour demand for land preparation, transplanting, crop maintenance and harvesting) ;

x_1 = Normalised wage rate for land preparation ;

x_2 = Normalised wage rate for transplanting ;

x_3 = Normalised wage rate for crop maintenance ;

x_4 = Normalised wage rate for harvesting ;

x_5 = Normalised price of fertiliser ;

x_6 = Expenditure on pesticides (rupees per acre) ;

x_7 = Capital expenditure (rupees per acre) ; and

x_8 = Technology adoption index.

a. Demand for Labour for Land Preparation

The land preparation operation denotes ploughing the land and reclaiming the soil fertility. The adoption of mechanical technology significantly tractors might decrease the demand for labour for land preparation. But since agricultural technology helps to augment output, the demand for labour for land preparation increases. Table LII brings out the linear discriminant function coefficients as affecting the demand for labour for land preparation. A sample calculation of the linear discriminant function is given in Appendix XXVIII.

TABLE LII

LINEAR DISCRIMINANT FUNCTION COEFFICIENTS AND PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS
TO TOTAL DISTANCE MEASURED (LAND PREPARATION)

S.No.	Variables	Type A Village				Type B Village					
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				Co- efficient	Group mean difference	L.D.	$\frac{L.D \times 100}{D^2}$	Co- efficient	Group mean difference	L.D.	$\frac{L.D. \times 100}{D^2}$
I. Pollachi South											
1.	Normalised wage for land preparation			-.0311	36	-1.12	-11.57	-.012	34	-.041	-.85
2.	Normalised wage rate for transplanting			.0015	-14	-.021	-.21	.003	-28	-.084	-.18
3.	Normalised wage rate for crop maintenance			.0012	-39	.0468	.48	-.0015	40	-.06	-.125
4.	Normalised wage rate for harvesting			.0080	276	2.21	22.83	.004	250	1.0	.21
5.	Normalised price of fertilizer			.0071	8.23	.098	1.01	.006	6.25	.0375	.078
6.	Pesticide expenditure			.0011	7.78	-.0085	-.08	-.002	5.7	-.0114	.0237
7.	Capital expenditure			.0015	-5475	8.21	84.81	-.0127	-3700	46.99	98.03
8.	Technology adoption index			.0158	19.99	.32	3.7	.0137	25.4	.35	.73
										$D^2 = 9.68$	
										$F = 5.49$	

TABLE LII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
II. Perur									
1.	Normalised wage for land preparation	-.0212	32	-.68	-10.46	-.0153	40	-.61	-2.42
2.	Normalised wage rate for transplanting	.0013	-16	-.02	-.30	-.0082	28	-.23	-.91
3.	Normalised wage rate for crop maintenance	-.0015	-36	.54	.83	-.0042	-40	.17	.67
4.	Normalised wage rate for harvesting	.006	240	1.44	.22	.003	200	.60	2.38
5.	Normalised price of fertiliser	.005	7.6	.038	.58	.004	8.2	.03	.12
6.	Pesticides expenditure	-.001	6.7	-.0067	-.10	-.002	6.9	.02	.07
7.	Capital expenditure	-.0012	-4525	5.43	83.53	-.004	-6200	24.8	98.76
8.	Technology adoption index	.0122	20.31	.25	3.84	.015	22.36	.33	1.31
$D^2 = 9.68$ $F = 5.49$									
III. Karamadai									
1.	Normalised wage for land preparation	-.0413	35	-1.44	-22.85	.012	25	-.3	-.87
2.	Normalised wage rate for transplanting	.0018	-19	-.0342	-.54	.0017	-15	-.03	-.08
3.	Normalised wage rate for crop maintenance	.0014	-42	.0588	.93	-.0015	-38	.06	.17
4.	Normalised wage rate for harvesting	.005	215	1.075	17.06	.003	227	.68	1.98
5.	Normalised price for fertiliser	.004	8.2	.0328	.52	.006	7.9	.05	.15
6.	Pesticide expenditure	-.002	7.4	-.0148	-.23	-.003	6.8	-.02	-.06
7.	Capital expenditure	.0013	-3700	4.81	76.34	-.008	-4200	33.6	97.98
8.	Technology adoption index	.014	24.16	.33	5.23	.011	22.6	.25	.72
$D^2 = 10.13$ $F = 6.2$									

TABLE LII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IV. Palladam									
1.	Normalised wage rate for land preparation	-.0216	47	-1.02	-9.51	-.0158	33	-.52	2.59
2.	Normalised wage rate for transplanting	.0019	-26	-.05	-.46	.0012	-42	-.0504	.25
3.	Normalised wage rate for crop maintenance	-.0016	-32	.05	-.46	-.008	-15	.12	.59
4.	Normalised wage rate for harvesting	.007	200	1.4	13.05	.005	275	1.38	6.88
5.	Normalised price for fertilizer	.009	10.2	.09	.83	.008	9.4	.08	.39
6.	Pesticides expenditure	.001	7.2	-.0072	.06	-.002	6.9	-.0138	-.07
7.	Capital expenditure	-.002	-5115	10.23	95.42	-.004	-4785	19.14	95.5
8.	Technology adoption index	.002	15.15	.03	.27	.0019	16.25	.03	.15
$D^2 = 12.68$									
$F = 9.2$									
V. Annur									
1.	Normalised wage rate for land preparation	-.0216	22	-.48	-4.2	-.003	24	-.072	-.48
2.	Normalised wage rate for transplanting	.0012	-30	-.036	-.32	.002	-25	-.05	-.33
3.	Normalised wage rate for crop maintenance	-.0019	.35	.0665	.58	-.0012	-54	.0648	-.43
4.	Normalised wage rate for harvesting	.003	2.82	.846	7.41	.002	220	.44	2.94
5.	Normalised price for fertilizer	.003	11.2	.0336	.29	.004	9.8	.04	.26
6.	Pesticides expenditure	-.005	8.3	-.0415	-.36	-.004	10.6	-.0424	-.28
7.	Capital expenditure	-.003	-36.72	11.01	96.49	-.004	3615	14.46	96.72
8.	Technology adoption index	.001	19.16	.02	.17	.005	20.12	.11	.73
$D^2 = 12.68$									
$F = 9.2$									

The significant D^2 and F values indicated that eight variables considered in the function were useful in distinguishing the farms into high and low labour demand farms for land preparation. In the high irrigated village of Pollachi South block, the percentage contribution of technological factors to distance measured was only 3.7 with regard to land preparation. In the low irrigated village of Pollachi South block, the percentage contribution of technological factors to demand for labour for land preparation was .73.

In Perur block, in the high irrigated village, technological factors were the basis for distinguishing high and low labour demand farms for land preparation to the extent of 3.84 per cent. In the low irrigated village the percentage contribution of technological factors to distance measured was only 1.31.

In Karamadai block in the high irrigated village, technological factors accounted for 5.23 percent for differentiating the farms on the basis of labour demand for land preparation. In the low irrigated village, the percentage contribution of technological factors to distance measured was .72.

In Palladam block, in the high irrigated village, technological factors were helpful to the extent of .27 percent for distinguishing the farms on the basis of labour demand for land preparation. In the low irrigated village, the percentage contribution of technological factors to distance measured was .15.

However in Annur block, in the high irrigated village, technological factors were able to discriminate the farms on the basis of labour demand for land preparation to the extent of .17 percent. But in the low irrigated village, the percentage contribution of technological factors to total distance measured was .73.

The above analysis indicates that the demand for labour for land preparation was affected to a small extent by the technological factors. However, the extent of contribution of technological factors for discriminant score with regard to demand for labour for land preparation was more in high irrigated villages as compared to low irrigated villages, except in Annur block.

b. Demand for Labour for Transplanting

The farms using HYV are doing transplanting to a great extent. Hence the demand for labour for transplanting varies with the adoption of agricultural technology. Table LIII brings out the linear discriminant functions co-efficients affecting the demand for labour for transplanting.

TABLE LJII

LINEAR DISCRIMINANT FUNCTION CO-EFFICIENT AND PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS
TO TOTAL DISTANCE MEASURED (FOR TRANSPLANTING)

S.No.	Variables	Type A Village				Type B Village			
		Co-efficient	Group mean difference	L.D.	$\frac{L.D. \times 100}{D^2}$	Co-efficient	Group mean difference	L.D.	$\frac{L.D. \times 100}{D^2}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I. Pollachi South									
1.	Normalised wage rate for land preparation	-.042	32	-1.34	-10.8	-.021	25	-.525	-10.82
2.	Normalised wage rate for transplanting	.0018	28	-.090	-.71	-.0015	22	-.033	-.68
3.	Normalised wage rate for crop maintenance	.002	-42	-.084	.66	.003	-20	-.06	-1.23
4.	Normalised wage rate for harvesting	.005	225	1.13	8.47	.005	150	.75	15.46
5.	Normalised price of fertilizer	.004	9.4	.037	.29	.003	8.6	.0258	.53
6.	Pesticide expenditure	-.001	6.2	-.0062	.05	.008	4.2	-.0338	-.69
7.	Capital expenditure	-.005	2510	12.55	99.38	-.003	-1500	4.5	92.78
8.	Technology adoption index	.024	18.16	.435	3.44	.018	25.6	.28	5.77
$D^2 = 12.63$									
$F = 5.83$									

TABLE LIII (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IV. Palladam									
1.	Normalised wage rate for land preparation	.012	25	-.30	-2.39	-.014	28	-.392	-4.96
2.	Normalised wage rate for transplanting	-.0018	32	-.0576	-.46	-.0015	35	-.0525	-.66
3.	Normalised wage rate for crop maintenance	.001	-26	-.026	-.20	.003	-24	-.072	-.91
4.	Normalised wage rate for harvesting	.002	210	.42	3.34	.004	272	1.08	13.67
5.	Normalised price for fertilizer	-.004	10.4	-.0416	.33	-.003	14.8	.04	-.50
6.	Pesticide expenditure	-.002	9.3	-.0186	4	-.003	11.2	-.03	-.37
7.	Capital expenditure	-.003	-4115	12.34	98.4	-.002	-3600	7.2	91.13
8.	Technology adoption index	.012	17.2	.21	1.67	.011	18.5	.20	2.53
$D^2 = 12.54$									
$F = 7.9$									
V. Annur									
1.	Normalised wage rate for land preparation	-.011	18	-.198	-1.46	-.021	22	-.46	-5.89
2.	Normalised wage rate for transplanting	-.002	20	-.04	-.30	-.001	25	-.025	-.32
3.	Normalised wage rate for crop maintenance	.002	-22	-.044	-30	.003	-41	-.123	-1.53
4.	Normalised wage rate for harvesting	.001	200	.20	1.53	.002	224	.45	5.76
5.	Normalised price for fertilizer	-.003	11.6	-.0348	-.26	-.004	12.9	-.0516	-.66
6.	Pesticide expenditure	-.004	10.4	-.0416	-.32	-.005	8.7	-.0435	-.55
7.	Capital expenditure	-.004	-3216	12.86	98.92	-.003	-2565	7.69	98.58
8.	Technology adoption index	.014	20.6	.28	2.15	.012	29.2	.36	4.48
$D^2 = 13.0$									
$F = 7.8$									

With regard to demand for labour for transplanting, in the high irrigated village of Pollachi South block, technological factors were the basis for distinguishing high and low labour demand farms to the extent of 3.44 percent. But in the low irrigated village the percentage contribution of technological factors to demand for labour for transplanting was only 5.77 percent.

In the high irrigated village of Perur block, technological factors accounted for 2.73 percent for differentiating the farms on the basis of labour demand for transplanting. However, in the low irrigated village, the percentage contribution of technological factors to demand for labour for transplanting was 3.89 percent.

In Karamadai block, in the high irrigated village, the percentage contribution of technological factors to demand for labour for transplanting was 1.52 percent. The corresponding percentage in the low irrigated villages was 3.02 percent.

In Palladam block, in the high irrigated village, technological factors were helpful to the extent of 1.67 percent for distinguishing the farms on the basis of labour demand for transplanting. In the low irrigated village, the percentage contribution of technological factors to distance measured was 2.53 percent.

However, in Annur block, in the high irrigated village, technological factors were able to distinguish the farms on the basis of labour demand

for transplanting to the extent of 2.15 percent. But in the low irrigated village, the percentage contribution of technological factors to total distance measured was 4.48 percent.

To sum up, the discriminant score between farms with respect to demand for labour for transplanting ranged from 1.52 to 5.77 percent. The percentage contribution of technological factors for discriminant score was found to be high in low irrigated villages as compared to high irrigated villages.

c. Demand for Labour for Crop Maintenance

The application of fertiliser and pesticides has got significant impact on the demand for labour for crop maintenance. Since human labour is involved for spreading fertilizer and operating the power sprayer, there is a fundamental relation between technology adoption and demand for labour for maintenance. Table LIV helps to explain the linear discriminant function coefficients influencing the demand for labour for crop maintenance.

TABLE LIV
LINEAR DISCRIMINANT FUNCTION CO-EFFICIENT AND PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS
TO TOTAL DISTANCE MEASURED (FOR CROP MAINTENANCE)

S.No.	Variables	Type A Village			Type B Village		
		Co-efficient	Group mean difference	L.D.	Co-efficient	Group mean difference	L.D.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					$\frac{L.D. \times 100}{D^2}$		$\frac{L.D. \times 100}{D^2}$
I. Pollachi South							
1.	Normalised wage rate for land preparation	-.003	40	-.12	-1.64	-.005	50
2.	Normalised wage rate for transplanting	-.002	32	-.064	-.87	-.003	34
3.	Normalised wage rate for crop maintenance	-.004	38	-.152	-2.07	-.008	26
4.	Normalised wage rate for harvesting	.001	150	.15	2.05	.002	200
5.	Normalised price of fertilizer	.005	8.2	-.004	-.054	-.004	7.8
6.	Pesticide expenditure	-.002	4.8	-.0096	.131	-.003	5.4
7.	Capital expenditure	-.004	-1525	6.1	83.16	-.008	-1600
8.	Technology adoption index	.07	20.2	1.41	19.28	.05	15.5

$D^2 = 7.31$

$F = 13.34$

TABLE LIV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
II. Perur									
1.	Normalised wage rate for land preparation	-.002	35	-.07	-1.43	-.004	45	-.18	3.90
2.	Normalised wage rate for transplanting	-.003	34	-.102	-2.04	-.002	36	-.072	-1.56
3.	Normalised wage rate for crop maintenance	-.004	40	-.16	-3.27	-.007	22	-.154	-3.27
4.	Normalised wage rate for harvesting	.002	160	.32	6.55	.003	210	.63	13.66
5.	Normalised price for fertilizer	.004	9.6	-.038	-.77	-.005	8.7	-.0435	-.94
6.	Pesticide expenditure	-.003	7.2	-.021	-.44	-.004	6.2	-.0248	-.53
7.	Capital expenditure	-.002	-1730	3.6	73.77	-.003	-1250	3.75	81.34
8.	Technology adoption index	.06	22.4	1.34	27.46	.04	17.5	.7	15.18
$D^2 = 6.2$									
$F = 4.3$									
III. Karamadai									
1.	Normalised wage rate for land preparation	-.001	32	-.032	-.39	-.002	-42	-.084	-.77
2.	Normalised wage rate for transplanting	-.005	30	-.15	-.018	-.001	38	-.038	-.35
3.	Normalised wage rate for crop maintenance	-.006	38	-2.28	-2.8	-.006	26	-.156	-1.44
4.	Normalised wage rate for harvesting	.003	120	.30	4.42	.004	180	.72	6.66
5.	Normalised price for fertilizer	-.003	10.2	-.0306	-.23	-.006	9.2	-.0552	-.51
6.	Pesticide expenditure	-.004	6.5	-.026	-.31	-.003	7.8	-.0234	-.21
7.	Capital expenditure	-.004	-1800	7.2	88.46	-.005	-19.50	9.75	90.36
8.	Technology adoption index	.05	20.8	1.04	12.77	.03	22.6	.678	6.30
$D^2 = 8.14$									
$F = 5.2$									

The demand for labour for crop maintenance was basically affected by the extent of adoption of agricultural technology. In the high irrigated village of Pollachi South block, technological factors were the basis for distinguishing high and low labour demand farms for crop maintenance to the extent of 19.23 percent. But in the low irrigated village, the percentage contribution of technological factors to total distance measured was only 5.77 percent.

In Perur block, in the high irrigated village, the percentage contribution of technological factors to demand for labour for crop maintenance was 27.46 percent. However, in the low irrigated village, the percentage contribution of technological factors to total distance measured was only 15.18 percent.

In Karamadai block, in the high irrigated village technological factors accounted for 12.77 percent for differentiating the farms on the basis of labour demand for crop maintenance. The corresponding percentage in high irrigated village was 6.30.

In Palladam block, in the high irrigated village, technological factors were helpful to the extent of 12.96 percent for distinguishing the farms on the basis of labour demand for crop maintenance. But in the low irrigated village, the percentage contribution of technological factors to total distance measured was only .42 percent.

In Annur block, technological factors were able to discriminate the farms on the basis of labour demand for crop maintenance to the extent of .88 percent in high irrigated village and .75 percent in low irrigated village.

From the above analysis, it can be inferred that the demand for labour for crop maintenance was affected to a significant extent by technological factors in all the study villages.

d. Demand for Labour for Harvesting

The volume of output obtained from the farms affects the number of people employed for harvesting. Since agricultural technology has a significant impact on farm output, it also affects the demand for labour for harvesting. Table LV provides information about the linear discriminant function coefficients influencing the demand for labour for harvesting.

