AN ECONOMETRIC ANALYSIS OF FARMING SYSTEMS IN NORTH KONKAN REGION OF MAHARASHTRA

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C O N T E N T S

Sl. No.	Chapter Particulars	Page No.
	CERTIFICATE	
	ACKNOWLEDGEMENT	
	LIST OF TABLES	
	LIST OF FIGURES	
	LIST OF PLATES	
	LIST OF APPENDICES	
1	INTRODUCTION	
2	REVIEW OF LITERATURE	
	2.1 Farming systems – Concepts and definitions	
	2.2 Cost and returns in different farming systems	
	2.3 Analytical techniques	
	2.4 Constraints and opportunities in farming system approach	
3	METHODOLOGY	
	3.1 Profile of the Maharashtra State	
	3.2 Profile of Konkan region	
	3.3 Description of study area	
	3.4 Data base and sampling design	
	3.5 Analytical techniques employed and terms and concepts related to study	
4	RESULTS	
	4.1 Delineation of study area	
	4.2 General characteristics of sample respondents	
	4.3 Existing farming systems	
	4.4 Per unit profitability of enterprises followed in study area	
	4.5 Cost and returns structure of farming systems	
	4.6 Resource use efficiency of enterprises followed under major farming systems	
	4.7 Optimum farming systems	
	4.8 Constraints faced by farmers and measures to overcome them	

Contd…..

Sl. No.	Chapter Particulars	Page No.
5	DISCUSSION	
	5.1 Delineation of study area on the basis of agro-climatic parameters	
	5.2 General characteristics of sample respondents	
	5.3 Existing farming systems	
	5.4 Per unit profitability enterprises followed in study area.	
	5.5 Cost and returns structure of farming systems	
	5.6 Resource use efficiency of enterprises followed under major farming systems.	
	5.7 Optimum farming systems	
	5.8 Constraints faced by farmers and measures to overcome them	
6	SUMMARY AND POLICY IMPLICATIONS	
	REFERENCES	
	APPENDICES	

LIST OF TABLES

Table No.	Title	Page No.
3.1	Land use pattern	
3.2	Cropping pattern	
3.3	Livestock population	
3.4	Distribution of group wise sample households from different clusters	
3.5	Distribution of Tahsilwise villages and sample households selected for study	
3.6	Activities carried out in major farming systems followed in North Konkan region	
4.1	Delineation of Study Area on the Basis of Agro-climatic Parameters	
4.2	Proximity Matrix of Different Clusters	
4.3	Validation of Clusters by Discriminent Analysis	
4.4	General Information of Sample Respondents in the Study Area	
4.5	Existing Farming Systems in North Konkan Region	
4.6	Land Holding under Existing Farming Systems	
4.7	Cropping Pattern of Sample Farms in Northern coastal plains region (Cluster I)	
4.8	Cropping Pattern of Sample Farms in Northern central plains and hills region (Cluster II)	
4.9	Cropping Pattern of Sample Farms in Southern central plains and hills region (Cluster III)	
4.10	Cropping Pattern of Sample Farms in Southern coastal plains region (Cluster IV)	
4.11	Profitability of Crops Grown and Other Enterprises Followed in Major Farming Systems in Northern coastal plains region	
4.12	Profitability Enterprises Followed in Northern central plains and hills region	
4.13	Profitability of Enterprises Followed in Southern central plains and hills region	
4.14	Profitability of Enterprises Followed in Southern coastal plains region	
4.15	Cost and Returns Structure of Major Farming Systems Followed in Northern coastal plains region	
4.16	Cost and Returns Structure of Major Farming Systems Followed in Northern central plains and hills region	

Contd…..

Table No.	Title	Page No.
4.17	Cost and Returns Structure of Major Farming Systems Followed in Southern central plains and hills region	
4.18	Cost and Returns Structure of Major Farming Systems Followed in Southern coastal plains region	
4.19	Cost and Return Structure of Farming Systems in North Konkan Region	
4.20	Production Function Estimates for Crops Grown Under Major Farming Systems in Costal Plains (North) Region	
4.21	Production Function Estimates for Other Enterprises Followed Under Major Farming Systems in Northern coastal plains region	
4.22	Production Function Estimates for Crops Grown Under Major Farming Systems in Northern central plains and hills region	
4.23	Production Function Estimates for Other Enterprises followed under Major Farming Systems in Northern central plains and hills region	
4.24	Production Function Estimates for Crops Grown Under Major Farming Systems Southern central plains and hills region	
4.25	Production Estimates for Other Enterprises Followed under Major Farming Systems in Southern central plains and hills region	
4.26	Production Function Estimates for Crops Grown Under Major Farming Systems in Costal Plains South Region	
4.27	Production Function Estimates for Other Enterprises followed Under Major Farming Systems in Costal Plains South Region	
4.28	Optimum Plans for Farming Systems in Northern coastal plains region	
4.29	Optimum Plans for Farming Systems in Northern central plains and hills region	
4.30	Optimum Plans for Farming Systems in Southern central plains and hills region	
4.31	Optimum Plans for Farming Systems in Southern Coastal Plains Region	
4.32	Net returns in optimum plans for farming systems followed in study area	
4.33	Shadow Prices of Resources Used in Major Farming Systems	
4.34	Constraints Faced by Farmers in Adoption of Farming Systems in Study Area	
4.35	Measures Suggested to Over Come the Constraints Faced by the Farmers in Study Area	

LIST OF FIGURES

Figure No.	Title	Page No.
1	Map of north Konkan region showing study area	
2	Delineation of study area	
3	Cluster diagram	
4	Cost and Returns Structure of Major Farming Systems Followed in Northern Coastal Plains Region	
5	Cost and Returns Structure of Major Farming Systems Followed in Northern Central Plains and Hills Region	
6	Cost and Returns Structure of Major Farming Systems Followed in Southern Central Plains and Hills Region	
7	Cost and Returns Structure of Major Farming Systems Followed in Southern Central Plains and Hills Region	
8	Net Income in Optimum Plans for Farming Systems in Northern Coastal Plains Region	
9	Net Income in Optimum Plans for Farming Systems in Northern Central Plains and Hills Region	
10	Net Income in Optimum Plans for Farming Systems in Southern Central Plains and Hills Region	
11	Net Income in Optimum Plans for Farming Systems in Southern Coastal Plains Region	
12	Net Income in Major Farming Systems Followed in Northern Coastal Plains Region	
13	Net Income in Major Farming Systems Followed in Northern Central Plains and Hills Region	
14	Net Income in Major Farming Systems Followed in Southern Central Plains and Hills Region	
15	Net Income in Major Farming Systems Followed in Southern Coastal Plains Region	

LIST OF PLATES

Plate No.	Title	Page No.
1	Farming systems enterprises in northern coastal plains	
2	Farming systems enterprises in northern coastal plains	
3	Farming systems enterprises in northern coastal plains	
4	Farming systems enterprises in northern coastal plains	
5	Farming systems enterprises in northern coastal plains	
6	Farming systems enterprises in northern central plains and hills	
7	Farming systems enterprises in southern central plains and hills	
8	Farming systems enterprises in southern coastal plains	

LIST OF APPENDICES

Appendix No.	Title	Page No.
I	Per hectare cost and returns of crop grown in farming systems in northern coastal plains	
II	Per unit cost and returns from other enterprises followed in Northern coastal plains	
III	Per hectare cost and returns of crop grown in farming systems in northern central plains and hills	
IV	Per hectare cost and returns of other enterprises in farming systems in northern central plains and hills	
V	Per hectare cost and returns of crops grown under farming systems in southern central plains and hills	
VI	Per hectare cost and returns of other enterprises in farming systems in southern central plains and hills	
VII	Per hectare cost and returns of crops grown under farming systems in southern coastal plains	
VIII	Per hectare cost and returns of other enterprises in farming systems in southern costal plains	

1. INTRODUCTION

Agriculture constitutes one of the most crucial sectors of Indian economy by virtue of its being single largest contributor of gross domestic product (GDP) hovering around 18.5 per cent (Rajmani, 2007) of the total income and provider of employment to 59.20 per cent of total workforce (Anonymous, 2006). Growth in agriculture has therefore, a direct impact both on poverty alleviation as well as food and nutritional security. This apart, the share of agricultural products vis-à-vis the total export earnings is also substantial relative to the perspective economic growth. Equally important is the kind and extent of support that agriculture and allied sectors provides to agro-based food and non food industrial growth since independence. One of the finest Indian success stories of post independent era has been the green revolution of sixties, which salvaged the country from being a chronic importer of food grains into an exporter. Since independence, the population has increased three times, from 361.1 million in 1950-51 to 1028.7 million by the year 2001, whereas production has increased four times from 50.8 million tones to 212 million tones during same period (Anonymous, 2004).

Out of total land area 57.2 per cent area is under agricultural crops, which is higher than the world average (11.70%) (Anonymous, 2006). The per capita availability of food grains which was 449.60 g/day in the year 1960-61 has fairly declined to 436.20 g/day, in spite of three fold increase in population during this period (Anonymous, 2004). India ranks second in total agricultural production in World. The country has 1st rank in sugarcane, Indian fruits, vegetables, groundnut, paddy, wheat etc. However, the productivity of most of the crops is less than world average.