TABLE LV

LINEAR DISCRIMINANT FUNCTION CO-EFFICIENT AND PERCENTAGE CONTRIBUTION OF INDIVIDUAL CHARACTERISTICS
TO TOTAL DISTANCE MEASURED (FOR HARVESTING)

S.No.	Variables	Type A Village				Type B Village					
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				Co- efficient	Group mean difference	L.D.	$\frac{L.D \times 100}{D^2}$	Co- efficient	Group mean difference	L.D.	$\frac{L.D \times 100}{D^2}$
I. Pollachi South											
1.	Normalised wage rate for land preparation			-.001	35	.035	.62	-.002	38	-.076	-3.36
2.	Normalised wage rate for transplanting			.002	28	.056	1.00	.001	25	.025	-1.10
3.	Normalised wage rate for crop maintenance			-.004	30	-.12	2.15	-.005	27	-.135	-5.57
4.	Normalised wage rate for harvesting			-.003	120	-.36	6.40	-.004	100	-.40	-1.76
5.	Normalised price of fertilizer			.004	7.6	.0304	.54	.003	82	.0246	1.08
6.	Pesticide expenditure			-.002	5.2	.0104	.18	-.001	48	-.0048	-.21
7.	Capital expenditure			-.004	-1200	48	86.7	-.002	-1000	2.0	88.49
8.	Technology adoption index			.06	18.7	1.12	20.10	.05	16.6	.83	36.72
$D^2 = 5.57$											
$F = 2.9$											

TABLE LV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
II. Perur									
1.	Normalised wage rate for land preparation	-.002	32	-.064	-.78	-.001	21	-.021	-.35
2.	Normalised wage rate for transplanting	-.001	25	-.025	-.30	-.002	16	-.032	-.53
3.	Normalised wage rate for crop maintenance	-.003	28	-.084	-1.03	-.004	20	-.08	-1.34
4.	Normalised wage rate for harvesting	-.004	130	-.52	-6.41	-.003	113	-.33	-5.56
5.	Normalised price for fertilizer	.005	10.3	.0515	.63	.003	12.8	.0384	.65
6.	Pesticide expenditure	-.001	6.4	-.0064	.078	-.002	5.2	-.0104	-.17
7.	Capital expenditure	-.006	-1300	7.8	96.17	-.004	-1425	5.7	96.12
8.	Technology adoption index	.05	19.2	.96	11.83	.04	17.9	.71	11.97
$D^2 = 8.18$									
$F = 4.3$									
III. Karamadai									
1.	Normalised wage rate for land preparation	-.003	15	-.045	-1.0	-.002	14	-.028	-.248
2.	Normalised wage rate for transplanting	-.002	26	-.052	-1.15	-.001	28	-.028	-.248
3.	Normalised wage rate for crop maintenance	-.0015	29	-.0435	-.96	-.0012	27	-.0324	.287
4.	Normalised wage rate for harvesting	-.001	162	-.162	-3.6	-.002	150	-.30	-.265
5.	Normalised price for fertilizer	-.004	11.8	-.0472	-1.04	.007	127	-.0889	.78
6.	Pesticide expenditure	-.002	3.9	.0078	-.17	-.001	4.6	-.0046	-.04
7.	Capital expenditure	-.003	-1425	4.28	95.11	-.007	-1600	11.20	99.29
8.	Technology adoption index	.03	16.5	.49	10.88	.02	19.5	.39	3.45
$D^2 = 4.5$									
$F = 11.28$									

TABLE LV (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IV. Palladam									
1.	Normalised wage rate for land preparation	-.001	10	-.01	-.36	-.002	12	-.024	-.71
2.	Normalised wage rate for transplanting	-.0135	18	-.243	-8.77	-.0142	19	-.2698	-8.07
3.	Normalised wage rate for crop maintenance	-.0041	17	-.068	-2.45	-.0025	20	-.05	-1.49
4.	Normalised wage rate for harvesting	-.002	175	-.35	-12.63	-.001	19.8	-.0198	-.59
5.	Normalised price for fertilizer	.006	13.9	.0834	3.01	.007	14.6	.1022	-3.05
6.	Pesticide expenditure	-.001	4.5	-.0045	-.16	-.002	3.5	-.007	-.20
7.	Capital expenditure	-.002	-1120	2.24	80.86	-.003	-1080	3.24	97.00
8.	Technology adoption index	.05	22.3	1.12	40.43	.02	18.3	.36	10.77
$D^2 = 8.7$									
$F = 6.3$									
V. Annur									
1.	Normalised wage rate for land preparation	-.003	11	-.033	-.48	-.002	12	-.024	-.23
2.	Normalised wage rate for transplanting	-.005	22	.11	-1.62	-.004	35	-.14	-1.35
3.	Normalised wage rate for crop maintenance	-.0037	19	-.0703	-1.03	-.0053	14	-.0742	.71
4.	Normalised wage rate for harvesting	-.001	18.2	-.0182	-.26	-.004	19.6	-.0784	.75
5.	Normalised price for fertilizer	.007	14.6	-.1022	-1.5	.006	12.8	.0768	.74
6.	Pesticide expenditure	-.002	5.4	-.0108	-.15	-.001	4.3	-.0043	-.041
7.	Capital expenditure	-.004	-1600	6.4	94.39	-.006	-1720	10.32	99.8
8.	Technology adoption index	.03	17.3	.152	7.66	.01	24.3	.24	2.32

208.7

6.3
11
12

02 - 10.32

With regard to demand for labour for harvesting, in the high irrigated village of Pollachi South block, technological factors accounted for 20.10 percent for distinguishing the farms. In low irrigated village, the corresponding percentage was 36.72.

In Perur block, in the high irrigated village, the percentage contribution of technological factors to demand for labour for harvesting was 11.83. In the low irrigated village technological factors accounted for 11.97 percent for distinguishing the farms on the basis of labour demand for harvesting.

In Karamadai block, in the high irrigated village the percentage contribution of technological factors to distance measured was 10.88. In the low irrigated village, the corresponding percentage was 3.45.

In Palladam block, in the high irrigated village, technological factors were helpful to the extent of 40.43 percent for distinguishing the farms on the basis of labour demand for harvesting. In the low irrigated village the percentage contribution of technological factors to distance measured was 10.77.

In Annur block, technological factors were able to discriminate the farms on the basis of labour demand for harvesting to the extent of 7.66 percent in high irrigated village and 2.32 percent in low irrigated village.

The above analysis indicates the fact that technological factors contributed to a great extent for discriminating the farms on the basis of demand for labour for harvesting. The percentage contribution of technological factors was more in high irrigated villages as compared to low irrigated villages. This might be due to the fact that, in high irrigated villages with the adoption of technology, output increases to a great extent, and consequently the demand for labour for harvesting increases.

Hence the current study is in conformity with the views of Sinha (1985) and Singh (1986) that with the adoption of agricultural technology, the demand for labour for transplanting, fertiliser application and harvesting increases.

SUMMARY AND CONCLUSION

CHAPTER V

SUMMARY AND CONCLUSION

Technology is the essential source of economic growth and it helps to speed up the process of economic development. Schultz (1964) in 'Transforming traditional agriculture' advanced the proposition that agricultural growth depends on the availability of modern agricultural factors'. Krishna (1970), Sidhu and Sankhayan (1973), Chourasia and Singh (1973), Prakash and Rajan (1975), Sain and Shah (1979), Singh (1983), Chattapadhyaya (1986), Dhawan (1986) and Umesh and Bisaliah (1987) noted the favourable impact of technology on farm output based on macro level data relating to a State or All India. Gundu Rao (1986), Rangaswamy (1980), Sirohi and Sharma (1985), Sitaram (1986) and Tewari (1990) have analysed the impact of farm technology on output based on the field level data collected from the farmers. Sharma (1972), Acharya (1973), Mellor and Uma (1973), Bina Agarwal (1983), Reddy (1991), Dixit and Singh (1970), Chinappa and Silva (1977), Diwakar (1988), Naidu and Selvam (1988) and Ghosh (1989) analysed the impact of HYV or tractors on the use of human labour input.

However, the previous studies relating to agricultural technology have analysed either the progress of technology at the macro level or the diffusion of technology at the macro level. They have concentrated on one of the technological variables - HYV seeds, fertiliser, pesticides, tractors. The current study on Impact of agricultural technology on farm output and employment adopted both macro and micro analytical approaches

and tried to analyse both the progress and constraints in the adoption of technology. It tried to suggest policy measures for closing the technology gap and improving returns on the use of the technology.

The specific objectives of the macro analytical study were to find out the nature of adoption pattern of agricultural technology in Tamil Nadu ; to study the trends in the use of agricultural technology ; to identify the significant technological variables influencing foodgrains production, and to find the relation between the use of agricultural technology and employment in agriculture. The major objectives of the micro analytical study were to find out the nature of technical change, the extent of adoption of agricultural technology by the farmers, to identify the factors favouring and limiting the adoption of agricultural technology, to evaluate the impact of agricultural technology on resource use, income and employment in farms with special attention to change in factor proportions and to suggest measures for realisation of full potentials of agricultural technology.

At the macro level, the study related to the impact of agricultural technology in the State of Tamil Nadu from 1980 - 91 to 1990 - 91. Specific emphasis was given to the impact of agricultural technology on foodgrains production. The data needed at the macro level - rainfall, land utilisation, irrigation, production and productivity of crops, area under HYV seeds, fertiliser consumption, area under pest control and disease control and use of agricultural implements were compiled from Season and Crop Reports of Tamil Nadu and Tamil Nadu Economic Appraisal

from 1980-81 to 1990-91. The information on agricultural labourers and cultivators was compiled from the 38th round of the National Sample Survey Report on Employment and Unemployment in selected States.

The micro analytical approach for the study related to Coimbatore District in the State of Tamil Nadu. For selecting the sample farmers required for micro analysis, the study adopted purposive two stage proportionate random sampling method. At the first stage, based on District average irrigation intensity, the existing blocks, excluding Valparai, the hilly area were divided into two groups - high irrigated blocks (blocks having the irrigation intensity above the District average and low irrigated blocks (blocks having the irrigation intensity lower than the District average). Using Tippet's Table of Random Numbers and giving proportional representation to blocks in both the groups, Pollachi South, Perur and Karamadai representing high irrigated blocks and Palladam and Annur representing low irrigated blocks were selected. At the second stage, based on Block irrigation intensity, the existing villages in the selected blocks were classified into high irrigated villages and low irrigated villages. By using Tippet's Table of Random Numbers, the list of villages selected in each block for the study was as follows.

S.No.	Block	High irrigated village	Low irrigated village
1.	Pollachi South	Gomangalampudur	Makkinampatti
2.	Perur	Vedapatti	Sundakkamuthur
3.	Karamadai	Karamadai	Marudur
4.	Palladam	Ayyampalayam	Ganapathipalayam
5.	Annur	Pasur	Kuppanur

From each village, 50 farmers were selected randomly using Tippet's Table of Random Numbers with replacement and hence the study covered 500 farmers. The micro analytical study related to three food crops - paddy, cholam and maize and three commercial crops - sugarcane, cotton and groundnut. The details regarding general information, land use, labour use, capital use, cropping pattern, production yield, cost of cultivation, profitability of farming, use of HYV seeds, fertiliser, pesticides and agricultural implements were collected by using pretested structured interview schedule. The primary data were collected between May 1992 to May 1993.

For analysing the macro level data, the study used growth rate analysis, decomposition analysis, logistic curve and multiple regression analysis. The important tools used for analysing the micro level data were, chi square analysis, t test, simple regression, multiple regression, geometric mean, weighted arthmetic mean, decomposition model and linear discriminant function analysis.

The major findings of the study were as follows :

I. Macro Analytical Study - Impact of Agricultural Technology on Farm Output and Employment in Tamil Nadu

A. Trends in Land Area, Sources of Water Supply and Rainfall

- a. Between 1981-92 on an average, of the total available land, only 45 percent had been used for agricultural purposes and the remaining part was kept either as fallow land or used for non agricultural purposes.
- b. Between 1981-91, gross area irrigated, decreased from 32.94 lakh hectares to 28.94 lakh hectares and net area irrigated decreased from 25.7 lakh hectares to 23.73 lakh hectares. Canals were an importance source of irrigation and on an average, 35 percent of irrigated area was by canals.
- c. The actual rainfall in the State was below the normal rainfall of 942.5 millimeters in all the reference years, except 1981-82, 1983-84, 1985-86 and 1987-88.

B. Trends in Area, Production and Productivity of Foodgrains

- a. In the reference period, on an average, 77.28 percent of the net area sown was under foodgrains and area under foodgrains registered the compound growth rate of - .8 percent. Foodgrains production increased at the compound growth rate of 1.12 percent and yield increased at the compound growth rate of 1.48 percent.

- b. The application of decomposition analysis revealed that between 1981-91, the yield effect accounted for 78.48 percent of the change in production of foodgrains, while the percentage contribution of area effect and interaction effect to foodgrains production respectively were 14.85 and 6.67 percent.
- c. Cropwise decomposition analysis revealed that in the reference period, the compound growth rate in the yield of paddy, cholam, cumbu, maize and ragi respectively were 17.3 percent, 11 percent, 4 percent, 4.6 percent and 3 percent. For all the crops, except maize and pulses the yield effect was greater than area effect and interaction effect indicating the intensive use of farm technology in the State.

C. Trends in Technology Use in Tamil Nadu

- a. Between 1981-91, the percentage of net irrigated area to gross cropped area was 37.31 and this was above the national average of 35 percent. However, during the reference period, net irrigated area decreased by .7 percent. In the reference period, the average percentage of HYV area in relation to GCA was 48.61. But the compound growth rate in area under HYV worked out to be -.4 percent. Fertilizer consumption increased at the compound growth rate of 5.14 percent. The average per hectare fertilizer consumption was 97 kilograms and it was above the national average of 86 kilograms. At the State level, on an average, 58.72 lakhs hectares were covered under pest control and 17.93 lakh hectares were

under disease control. In the reference period, the use of agricultural implements increased at the compound growth rate of 2.27 percent.

- b. The application of logistic curve analysis revealed that by 2000 AD, about half of GCA would be under HYV seeds and more than 90 percent of the area would be under pest control.
- c. The estimated trend values in technology use in Tamil Nadu indicated that the discrepancy between the trend and actual values was more high regard to fertiliser consumption and it was low with regard to the use of agricultural implements.

D. Technology - Foodgrains Productivity Relationships

- a. Of the technological variables, foodgrains productivity was positively related to fertiliser consumption, area under disease control and use of agricultural implements, as indicated by the estimated correlation coefficients respectively (.67, .27 and .35). The net irrigated area, HYV area and area under pest control have a negative association since the estimated correlation coefficients respectively were -.66, -.57 and -.37.

- b. The estimated multiple regression equation of foodgrains productivity as related to technological variables is as follows :

$$y = 3196.56 - 90.22 \times 1 - 4.73 \times 2 + 6.91 \times 3 - .27 \times 4$$

(-91)
(.66)
(1.26)
(1.47)

$$- 13.44 \times 4 + 1097.53 \times 6$$

(-1.26)
(1.53)

$$R^2 = .69 \quad N = 11$$

$$F \text{ value} = 5.66 > 4.98$$

In the equation

- X_1 = Percentage of net irrigated area to GCA ;
- X_2 = Percentage of HYV area to GCA ;
- X_3 = Per hectare fertiliser consumption ;
- X_4 = Percentage of area under pest control to GCA ;
- X_5 = Percentage of area under disease control to GCA ; and
- X_6 = Per hectare use of agricultural implements.

E. Technology - Employment Relationships

- a. Between 1981 - 91, the number of cultivators increased at the compound growth rate of .3 percent and agricultural labourers increased at the compound growth rate of 2 percent.
- b. In the reference period, the average physical productivity of cultivators increased from 1.01 tonnes to 1.30 tonnes and that of agricultural labourers increased from 0.93 tonnes to 0.95 tonnes.

II. Micro Analytical Study - Impact of Agricultural Technology on Farm Output and Employment in the Selected Villages

A. General Profile of the Sample Farmers

- 1. By and large, there were no remarkable differences between farmers in high and low irrigated villages in respect of age, education and farming experience.
- 2. The farmers in the selected high irrigated villages had better economic status since 66 percent of them were having monthly income

of more than Rs.2000 and 84.5 percent were having property worth Rs.50,000 and above. But in the low irrigated villages, only 44 percent of the farmers had monthly income of more than Rs.2000 and 80 percent were having the property worth Rs.5000 and above.

3. On an average, in high irrigated villages, 71 percent of the population were in the work force while in the low irrigated villages 65 percent of them were in the work force category.
4. In the selected high irrigated villages economic status has got high significant association with technology adoption since the estimated χ^2 values were greater than table value. But in low irrigated villages educational level of the farmers has got high significant association with technology adoption by the farmers as the estimated χ^2 values were greater than table value.

B. Resource Use Pattern

a. Land Use and Cropping Pattern

(i) Land Use

1. The average land area owned by a farmer in high irrigated blocks was 10.41 acres and in low irrigated blocks the corresponding figure was 9.52 acres.
2. On an average in high irrigated villages, of the total land, 82.9 percent was cultivated and 17.1 was left as fallow land. Comparatively in the low irrigated villages 77.6 percent was cultivated and 22.4 percent was left as fallow land.
3. The average cropping intensity in high irrigated blocks was 89

percent. But in low irrigated blocks, the average cropping intensity amounted to be 72 percent.

(ii) Cropping Pattern

1. On an average, the farmers in high irrigated villages were devoting 43 percent for food crops and 57 percent for commercial crops. Comparatively, the farmers in low irrigated villages were devoting 68 percent of the area for food crops and 32 percent for commercial crops.
2. Among the food crops, cholam was the most cultivated crop by the farmers in all types of villages. Among the commercial crops, sugarcane and cotton were cultivated to a great extent in high irrigated villages while groundnut and cotton were cultivated in large area in low irrigated villages.

b. Labour Use

(i) Labour Use Pattern in the Selected Villages

1. On an average, in high irrigated villages the average per acre man hours employed was 800. In low irrigated villages the corresponding figure was 600.
2. The average per acre family labour man hours employed in high irrigated villages was 192. In low irrigated villages, the corresponding figure was 392.

3. On an average the high irrigated villages were employing 608 hired labour manhours per acre as against 208 hired labour manhours in low irrigated villages.
4. In the study villages, there had been no significant sex wise difference in employment of farm labour. In high irrigated blocks, on an average, 65.31 percent were males and 34.69 percent were females. In low irrigated blocks, the corresponding figures were 64.17 percent and 35.83 percent.

(ii) Cropwise - Operation wise Use of Labour

1. Among the food crops, the cultivation of paddy required highest man hours. For paddy cultivation, per acre man hours employed ranged from 30.41 to 68.55. Among the commercial crops, the cultivation of sugarcane employed highest man hours.
2. In all the selected villages, the cultivation of paddy, sugarcane and cotton required more man hours for crop maintenance. However the cultivation of cholam and groundnut required more man hours for harvesting.

c. Capital Invested

1. On an average, in high irrigated villages, per acre investment was Rs.85,000. But in low irrigated villages, the corresponding figure was Rs.28000.

2. The average percentage of borrowed funds was 40 in high irrigated villages as against 60 in low irrigated villages.
3. In high irrigated villages, the average percentage of bank credit to total borrowed fund was 45 and this was greater than that of low irrigated villages (36 percent).

C. Nature of Technical Change and Measurement of Technical Change

a. Nature of Technical Change

1. Both in high and low irrigated villages there was more use of labour intensive technology. In the high irrigated villages the estimated labour coefficient (1.03) was greater than capital coefficient (0.01). In the low irrigated villages, the estimated labour coefficient (.06) was greater than capital coefficient (.03).
2. All types of farmers - marginal, small, semi medium, medium and large were using more of labour intensive technology. The estimated labour coefficient for all types of farmers (.35, .18, .18, 1.21 and .48 respectively) was greater than capital coefficient (.0036, -.0054, -.0054, .0165 and .0104 respectively).
3. In Pollachi South block, there was more use of capital intensive technology since the estimated $\hat{\beta}$ was greater than $\hat{\alpha}$. In Perur, Karamadai, Palladam and Annur blocks there was more emphasis on labour intensive technology since the estimated $\hat{\alpha}$ was greater than $\hat{\beta}$.
4. In the blocks of Pollachi South and Perur, there had been increasing returns to scale since $\hat{\alpha} + \hat{\beta}$ was greater than one. But in other

blocks, there was decreasing returns to scale since $\alpha + \beta$ was less than one.

b. Measurement of Technical Change

1. In all the study villages, by switching over to HYV from NHYV there had been non neutral technical change since there was change in both efficiency parameters (A_0) and the slope coefficients (b_i).
2. In the high irrigated villages the positive technical change was found with regard to paddy, sugarcane, cotton and groundnut as there was increase in slope coefficients. But in low irrigated villages, maize, cotton and groundnut depicted positive technical change.