India with 2.4 per cent of global geographical area supports 16.7 per cent of total world population (Anonymous, 2006). As of now, out of 328.73 million ha of geographical area approximately 18 per cent is under forest. The total problem area constitutes 173.65 million ha. (52.82 Per cent) which include area subject to wind and water erosion, water logged area, alkali soils, saline and costal sandy areas, ravines and gullies, reveries and torrents etc. Besides, 40 million ha (12 per cent) is flood prone and 260 million ha (79.09 per cent) is drought prone (Rangasami *et al*., 2002).

The country's population is expected to reach 1660 million in the year 2050. In the year 2050, 349 million tones of foodgrains, 25 million tones of vegetable oil and 92 million meter^3 of industrial wood will be required. It is anticipated that land area available in 2050 would be 137 million ha (Rangasami *et al* 2002). So it becomes therefore necessary to increase the productivity of agricultural crops almost to double of what we are producing today.

Since there is no further scope for horizontal expansion of land for cultivation of farm enterprise, the emphasis should be on vertical expansion by increasing the productivity using the available resources properly choosing the best enterprise mix. The income from cropping alone is hardly sufficient to sustain the farmer's family in case of small and marginal farmers, who constitute 80.3 per cent of agricultural population with only 36 per cent of area operated. With decline in farm size due to explosion of population, it would be increasingly difficult to produce enough food for the family by the end of 21st century. The farmers need to be assured of regular income for living at least above poverty line. The progress in production or steady growth in output is necessary to face the challenges posed by present economic, political and technological environment. In this context, farming system approach is one of the important solutions to face this peculiar situation because in farming system approach the different enterprises can be carefully undertaken and the location specific system can be developed based on available resources which will result into sustainable development.

Farming System

In its broadest sense the term farming systems research is any research that views the farm in a holistic manner and considers interacting factors in the system (CGIAR, 1978) A farming system is a complex interrelated matrix of soils, plants, animals, implements, labour, capital and other inputs controlled in the past by farming families and influenced to varying degrees by political, economical, institutional and social forces that operate at any levels .

Research on farming system has various objectives ranging from increasing the body of knowledge about farming systems to solving different problems of farming system.

The farm is viewed in holistic manner. The farmers are subjected to many socio-economic, biophysical, institutional, administrative and technological constraints. The farming system conceptually is a set of elements or components that are interrelated which interact among themselves. At the centre of interaction is the farmer exercising control and choice regarding the type and results of interaction.

The farming system research (FSR) originates from recognizing the interdependence and inter-relationships of natural environment within the farming system. In FSR, the farmers by participating in the research process help in the identification of the research problem as well as take part in testing the possible solution. Farmer's participation in farming system research means that the system itself can be incorporated in the experiment and realistic results can be obtained through farmer managed trials.

Components of farming System

Farming enterprise includes crop, livestock, poultry, fish, sericulture vermicompost, dairy, goat, *etc*. A combination of one or more enterprises with cropping, when carefully chosen, planned, and executed, gives greater dividends than single enterprise especially for small and marginal farmers. Farm as a unit is to be considered and planned for effective integration of enterprises to be combined with crop production activity. Judicious mix of one or more of these enterprises with agronomic crop should complement the farm income and help in recycling the farm residue. The selection of enterprise must be based on the cardinal principle of minimizing the competition and maximizing the complementarity between the enterprises.

Need for Study

So far studies conducted on farming systems in the Konkan region of Maharashtra state are few, and farming system approach in analyzing the problems of agriculture is gaining lot of importance in recent years. Such study will throw light on the problems associated with different farming systems and enable the academicians and policy makers to issue instead of blanket recommendations, a region specific, appropriate and tailor-made recommendations and policy can be implemented for overall agricultural development in north Konkan region of Maharashtra.

The present study is a modest attempt to study farming systems in north Konkan region with following specific objectives.

Objectives of investigation

1. To delineate study area on the basis of agro climatic parameters
2. To estimate cost, returns and resource use efficiency of major farming systems in delineated areas
3. To estimate optimum farming systems under existing farming practices at present resource levels and enhanced resource levels
4. To study the constraints experienced by farmers in operationalising the existing farming systems and to suggest appropriate policy options

Hypotheses

1. In each agro climatic situation specific type of farming system is followed.
2. Economic advantages for a specific farming system in a given region are more as compared to other systems.
3. In existing farming system, various resource allocations and resource levels are not properly organized.
4. There are various constraints faced by the farmers in existing farming system.
5. The net returns received are the same in all farming systems.

Scope of Study

The outcome of the present investigation will be of immense importance to evolve, develop and implement the location specific farming systems, in study area, as well as the area with similar situations elsewhere. It will help farmers, academicians and policy makers to decide the strategies which will lead to overall development of agriculture in the region.

Limitations of Study

The present study is based on primary as well as secondary data. There were limitations to classify the study area across villages or revenue circles due to paucity of village wise, or revenue circle wise secondary data on agro climatic parameters. Hence the study was carried out with the tahsils wise data. Due to some limitations of software integer programming was not performed which has more relevance in dairy and poultry enterprises. In farming system studies risk efficient farming system should be included, however due to high quantum of study this aspect was not considered. The primary data is based on the memory recall of the sample respondents as farmers seldom keep records.

2. REVIEW OF LITERATURE

Review of literature published by earlier researchers related to the subject under study is always useful to the investigator to outline the problem of research, formulate the objective and choose suitable methodology. It also provides a general orientation about the subject as a whole, therefore, an attempt has been made to review the literature on the problem in this chapter. It is described under four broad headings.

2.1 Farming systems – Concepts and definitions

2.2 Cost and returns in different farming systems

2.3 Analytical techniques

2.4 Constraints and opportunities in farming system approach

2.1 Farming Systems – Concepts and Definitions

The Indian Council of Agricultural Research (1981) viewed the farming system as a combination of productive enterprises – crops, livestock, fish, poultry etc., and development of farming programme in such a manner as to utilize resources optimally for deriving maximum profits.

Byerlee *et al*. (1982) stated that, farming system research (FSR) offered promising scope to improve the traditional and subsistence farming in developing countries. They defined FSR as a farm research that views the farm in a holistic manner and considers the interaction in the system. The major objective of this type of study was to solve the specific problems in farming and to increase the productivity of farming systems by generating new technology which would be appropriate for farmers They stressed the need for actively including the farmers in farm researches to develop less ambitious and more practical farming systems.

The major components of farming systems, according to Desai (1982) are crops including horticulture and plantation, livestock, fisheries and forestry production. In Indian agriculture food grains production is found to be the most important. He emphasized that other components need to be included and developed as an integrated part of the farming system.

The primary objective of FSR, according to Norman and Collinson (1985), is to improve the well being of individual farming families by increasing the productivity of their farming systems given the constraints imposed by resources and environment. FSR, in another sense, is on-farm research consisting of development and dissemination of relevant improved technology and implementation of appropriate policy. In farming systems research farm as a whole is viewed in a comprehensive manner. According to them, there are four stages in FSR, *viz.,* description and diagnosis, designing and planning; testing and evolution and finally recommendations and dissemination of the knowledge of the optimum farming systems.

Remenyi and Coxhead (1985) described the usefulness and effectiveness of FSR in terms of multi disciplinary and complexity of farming. He explained the five critical characteristics of FSR in terms of its relation to small holders, multi disciplinary and holistic approach, inclusion of farmer in research, aiming at generating viable technology and lastly testing and verifying the research results. He also stated that, FSR is useful in the research which is conducted with the recognition and focus towards the inter dependence and inter-relationship that exist among the different elements of the farming systems. The main thrust is towards the systems diagnosis, problems identification and solution formulation.

Rosario (1985) emphasized the need for FSR which is arising because of growing disparity between experimental and farmers' yields and limited adoption of recommended technology. Due to these reasons, yields are low and increased yields do not translate into improved economic well being. Therefore, FSR is a strategy who properly accounts for the needs of farm sector, particularly, the small farmers which constitute bulk of the farms.

Sabrani *et al.* (1985) explained the major thrust of FSR on crop livestock research. The main aims of FSR are to develop stable cropping pattern, maintenance of soil fertility,

efficient utilization of land and labour and the provision of sustained cash income. According to them, future needs of FSR are to impart training, regular research, evaluation and formulation of nation wide FSR network.

Satish and Sharma (1988) defined farming system as 'The farming systems specifically refers to a crop combination or enterprise mix in which the products and/or the by-products of one enterprise serve as the input for the production of other enterprises'. It takes into account the consumption needs of the family. They further opined that farming was a stochastic, dynamic, biological and open system with human or social involvement. Being primarily biological with a high degree of dependence on weather variables and changing socio-political environments, farming system was inherently more risky than other system.

Sain (1991), commented that study of farming systems is important not only from the view point of planners but from the view point of farmers also. The planners are mainly concerned with the framing of policies in the national interest while the farmers are interested in maximizing their profit. Sound resource base and unmatched development in technical breakthrough are obvious reasons behind the efficiency of any farming system.

Sharma *et al.* (1991) viewed farming system as a set of agro-economic activities that are inter-related and interact among themselves in a particular agrarian setting. They tried to identify farming systems followed in different agro-climatic zones of Himachal Pradesh. They indicated that vegetable-based and fruit-based farming systems are the harbinger of profitability and surplus in the agrarian economy. In each zone there is heavy interdependence of strong linkages among different systems of farming and common property resources. Hence, integrated planning for sustainable farming system development is essential.