D. Adoption of Agricultural Technology

a. Extent of Discrepancy Between the Optimal and Actual Use of Inputs

1. The farmers in high irrigated villages were aware of the recommended dose of seed, fertiliser and pesticides and hence there was low discrepancy between the optimum and actual use, as compared to the farmers in low irrigated villages.
2. The extent of discrepancy between the optimal and actual use of technology was small for the commercial crops as compared to food crops.

b. Profitability of Farming Enterprise

1. For all the crops cultivated net return per acre was more in HYV farms as compared to NHYV farms.
2. Among the food crops, paddy gave the highest net return and among the commercial crops, sugarcane and cotton gave high net return.

F. Determination of Factor Shares, Factor Substitution and Resource Use Efficiency Due to Technical Change

a. Determination of Factor Shares

1. In high irrigated villages, technological factors apparently played a primary role. The estimated marginal value productivity of seed, fertilisers, pesticides and tractor timings was greater than that of labour and capital. In low irrigated villages they played only a secondary role. The estimated marginal value productivity of labour and capital was greater than that of the technological factors.
2. The spread of technology was selective since paddy, sugarcane, cotton and groundnut were significantly affected by technological factors as compared to cholam and maize. The estimated marginal value productivity of technological factors in these crops were greater as compared to other crops.
3. Of the technological variables, tractor use seemed to be more important since the estimated marginal value productivity of tractor timings was the highest in all the study village.

b. Determination of Factor Substitution

1. In all the study villages, the marginal rate of substitution of fertiliser for land was remarkable.
2. By using additional dose of fertiliser, the farmers in high irrigated village can save land to a larger extent than the farmers in low irrigated villages.

c. Impact of Technical Change on Share of Different Factors in Total Production

1. The analysis of bias in factor shares indicated that in high irrigated villages, there had been no bias in factor share in respect of fertiliser for paddy, and in respect of seeds for cholam.
2. In the low irrigated villages for all the crops the factor share in respect of capital had been significant.

d. Impact of Technical Change on Resource Use Efficiency

1. Resource saving effect and resource loss averted due to the adoption of technology was more in high irrigated villages as compared to low irrigated villages.
2. The adoption of agricultural technology helped to minimise the use of resources and avert the resource loss to a significant extent for paddy, sugarcane and cotton as compared to other crops.

the food crops fertiliser had the highest impact on paddy crop and among the commercial crops, sugarcane was more benefitted by the use of fertiliser.

d. Effect of Pesticides on Farm Output and Yield

1. The impact of pesticide on yield was found more in high irrigated villages as compared to the low irrigated villages. The estimated pesticide yield response coefficients for the first group was greater than that of the other group.
2. Among the food crops, impact of pesticides on the yield of cholam was more and among the commercial crops, cotton was more benefitted by the use of pesticides.

e. Effect of Tractors on Farm Output and Yield

1. In all the study villages, the tractor farms were able to give more output and yield as compared to non tractor farms. This is indicated by the estimated percentage difference in output and yield between tractor and non tractor farms and also the 't' values.

H. Cropwise and Sizewise Variations in Technology Impact

a. Overall Effect of Technology Adoption Index on Farm Income

1. By relating farm income with technology adoption, cultivated area and cropping intensity, the study found that technology adoption

had a positive effect on farm income in all the study villages. The estimated multiple regression coefficients of farm income as related to technology adoption index were positive. But the extent of change in farm income due to technology adoption was more in high irrigated villages as compared to low irrigated villages.

b. Cropwise Technology Impact Model

1. By and large, technology had a positive impact on farm income for all crops, since the estimated partial regression coefficients of technology adoption index with respect to farm income were positive.
2. Among the food crops, the highest positive impact of technology was found with regard to paddy.
3. Among the commercial crops, the extent of positive impact was more on sugarcane and cotton as against groundnut.

c. Sizewise Technology Impact Model

1. By and large, the benefits of technology were not scale neutral. The adoption of agricultural technology created more positive impact on medium and large farmers as compared to marginal and small farmers.
2. In high irrigated blocks - Pollachi South, Perur and Karamadal, the adoption of agricultural technology had created a positive impact on farm income for large farmers.

3. In low irrigated blocks, Palladam and Annur the adoption of agricultural technology resulted in a higher positive impact on farm income for semi medium and medium farmers.

- I. **Effect of High Yielding Variety Seeds and Tractors on Farm Employment**

- a. **Effect of High Yielding Variety Seeds on Employment**

1. In all the study villages, per acre man hours labour employed in HYV farms was greater than NHYV farms. On an average, per acre man hours of labour employed in HYV farms was (623) as against NHYV farms (565).
2. Both the family and hired man hours of labour employed in HYV farms was greater than NHYV farms. The percentage difference in the employment of family and hired labour was statistically significant as indicated by the estimated t value.
3. The percentage difference in employment between HYV and NHYV farms was more in the farms cultivating paddy, cholam and cotton.

- b. **Effect of Tractors on Farm Employment**

1. In all the study villages, there was a significant difference in employment between tractor farms and non tractor farms.
2. Between tractor and non tractor farms the percentage difference in per acre family labour man hours employed was more as compared to per acre hired labour man hours employed.

3. The percentage difference in employment between tractor and non tractor farms was more in paddy and cotton farms as against other farms.

J. Technology Impact Model with Respect to Employment

1. In all the study villages, technology had a favourable effect on employment since the estimated multiple regression coefficients of employment in relation to technology adoption index were positive.
2. The extent of increase in employment due to technology adoption was more in high irrigated villages as compared to low irrigated villages.

K. Derivation of Labour Demand Functions and Employment Decomposition Model

a. Derivation of Labour Demand Functions

1. In all the study villages, in high technology and low technology farms, there was negative employment elasticity with respect to normalised wage rate, exhibiting a normal demand function for labour. However the employment elasticities with respect to land, fertiliser and capital were positive, showing them as the major shift factors in the labour demand function.
2. The employment elasticity with regard to fertiliser and capital in high technology farms was greater than low technology farms.

b. Employment Decomposition Model

1. The decomposition analysis of total change in per acre employment between high and low technology farms indicated that in all the study villages, for all the crops, the technology effect had made a positive contribution towards change in employment. The technology effect was greater than the normalised wage rate effect.
2. The contribution of technology effect to total change in employment was more in high irrigated villages as compared to low irrigated villages.
3. The contribution of technology effect to total change in employment was found more in paddy, and cotton farms as compared to other farms.

L. Determination of Technological Factors in Operation wise Demand For Labour : Linear Discriminant Function Analysis

1. Demand for labour for land preparation was affected to a small extent by technological factors. The percentage contribution of technological factors for discriminating the farms on the basis of labour demand for land preparation ranged from .15 percent to 5.43 percent.
2. The discriminant score between high technology and low technology farms with respect to demand for labour for transplanting ranged from 1.52 to 5.7 percent.

11. There is a need to ensure seed testing to protect the interest of the farmers. Further, careful seed bed preparation is required to gain optimum use of technology.
12. To promote the use of fertiliser, the fertiliser price can be lowered and there should be equitable and efficient fertiliser distribution system.
13. The majority of farmers are not fully aware of the importance of mixture of fertiliser at the time of sowing. Hence in this aspect proper guidance should be given to the farmers.
14. Efforts should be undertaken for mobilisation of organic and bio fertiliser resources in order to supplement the use of fertiliser and thereby promoting integrated nutrient supply system.
15. Timely and appropriate information regarding the intensity of pest damage and the type of pesticide to be applied needs to be disseminated among the farmers.
16. There is need for enhancing precision in input use by the farmers ;
17. Provision should be made for the availability of HYV seeds, fertiliser and pesticides where the small farmer is located.
18. Efforts should be undertaken for making technology highly profitable so as to induce the farmers to adopt the technology ;
19. Input delivery system should be made perfect for the farmers to realise full benefits of technology ; and
20. Above all, market support ensuring competitive attractive product price is necessary in order to compensate the farmers for high cost of cultivation arising from the purchase of HYV seeds, fertiliser and pesticides.

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G. Effect of HYV Seeds, Fertiliser, Pesticides and Tractors on Farm Output

a. Effect of High Yielding Variety Seeds on Farm Output

1. There was significant percentage difference in output and yield between HYV and NHYV farms in high irrigated villages as compared to low irrigated villages. This is indicated by the estimated difference 't' value.
2. Among the food crops, the percentage difference in yield between HYV and NHYV farms was more for cholam and among the commercial crops, it was more for sugarcane and groundnut.

b. Output Decomposition Model

1. The estimates of the output decomposition model revealed that in the high irrigated villages, on an average, variety effect accounted for 45 percent of the change in output and complementary input effect accounted for 55 percent of the change in output. But in low irrigated villages the variety effect and complimentary input effect respectively accounted for 35 percent and 65 percent.

c. Effect of Fertiliser on Farm Output and Yield

1. The impact of fertiliser on yield was more for HYV crops as compared to NHYV crops. The estimated fertiliser yield response coefficient for HYV farms was greater than that of NHYV. Among

the food crops fertiliser had the highest impact on paddy crop and among the commercial crops, sugarcane was more benefitted by the use of fertiliser.

d. Effect of Pesticides on Farm Output and Yield

1. The impact of pesticide on yield was found more in high irrigated villages as compared to the low irrigated villages. The estimated pesticide yield response coefficients for the first group was greater than that of the other group.
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2. The discriminant score between high technology and low technology farms with respect to demand for labour for transplanting ranged from 1.52 to 5.7 percent.

3. In all the study villages, the demand for labour for crop maintenance was affected to a significant extent by technological factors. The discriminant score between high and low technology farms with respect to demand for labour for crop maintenance ranged from .75 to 27.45 percent.
4. With respect to demand for labour for harvesting, discriminant score between high and low technology farms ranged from 2.32 to 40.43 percent.

Conclusion

1. The adoption of agricultural technology depends to a significant extent on the availability of irrigation facilities. Technology adoption index is high in high irrigated villages as compared to low irrigated villages.
2. The adoption of agricultural technology is scale neutral. All types of farmers - marginal, small, semi medium, medium and large farmers are adopting agricultural technology.
3. Adoption of agricultural technology is rather selective and is found more in the case of paddy, sugarcane, cotton and groundnut farms as against cholan and maize farms.
4. The use of HYV seeds had a favourable impact on farm output by increasing the marginal value productivity of inputs, by minimising the use of resources and avoiding the loss in the use of resources.
5. Adoption of agricultural technology created positive impact on farm income. However, medium and large farmers were more

benefitted as compared to marginal and small farmers. Hence, the benefits of agricultural technology were not scale neutral.

6. The benefits of agricultural technology in terms of output and income was more in paddy, sugarcane and cotton farms as against cholam, maize and groundnut farms.
7. Technology adoption created favourable impact on employment and the extent of increase in employment was more in high irrigated villages as compared a low irrigated villages.
8. Due to technology adoption, the farms cultivating paddy, sugarcane and cotton were more benefitted in terms of employment.
9. Technological factors were significant for discriminating the farms on the basis of labour demand for land preparation, transplanting, crop maintenance and harvesting.

Recommendations

To remove the technology gap between the high and low irrigated areas and to realise the full benefits of technology, the current study recommends the following measures :

1. Agricultural research stations should evolve varieties suitable to the agro climatic conditions of the areas and develop suitable package of practices for the evolved varieties.
2. There is need for emphasising field tested technology to reduce risks in innovation and greater stress should be laid on multilocation testing and on farm verification.

3. Further, a set of farming practices suitable to different categories of farmers in a region must be available.
4. Although agricultural technology is scale neutral, access to scarce resource is not scale neutral. Hence inequality in the distribution of land holdings should be reduced and land size should be made viable through co-operative farming and consolidation of holdings.
5. The technology should be divisible so that it can be adopted in individual holdings.
6. The extension agencies should identify effective means of diffusion of new technology. They have to educate the farmers about the optimum level of fertiliser use and about the need for pesticides use. The extension agencies should provide help and guidance at every step, testing of soil, selection of seeds, sowing, harvesting, etc.
7. Soil survey should be done and soils should be classified into different categories and soil conservation practice should be followed by the farmers.
8. Sprinkler irrigation can be introduced in tank and canal irrigated areas.
9. In the low irrigated areas, water management practice should be followed. In these areas, suitable tillage and moisture conservation technology has to be introduced to capture and retain as much of the precipitation as possible.
10. Irrigation development is to be based on quick completion of on-going irrigation projects. New schemes should be restricted to irrigated projects in drought prone area.

11. There is a need to ensure seed testing to protect the interest of the farmers. Further, careful seed bed preparation is required to gain optimum use of technology.
12. To promote the use of fertiliser, the fertiliser price can be lowered and there should be equitable and efficient fertiliser distribution system.
13. The majority of farmers are not fully aware of the importance of mixture of fertiliser at the time of sowing. Hence in this aspect proper guidance should be given to the farmers.
14. Efforts should be undertaken for mobilisation of organic and bio fertiliser resources in order to supplement the use of fertiliser and thereby promoting integrated nutrient supply system.
15. Timely and appropriate information regarding the intensity of pest damage and the type of pesticide to be applied needs to be disseminated among the farmers.
16. There is need for enhancing precision in input use by the farmers ;
17. Provision should be made for the availability of HYV seeds, fertiliser and pesticides where the small farmer is located.
18. Efforts should be undertaken for making technology highly profitable so as to induce the farmers to adopt the technology ;
19. Input delivery system should be made perfect for the farmers to realise full benefits of technology ; and
20. Above all, market support ensuring competitive attractive product price is necessary in order to compensate the farmers for high cost of cultivation arising from the purchase of HYV seeds, fertiliser and pesticides.

Scope For Future Research

1. Studies are needed to find out the impact of agricultural technology on income distribution among the farmers ;
2. Research is required to find out the comparative impact of agricultural technology on output and employment, between two or three states ; and
3. Studies may be focussed to find out the interrelationship between agricultural production, prices and technology.

In conclusion the study points to the need for expanding irrigation facilities for the farmers to realise the benefits of agricultural technology. Efforts need to be taken to bridge the technology gap. Further, the adoption of technology needs to be widespread for all crops and among all types of farmers.

To conclude, this study has made an attempt to extend the high pay off input theory and diffusion theory of agricultural development to cover the variations in soil fertility and irrigation conditions. Its methodological contribution lies in evolving a technology adoption index to quantify the extent of adoption of technology. The study has further identified the determinants of technology adoption and assessed the tangible benefits arising there from to the farmers. It has predicted the technology gap, which if filled will help to raise the agricultural productivity in the state.

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APPENDICES

APPENDIX - I

LIST OF HIGH AND LOW IRRIGATED VILLAGES IN THE SELECTED BLOCKS

POLLACHI SOUTH BLOCK

S.NO.	Name of the Village	Cropped area (in acres)	Irrigated area (in acres)	Irrigation intensity (in percent)
1.	Pollachi	618	420	69.96
2.	Solapalayam	601	187	31.14
3.	Nattukalipalayam	1263	340	26.92
4.	Unjavelampatti	1725	305	17.68
5.	Z. Kottampatti	1770	1107	62.54
6.	Samathur	1371	627	45.73
7.	S. Ponnapuram	822	551	67.03
8.	Makinampatti	772	159	20.59
9.	Chinnampalayam	327	75	22.93
10.	Soleeswarampatti	1136	347	30.54
11.	Vakkampalayam	741	233	31.44
12.	Naikanpalayam	848	554	65.33
13.	Singanallur	791	520	65.73
14.	Ambarampalayam	638	513	80.40
15.	Nallampalli	1500	850	54.62
16.	Thalavaipalayam	866	364	42.03
17.	Palagur	853	308	36.10
18.	Veeralpatti	474	208	43.88
19.	Thenkumarapalayam	1521	732	48.12
20.	Thondamuthur	979	486	49.64
21.	Nallur	1414	253	17.89
22.	Kolarpatti	1445	770	53.28
23.	Kanjampatti	1864	505	27.09
24.	Uthukuli	2743	1213	44.22
25.	Sinjavadi	326	131	40.18
26.	Gomangalam	217	205	94.47
27.	Gomangalampudur	343	221	64.43
28.	S.Maliyandipattanam	800	293	36.62
29.	Koolanaiyakanpatti	431	263	61.02
30.	Seelakampatti	279	191	68.45
31.	T. Kottampatti	802	194	24.18

LIST OF HIGH IRRIGATED VILLAGES - POLLACHI SOUTH BLOCK

S.NO. NAME OF THE VILLAGE

1. Pollachi
2. Z. Kottampatti
3. S. Ponnapuram
4. Naickenpalayam
5. Singanallur
6. Ambanampalayam
7. Nallampalli
8. Thukumarapalayam
9. Thondamuthur
10. Kolarpatti
11. Gomangalam
12. Gomangalampudur
13. Koolanaickenpalayam
14. Seelathampatti

LIST OF LOW IRRIGATED VILLAGES

1. Solapalayam
2. Nattukalipalayam
3. Unjavelampatti
4. Samathur
5. Makkinampatti
6. Chinnampalayam
7. Sulasovasapatti
8. Vakkampalayam
9. Thelavaipalayam
10. Poliyur
11. Veeralpatti
12. Nellur
13. Kanjampatti
14. Uthukuli
15. Sinjavadi
16. S. Maliyandi pattanam
17. T. Kottampatti

PERUR BLOCK

S.No.	Name of the Village	Cropped area (in acres)	Irrigated area (in acres)	Irrigation intensity (in percent)
1.	Kurichi	425	200	47.05
2.	Podanur	815	365	44.78
3.	Mettur	490	200	40.81
4.	Ganesapuram	770	260	33.76
5.	Chikannapuram	465	200	52.0
6.	Machampalayam	625	285	45.6
7.	Sundarapuram	1370	550	40.14
8.	Ammanpudur	420	200	44.44
9.	Annapuram	600	290	48.33
10.	Loganathapuram	670	360	53.73
11.	Kuniamuthur	1050	565	53.80
12.	Idaiyarpalayam	1025	620	60.48
13.	Narasimapuram	575	340	59.13
14.	Padrakaliammanpudur	375	100	26.66
15.	Sugunapuram	450	200	44.44
16.	Sundakamuthur	1120	485	43.30
17.	Ramichettipalayam	975	425	43.58
18.	Kulathupalayam	1080	561	51.85
19.	Perur	605	318	52.56
20.	Vedapatti	950	665	70.00
21.	Nambiazahanpalayam	865	550	63.58
22.	Kurumpalayam	790	260	32.91
23.	Andipalayam	765	290	37.90

PERUR BLOCK

LIST OF HIGH IRRIGATED VILLAGES

1. Chikkanapuram
2. Annapuram
3. Loganathapuram
4. Kuniimuthur
5. Idaiyarpalayam
6. Narasimapuram
7. Kulathupalayam
8. Perur
9. Vedapatti
10. Nambiazahan palayam

LIST OF LOW IRRIGATED VILLAGES

1. Kurichi
2. Podanur
3. Mettur
4. Ganesapuram
5. NACHAMPALAYAM
6. Sundarapuram
7. Ammanpudur
8. Padrakaliammanpudur
9. Sugunapuram
10. Sundakamuthur
11. Ramichettipalayam
12. Kurumpalayam
13. Andi palayam