Singh *et al.* (1991) conducted a study for developing most remunerative farming system in relation to the agro socio-economic conditions of western Haryana. The study revealed that mixed farming with three milch animals was always better than arable farming in all respects.

Ganapati (1993) in his study on economics of farming systems in Malnad region, observed that farming system in general tend to be location specific. It undergoes continuous changes because of dynamic nature of agriculture, changes in population density, other activities of man, education, goals, income level of the people, availability of credit, extent of intervention by Governments, forms of land tenure, etc.

The literature reviewed so far under this heading indicates nature and wide scope of farming systems in general. Farming systems are considered as bio-economic systems, where man is attempting to control his environment to maximize his income from farming. Farming systems have been developed as a result of intervention of human with natural environment and have now come to prevail as location specific systems.

2.2 Cost and Returns in Different Farming Systems

Setty *et al*. (1990) conducted an experiment on cropping system at Agricultural Research Station, Siruguppa during 1987-88 to find out suitable cropping sequences for Tungabhadra Project Area. Among the various sequences tried, maize-bengalgram yielded the highest net return (Rs. 6370/ha) followed by maize-wheat sequence (Rs. 3693/ha).

Timothy and Krishnamoorthy (1990) studied productivity variation and water use in farms of Madurantakam tankfed area of Chengalpattu district (Tamil Nadu) and concluded that there was a positive influence of farm area on the productivity, which was due to the presence of supplemental irrigation on farms of larger area; there was productivity variation due to farm size even under homogenous irrigation situations indicated existing potential for increasing productivity of marginal farms through community tanks. The cropping intensity was found as most determining factor in the farm income followed by labour and capital and study suggested that employment opportunities could be created in the area due to low levels of labour use credit facilities need to be provided to the farmers in the form of short term credit since capital has a scope to improve the productivity.

Rangaswamy *et al*. (1992) in a study to evolve an economically viable and sustainable farming system for small and marginal farmers in rice based wetlands of Coimbatore opined that the net profit worked out under integrated farming systems was 100

per cent higher than conventional cropping systems followed in these wetlands and the additional employment generated through integrated farming system over conventional cropping system was 48 per cent higher. They concluded that the farming system combining cropping. poultry, fishery and mushroom production enhanced the net income of the low land rice farmers.

Anonymous (1993) estimated the cost of production of irrigated groundnut in northern dry zone was Rs. 8496.11 per ha. Seed cost was a single largest component of expenditure for 26.13 per cent of the total cost (Rs.2219.93) followed by labour cost amounting to Rs. 1233 per ha. Expenditure on fertilizer was Rs. 103.34. The average yield obtained was 10.82 quintals. The gross and net returns realized was Rs. 669.44 per ha.

Jayaram *et al*. (1993) conducted a study on the feasibility and economics of integrated fish culture. Results revealed that the integrated fish culture system was found to be a profitable small-scale system. The total returns and returns less total cost were Rs. 20,848 and Rs. 5,290 respectively.

Prasad (1993) while studying the economics of groundnut production in different zones of Karnataka found that the cost of production was highest in the north eastern dry zone (Rs.3248.30 per ha) followed by northern dry zone (Rs.3165 per ha) and central dry zone (Rs.2848.28 per ha). He attributed higher seed cost accounted for a large proportion of the total cost.

Singh (1994) studied the economics of rice based cropping systems in eastern Uttar Pradesh involving mustard, chickpea, lentil and linseed under low input management conditions. The results indicated that rice mustard-mungbean sequence appeared to be the most remunerative cropping system with a net return of Rs. 2.78 per rupee invested, followed by rice-lentil system with a net return of Rs. 2.71 per rupee investment.

Koppad and Khan (1996) made a comparative economic analysis of two farming systems *viz*., maize-wheat and maize-sunflower on large farms in Malaprabha Command Area, Karnataka. A comparison of resource use pattern showed that human labour and bullock labour were higher in the maize-sunflower system, while use of fertilizer was higher in maize-wheat system.

Korikanthimath *et al*. (1996) conducted a study for three years on mixed cropping of *Arabica* coffee with cardamom verses sole cropping of arabica coffee. The study revealed that, the cost of cultivation was higher in mixed cropping than mono cropping. The highest net returns of Rs. 2,02,690 per hectare was realised in mixed cropping and due to a bumper crop of cardamom when averaged over three years, the returns of mixed cropping were 4.04 times greater than those of mono cropping.

Olekar (1996) studied the comparative profitability of sunflower based cropping sequences under rainfed condition in Bijapur district of Karnataka state. In case of small farmers the net profit was high in the groundnut-sunflower cropping sequence (Rs.15356.27 per ha) and least in sunflower fallow sequence (Rs.6684.59 per ha). In large farmers also the net returns were highest in groundnut-sunflower system. Similarly, for the overall category of farmers the net returns were highest in groundnut –sunflower sequence and least in sunflower-fallow sequence. Here the benefit Cost ratio was highest in the case of sunflower chickpea sequence (2:51).

Kerur *et al*. (1997) while studying the economics of sunflower production in north Karnataka viewed that per hectare cost of production of sunflower was Rs. 5,652.55, Rs. 5,693.11 and Rs. 5,587.77 for small, medium and large farmers respectively. The average yield obtained for the overall sample was 8.99 quintal per hectare. The benefit cost ratio was found to be 1.88 indicating sunflower production was a profitable enterprise.

Mohandas and Thomas (1997) studied the economics of rice production in Kuttonad area of Kerala. They reported that cost of cultivation of paddy for state was Rs.13108 for marginal farms (class I), Rs. 13309 for small farmers (class II) and Rs. 13858 for large farmers (class III). Rental value of own land recorded the highest expenditure in class I and II which accounted for 24.19 per cent (Rs.3171) and 22.38 per cent (Rs. 3112) respectively. The net returns and input output ratio was also found to be highest in case of marginal farms.

(Rs. 2748 and Rs. 1.21) followed by small farms (Rs. 2250 and 1.17) and large farms (Rs. 1529 and 1.11).

Kandasamy (1998) analyzed economics of Integrated Farming Systems at Pariyar in Tamil Nadu. He reported that among the different farming system practices, dairy-based system was found to be more profitable than others. The next best system was dairy cum poultry based mixed farming with a mean annual net income of Rs. 5,899 per ha with per day income of Rs.16.16. Poultry based mixed farming system observed net income of Rs. 2,287 with per day income of Rs. 6.27 over pure cropping system which recorded mean annual net income of Rs. 2,219 with per day income of Rs. 6.08. Farmers method of sole cropping could give the least mean annual net income of Rs. 1,902 and Rs. 5.21 of per day income.

Alagumani and Anjugam (2000) in their study on impact of dairy enterprises on income and employment in Madhurai district of Tamil Nadu found that, about 57 per cent of the farm households were engaged in dairy enterprises and 43 per cent of them were having both crop and livestock enterprise. Additional income and employment generated per household were Rs.4900 and 365 mandays, respectively.

Autkar *et al.* (2000) studied economic viability of draught animals in Maharashtra. It was found that employment of bullock labour during the year worked out to be 186 and 227 days for small and large farmers respectively. Overall cost per day including working and non-working days in a year worked out to be Rs. 22.66 and Rs. 23.27 respectively. The viable level of maintaining bullock pair was 179.11days

Regeena (2000) in her study on smallholder livestock production in the home gardens of south Kerala, noticed that small households invariably had a unit of one or two crossbreed milch animals. Further it was observed that, the average milk yield was 6.37 litres per day, which at the rate of Rs. 13 per litres fetched an annual income of Rs. 24,843 per annum. The activity was found to generate 141 man-days of gainful employment. The dairy enterprise also had complementary relation with the crop enterprise.

Ganesh (2000) made an evaluation of alternative farming systems *viz*., paddy cultivation, paddy cum prawn farming and mixed farming in Gazani lands of coastal Karnataka. The highest net profit realised was Rs. 2,52,495 and Rs. 2, 27,082 small and larger farms respectively.

Neelappa Shetty (2002) studied the technical and allocative efficiency of paddy production in TBP area. The per hectare cost of paddy cultivation was Rs.26,192, and Rs. 25,938 in Bellary and Raichur districts, respectively. The variable costs constituted the major portion (85 per cent) of the total cost of cultivation. The expenditure on human labour was found to be the major item of variable cost. The fixed cost per hectare was estimated to be Rs. 33,896 and Rs. 33, 746 respectively for Bellary and Raichur district farmers. Rental value of land formed the major component of fixed cost. The gross returns realized by the farmer in Bellary and Raichur district for per hectare paddy cultivation was Rs. 42,842 and Rs. 40,735.

Sandeep (2002) study on cropping systems in Bidar district of Karnataka revealed that under irrigated conditions the per hectare net profit was found highest in sugarcane cropping system in case of both small (Rs.52016.66) and large farms (Rs.42217.04) with a benefit cost ratio of 3.36 and 3.12 respectively. The ratio of MVP to MFC was greater than one for human labour, bullock labour, seeds, FYM and fertilizers indicating the scope for using additional quantity of these inputs to increase gross income.

Verma (2002) studied the economics of onion and found that the average cost of production per quintal of onion was worked out to Rs. 113.18 on cost C_3. The average family labour income and farm business income were calculated at Rs.45,318.28 and Rs. 46,459.66 per hectare respectively. The average input-output ratio at cost C_3 worked out to be 1:2.42.