KARAMADAI BLOCK

S.No.	Name of the village	Cropped area (in acres)	Irrigated area (in acres)	Irrigation intensity (in percent)
1.	Velliangadu	875	320	36.57
2.	Kammarampalayam	650	280	43.07
3.	Tholampalayam	925	360	38.91
4.	Dhayanur	765	285	37.25
5.	Marudur	890	350	39.32
6.	Karamadai	950	465	48.94
7.	Chikkarampalayam	1015	460	45.32
8.	Bellari	970	550	56.70
9.	Jadayapalayam	1157	450	38.89
10.	Alankombu	1075	525	48.83
11.	Thekkampatty	1120	690	61.60
12.	Nellithurai	1127	700	62.11
13.	Chikkadasampalayam	535	215	40.18
14.	Mettupalayam	1050	500	47.61
15.	Odanthurai	965	520	53.88
16.	Sirumugai	1075	850	79.06
17.	Illupanatham	560	200	35.71
18.	Bellapalayam	535	220	41.12
19.	Irumborai	865	420	48.55
20.	Chinnakalipatti	820	360	43.90
21.	Mooduthurai	750	320	42.66

KARAMADAI BLOCK

LIST OF HIGH IRRIGATED VILLAGES

1. Karamadai
2. Bellari
3. Alankombu
4. Thekkampatty
5. Nellithurai
6. Mettupalayam
7. Odanthurai
8. Sirumugai
9. Irumborai

LIST OF LOW IRRIGATED VILLAGES

1. Velliangadu
2. Kemmarampalayam
3. Tholampalayam
4. Dhayanur
5. Mamdur
6. Chikkarampalayam
7. Jadayapalayam
8. Chikkadasampalayam
9. Illuparatham
10. Bellapalayam
11. Chinnakalipatti
12. Mooduthurai

PALLADAM BLOCK

S.No.	Name of the village	Cropped area (in acres)	Irrigated area (in acres)	Irrigation intensity (in percent)
1.	Karadivavi	997	201	20.16
2.	Paruvai	877	200	22.80
3.	Kodangipalayam	852	295	34.62
4.	Echipatti	650	403	62.00
5.	Semapalayam	425	127	29.88
6.	Chuckampalayam	672	244	36.30
7.	K.Ayampalayam	587	328	55.87
8.	Panikampatti	454	178	39.20
9.	Anupatti	790	105	13.29
10.	Puliyampatti	560	172	30.71
11.	Nellagoundenpalayam	410	242	59.02
12.	K.Krishnapuram	480	170	35.41
13.	Palladam	1144	221	19.31
14.	Vadagapalayam	1474	314	21.30
15.	Chittampalayam	1296	220	16.97
16.	Ganapathipalayam	2287	239	10.45
17.	Karai pudur	2243	304	13.55
18.	Poomalur	1795	236	13.14
19.	Velupalayam	895	132	14.74
20.	Shyamalapuram	2790	479	17.16
21.	Naranapuram	1779	367	20.62

PALLADAM BLOCK

LIST OF HIGH IRRIGATED VILLAGES

1. Kodangipalayam
2. Echipatti
3. Samapalayam
4. Chukampalayam
5. K.Ayampalayam
6. Panikampatti

LIST OF LOW IRRIGATED VILLAGES

1. Karadivavi
2. Paruvai
3. Anupatti
4. Puliyampatti
5. Nallasoundampalayam
6. K.Krishnapuram
7. Palladam
8. Vedasapalayam
9. Chittampalayam
10. Ganapathipalayam
11. Karaipudur
12. Poomalur
13. Velupalayam
14. Shyamalapuram
15. Naranapuram

ANNUR BLOCK

S.No.	Name of the village	Cropped area (in acres)	Irrigated area (in acres)	Irrigation intensity (in percent)
1.	Kunnathur	902.05	506.30	56.12
2.	Pachapalayam	731.97	207.06	28.28
3.	Kattampatti	1017.10	339.98	33.42
4.	Kuppaipalayam	1251.20	419.15	33.49
5.	Karakoundampalayam	2328.28	1266.88	32.93
6.	Kariyampalayam	819.52	361.38	44.09
7.	Masagoundenpalayam	2736.23	833.73	30.47
8.	Naranapuram	915.80	304.61	33.26
9.	Pogalur	1535.96	500.78	32.60
10.	Ottarpalayam	1229.59	380.60	30.95
11.	Vadavalli	1557.35	504.32	32.38
12.	Annur	1998.32	922.22	46.14
13.	Pillaiyappapalayam	868.22	313.09	36.06
14.	Pesur	941.51	357.55	37.97
15.	A.Mettupalayam	1038.43	561.5	54.07
16.	Allapalayam	973.15	329.5	33.85
17.	Kanjapalli	1462.63	454.83	31.09
18.	Vedakalur	1167.63	335.0	28.69
19.	Ambodi	1050.19	310.38	29.55
20.	Kanuvakarai	1238.20	586.30	47.35
21.	A.Sengapalli	1402.52	553.56	39.46
22.	Kuppanur	1837.11	620.0	33.74

ANNUR BLOCK

LIST OF HIGH IRRIGATED VILLAGES

1. Kunnathur
2. Kariyampalayam
3. Annur
4. Pillaiyappalayam
5. Pasur
6. A. Mettupalayam
7. Allapalayam
8. Kanuvakarai
9. A. Sengapalli

LIST OF LOW IRRIGATED VILLAGES

1. Poachapalayam
2. Kattampatti
3. Kuppaipalayam
4. Karakkavundampalayam
5. Masakgoundenchettipalayam
6. Naranapuram
7. Pogalur
8. Ottarpalayam
9. Vadavalli
10. Kanjapalli
11. Vadakanur
12. Ambodi
13. Kuppanur

APPENDIX - II

AN INTERVIEW SCHEDULE TO ELICIT INFORMATION ON THE IMPACT OF
AGRICULTURAL TECHNOLOGY ON FARM OUTPUT AND EMPLOYMENT

SCHEDULE A

I. General Information

1. Name of the respondent :
2. Age :
3. Education :
4. Type of family :
5. Caste :
6. Years of experience in farming :
7. Address :

II. Family Background

S.No.	Name	Age	Sex	Education			Main occupation	Subsidiary occupation	Income per month (in Rs.)
				Illiterate	Studied upto	Studying upto			

III. Land ownership pattern :

1. Are you owner of land ? :
2. Are you a tenant cultivator ? :
3. Are you owner cum tenant ? :

IV. Land utilisation pattern (in acres)

S.No.	Item	Wet	Dry
1.	Land owned		
2.	Land leased		
3.	Fallow land		
4.	Total cultivated land		

V. Source of Irrigation

Area irrigated (in acres)

1. Wells
2. Canals
3. Tanks
4. Rivers
5. Sprinkler irrigation
6. Any other

VI. Investment Pattern

S.No.	Item	Quantity	Money value at present
1.	Land (in acres)		
2.	Bullocks (in numbers)		
3.	Tractors (in numbers)		
4.	Sprillers (in numbers)		
5.	Treshers (in numbers)		
6.	Seed cum fertiliser drill (In numbers)		
7.	Other machinery (in numbers)		
8.	Vehicles (specify)		
9.	Any other		

VII. Source of Finance for Investment (in Rupees) :

1.	Amount invested	:
2.	Amount of owned fund	:
3.	Amount of borrowed fund	:
4.	Amount of borrowed fund from banks	:
5.	Amount of borrowed fund from money lenders	:
6.	Amount of borrowed fund from friends	:
7.	Amount of borrowed fund from relatives	:

VIII. Cropping pattern (in acres) ;

S.No.	Crops	Kharif season		Rabi season	
		Wet	Dry	Wet	Dry
1.	Paddy				
2.	Cholam				
3.	Maize				
4.	Cumbu				
5.	Ragi				
6.	Sugarcane				
7.	Cotton				
8.	Groundnut				
9.	Pulses				
10.	Turmeric				
11.	Tobacco				
12.	Banana				

IX. Crop Production :

S.No.	Crops	Output in quintals	Money value (in Rupees)
1.	Paddy		
2.	Cholam		
3.	Maize		
4.	Cumbu		

S.No.	Crops	Output in quintals	Money value (in Rupees)
5.	Ragi		
6.	Sugarcane		
7.	Cotton		
8.	Groundnut		
9.	Pulses		
10.	Turmeric		
11.	Tobaccos		
12.	Banana		

X. Employment Pattern :

S.No.	Item	Male	Female
1.	Number of labourers employed		
2.	Number of family labourers employed		
3.	Daily hours spent by the family labourers for farm operation		
4.	Number of hired labourers employed		
5.	Number of permanent hired labourers employed		
6.	Daily hours of work by the permanent hired labourers		
7.	Daily wage for the permanent hired labourers		
8.	Number of temporary hired labourers		
9.	Daily hours of work by the temporary hired labourers		
10.	Daily wage for the temporary hired labourers		

XI. Operation wise use of labour :

S.No.	Item	Male		Female	
		Number employed	Wage rate (in rupees)	Number employed	Wage rate (in rupees)
I.	PADDY				
1.	Sowing				
2.	Planting				
3.	Transplanting				
4.	Threshing				
5.	Manuring				
6.	Fertiliser spreading				
7.	Irrigating				
8.	Reeping				
9.	Plucking				
10.	Harvesting				
11.	Interculture				
12.	Plant Protection				
II.	CHOLAM				
1.	Sowing				
2.	Planting				
3.	Transplanting				
4.	Threshing				
5.	Manuring				
6.	Fertiliser spreading				
7.	Irrigating				
8.	Reeping				
9.	Plucking				
10.	Harvesting				
11.	Interculture				
12.	Plant Protection				

S. No.	Item	Male		Female	
		Number employed	Wage rate (in rupees)	Number employed	Wage rate (in rupees)
III.	MAIZE				
1.	Sowing				
2.	Planting				
3.	Transplanting				
4.	Threshing				
5.	Manuring				
6.	Fertiliser spreading				
7.	Irrigating				
8.	Reeping				
9.	Plucking				
10.	Harvesting				
11.	Interculture				
12.	Plant Protection				
IV.	SUGARCANE				
1.	Sowing				
2.	Planting				
3.	Transplanting				
4.	Threshing				
5.	Manuring				
6.	Fertiliser spreading				
7.	Irrigating				
8.	Reeping				
9.	Plucking				
10.	Harvesting				
11.	Interculture				
12.	Plant Protection				

S.No.	Item	Male		Female	
		Number employed	Wage rate (in rupees)	Number employed	Wage rate (in rupees)
V.	COTTON				
1.	Sowing				
2.	Planting				
3.	Transplanting				
4.	Threshing				
5.	Manuring				
6.	Fertiliser spreading				
7.	Irrigating				
8.	Reeping				
9.	Plucking				
10.	Harvesting				
11.	Interculture				
12.	Plant Protection				
VI.	GROUNDNUT				
1.	Sowing				
2.	Planting				
3.	Transplanting				
4.	Threshing				
5.	Manuring				
6.	Fertiliser spreading				
7.	Irrigating				
8.	Reeping				
9.	Plucking				
10.	Harvesting				
11.	Interculture				
12.	Plant Protection				

XII. Cropwise capital invested

S.No.	Crop	Amount invested (in rupees)
1.	Paddy	
2.	Cholam	
3.	Maize	
4.	Sugarcane	
5.	Cotton	
6.	Groundnut	

[illegible]

S.No.	Land Crops reclamation cost	Seed Fertiliser cost	Machinery cost	Cost of pesticides	Running charges for bullocks	Running charges for tractors	Irrigation charges	Transport cost	Depreciation cost	Interest	Any other

XIV. Sales and Profitability :

S.No.	Crops	Quantity retained for self consumption	Quantity sold	Sales price per quintal	Total amount earned
1.	Paddy				
2.	Cumbu				

XV. Problems in Production

1. High cost of inputs.
2. Non-availability of labour
3. Low price
4. Inadequate credit facilities
5. Inadequate irrigation facilities
6. Any other

SCHEDULE B

ADOPTION OF SEED TECHNOLOGY - USE OF HIGH YIELDING VARIETY SEEDS

I. Area Under Improved Seeds

S.No.	Crop	Area under local varieties	Name of the improved seeds used	Area under high yielding varieties

II. Source of Getting Improved Seeds

S.No.	Crop/ Variety	Panchayat Union Agri- cultural Department	Co- operative Societies	Agri. Univer- sity	Extension agencies	Market	Others

III. Source of Purchase of HYV

S.No.	Item	Amount	Rate of interest charged
1.	Owned fund		

S.No.	Item	Amount	Rate of interest charged
2.	Borrowed funds :		
	a. Borrowed from banks		
	b. Borrowed from relatives		
	c. Borrowed from friends		
	d. Any other		

IV. Extent of Use of Improved Seeds

1. Did you get adequately the improved seeds? Yes No
2. Did you get in time? Yes No
3. Cost on improved seeds

S.No.	Crop	Quantum of improved seeds used (kg)	Amount spent (Rs.)

V. Reasons for adoption of improved seeds.

1. More production
2. Quick yielding
3. Improved quality
4. Pest resistant
5. Low wastage
6. High return
7. Any other (specify)

VI. Reasons for Not Using Improved Seeds :

1. High cost
2. Non-availability
3. Lack of storage facilities
4. Any other (specify)

VII. Problems in Using Improved Seeds :

1. High cost
2. Non-availability
33. Lack of training
4. Any other (specify)

VIII. What measures would you recommend for popularising improved seeds?

1. Establishment of more seed control agencies
2. More field demonstrations
3. Motivation by extension agencies
4. Provision of credit facilities
5. Provision of subsidy

SCHEDULE C

ADOPTION OF FERTILISER TECHNOLOGY

I. Quantum of fertiliser used (in kilograms)

S.No.	Crop	Ammonium Sulphate kg	Urea kg	Potash kg	Phosphorus kg	Superphosphate kg

II. Substitutes for fertiliser

S.No.	Item	Crop	Quantity used	If not used the additional quantum of fertiliser to be used
1.	Green leaves			
2.	Organic manure			
3.	Compost manure			
4.	Gobar gas waste			

III. Source of Getting Fertilisers

S.No.	Fertiliser	Panchayat Union Agri-cultural dept.	Co-operative Societies	Agri. University	Extension agencies	Market	Others
1.	Urea						
2.	Potash						
3.	Superphosphate						
4.	Ammonium sulphate						

IV. Source of Purchase of Fertiliser :

S.No.	Item	Amount	Rate of interest charged
1.	Owned fund		
2.	Borrowed funds :		
	a. Borrowed from banks		
	b. Borrowed from relatives		
	c. Borrowed from friends		
	d. Any other		

V. Extent of Use of Fertiliser :

1. Did you get adequately the required fertilisers ?
Yes NO
2. Did you get in time ? Yes No
3. Cost of fertiliser

S.No.	Fertiliser Variety	Quantum used kg	Amount spent Rs.
1.	Urea		
2.	Potash		
3.	Superphosphate		
4.	Ammonium sulphate		

VI. Reasons for the use of fertilisers

1. High output
2. Quick return
3. More profit
4. Any other (specify)

VI. Reasons for not using fertiliser :

1. High price
2. Non-availability
3. Inadequate credit facilities
4. Lack of subsidy
5. Any other (specify)

VIII. Problems in Using Fertilisers :

1. Inadequate supply
2. Non-availability
3. Soil degradation
4. Any other (specify)

IX. What measures would you recommend for the use of fertilisers?

1. Provision of credit facilities
2. Provision of subsidy
3. Reducing the price of fertiliser
4. Any other (specify)

SCHEDULE D

ADOPTION OF MECHANICAL TECHNOLOGY

I. Operation wise use of Bullocks/Tractors/Threshers/Seed Cum Fertiliser Drill/Sprayers :

S.No.	Item	Sowing	Planting	Spreading	Plucking	Reaping	Harvesting	Others
1.	Bullocks (in number)							
2.	Tractors							
3.	Threshers							
4.	Seed cum fertiliser drill							
5.	Sprayer							
6.	Any other							

II. Crop wise use of tractor (in hours)

[illegible]

III. Source of Getting Agricultural Implements :

S.No.	Item	Panchayat Union agri. dept.	Co-operative societies	Agri. university	Extension agencies	Market	Any other
1.	Tractors						
2.	Threshers						
3.	Seed-cum fertiliser drill						
4.	Sprayers						
5.	Any other						

IV. Source of funds for the purchase of bullocks and agricultural implements

S.No.	Item	Amount	Rate of interest charged
1.	Owned funds		
2.	Borrowed funds :		
	a. Borrowed from banks		
	b. Borrowed from relatives		
	c. Borrowed from bank		
	d. Any other		

V. Comparative cost of Use Bullocks/Agricultural Implements

Bullocks

1. Feeder cost
2. Maintenance cost
3. Labour cost

Agricultural Implements

1. Lubrication cost
2. Repair cost
3. Labour cost
4. Depreciation cost

VI. Reasons for Using Agricultural Implements

1. High output
2. More profit
3. Non-availability of labour
4. High labour cost
5. Any other (Specify)

VII. Reasons for Not Using Agricultural Implements

1. High Price
2. Credit facilities
3. Lack of subsidy
4. Any other (Specify)

VIII. Problems in Using Agricultural Implements

1. Non-availability
2. Suitable only for scientific operations
3. High maintenance cost
4. Any other (specify)

IX. What measures would you recommend to popularise the use of agricultural implements ?

1. Provision of credit facilities
2. Provision of subsidy
3. Reduction in the price
4. Any other (Specify)

SCHEDULE E
USE OF PESTICIDES

I. Quantum of pesticides used :

S.No.	Crop	Variety used	Quantity in Kilograms
1.	MAIZE		
2.	WHEAT		

II. Source of Getting Pesticides

S.No.	Pesticide Variety	Panchayat Union agricultural dept.	Co-operative societies	Agri. university	Extension agencies	Market	Others
1.	Endrin						
2.	Carphouran						

III. Source of Purchase of Pesticides :

S.No.	Item	Amount	Rate of interest charged
1.	Owned fund		
2.	Borrowed funds		
	a. Borrowed funds		
	b. Borrowed from relatives		
	c. Borrowed from friends		
	d. Any other		

APPENDIX - II A

Definition of the Concepts Used

1. GROSS CROPPED AREA

This refers to net sown area plus area sown more than once.

2. NET CROPPED AREA

It refers to the area used for the cultivation of crops during an agricultural year.

3. CROPPING INTENSITY

It is defined as gross cropped area as a percentage of net sown area.

4. TECHNOLOGICAL CHANGE

It refers to the adoption of a new technology or a technology not previously used in the production process. It describes a movement from one technological state to another.

5. RESOURCE SAVING TECHNICAL CHANGE

This type of technical change brings about greater production with the same amount of the resource or maintains existing production with a reduction in the amount of resource used.

6. RESOURCE USING TECHNICAL CHANGE

If existing production can be maintained only if the quantity of the particular resource use is increased, it is known as resource using technical change.

7. TECHNOLOGY ADOPTION INDEX

The adopted practices are expressed as percentage to the recommended packages of practices summed up and the weighted mean value to the number of practices is taken as the technology index. It is calculated as

$$Z = \frac{\sum w_j \cdot X_j}{\sum w_j}$$

where

X_j = Percentage of actual quantity of inputs used to the optimum quantity recommended in Crop Manual Survey; and

w_j = Weights assigned for inputs based on the percentage of each input cost to total input cost.

8. EMPLOYMENT

It refers to human labour input consisting of total hired and family labour utilised for various farm operations and has been expressed in terms of man hours employed during the year.

9. FAMILY LABOUR

It refers to labour put in by the members of the farmer's family and for which no direct payment is made.

10. PERMANENT HIRED LABOUR

Permanent labour is hired generally for one year and is paid either in cash or in kind or in both. In most of the cases, the payment is made on monthly basis, but the labourer is supposed to work on the farm atleast for one year.

11. TEMPORARY HIRED LABOUR

They are casual labourers and they fulfil the need for additional labourers at the peak period of farm operations. They are engaged temporarily according to requirement and are paid at a rate fixed for 8 hours a day.

12. MANHOUR UNIT

It refers to units of work equivalent to one hour work by a male adult worker. The productivity of female labour is considered as half of the man hour unit of male worker.

13. BULLOCK HOUR UNIT

It refers to units of work equivalent to 8 hours of work by a pair of bullocks.

14. NORMALISED WAGE RATE

This is measured in terms of rupees per man days. It is defined as

$$\bar{p} = \sum_{i=1}^n a_i p_i$$

$\bar{p}$ = Normalised wage rate,

$$a_i = \frac{P_i X_i}{EX}$$

where

P_i = Price paid for i^{th} type of labour,

X_i = Quantity of i^{th} type of labour,

EX = Total expenditure on labour.

15. FARM INVESTMENT

It includes value of owned land, farm buildings, livestock, agricultural machinery and implements.

16. COST OF CULTIVATION

- a) Cost A_1 includes value of hired human labour, value of hired and owned bullock/tractor labour, value of seed, fertilisers, manures, pesticides, irrigation charges and interest on working capital ;
- b) Cost A_2 includes cost A_1 plus rent paid for leased in land.

- c) Cost B is Cost A_2 plus rental value of own land plus interest on owned fund capital ; and
- d) Cost C is Cost B plus imputed values of family labour.

17 FARM INCOME

This refers to gross value of farm output.

18. GEOMETRIC MEAN

It is defined as the n^{th} root of the product N items or values.
Symbolically,

$$\text{G.M.} = [x_1 \times x_2 \times x_3, \dots x_n]^{\frac{1}{n}}$$

In log form,

$$\log \text{ GM} = \frac{\log x_1 + \log x_2 + \dots + \log x_n}{N}$$

$$\text{GM} = \text{Antilog } \frac{\sum \log x}{N}$$

19. COMPLEMENTARY INPUTS

When several inputs are combined in fairly definite proportions in the production process, they are known as complementary input.

20. MARGINAL VALUE PRODUCTIVITY (MVP)

It refers to net increment to the value of output by using the input.

21. MARGINAL RATE OF SUBSTITUTION

Marginal rate of substitution of one factor for another denotes the rate at which one factor is substituted in the place of another. It is obtained by dividing the marginal product of the first factor with the marginal product of the factor for which it is substituted.

22. FACTOR SHARES

This refers to share of different inputs in total production. It is denoted as contribution of factors to total output.

23. YIELD GAP

Yield gap I refers to the difference in yield between the experimental farm and the other farms.

Yield gap II refers to the difference in yield between the best farm and the other farms.

24. CLASSIFICATION OF FARMERS

Based on the area owned / operated, the farmers were classified into the following categories :

Type of farmer	Land owned / operated
1. Marginal farmers	Below 1 hectare (ie) Below 2.47 acres or approximately 2.5 acres
2. Small farmers	1-2 hectares (ie) 2.5 to 5 acres
3. Semi medium farmers	2-4 hectares (ie) 5 to 10 acres
4. Medium farmers	4-10 hectares (ie) 10 to 25 acres
5. Large farmers	Above 10 hectares (ie) above 25 acres

APPENDIX - III

DECOMPOSITION ANALYSIS OF CHANGE IN FOODGRAINS PRODUCTION IN TAMIL NADU DUE TO AREA EFFECT, YIELD EFFECT AND INTERACTION EFFECT

Year	Area under foodgrains (lakh hectares)	Foodgrains production (lakh hectares)	Yield of foodgrains (kilograms per hectare)
1980 - 81	42.46	56.51	1331
1981 - 82	46.61	73.75	1582
1982 - 83	39.29	49.22	1253
1983 - 84	46.78	62.60	1338
1984 - 85	46.28	68.87	1488
1985 - 86	43.58	72.70	1668
1986 - 87	41.31	71.81	1738
1987 - 88	39.96	74.80	1872
1988 - 89	37.43	73.29	1958
1989 - 90	40.23	79.17	1968
1990 - 91	38.85	74.96	1929

$$\Delta P = A_0 \times \Delta Y + Y_0 \Delta A + \Delta A \times \Delta Y$$

ΔP = Change in foodgrains production ;

A_0 = Area in the base period 0 ;

Y_0 = Yield in the base period 0 ;

ΔA = Change in area ;

ΔY = Change in yield

$$A_0 \Delta Y = \text{Yield effect ;}$$

$$Y_0 \Delta A = \text{Area effect ;}$$

$$\Delta A \times \Delta Y = \text{Interaction effect}$$

$$\Delta Y = Y_n - Y_0$$

$$\Delta Y = 1920 - 1331 = 598$$

$$\Delta P = 74.96 - 565.1 = 18.45$$

$$\Delta A = A_n - A_0$$

$$\Delta A = 38.85 - 42.46 = - 3.61$$

$$\Delta P = 42.56 \times 598 + 1331 (- 3.61) + (- 3.61) \times 598$$

$$= 25391.08 + (- 4804.91) + (- 2158.78)$$

$$\text{Yield effect} = 25391.08$$

$$\text{Area effect} = - 4804.91$$

$$\text{Interaction effect} = - 2158.78$$

$$\text{Yield effect in percentage} = \frac{25391}{32354.77} \times 100 = 78.48$$

$$\text{Area effect in percent} = \frac{4804.91}{32354.77} \times 100 = 14.85$$

$$\text{Interaction effect in percent} = \frac{2158.78}{32354.77} \times 100 = 6.67$$

APPENDIX - IV

COEFFICIENT OF VARIATION IN FERTILISER CONSUMPTION IN TAMIL NADU

Fertiliser consumption (x)	(x - $\bar{x}$)	(x - $\bar{x}$) ²
4.79	- 1.72	2.96
5.08	- 1.43	2.04
4.72	- 1.79	3.20
5.88	- 0.73	0.53
6.91	0.41	0.17
6.68	0.17	0.03
6.74	0.25	0.06
6.79	0.28	0.08
7.68	1.17	1.37
7.93	1.42	2.02
8.31	1.80	3.24
		15.70

$$\bar{x} = 6.51$$

$$\sigma = \sqrt{\frac{\sum (x - \bar{x})^2}{N}} = \frac{15.79}{111} = 1.19$$

$$CV = \frac{\sigma}{\bar{x}} \times 100 = \frac{1.19}{6.51} \times 100$$

$$= 18.27$$

APPENDIX - VI

ESTIMATED COEFFICIENTS OF LOGISTIC CURVE IN TAMIL NADU

	Year	Net Irrigated area
	1980 - 81	25.71
x_0	1981 - 82	27.09
	1982 - 83	22.54
	1983 - 84	26.18
x_1	1984 - 85	26.40
	1985 - 86	25.01
	1986 - 87	23.55
x_2	1987 - 88	24.37
	1988 - 89	23.74
	1989 - 90	24.96
	1990 - 91	23.72

$$Y_0 = \frac{75.81}{3} = 25.27$$

$$Y_1 = \frac{74.96}{3} = 24.98$$

$$Y_2 = \frac{73.07}{3} = 24.36$$

$$K = \frac{2 \cdot Y_0 \cdot Y_1 \cdot Y_2 - Y_1 \cdot (Y_0 + Y_2)}{Y_0 \cdot Y_2 - Y_1^2}$$

$$= \frac{2(25.27 \cdot 24.98 \cdot 24.36) - 24.98(25.27 + 24.36)}{25.27 \cdot 24.36 - (24.98)^2} = 38.93$$

$$a = \log \left(\frac{K - Y_0}{Y_0} \right) = \log \frac{(38.93 - 25.27)}{25.27} = -1.51$$

$$b = \frac{1}{n} \log \frac{Y_0 \cdot (K - Y_1)}{Y_1 \cdot (K - Y_0)} = \frac{1}{n} \log \frac{25.27 \cdot (38.93 - 24.98)}{24.98 \cdot (38.93 - 25.27)}$$

$$= .0163$$

APPENDIX - VII

ESTIMATED TREND VALUES IN NET IRRIGATED AREA IN TAMIL NADU BASED ON THE LOGISTIC CURVE

Time	log	μ	$Y_C = K + (1 + \mu)$	Y_C
1	- 1.49	.3090	$38.93 + (1 + .3090)$	29.74
2	- 1.47	.2951	$38.93 + (1 + .2951)$	30.05
3	- 1.45	.2818	$38.93 + (1 + .2818)$	30.37
4	- 1.43	.2692	$38.93 + (1 + .2692)$	30.67
5	- 1.41	.2570	$38.93 + (1 + .2570)$	30.97
6	- 1.39	.2455	$38.93 + (1 + .2455)$	31.25
7	- 1.37	.2344	$38.93 + (1 + .2344)$	31.53
8	- 1.35	.2239	$38.93 + (1 + .2239)$	31.80
9	- 1.33	.2138	$38.93 + (1 + .2138)$	32.07
10	- 1.31	.2042	$38.93 + (1 + .2042)$	32.32

APPENDIX - VIII

ESTIMATED MULTIPLE REGRESSION COEFFICIENTS OF FOODGRAINS PRODUCTIVITY AS RELATED TO TECHNOLOGICAL VARIABLES

Yield	Percentage of net irrigated area to gross cropped area	Percentage of HYV area to gross cropped area	Per hectare fertiliser consumption	Percentage of area covered under pest control to gross cropped area	Percentage of area covered under disease control to gross cropped area	Per hectare use of agricultural implements
1331	39.73	48.99	74.8	87.27	27.95	1.16
1582	39.20	53.64	73.5	83.25	25.01	1.14
1253	37.37	47.52	78.2	82.48	26.63	0.95
1338	37.69	55.24	84.6	87.24	29.08	1.06
1488	37.24	56.30	97.4	86.27	44.62	1.04
1668	36.57	61.88	97.9	91.25	30.07	0.96
1728	36.18	42.76	103.5	87.61	30.93	0.89
1872	36.22	45.37	100.9	92.24	33.20	1.12
1958	36.00	40.92	119.0	91.31	31.76	1.21
1958	36.58	40.86	116.2	86.36	34.05	1.17
1929	35.75	41.93	125.3	92.61	34.16	1.08

CORRELATION MATRIX

	YIELD	X1	X2	X3	X4	X5	X6
YIELD	1.00000						
X1	-.66046	1.00000					
X2	-.57854	.36095	1.00000				
X3	.67156	-.62522	-.56496	1.00000			
X4	-.37410	.11622	.30067	-.22249	1.00000		
X5	.26962	-.44760	-.01595	.51657	-.15455	1.00000	
X6	.35337	.29633	-.31664	.16741	-.03015	.02617	1.00000

CRITICAL VALUE (1-TALL, .05) - + or - .52366

CRITICAL VALUE (2-tail, .05) - +/- .59997

N-11

REGRESSION ANALYSIS

NUMBER OF CASES. 11 NUMBER OF VARIABLES. 7

* MULTIPLE REGRESSION ***

INDEX	NAME	MEAN	STD. DEV.
1	X1	37.2209	1.2466
2	X2	46.6191	7.2369
3	X3	97.3162	16.1640
4	X4	159.6100	237.9696
5	X5	31.5673	5.2464
6	X6	1.0700	.1017
DEP. VAR.	YIELD	1647.7273	266.0670

DEPENDENT VARIABLE. YIELD

VAR.	REGRESSION COEFFICIENT	STD. ERROR	T (DF - 4)	PROB.	PARTIAL P2
X1	-90.2244	99.6213	-.906	.41633	.1702
X2	4.7310	6.4253	.562	.60441	.0731
X3	6.9136	7.0502	1.264	.27476	.2655
X4	-.2693	.1966	-1.472	.21509	.3513
X5	-13.2400	10.4763	-1.264	.27494	.2654
X6	1097.5321	716.2660	1.532	.20022	.3699
CONSTANT	3196.5631				

STD. ERROR OF EST. - 135.2441

ADJUSTED R SQUARED - .7455

R SQUARED - .6962

MULTIPLE R - .9477

APPENDIX - IX

CHI SQUARE ANALYSIS TO FIND OUT THE ASSOCIATION BETWEEN EDUCATIONAL LEVEL OF THE FARMERS AND TECHNOLOGY ADOPTION - PERUR BLOCK - HIGH IRRIGATED VILLAGE.

	High Technology	Low Technology	Total
Illiterate	4	1	5
Literate	8	37	45
Total	12	38	50

O	E	(O - E)	(O - E) ²	(O - E) ² / E
4	1.2	2.8	7.84	6.53
1	3.8	- 2.8	7.84	2.06
8	10.8	- 2.8	7.84	0.72
37	34.2	2.8	7.84	0.22
				9.53

$$\chi^2 = \frac{(\sum O - E)^2}{E} = 9.53 < 5.59$$

S. No.	Output (Y)	Capital (K)	Labour (L)
41	50	70000	12
42	50	10000	10
43	525	7500000	115
44	610	45000000	100
45	976	600000	275
46	380	300000	150
47	780	338000	225
48	230	200000	100
49	622	110000	200
50	200	300000	102
51	3	1500	14
52	12	2500	2
53	2	1400	4
54	8	2000	5
55	4	1000	3
56	8	1000	2
57	10	2000	3
58	7	2000	2
59	5	2000	4
60	9	1500	5
61	10	2500	10
62	47	10000	15
63	30	7500	9
64	25	5000	17
65	270	10000	10
66	50	20000	25
67	528	130000	9
68	65	70000	8
69	55	40000	5
70	5	4000	12
71	18	7500	17
72	24	8000	6
73	6	4500	11
74	25	9000	13
75	18	8000	15
76	15	5000	12
77	25	8500	11
78	175	12000	9
79	32	9500	8
80	20	7000	
81	100	10000	10
82	22	9200	12
83	32	8500	15
84	100	13000	11
85	5	4500	5

S.No.	Output (Y)	Capital (K)	Labour (L)
86	63	6000	10
87	153	20000	9
88	250	16000	7
89	235	16000	10
90	131	11000	11
91	183	16000	13
92	179	15500	15
93	250	450000	70
94	150	350000	59
95	170	3700000	58
96	182	3800000	65
97	114	3200000	60
98	142	100000	90
99	32	80000	50
100	18	2000	9
101	25	3000	26
102	14	2000	10
103	22	3000	11
104	14	2000	7
105	10	2100	8
106	20	2500	10
107	30	1750	8
108	29	3000	12
109	35	4000	10
110	45	4000	22
111	197	8000	36
112	30	3500	10
113	110	6000	25
114	16	2000	10
115	110	7500	15
116	12	2500	9
117	6	2000	8
118	74	20000	20
119	65	21000	21
120	140	30000	20
121	238	22000	50
122	215	15000	45
123	110	11000	38
124	60	10000	22
125	24	12000	10
126	45	15000	20
127	200	50000	80
128	75	200000	50
129	170	1500000	75
130	290	200000	160

S.No.	Output (Y)	Capital (K)	Labour (L)
131	170	120000	90
132	158	150000	82
133	250	200000	100
134	15	1500	4
135	10	1500	3
136	14	1600	4
137	20	2250	5
138	20	1750	4
139	24	2000	5
140	21	2150	4
141	18	2000	3
142	25	2750	5
143	15	1400	3
144	20	1800	4
145	22	2250	5
146	16	1750	4
147	15	2000	3
148	12	1750	2
149	45	4000	12
150	52	5500	13
151	95	6000	12
152	45	4000	11
153	132	7000	23
154	100	7000	20
155	106	7000	21
156	65	7000	12
157	80	6000	13
158	45	3000	10
159	96	4000	16
160	37	2500	9
161	60	3500	16
162	23	2000	8
163	30	2500	9
164	27	2500	8
165	25	2250	14
166	40	3000	9
167	38	2750	22
168	87	4000	15
169	109	7500	16
170	105	7500	20
171	60	6000	12
172	90	8000	12
173	4	1200	15
174	2	1100	7

S.No.	Output (Y)	Capital (K)	Labour (L)
175	2	1200	6
176	43	650	12
177	4	550	5
178	12	400	6
179	25	1000	10
180	20	2500	7
181	6	900	8
182	42	1000	44
183	7	1000	3
184	5	1100	4
185	10	1000	3
186	4	1000	5
187	45	1000	9
188	7	1000	4
189	35	1050	4
190	21	1000	6
191	14	1000	5
192	174	12000	5
193	155	13000	80
194	46	10000	75
195	168	7500	15
196	130	19000	175
197	12	12500	56
198	20	8000	225
199	13	12500	42
200	505	20000	33
201	403	15000	275
202	500	20000	16
203	620	10000	2
204	103	10000	5
205	350	15000	3
206	73	5000	4
207	95	3000	45
208	30	3500	52
209	30	5000	10
210	200	8500	20
211	250	5000	50
212	99	5000	25
213	30	12000	70
214	80	8000	50
215	120	11000	8
216	280	12000	15
217	14	5000	10

S.No.	Output (Y)	Capital (K)	Labour (L)
218	40	9000	8
219	306	6000	15
220	8	5000	60
221	18	2000	20
222	135	10000	2
223	400	14500	100
224	63	5000	50
225	245	12500	35
226	480	10000	10
227	348	9000	366
228	585	180000	278
229	205	1250000	300
230	403	175000	500
231	366	1500000	450
232	540	150000	250
233	250	115000	32
234	100	12000	40
235	110	10000	110
236	120	8000	50
237	80	7000	40
238	15	6000	8
239	40	4000	12
240	60	3000	100
241	60	8000	10
242	80	7000	8
243	100	6000	15
244	70	5000	7
245	80	4000	9
246	30	3000	8
247	40	2500	6
248	25	1000	10
249	15	7000	12
250	10	3000	14

CORRELATION MATRIX

HEADER DATA FOR : B : WET LABEL : POOLED DATA OF WET *****
NUMBER OF CASES : 250 NUMBER OF VARIABLES : 3

ROW	COL.	RAW SSCP	ADJUSTED SSCP	VAR-COVAR.	CORR
OUT	OUT	1.031504E + 07	6.648739E + 06	2.670176E + 04	1.00000
CAPT	OUT	2.106110E + 10	1.558570E + 10	6.259316E + 07	.56253
LABR	OUT	2.864264E + 06	1.649873E + 06	6.625997E + 03	.57429

ROW	COL.	RAW SSCP	ADJUSTED SSCP	VAR-COVAR.	CORR
CAPT	CAPT	1.236336E + 14	1.154564E + 14	4.636805E + 11	1.00000
LABR	CAPT	5.498113E + 09	3.684495E + 09	1.479717E + 07	.30777