Hyma Jyothi *et al*. (2003) undertook an investigation in small (1-2 buffaloes), medium (3-4 buffaloes) and large herd size (5 and above buffaloes) milk producers in west Godavari district of Andhra Pradesh to examine economics of buffalo milk production. Expenditure on fodder and concentrates formed the major share in the total cost of milk production in all the categories of milk producers. The average cost of buffalo milk production was Rs. 7.95 per litre for small herd size milk producer Rs. 7.92 per liter for medium herd size milk producer

and Rs. 7.86 for large herd size milk producer. However, net returns per litre of buffalo milk were found to be highest in small herd size milk producers followed by medium and large herd size milk producers.

Narasimham *et al*. (2003) in Pandichery studied the cost and returns of paddy in Yanam region of Union Territory. The study highlighted that the cost of production of paddy per hectare was found to be highest among all the size groups. The total costs were high on large farms in both crop I (*Kharif*) and crop II (*rabi*) with Rs. 18,094.26 and Rs. 19,071.29, respectively.

Study on different animal based farming systems in northern Karnataka (Wader, 2003) showed that sugarcane during *Kharif* and Bengal gram during *rabi* were found to be most profitable crops in Zone-I, while in Zone-II, chilly (*kharif*) and Bengal gram (*rabi*) were most remunerative. Similarly onion (*kharif*) and maize (*rabi*) turned out to be most profitable crops in Zone-III. Across the selected zones, milk production increased with the farm size and ranged from 4.5-5.0 litre per day per animal.

Singh (2004) during his study on economics of efficiency in vegetable business system reported that cost of cultivation for tomato, onion arvi, okra, brinjal and potato was estimated Rs. 12,599.00, Rs. 13,338.10, Rs. 9,742.10, Rs. 10,046.40, Rs. 11,274.60 and Rs. 13,480.20 per hectare respectively. Further, it also showed that about 95 per cent of the cost of cultivation of these vegetable consisted of human labour and working capital cost. The bullock labour cost for these vegetable ranged from 4 to 5 per cent. The per hectare net profit of vegetable growers for tomato, onion, arvi, okra, brinjal and potato were estimated to Rs. 31470.25, Rs. 2644.34, Rs.22015.90 and Rs. 31353.60, Rs. 29205.40 and Rs. 25328.25 respectively.

Chandel and malhotra (2006) studied livestock systems in poor endowment of India. Study revealed that seven major systems were prevalent in semi-arid region of country. Vast differences have been observed in existing averages and exploitable potential in milk productivity, a high milk productivity in buffalo based livestock system has been traced.

Ganesh Kumar and Rai (2006) studied economic status of poultry farming enterprises in Andaman and Nicobar islands. Study revealed that, at overall level out of total investment 45.18 per cent investment was on land while 51.06 per cent it was on building. Among the various cost involved for maintenance of broiler poultry farm, the total variable cost constituted 95.85 per cent (Rs.90682). The net return per bird was Rs. 14.13 at overall level and benefit cost ratio was ranging from 1.13 to 1.24 among different size groups.

Vichare (2007) studied different rice based cropping systems in north Konkan of Maharashtra. It was observed that, rice-vegetable cropping system gave maximum net returns (Rs. 31493 per ha.) followed by rice- pulses (Rs.9485 per ha.) and rice – rice (Rs. 9964 per ha.)

The literature reviewed so far under this heading indicated that inclusion of livestock, poultry or any other non crop farm enterprise combined with field crops have resulted into earning more income per rupee invested than only crop enterprise.

2.3 Analytical Techniques

2.3.1 Cluster Analysis

Sastry (1983) used cluster analysis in order to assess the effect of the changes on the crop regions over the period considering the area allocation to the 16 selected crops. He used B. coefficient (co efficient of belongingness) method. He reported that land use efficiency improved not only in quantitative but also in qualitative terms, as indicated by the increasing cropping intensity and changes in cropping pattern, particularly in favour of food crops. He also reported that the prevalence of current fallows appeared to be due to unfavourable weather conditions, whereas the existence of permanent fallow was partly due to pattern of holding and the reforms in legislation in the state conferring rights to the tenants.

Aldenderfer and Blashfield (1984) explained the various methodologies for cluster analysis. These methods included hierarchical agglomerative, hierarchical divisive, iterative portioning, density search, factor analytic, clumping, and graph theoretic. Among these methods hierarchical agglomerative, iterative portioning, and factor analytic, are popular in

social sciences. The cophenetic correlation and discriminent analysis were proposed for validation of clusters.