ROW	COL	RAW SSCP	ADJUSTED SSCP	VAR-COVAR.	CORR
LABR	LABR	1.643592E + 06	1.241349E + 06	4.985337E + 03	1.00000

CORRELATION MATRIX

HEADER DATA FOR : B : WET LABEL : POOLED DATA OF WET *****
NUMBER OF CASES : 250 NUMBER OF VARIABLES : 3

	OUT	CAPT	LABR
OUT	1.00000		
CAPT	.56253	1.00000	
LABR	.57429	.30777	1.00000

CRITICAL VALUE (1-TALL, .05) = + or - .10430
CRITICAL VALUE (2-tall, .05) = +/- .12409

N = 250

REGRESSION ANALYSIS

HEADER DATA FOR : B : WET LABEL : POOLED DATA OF WET *****
NUMBER OF CASES : 250 NUMBER OF VARIABLES : 3

MULTIPLE REGRESSION * FULL MODEL ***

INDEX	NAME	MEAN	STD.DEV.
1	CAPT	180855.5000	680940.8566
2	LABR	40.1120	70.6069
DEP. VAR. :	OUT	121.1000	163.4067

DEPENDENT VARIABLE : OUT

VAR	REGRESSION COEFFICIENT	STD. ERROR	T(DF=247)	PROB.	PARTIAL r 2
CAPT	1.02264E-04	1.14131E-05	8.960	.00000	.2453
LABR	1.0256	.1101	9.317	.00000	.2601
CONSTANT	61.4676				

STD. ERROR OF EST. " 116.6281

ADJUSTED R SQUARED " .4901
R SQUARED " .4942
MULTIPLE R " .7030

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
REGRESSION	3285903.2029	2	1642951.6015	120.675	.000E+00
RESIDUAL	3362835.2971	247	13614.7178		
TOTAL	6648738.5000	249			

CORRELATION MATRIX

HEADER DATA FOR : B : ANNA29 LABEL : POLLACHI WET * SUGARCANE * HYV *
NUMBER OF CASES : 28 NUMBER OF VARIABLES : 8

	YIELD	CU.AREA	SEEDCOST	PESTCOST	FER.COST	LABOUR	CAPITAL	TRACTOR
YIELD	1.00000							
CU.AREA	.53765	1.00000						
SEEDCOST	.59428	.58940	1.00000					
PESTCOST	.56711	.45598	.96486	1.00000				
FER.COST	.73614	.61881	.96872	.94419	1.00000			
LABOUR	.96184	.55951	.46490	.41757	.62787	1.00000		
CAPITAL	.31103	.93995	.47587	.35144	.48344	.35119	1.00000	
TRACTOR	-.27592	.18498	.33050	.40228	.23939	-.43964	.31518	1.00000

CRITICAL VALUE (1-TAIL, .05) = + or - .58607

CRITICAL VALUE (2-tail, .05) = +/- .66422

N=9

REGRESSION ANALYSIS

HEADER DATA FOR : B : ANNA 29 LABEL : POLLACHI WET * SUGARCNE * HYV *
NUMBER OF CASES : 28 NUMBER OF VARIABLES : 8

INDEX	NAME	MEAN	STD.DEV.
1	CU.AREA	5.4444	6.1260
2	SEEDCOST	3533.3333	1752.3199
3	PESTCOST	4555.5556	2898.7545
4	FER.COST	2972.2222	1553.4460
5	LABOUR	384.0000	797.6465
6	CAPITAL	337222.2222	584524.9733
7	TRACTOR	5.1111	3.3706
DEP. VAR. :	YIELD	146.7033	212.5891

DEPENDENT VARIABLE : YIELD

VAR.	REGRESSION COEFFICIENT	STD. ERROR	T(DF = 1)	PROB.	PARTIAL r 2
CU.AREA	-5.7438	21.4643	-.268	.83354	.0668
SEEDCOST	.1368	.1505	.906	.53153	.4505
PESTCOST	-.0349	.0545	-.640	.63744	.2908
FER.COST	-.0993	.1512	-.657	.63013	.3012
LABOUR	.3887	.1531	2.539	.23884	.8657
CAPITAL	-7.4696E-05	1.61014E-04	-.464	.72348	.1771
TRACTOR	28.6605	21.5238	1.332	.41007	.6394
CONSTANT	-120.0464				

SID. ERROR OF EST. = 65.5848

ADJUSTED R SQUARED = .9048

 R SQUARED = .9881

 MULTIPLE R = .9940

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
REGRESSION	357251.7169	7	51035.9596	11.865	.2200
RESIDUAL	4301.3599	1	4301.3599		
TOTAL	361553.0768	8			

APPENDIX - XII

FORMULATION OF TECHNOLOGY ADOPTION INDEX

ANNUR BLOCK - LOW IRRIGATED VILLAGE - CHOLAM

SEED

S.No.	Actual Qty.	Optimum Qty.	AD	SC	TC	XW	aj	xwaj	xw ad aj
1	28	40	70	135	935	.14	.4	.06	4.04
2	30	40	75	185	1185	.15	.25	.04	2.92
3	20	40	50	700	2025	.34	.5	.17	8.64
4	20	40	50	200	1050	.19	.24	.04	2.28
5	35	40	87.5	425	2425	.17	.4	.07	6.13
6	28	40	70	700	3000	.23	.36	.08	5.88
7	30	40	75	200	900	.22	.60	.13	10
8	35	40	87.5	500	1720	.29	.42	.12	10.9
9	25	40	62.5	500	2000	.25	1	.25	15.62
10	35	40	87.5	200	1200	.16	1	.16	14.58
11	20	40	50	500	2400	.20	1	.20	10.41
12	15	40	37.5	500	1500	.33	.36	.12	4.5
13	25	40	62.5	180	780	.23	.46	.10	6.73
14	20	40	50	200	900	.22	.75	.16	8.33
15	12	40	30	200	800	.25	.44	.11	3.34
16	25	40	62.5	400	1100	.361	1	.36	22.72
17	22	40	55	2200	6800	.321	1	.32	17.79
18	25	40	62.5	300	1000	.301	.4	.12	7.5
19	20	40	50	1000	2500	.40	.42	.17	8.57
20	20	40	50	200	1000	.20	.20	.04	2
21	20	40	50	3000	9200	.32	.46	.15	7.64
22	20	40	50	300	1000	.30	.20	.06	3
23	20	40	50	100	490	.20	.50	.10	5.10
24	12	40	30	100	500	.20	.50	.1	3
25	20	40	50	2000	6200	.35	.25	.07	2.9
26	20	40	50	500	1500	.33	.4	.13	6.66
27	14	40	35	100	550	.18	.8	.14	5.09

S.No.	Actual Qty	Optimum Qty	AD	SC	TC	XW	aj	xw aj	xw ad aj
28	90	120	75	1000	3200	.83	1	75	62.5
29	75	120	62.5	1800	2400	.75	1	62.5	46.87
30	90	120	75	1000	1500	.66	.36	27	18
31	50	120	41.6	500	780	.64	.46	29	12.46
32	85	120	70.83	600	900	.66	.75	.5	35.41
33	75	120	62.5	600	800	.75	.44	.33	20.92
34	0	120	0	0	1100	0	1	0	0
35	31	120	25.83	2000	6800	.29	1	.25	3.03
36	0	120	50	0	1000	0	.4	0	0
37	60	120	0	750	2500	.3	.43	.21	3
38	0	120	33.33	0	1000	0	.2	0	0
39	40	120	0	3000	9200	.32	.46	.15	2.17
40	0	120	0	0	1000	0	.2	0	0
41	0	120	0	0	490	0	.5	0	0
42	0	120	66.6	0	500	0	.5	0	0
43	80	120	50	2000	6200	.32	.24	.16	10.75
44	60	120	0	750	2100	.35	.5	.25	7.14
45	0	120	0	0	1500	0	.4	0	0
46	0	120	41.66	0	550	0	.8	0	0
47	50	120	0	1200	6000	.2	.2	8.33	2.77
48	0	120	0	0	1000	0	.33	0	0
49	0	120	0	0	490	0	.5	0	0
50	0	120	0	0	500	0	.5	0	0
51	80	120	66.6	2000	6200	.32	.24	.16	10.75
52	60	120	50	750	2100	.35	.5	.25	7.14
53	0	120	0	0	1500	0	.4	0	0

FERTILISER

S.No.	Actual Qty	Optimum Qty	AD	SC	TC	XW	aj	xw aj	xw ad aj
1	32	120	27.08	500	1700	.29	.75	20.31	5.97
2	40	120	33.33	1000	1600	.62	.5	16.66	10.41
3	25	120	20.83	500	1500	.33	.63	13.02	4.34
4	38	120	31.25	1000	100	.55	1	31.25	17.36
5	18	120	14.58	1000	1500	.66	8	11.66	7.77
6	25	120	20.83	1000	200	.5	1	20.83	10.41
7	15	120	12.5	1000	3000	.33	.88	11.11	3.70
8	35	120	29.16	1200	2500	.4	1	29.16	11.66
9	32	120	27.08	1250	2750	.43	11	27.08	11.81
10	38	120	31.25	1100	2000	.62	.6	18.75	11.71
11	40	120	33.33	0	3100	.35	.61	20.37	7.22
12	0	120	0	1700	1000	0	.8	0	0
13	40	120	33.3	2000	3400	.5	.75	25	12.5
14	48	120	39.58	2500	3750	.53	.81	32.38	17.27
15	40	120	33.33	2000	4500	.55	.8	26.66	14.81
16	45	120	37.5	2500	4000	.5	.72	27	13.5
17	50	120	41.6	1800	5000	.5	.55	23.14	11.57
18	45	120	37.5	1000	2500	.72	.68	25.5	18.36
19	60	120	50	700	935	.74	.4	20	14.97
20	50	120	41.66	600	1185	.51	.25	10.41	5.27
21	60	120	50	500	2025	.24	.5	25	6.17
22	80	120	66.6	450	1050	.42	.24	16	6.85
23	75	120	62.5	1000	2425	.41	.4	25	10.30
24	75	120	62.5	1000	000	.33	.36	22.5	7.5
25	50	120	41.6	500	900	.55	.6	25	13.88
26	85	120	70.83	600	1720	.34	.42	30.35	10.58
27	85	120	70.83	1000	2000	.5	1	70.83	35.41

S.No.	Actual Qty	Optimum Qty	AD	SC	TC	XW	aj	xw aj	xw ad aj
28	1	5	20	500	2000	.25	1	0	5
29	0	5	0	0	1200	0	1	0	0
30	0	5	0	0	2400	0	1	0	0
31	0	5	0	0	1500	0	.36	0	0
32	0	5	0	0	780	0	.46	0	0
33	0	5	0	0	900	0	.75	0	0
34	0	5	0	0	800	0	.44	0	0
35	0	5	0	0	1100	0	1	0	0
36	0	5	0	0	6800	0	1	0	0
37	0	5	0	0	1000	0	.4	0	0
38	0	5	0	0	2500	0	.42	0	0
39	0	5	0	0	1000	0	.2	0	0
40	0	5	0	0	9200	1.25	.46	0	0
41	.5	5	10	150	1000	0	.2	2.5	.3
42	0	5	0	0	490	0	.5	0	0
43	0	5	0	0	500	0	.5	0	0
44	0	5	0	0	6200	0	.24	0	0
45	0	5	0	0	2100	0	.5	0	0
46	0	5	0	0	1500	0	.4	0	0
47	0	5	0	0	550	.25	.8	0	0
48	.01	5	.2	1000	6000	0	.2	.05	.06
49	0	5	0	0	1000	0	.33	0	0
50	0	5	0	0	900	.5	.25	0	0
51	.05	5	1	750	3200	.25	.5	.25	.11
52	.01	5	.2	2000	2000	0	.4	.05	.01
53	1	5	20	7200	7200	0	.26	0	1.11

S.No.	Seed	Fertiliser	Pesticide	Z
29	.83	46.87	0	47.70
30	1.73	18	0	19.73
31	8.90	12.46	0	21.36
32	7.5	35.41	0	42.91
33	5.09	2.92	0	26.01
34	1.42	0	0	1.42
35	18.75	3.03	0	21.78
36	15	0	0	15
37	12.5	3	0	15.5
38	20.83	0	0	20.83
39	19.2	2.17	0	21.37
40	13.13	0	0	13.13
41	17.77	0	3	20.77
42	18	0	0	18
43	16.36	10.75	0	27.11
44	11.57	7.14	0	18.71
45	12.15	0	0	12.15
46	5.86	0	0	5.86
47	28.8	2.77	0	31.57
48	11.91	0	.06	11.97
49	13.09	0	0	13.09
50	12	0	0	12
51	12.24	10.75	.11	23.10
52	9	7.14	.01	16.15
53	12.24	0	1.11	13.35

$$AD = \frac{\text{Actual quantity used}}{\text{Optimum quantity}} \times 100$$

SC, FC, PC = Seed cost, fertiliser cost and pesticide cost ;

TC = Total cost ;

X_w = Proportion of seed cost, fertiliser cost, pesticide cost to total cost ;

a_j = Proportion of cholam area to total area ;

Z = Seed + Fertiliser + Pesticide technology adoption index

Mean technology adoption index = 22.62

APPENDIX - XIII

ESTIMATED GEOMETRIC MEAN OF INPUTS

POLLACHI SOUTH - HIGH IRRIGATED VILLAGE - CHOLAM

HYV

S.No.	Output (Y)	Cropped area (x_1)	Seed expenditure (x_2)	Pesticide expenditure (x_3)	Fertiliser expenditure (x_4)	Man hours employed (x_5)	Capital invested (x_6)	Tractor timings (x_7)
1	14	2	1100	1000	1000	2	1000	2
2	6	2	450	500	1000	15	70000	0
3	39.9	35	1000	1160	1000	2	5000	0
4	6	2	500	300	0	8	10000	0
5	30	2	750	750	100	7	8000	3
6	20	4	500	500	0	5	2000	0
7	28	2	800	750	500	1	10000	0
8	120	3	1000	1200	1000	3	10000	3
9	40	2	750	500	500	12	11000	5
10	700	2	1520	1250	1000	3	10000	4
11	199.92	28	1250	1500	1000	0	15000	8
12	250	10	1250	1000	1000	1	2000	2
13	249.9	15	1000	1000	1000	6	4000	4

S.No.	log y	log x_1	log x_2	log x_3	log x_4	log x_5	log x_6	log x_7
1	1.1461	0.3010	3.0413	3.000	3.000	0.3010	3.000	0.3010
2	0.7781	0.3010	2.6532	2.6989	3.000	1.1760	4.8450	0
3	1.6009	1.5440	3.0000	3.0644	3.000	0.3010	3.6989	0
4	0.7781	0.3010	2.6989	2.4771	0	0.9030	4.000	0
5	1.4771	0.3010	2.8750	2.8750	2.00	0.8450	3.9030	0.4771
6	1.3010	0.6020	2.6989	2.6989	0	0.6989	3.3010	0
7	1.4471	0.3010	2.9030	2.8750	2.6989	0.00	4.00	0
8	2.0791	0.4771	3.0000	3.0791	3.000	0.4777	4.00	0.4771
9	1.6020	0.3010	2.8750	2.6989	2.6989	1.0791	4.0413	0.6989
10	2.8450	0.3010	3.1818	3.0969	3.000	0.4777	4.00	0.6020
11	2.3008	1.4471	3.0969	3.1760	3.000	1.6989	4.1760	0.9030
12	2.3979	1.0000	3.0969	3.0000	3.000	0	3.3010	0.3010
13	2.3977	1.1760	3.0000	3.0000	3.000	0.7781	3.6020	0.6020

Geometric mean = Anti log of $\bar{x}$ log x + N

Geometric mean of output = Anti log of (22.1509 + 13)
= Anti log of 1.7039 = 50.58

Geometric mean of cropped area = Anti log of (8.3532 + 13)
= Anti log of .6425 = 4.390

Geometric mean of seed expenses = Anti log of (38.1209 + 13)
= Anti log of 2.9323 = 855.5

Geometric mean of pesticide expenses = Anti log of (37.7402 + 13)
= Anti log of 2.9030 = 798.0

Geometric mean of fertiliser expenses = Anti log of (31.3978 + 13)
= Anti log of 2.4152 = 260.2

Geometric mean of labour (man hours employed) = Anti log of (8.7364 + 13)
= Anti log of .6720 = 46.99

Geometric mean of capital invested = Anti log of (49.8682 + 13)
= Anti log of 3.8360 = 685.5

Geometric mean of tractor timings employed = Anti log of (4.3621 + 13)
= Anti log of .3355 = 2.165

APPENDIX - XIV

ESTIMATED MARGINAL VALUE PRODUCTIVITY OF INPUTS

POLLACHI SOUTH - HIGH IRRIGATED VILLAGE - CHOLAM - HYV

$$MVP = \hat{b}_i \frac{\hat{y}}{\hat{x}_i}$$

$\hat{b}_i$ = Estimated regression coefficient of output as related to inputs ;
1, 2, 3, ... i ;

$\hat{y}$ = Geometric mean of output ;

$\hat{x}_i$ = Geometric mean of inputs - 1, 2, 3, ... i

Marginal value productivity of cropped area	= [27.8] x [50.58 + 4.39]
	= 32.03

Marginal value productivity of seed expenditure	= [.19] x [50.58 + 855.5]
	= .0112

Marginal value productivity of pesticide expenditure	= [-.14] x [50.58 + 798]
	= -.0088

Marginal value productivity of fertiliser expenditure	= [.0015] x [50.58 + 260.2]
	= .0029

Marginal value productivity of labour employed	= [.33] x [50.58 + 4.69]
	= - 3.55

Marginal value productivity of
capital invested

$$= [.0036] \times [50.58 + 685.5]$$

$$= .0026$$

Marginal value productivity of
tractor timings employed

$$= [23.44] \times [50.58 + 2.165]$$

$$= 547.61$$

APPENDIX - XV

ESTIMATED MARGINAL RATE OF SUBSTITUTION BETWEEN FERTILISER

POLLACHI SOUTH - HIGH IRRIGATED VILLAGE - CHOLAM - HYV

$$x_1 = \frac{\hat{b}_1}{\hat{b}_i} \hat{x}_i$$

$\hat{b}_1$ = Elasticity coefficient of the input for High MRS on substituted;

$\hat{b}_i$ = Elasticity coefficient of ith input ;

$\hat{x}_i$ = Geometric mean of ith inputs

Marginal rate of substitution of land for

a.	Labour	=	[32.03 + .3155] x 46.99	=	48.96
b.	Fertiliser	=	[32.03 + .0029] x 260.2	=	287.68
c.	Other working expenses	=	[32.03 + .0112] x 285.5	=	240.6

Marginal rate of substitution of fertiliser for

a.	Land	=	[.0029 + 32.09] x 4.39	=	.59
b.	Labour	=	[.0029 + 3.55] x 46.99	=	.46
c.	Other working expenses	=	[.0029 + .0112] x 285.5	=	2.05

Marginal rate of substitution of labour for

a.	Land	=	[.0112 + 32.03] x 4.39	=	.03
b.	Tractor	=	[.0112 + 547.61] x 2.16	=	.011
c.	Fertiliser	=	[.0112 + .0029] x 260.2	=	97.63

NHYV - CHOLAM

S.No.	Output (Y)	Cropped area (x_1)	Seed expenditure (x_2)	Pesticide expenditure (x_3)	Fertiliser expenditure (x_4)	Man hours employed (x_5)	Capital invested (x_6)	Tractor timings (x_7)
1	8	4	1200	1000	600	4	1200	2
2	7	3	750	500	700	10	8000	0
3	10	7	300	420	0	8	10000	3
4	12	5	100	1200	800	7	4000	4
5	9	2	150	900	400	6	9000	2
6	6	4	400	1300	300	12	7000	0
7	4	5	700	1200	270	15	10000	4
8	12	3	800	750	720	10	8000	5
9	10	2	750	620	0	4	7000	6
10	4	7	900	850	610	9	1800	0
11	6	8	1000	1100	700	8	12000	2
12	8	4	475	950	810	7	6000	4
13	10	3	350	600	820	5	9000	0
14	7	2	750	320	0	4	3000	6
15	9	7	600	450	300	10	7200	5
16	6	6	700	270	0	6	1500	0
17	5	5	525	410	0	8	9200	4
18	12	4	1000	1200	320	15	12000	2
19	4	2	920	300	0	2	10000	3
20	10	6	700	800	510	9	9000	0
21	7	4	550	1000	420	8	8000	6
22	5	3	300	170	710	7	15000	5
23	4	2	910	800	510	10	9000	0
24	2	1	700	1000	1000	6	8000	4
25	5	2	600	500	420	4	4000	2
26	12	4	700	300	0	7	1000	0
27	10	3	450	400	200	8	1500	2
28	8	2	900	700	0	9	7000	0

$$B_i = b_i \text{ (HYV)} - b_i \text{ (LV)} + b_i \text{ (LV)}$$

$$\begin{aligned} \text{Bias in respect of land} &= [2.78 - (-3.18)] + (-3.18) \\ &= -1.87 \end{aligned}$$

$$\begin{aligned} \text{Bias in respect of seeds} &= [.19 - .006] + .006 \\ &= 3.08 \end{aligned}$$

$$\begin{aligned} \text{Bias in respect of pesticides} &= [-.14 - 0.258] + .0258 \\ &= -8.8 \end{aligned}$$

$$\begin{aligned} \text{Bias in respect of fertilisers} &= [.0015 - .028] + .028 \\ &= -.94 \end{aligned}$$

$$\begin{aligned} \text{Bias in respect of labour} &= [-.33 - (-.007)] + [-.007] \\ &= -4.8 \end{aligned}$$

$$\begin{aligned} \text{Bias in respect of capital} &= [.0036 - .0016] + .0016 \\ &= 1.29 \end{aligned}$$

$$\begin{aligned} \text{Bias in respect of tractor timings} &= [23.44 - 5.85] + 5.85 \\ &= 3.0 \end{aligned}$$

APPENDIX - XVII

IMPACT OF TECHNICAL CHANGE ON RESOURCE USE EFFICIENCY

POLLACHI SOUTH - HIGH IRRIGATED VILLAGE - CHOLAM

HYV

S.No.	Output (Y)	Cropped area (x_1)	Seed expenditure (x_2)	Pesticide expenditure (x_3)	Fertiliser expenditure (x_4)	Man hours employed (x_5)	Capital invested (x_6)	Tractor timings (x_7)
1	7	2	1100	1000	1000	2	1000	2
2	3	2	450	500	1000	15	70000	0
3	1.14	35	1000	1160	1000	2	5000	0
4	3	2	500	300	0	8	10000	0
5	15	2	750	750	100	7	8000	3
6	5	4	500	500	0	5	2000	0
7	14	2	800	750	500	11	10000	0
8	40	3	1000	1200	1000	3	10000	3
9	20	2	750	500	500	12	11000	5
10	350	2	1520	1250	1000	3	10000	4
11	7.14	28	1250	1500	1000	50	15000	8
12	25	10	1250	1000	1000	1	2000	2
13	16.66	15	1000	1000	1000	6	4000	4

NHYV - CHOLAM

S.No.	Output (Y)	Cropped area (x_1)	Seed expenditure (x_2)	Pesticide expenditure (x_3)	Fertiliser expenditure (x_4)	Man hours employed (x_5)	Capital invested (x_6)	Tractor timings (x_7)
1	8	4	1200	1000	600	4	1200	2
2	7	3	750	500	700	10	8000	0
3	10	7	300	420	0	8	10000	3
4	12	5	100	1200	800	7	4000	4
5	9	2	150	900	400	6	9000	2
6	6	4	400	1300	300	12	7000	0
7	4	5	700	1200	270	15	10000	4
8	12	3	800	750	720	10	8000	5
9	10	2	750	620	0	4	7000	6
10	4	7	900	850	610	9	1800	0
11	6	8	1000	1100	700	8	12000	2
12	8	4	475	950	810	7	6000	4
13	10	3	350	600	820	5	9000	0
14	7	2	750	320	0	4	3000	6
15	9	7	600	450	300	10	7200	5
16	6	6	700	270	0	6	1500	0
17	5	5	525	410	0	8	9200	4
18	12	4	1000	1200	320	15	12000	2
19	4	2	920	300	0	2	10000	3
20	10	6	700	800	510	9	9000	0
21	7	4	550	1000	420	8	8000	6
22	5	3	300	170	710	7	15000	5
23	4	2	910	800	510	10	9000	0
24	2	1	700	1000	1000	6	8000	4
25	5	2	600	500	420	4	4000	2
26	12	4	700	300	0	7	1000	0
27	10	3	450	400	200	8	1500	2
28	8	2	900	700	0	9	7000	0

APPENDIX - XVIII

'T' TEST TO FIND OUT THE SIGNIFICANT DIFFERENCE IN YIELD BETWEEN

HYV AND NHYV FARMS

POLLACHI SOUTH - LOW IRRIGATED VILLAGE - CHOLAM

HYV Output (X_1)	NHYV Output (X_2)	$(X_1 - \bar{X}_1)$	$(X_1 - \bar{X}_1)^2$	$(X_2 - \bar{X}_2)$	$(X_2 - \bar{X}_2)^2$
7	5	-3.15	9.92	- 1.88	3.56
8	6	- 2.15	4.62	.11	.01
11	5	.85	.72	- .88	.79
7	7	- 3.15	9.92	1.11	1.23
10	7	- .15	.02	1.11	1.23
20	7	9.85	97.02	1.11	11.23
8	5	- 2.15	4.62	- .88	.78
10	12	- .15	.02	6.11	37.34
75	8	- 2.65	7.02	2.11	4.45
13		2.85	8.12		
101.5	53		142.02		46.21

APPENDIX - XIX

PARTITIONING OF DIFFERENTIAL OUTPUT INTO COMPLEMENTARY COMPONENTS OF VARIETY EFFECT AND INPUT EFFECT POLLACHI SOUTH - HIGH IRRIGATED VILLAGE - CHOLAM

HYV

S.No.	Output (Y)	Cropped area (x_1)	Seed expenditure (x_2)	Pesticide expenditure (x_3)	Fertiliser expenditure (x_4)	Man hours employed (x_5)	Capital invested (x_6)	Tractor timings (x_7)
1	14	2	1100	1000	1000	2	1000	2
2	6	2	450	500	1000	15	70000	0
3	39.9	35	1000	1160	1000	2	5000	0
4	6	2	500	300	0	8	10000	0
5	30	2	750	750	100	7	8000	3
6	20	4	500	500	0	5	2000	0
7	28	2	800	750	500	1	10000	0
8	120	3	1000	1200	1000	3	1000	3
9	40	2	750	500	500	12	11000	5
10	700	2	1520	1250	1000	3	10000	4
11	199.92	28	1250	1500	1000	0	15000	8
12	250	10	1250	1000	1000	1	2000	2
13	249.9	15	1000	1000	1000	6	4000	4

NHYV - CHOLAM

S.No.	Output (Y)	Cropped area (x_1)	Seed expenditure (x_2)	Pesticide expenditure (x_3)	Fertiliser expenditure (x_4)	Man hours employed (x_5)	Capital invested (x_6)	Tractor timings (x_7)
1	8	4	1200	1000	600	4	1200	2
2	7	3	750	500	700	10	8000	0
3	10	7	300	420	0	8	10000	3
4	12	5	100	1200	800	7	4000	4
5	9	2	150	900	400	6	9000	2
6	6	4	400	1300	300	12	7000	0
7	4	5	700	1200	270	15	10000	4
8	12	3	800	750	720	10	8000	5
9	10	2	750	620	0	4	7000	6
10	4	7	900	850	610	9	1800	0
11	6	8	1000	1100	700	8	12000	2
12	8	4	475	950	810	7	6000	4
13	10	3	350	600	820	5	9000	0
14	7	2	750	320	0	4	3000	6
15	9	7	600	450	300	10	7200	5
16	6	6	700	270	0	6	1500	0
17	5	5	525	410	0	8	9200	4
18	12	4	1000	1200	320	15	12000	2
19	4	2	920	300	0	2	10000	3
20	10	6	700	800	510	9	9000	0
21	7	4	550	1000	420	8	8000	6
22	5	3	300	170	710	7	15000	5
23	4	2	910	800	510	10	9000	0
24	2	1	700	1000	1000	6	8000	4
25	5	2	600	500	420	4	4000	2
26	12	4	700	300	0	7	1000	0
27	10	3	450	400	200	8	1500	2
28	8	2	900	700	0	9	7000	0

A_2	=	66.31 ;	A_1	=	1.8
a_2	=	-.58 ;	a_1	=	-.41
b_2	=	.58 ;	b_1	=	.45
c_2	=	.11 ;	c_1	=	.09
d_2	=	.29 ;	d_1	=	.18
N_2	=	126 ;	N_1	=	64
W_2^*	=	470 ;	W_1^*	=	227
L_2	=	6.65 ;	L_1	=	5
F_2	=	538 ;	F_1	=	148
K_2	=	8961 ;	K_1	=	6478

$$\begin{aligned}
\text{Log } (N_2 - N_1) = & \text{Log } (A_2 - A_1) + (a_2 - a_1) \log W_1^* \\
& + (b_2 - b_1) \log L_1 + (c_2 - c_1) \log F_1 \\
& + (d_2 - d_1) \log K_1] + \{a_2 \log (W_2^* + W_1^*) + \\
& + b_2 \log (L_2 + L_1) + c_2 \log (F_2 + F_1) \\
& + d_2 \log (K_2 + K_1) + (u_2 - u_1)
\end{aligned}$$

$$\begin{aligned}
\text{Log } (126 - 64) = & \log (66.31 - 1.8) + (-.58 - (-.41)) \log 227 + \\
& (.58 - .45) \log 5 + (.11 - .09) \log 148 + \\
& (.29 - .18) \log 6478 + (-.58 \log 476 + 227) \\
& + .58 \log (0.65 + 5) + .11 \log (538 + 148) \\
& + .29 \log 8961 + 6478
\end{aligned}$$

Total change in employment	=	10.1 percent
Technology effect	=	2.2 percent
Normalised wage rate effect	=	4.13 percent
Complementary input effect	=	3.7 percent

APPENDIX - XX

ESTIMATED FERTILISER YIELD RESPONSE COEFFICIENTS POLLACHI SOUTH - HIGH IRRIGATED VILLAGE - COTTON - HYV

S.No.	Yield (y)	Fertiliser consumption	log Y	log X	log (Y - $\bar{Y}$)	log (Y - $\bar{Y}$) ²	log (X - $\bar{X}$)	log (X - $\bar{X}$) ²	xy
1	33.3	300	1.52	2.47	.03	.0009	.22	.0484	.0066
2	200.0	300	2.30	2.47	.81	.6561	.22	.0484	.1782
3	15.0	300	1.17	2.47	-.32	.1024	.22	.0484	-.0704
4	50.0	400	1.69	2.60	.20	.0400	.35	.1225	.0700
5	25.0	300	1.30	2.47	.10	.0100	.22	.0484	.0220
6	50.0	250	1.69	2.39	.20	.0400	.14	.0196	.0280
7	1.0	250	1.48	2.39	-1.49	.1731	.14	.0196	-.2086
8	30.0	280	2.39	2.44	-.01	.0001	.19	.0361	-.0019
9	250.0	200	.69	2.30	.9	.81	.05	.0025	.0450
10	5.0	250	1.06	2.39	-.08	.64	.14	.0196	-.0112
11	11.66	350	.3010	2.54	-.43	.1849	.29	.0841	-.1247
12	2.0	300	.6990	2.47	-1.18	1.4137	.22	.0484	-.2596
13	5.0	300	1.69	2.47	-.0791	.6256	.22	.0484	-.0174
14	50.0	350	1.78	2.54	.20	.0400	.29	.0841	.0580
15	60.0	300	1.69	2.47	.29	.0841	.22	.0484	.0638
16	50.0	350	1.60	2.54	.20	.0400	.29	.08411	.0580
17	40.0	300	.92	2.47	.11	.0121	.22	.0484	.0242
18	8.33	250	1.38	2.39	-.57	.3249	.14	.0196	-.0798
19	24.0	150	2.06	2.17	-.11	.0121	-.08	.0064	.0088
20	115.0	400	1.94	2.60	.57	.3249	.35	.1225	.1995
21	88.0	75	1.81	1.87	.45	.2025	-.38	.1444	.1710
22	65.0	450	1.69	2.65	.32	.1024	.40	.1600	.1280
23	50.0	600	1.65	2.77	.20	.0400	.52	.2704	.1040
24	45.0	210	1.68	2.32	.16	.0256	.07	.0049	.0112
25	48.0	120	2.06	2.07	.19	.0361	-.18	.0324	-.0342
26	115.0	350	2.10	1.06	.57	.3249	-1.19	1.4161	-.6783
27	128.0	400	2.11	2.06	.61	.3721	-.19	.0361	-.1159
28	130.0	600		1.69	.62	.3844	.56	.3136	-.3472
			1.49	2.25		.60032		3.3017	.2151

$$\hat{b} = \frac{\sum xy}{\sum x^2} = \frac{.2157}{3.3017} = .07$$

$$\hat{a} = \bar{Y} - b \bar{X} = 1.49 - .07 (2.25) = .33$$

$$R^2 = \frac{b \sum xy}{\sum y^2} = \frac{.07 \times (.2151 + 6.0032)}{.04} = .04$$

$$e^2 = (1 - R^2) \sum y^2 = (1 - .04) (6.0032) = 5.76$$

$$\sigma_u^2 = \frac{e^2}{n-K} = \frac{5.76}{26} = .22$$

Variance of

$$b = \frac{\sigma_u^2}{\sum x^2} = \frac{.22}{3.3017} = .06$$

$$\text{Standard error of } b = .06 = .24$$

$$t_{\hat{b}} = \frac{\hat{b}}{SE} = \frac{.07}{.24} = .29$$

$$\hat{b} = \frac{\sum xy}{\sum x^2} = \frac{2.8124}{4.4146} = .64$$

$$\hat{a} = \bar{y} - b \bar{x} = 1.52 - .64 (1.07) = .84$$

$$R^2 = \frac{b \sum xy}{\sum y^2} = \frac{.64 \times (2.8124 + 6.0059)}{6.0059} = .29$$

$$e^2 = (1 - R^2) \sum y^2 = (1 - .29) (6.0059) = 4.26$$

$$\sigma_u^2 = \frac{e^2}{n-K} = \frac{4.26}{26} = .16$$

$$\text{Variance of } b = \frac{\sigma_u^2}{\sum x^2} = \frac{.16}{2.8124} = .0568$$

$$\text{Standard error of } b = \sqrt{\text{Variance of } b} = \sqrt{.0568} = .23$$

$$\hat{y}_{tb} = \hat{a} + b x = .84 + .64 x = 2.78$$

CORRELATION MATRIX

	Y	X1	X2	X3
Y	1.00000			
X1	.04799	1.00000		
X2	.25766	.01996	1.00000	
X3	.15646	.70846	-.07135	1.00000

CRITICAL VALUE (1-TAIL, .05) = + or - .24045
 CRITICAL VALUE (2-tail, .05) = +/- .28419

N = 48

REGRESSION ANALYSIS

HEADER DATA FOR : A : ANNA21 LABEL : PPALLADAM WET * FARM INCOME **
 NUMBER OF CASES : 48 NUMBER OF VARIABLES : 4

MULTIPLE REGRESSION FULL MODEL *

INDEX	NAME	MEAN	STD. DEV.
1	X1	52.6751	12.0677
2	X2	9.3854	7.4070
3	X3	86.3750	13.9263
DEP. VAR. :	Y	84.1073	102.6423

DEPENDENT VARIABLE : Y

VAR.	REGRESSION COEFFICIENT	STD. ERROR	T(DF = 44)	PROB.	PARTIAL r 2
X1	11.4128	1.7220	-.820	.41638	.0151
X2	3.9074	1.9851	1.968	.05534	.0809
X3	2.1688	1.4957	1.450	.15415	.0456
CONSTANT	-65.4733				

STD. ERROR OF EST = 100.0388

ADJUSTED R SQUARED = .0501
 R SQUARED = .1107
 MULTIPLE R = .3327

ANALYSIS OF VARIABLE TABLE

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
REGRESSION	54824.7732	3	18274.9244	1.826	.1563
RESIDUAL	440341.3618	44	10007.7582		
TOTAL	495166.1349	47			

CORRELATION MATRIX

HEADER DATA FOR : A : ANNA7 LABEL : PALLADAM WET ** MAIZE **
 NUMBER OF CASES : 17 NUMBER OF VARIABLES : 4

	Y	X1	X2	X3
Y	1.00000			
X1	-.04971	1.00000		
X2	.54106	-.17708	1.00000	
X3	-.19008	.84941	-.28108	1.00000

CRITICAL VALUE (1-TAIL, .05) = + or - .41340
 CRITICAL VALUE (2-tail, .05) = +/- .48073

N=17

REGRESSION ANALYSIS

HEADER DATA FOR : A : ANNA7 LABEL : PALLADAM WET ** MAIZE **
 NUMBER OF CASES : 17 NUMBER OF VARIABLES : 4

INDEX	NAME	MEAN	STD. DEV.
1	X1	39.8053	14.8240
2	X2	6.5000	4.2131
3	X3	67.5441	21.9636
DEP. VAR. :	Y	24.1412	20.1193

DEPENDENT VARIABLE : Y

VAR.	REGRESSION COEFFICIENT	STD. ERROR	T(DF= 13)	PROB.	PARTIAL r 2
X1	.3912	.5939	.659	.52153	.0323
X2	2.4363	1.1490	2.120	.05380	.2570
X3	-.2670	.4111	-.650	.52722	.0314
CONSTANT	10.7703				

STD. ERROR OF EST = 18.4449

ADJUSTED R SQUARED = .1596
 R SQUARED = .3171
 MULTIPLE R = .5631

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
REGRESSION	2053.7982	3	684.5994	2.012	.1620
RESIDUAL	4422.8030	13	340.2156		
TOTAL	6476.6012	16			

APPENDIX - XXV

ESTIMATED MULTIPLE REGRESSION COEFFICIENTS OF EMPLOYMENT AS
RELATED TO TECHNOLOGY ADOPTION INDEX, CULTIVATED AREA AND CROPPING
INTENSITY

ANNUR BLOCK : LOW IRRIGATED VILLAGE

S.No.	Employment in man hours (E)	Technology adoption index (X1)	Size of the farm (X2)	Cropping intensity (X3)
1.	56	24.72426	2	75
2.	40	24.60317	1.75	57
3.	32	25.41667	2	50
4.	40	20.25	2.5	60
5.	32	18.50694	2	62
6.	32	30.55556	2	62
7.	40	38.19444	2.5	100
8.	48	28.91429	2.5	80
9.	32	26.97778	2.5	80
10.	40	36.26	2.5	70
11.	40	47.36111	2.5	100
12.	32	16.58333	4	50
13.	40	34.79167	4	75
14.	40	20.27778	3	66
15.	40	19.48052	2.75	54
16.	48	17.30556	3	58
17.	104	23.54167	5	100
18.	80	23.61034	5	60
19.	32	13.66071	2.8	64
20.	56	17.7793	3.5	78
21.	48	27.08333	3	66
22.	64	17.83333	5	60

S.No.	Employment in man hours (E)	Technology adoption index (X1)	Size of the farm (X2)	Cropping intensity (X3)
23.	40	6.666667	6	33
24.	88	21.48148	9	88
25.	72	8.653846	6	50
26.	80	30.92107	8	100
27.	72	17.29323	7	57
28.	96	29.11273	9	100
29.	64	20.95588	6	50
30.	136	22.86429	20	75
31.	128	23.86875	10	60
32.	112	14.27569	18	61
33.	104	28.8	15	80
34.	136	26.17467	20	75
35.	144	31.89091	22	81
36.	280	28.23704	25	80
37.	256	28.332	25	72
38.	240	22.17407	36	55
39.	224	30.6	25	68
40.	110	10.2	10	70
41.	170	8.6	7	65
42.	220	7.5	6	72
43.	190	5.8	4	60
44.	220	7.5	5	75
45.	180	6.8	6	80
46.	190	9.2	6	75
47.	240	12.6	8	72
48.	260	14.2	7	80
49.	180	20.2	5	85
50.	160	5.9	4	90

CORRELATION MATRIX

HEADER DATA FOR : A : ANNA41 LABEL : ANNUR DRY * EMPLOYMENT
 NUMBER OF CASES : 50 NUMBER OF VARIABLES : 4

	Y	X1	X2	X3
Y	1.00000			
X1	.11172	1.00000		
X2	.94355	.06760	1.00000	
X3	.10771	.66317	.03443	1.00000

CRITICAL VALUE (1-TAIL, .05) = + or - .26753
 CRITICAL VALUE (2-tail, .05) = + / - .31558

N = 39

REGRESSION ANALYSIS

HEADER DATA FOR : A ANNA41 LABEL : ANNUR DRY * EMPLOYMENT
 NUMBER OF CASES : 39 NUMBER OF VARIABLES : 4

MULTIPLE REGRESSION * FULL MODEL ***

INDEX	NAME	MEAN	STD. DEV.
1	X1	24.2568	7.9509
2	X2	8.5846	8.6558
3	X3	69.8974	17.0213
DEP. VAR. :	Y	82.2564	60.6477

DEPENDENT VARIABLE : Y

VAR.	REGRESSION COEFFICIENT	STD.ERROR	T(DF = 5)	PROB.	PARTIAL r 2
X1	.0250	.5567	.045	.96441	5.76998E-05
X2	6.5939	.3829	17.219	.00000	.8944
X3	.2760	.2596	1.063	.29488	.0313
CONSTANT	6.9626				

STD. ERROR OF EST. = 20.3843

ADJUSTED R SQUARED = .8870
 R SQUARED = .8959
 MULTIPLE R = .9465

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
REGRESSION	125226.2119	3	41742.0706	100.457	.000E+00
RESIDUAL	14543.2240	35	415.5207		
TOTAL	139769.4359	38			

APPENDIX - XXVI

ESTIMATED EMPLOYMENT ELASTICITIES

POLLACHI SOUTH - HIGH IRRIGATED VILLAGE - HIGH TECHNOLOGY

FARMERS - CHOLAM

S.No.	Employment in man hours	Wages (in rupees)	Land area (in acres)	Fertiliser	Capital expenditure
1	200	500	6	1000	200100
2	88	220	2.5	0	10500
3	10	40	10	0	100500
4	240	600	22	0	110500
5	24	60	6	1000	6000
6	32	80	2.5	0	25500
7	16	40	4	1000	3520
8	80	200	6	500	40500
9	816	2040	35	1000	301250
10	240	600	35	1000	201000
11	110	410	8	800	12000
12	80	200	7	700	7000
13	30	75	6	900	32000
14	18	90	10	600	7500
15	10	80	5	400	8000
16	20	120	4	600	15000
17	24	140	3	700	27000
18	410	1000	7	750	90000
19	520	1700	5	500	18000
20	110	1000	7	600	12000
21	80	910	6	500	25000
22	50	500	5	400	30000
23	30	600	10	300	40000
24	20	410	9	200	8000
25	12	520	8	110	17000
26	18	680	7	600	9000

REGRESSION ANALYSIS

HEADER DATA FOR : A. ANNA30 LABEL : POLLACHI WET * CHOLAM * HIGH ***
 NUMBER OF CASES : 26 NUMBER OF VARIABLES : 5

INDEX	NAME	MEAN	STD. DEV.
1	N	978.0000	1865.1291
2	L	18.3000	19.3953
3	F	650.0000	474.3416
4	K	369900.0000	927625.4198
DEP. VAR. :	E	175.2000	242.7531

DEPENDENT VARIABLE : E

VAR.	REGRESSION COEFFICIENT	STD. ERROR	T(DF = 5)	PROB.	PARTIAL r ²
N	-.58	.0121	-1.59	.19675	.3071
L	.58	1.2060	2.092	.09061	.4669
F	.11	.0450	1.988	.23862	.2635
K	.29	2.31395E-05	9.844	.00018	.9509
CONSTANT	66.3152				

STD. ERROR OF EST. = 58.8067

ADJUSTED R SQUARED = .9413
 R SQUARED = .9674
 MULTIPLE R = .9836

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
REGRESSION	513070.4559	4	128267.6140	37.091	6.561E-04
RESIDUAL	17291.1441	5	3458.2288		
TOTAL	530361.6000	9			

D.W.TEST = 3.04

APPENDIX - XXVII

DECOMPOSITION ANALYSIS OF TOTAL CHANGE IN PER ACRE EMPLOYMENT

BETWEEN HIGH AND LOW TECHNOLOGY FARMS

POLLACHI SOUTH - HIGH IRRIGATED VILLAGE - HIGH TECHNOLOGY

FARMS - CHOLAM

S.No.	Employment (in manhours)	Wages (in rupees)	Land area (in acres)	Fertiliser	Capital Expenditure
1	200	500	6	1000	200100
2	88	220	2.5	0	10500
3	10	40	10	0	100500
4	240	600	22	0	110500
5	24	60	6	1000	6000
6	32	80	2.5	0	25500
7	16	40	4	1000	3520
8	80	200	6	500	40500
9	816	2040	3.5	1000	301250
10	240	600	3.5	1000	201000
11	110	410	8	800	12000
12	80	200	7	700	7000
13	30	75	6	900	32000
14	18	90	10	600	7500
15	10	80	5	400	8000
16	20	120	4	600	15000
17	24	140	3	700	27000
18	400	1000	7	750	70000
19	520	1100	5	500	18000
20	110	1000	7	600	12000
21	80	910	6	500	25000
22	50	500	5	400	30000
23	30	600	10	300	40000
24	20	410	9	200	8000
25	12	520	8	110	17000
26	18	680	7	600	9000
					4000
X	126	470	6.65	5.38	8961

POLLACHI SOUTH - HIGH IRRIGATED VILLAGE - LOW TECHNOLOGY

FARMS - CHOLAM

S.No.	Employment (in manhours)	Wages (in rupees)	Land area (in acres)	Fertiliser	Capital Expenditure
1	100	200	8	200	10000
2	48	120	4	0	5000
3	8	20	6	100	8000
4	180	400	10	50	12000
5	12	80	5	0	7000
6	20	160	3	0	6000
7	24	180	2	0	4000
8	8	60	6	200	12000
9	76	130	3.5	100	9000
10	250	800	4.5	300	7000
11	160	520	7	0	4000
12	112	410	9	0	9000
13	98	320	5	400	10000
14	80	400	4	0	8000
15	12	100	3	0	4000
16	8	60	2	0	7000
17	16	120	7	300	6000
18	20	160	9	200	3000
19	24	300	6	100	2500
20	32	220	5	0	2000
21	40	100	4	700	7000
22	80	220	3	800	1700
23	72	180	2	0	4000
	64	227	5	148	6478

APPENDIX - XXVIII

LINEAR DISCRIMINANT FUNCTION ANALYSIS

POLLACHI BLOCK - HIGH IRRIGATED VILLAGE - LAND PREPARATION

E	X1	X2	X3	X4	X5	X6	X7	X8
16	40	40	60	60	450	650	1000	43.4375
24	60	80	60	140	300	300	8000	56.70573
8	20	20	20	20	350	350	1400	57.06667
8	20	20	20	40	250	250	2000	40.2
24	60	40	80	80	800	900	8000	45.79398
32	80	20	20	20	5000	6000	20000	50.43732
16	40	40	40	80	1250	1000	8500	46.18056
24	60	40	20	20	6000	4000	80000	39.65015
16	40	60	90	120	5000	5000	7500	60.50944
32	80	40	40	40	4000	5000	10000	74.72789
232	580	90	80	80	9000	9000	350000	59.93294
16	40	40	100	80	6000	8500	9200	71.55469
16	40	20	60	60	600	1100	5000	56.69271
16	40	20	80	60	9000	10500	20000	57.53712
48	120	60	60	60	1100	1200	8500	49.89793
72	180	120	100	100	7000	10000	130000	60.48764
16	40	20	80	60	9000	20000	70000	63.35145
16	40	20	40	60	8000	18000	40000	61.78947
64	160	180	168	400	10000	25000	370000	81.65509
224	560	80	80	80	5000	11000	380000	65.36939
200	500	300	200	300	2800	3000	320000	49.5873
312	780	420	300	300	7500	10000	100000	59.16646
8	20	10	10	20	200	250	1000	43.57985

OUTPUT STARTS FROM HERE
NO OF OBSERVATIONS 20 NO OF INDEPENDENT VARIABLES 8

	CRUDE SS&SP	SS&SP	CORRELATION COEFFICIENT
VY	210174	149821	1
YX 1	4.20352E+06	2.97642E+06	1
YX 2	2.50688E+06	1.6544E+06	.973489
YX 3	2.00864E+06	1.37043E+06	.967642
YX 4	1.57984E+06	1.07066E+06	.948686
YX 5	7466.08	-3284.96	-.0931019
YX 6	11819.9	-15575.8	-.138965
YX 7	7.5348E+06	-68400	-3.92944E-03
YX 8	3961.2	-1771.95	-.262648
X 1 X 1	8.40704E+07	5.75283E+07	1
X 1 X 2	5.01376E+07	3.3088E+07	.973489
X 1 X 3	4.01728E+07	2.74084E+07	.967642
X 1 X 4	3.15968E+07	2.14131E+07	.948686
X 1 X 5	149322	-65699.2	-.0931019
X 1 X 6	236398	-311516	-.138965
X 1 X 7	1.50696E+08	-1.368E+06	-3.92944E-03
X 1 X 8	79224	-35438.9	-.262648
X 2 X 2	3.10336E+07	2.00816E+07	1
X 2 X 3	2.48352E+07	1.6636E+07	.994071
X 2 X 4	1.96896E+07	1.3148E+07	.985924
X 2 X 5	77860.8	-60260.2	-.144534
X 2 X 6	130398	-221560	-.167286
X 2 X 7	9.974E+07	2.06E+06	.010015
X 2 X 8	50046.1	-23608.9	-.29615
X 3 X 3	2.00848E+07	1.39465E+07	.999999
X 3 X 4	1.59632E+07	1.10658E+07	.995716
X 3 X 5	63995.2	-39408.9	-.113423
X 3 X 6	124299	-139194	-.126112
X 3 X 7	7.1226E+07	-1.902E+06	-.0110959
X 3 X 8	37593	-17548.8	-.264149
X 4 X 4	1.27632E+07	8.85592E+06	1
X 4 X 5	44796.8	-37702.5	-.136173
X 4 X 6	84299.2	-125925	-.143173
X 4 X 7	5.521E+07	-3.134E+06	-.0229439
X 4 X 8	28672.7	-15321.2	-.289408
X 5 X 5	10398	8656.09	1
X 5 X 6	29163.7	24725	.899172
X 5 X 7	1.8265E+06	594610	.139237
X 5 X 8	2206.74	1277.84	.772057
X 6 X 6	98661.3	87350.6	1
X 6 X 7	1.68309E+06	-1.456E+06	-.107328
X 6 X 8	6292.49	3925.48	.746661
X 7 X 7	2.97804E+09	2.10684E+09	.999998
X 7 X 8	400027	12004.1	.0514412

3 X 8 811.819 313.47 1

	VARIANCE	STANDARD DEVIATION	TOTALS	MEAN	C. V. (
	7569.52	87.003	1152	57.6	151.047
1	3.02781E+06	1740.06	23040	1152	151.047
2	1.05693E+06	1028.07	14800	740	138.928
3	734025	856.752	11080	554	154.648
4	466101	682.716	8840	442	154.461
5	455.584	21.3444	186.65	9.3325	228.711
6	4527.4	67.8041	475.62	23.794	285.119
7	1.10886E+08	10530.2	132000	6600	159.549
8	16.6563	4.08121	99.5339	4.97669	92.0066

OUTPUT STARTS FROM HERE

NO OF OBSERVATIONS 20 NO OF INDEPENDENT VARIABLES 8

	CRUDE SS&SP	SS&SP	CORRELATION COEFFICIENT
Y	93072	26521.6	1
X 1	1.65632E+06	537344	.999027
X 2	733440	210048	.733139
X 3	560640	175616	.782457
X 4	444800	158024	.792057
X 5	16904	3698.88	.255393
X 6	10900	-12835	-.487815
X 7	3.626E+06	524000	.49853
X 8	20270.6	1495.52	.152041
1 X 1	3.30496E+07	1.09082E+07	1
1 X 2	1.46368E+07	4.28032E+06	.736661
1 X 3	1.11904E+07	3.57184E+06	.784717
1 X 4	8.88E+06	3.10656E+06	.792869
1 X 5	337600	76007.2	.259794
1 X 6	218000	-251650	-.471606
1 X 7	7.172E+07	1.034E+07	.48507
1 X 8	402057	31549.9	.158158
2 X 2	7.9322E+06	3.09504E+06	1
2 X 3	5.912E+06	2.34848E+06	.968612
2 X 4	4.648E+06	1.94752E+06	.933139
2 X 5	183616	61398.4	.39243
2 X 6	146000	-73675	-.259207
2 X 7	2.948E+07	770000	.0678137
2 X 8	201899	28129.6	.264728

X 3 X 3	4.5208E+06	1.89936E+06	1
X 3 X 4	3.5928E+06	1.60624E+06	.982436
X 3 X 5	143264	53356.8	.435336
X 3 X 6	95500	-66400	-.296863
X 3 X 7	2.222E+07	1.4E+06	.123666
X 3 X 8	152717	24986.6	.299972
X 4 X 4	2.9128E+06	1.40736E+06	1
X 4 X 5	117408	49275.2	.467051
X 4 X 6	60500	-61962.5	-.323285
X 4 X 7	1.75E+07	1.495E+06	.195254
X 4 X 8	117325	20453.9	.285458
X 5 X 5	10992.6	7909.02	1
X 5 X 6	5981.25	439.875	.0305449
X 5 X 7	830450	106100	.184848
X 5 X 8	9288.25	4904.07	.912985
X 6 X 6	36064.5	26102.5	1
X 6 X 7	846875	-455078	-.43642
X 6 X 8	9165.86	1285.69	.131754
X 7 X 7	2.11813E+08	4.16562E+07	1
X 7 X 8	1.01667E+06	-13213.7	-.0238963
X 8 X 8	9881.52	3648.07	1

	VARIANCE	STANDARD DEVIATION	TOTALS	MEAN	C.V.
Y)					
Y	2946.84	54.2849	752	75.2	72.1873
X 1	1.21202E+06	1100.92	14880	1488	73.9863
X 2	343893	586.424	6960	696	84.2564
X 3	241040	489.394	5120	512	89.7248
X 4	156373	395.441	3880	388	101.918
X 5	978.78	29.6442	175.6	17.56	168.817
X 6	2900.28	53.8543	315.625	31.5625	170.627
X 7	4.62847E+06	2151.39	41250	4125	52.1549
X 8	405.341	20.1331	249.669	24.9669	80.6392

Discriminant function:

	CRUDE SS&SP	SS&SP	CORRELATION COEFFICIENT
YY	0	170343	1
YX 1	0	3.41376E+06	.999835
YX 2	0	1.86445E+06	.938347
YX 3	0	1.54605E+06	.941029
YX 4	0	1.22368E+06	.925475
YX 5	0	413.92	7.79216E-03
YX 6	0	-28410.8	-.204368
YX 7	0	455600	.0238152
YX 8	0	-276.43	-.0106372

X 4 X 4 0	6.84365E+07	.999999
X 4 X 2 0	3.73693E+07	.939285
X 4 X 3 0	3.09804E+07	.940776
X 4 X 4 0	2.45197E+07	.925183
X 4 X 5 0	10609	9.96306E-03
X 4 X 6 0	-563166	-.202109
X 4 X 7 0	8.972E+06	.023398
X 4 X 8 0	-3889	-7.46616E-03
X 2 X 2 0	2.31766E+07	1
X 2 X 3 0	1.89845E+07	.99064
X 2 X 4 0	1.50955E+07	.978769
X 2 X 5 0	1138.2	1.83694E-03
X 2 X 6 0	-295235	-.192069
X 2 X 7 0	2.83E+06	.0126922
X 2 X 8 0	4520.7	.0149137
X 3 X 3 0	1.58459E+07	1
X 3 X 4 0	1.2672E+07	.993677
X 3 X 5 0	13947.9	.0272241
X 3 X 6 0	-205294	-.153112
X 3 X 7 0	-802000	-4.3466E-03
X 3 X 8 0	7337.9	.029276
X 4 X 4 0	1.02633E+07	1
X 4 X 5 0	11572.7	.0290669
X 4 X 6 0	-187898	-.174119
X 4 X 7 0	-1.639E+06	-.0110374
X 4 X 8 0	5132.7	.0254452
X 5 X 5 0	16565.1	1
X 5 X 6 0	25163.9	.58046
X 5 X 7 0	700710	.117456
X 5 X 8 0	6181.91	.762833
X 6 X 6 0	113453	1
X 6 X 7 0	-1.91108E+06	-.122406
X 6 X 8 0	5211.17	.245715
X 7 X 7 0	2.1485E+09	.999999
X 7 X 8 0	28790.5	9.86474E-03
X 8 X 8 0	3964.54	.999999