Eswarappa (1993) used the procedure of Tryon's modification of Holzinger and Harmon's B-coefficient to bring together the taluks having similar changes in the cropping pattern, while suggesting a model seed plan for annual crops for Shimoga district in Karnataka. The cluster brought together the taluka's based on their association among themselves with respect to cropping pattern. The result delineated three distinct clusters for the district.

Pattanshetti (1993) applied cluster analysis technique (B co-efficient methods) for the purpose of regionalization of Karnataka State Social Forest Project, for finding out the cluster of different districts of Karnataka, based on the data available on the achievement of different components of social forestry projects, namely, plantations in Gomal lands, in C and D class lands, tank foreshore, canal bank, bamboo plantations and farm forestry.

Nagabhushana (1994) studied the dynamics of land use in Dharwad district of Karnataka. In this study cluster analysis was carried out for three periods, that is 1971-72, 1981-82 and 1991-92. In the first period all the 17 taluks came together in the one cluster with B co-efficient of 1.18. In the second period these 17 taluks were grouped in three different clusters with B co-efficients of 3.44, 2.42 and 4.89 for the first, second and third clusters respectively. In the third period there was a realignment in the taluks to form same number of clusters.

Pawar (1996) employed B co-efficient method of cluster analysis for quantitative data of different characteristics of districts of Maharashtra. An inter-correlation matrix of 30 x 30 was developed to identify the districts of Maharashtra state favorable for the dairy development based on the set of twenty six characteristics relating to dairying. Thus, in all, 5 clusters were identified for the state. To classify the opinion of dairy owners and officials for various dairy development schemes the method of maximum similarity measures was used.

Veena (1996) carried out B co-efficient (co-efficient of belongingness) method considering the area allocation to major fruit and vegetable crops in different districts of the Karnataka state. The cluster analysis brought together the districts based on their association among themselves with respect to cropping pattern. During the first period (1975-1984) there were three clusters and during second period (1985-1994) four clusters were identified for the districts based on allocation of area for major fruits and vegetables crops.

Managoli (1997) in an appraisal of land use dimensions in Bijapur district used cluster analysis to group the taluks having similarities in area under different categories of land. He did it for two periods *viz.,* 1971-72 and 1991-92 in order to study the changes over the study period. The realignment among the taluks in two periods broadly implied that there was a shift in the land use pattern from one period to another across the taluks.

Naik (1998) used cluster analysis for classification of study area on the basis of agro climatic parameters. The hobli wise data were used for cluster analysis. The inter-correlation matrix of 35 x 35 (NXP) was developed to identify the hoblis with similar farming system. The B –coefficient method was used for cluster analysis. The study area was delineated into three clusters namely costal region, malnad region and the plains region.

Hiremath (2001) used cluster analysis to classify the districts of Karnataka state on the basis of 9 development indicators. Mahalnobis D^2 method was used as a distance measure and Tocher's method was used as a linkage form or a clustering method. All the districts of Karnataka were classified into 10 clusters. Agricultural development index were formed and districts were further divided into highly developed, moderately developed and low developed districts.

The literature reviewed so far under this heading indicates that cluster analysis is useful tool to classify the data in to different meaningful groups.

2.3.2 Production Function Analysis

Muralidharan (1987) studied the resource use efficiency in rice production in Kerala employing the Cobb-Douglas production function. The adjusted R^2 was 0.84 indicating that 84 per cent of the variation in yield of paddy was explained by the estimated production function.

The coefficient of land and human laobur were positive and significant at one per cent probability level.

Sharma and Singh (1993) in their study on resource use productivity and resource allocation efficiency used a Cobb-Douglas type of production function. The results of the study indicated that the feed concentrate was the most important input affecting milk production. The regression co-efficient of this input was positive and statistically significant in all the equations fitted, indicating that the farmers could increase their milk production by feeding more of concentrates to the animals. The regression coefficients of green fodder and dry fodder were also positive.

Vishweshwar (1994) employed Cobb-Douglas type of production function to measure the efficiency of inputs used in the production of cotton by IPM and non-IPM adopted farmers in Malaprabha command area in Karnataka. The study indicated that the ratio of MVP to MFC for land was greater than one. While it was less than one for labour and it was negative for seed, fertilizers and pesticides in conventional farmers. In case of IPM adopted farmers, the MVP to MFC ratio for land, labour seed and fertilizers were greater than one and it was negative for fertilizers.

Nagraj *et al.* (1996) in their study to evaluate the economics of maize-sunflower farming system at different size group of farmers of Tungabhadra command area, concluded that the variation in the gross returns explained by the variables included in the production function analysis was to the extent of 89.49 per cent and 99.03 per cent in maize and sunflower, respectively. The resource use efficiency indicated that land, manures and fertilizers together had maximum influence on gross returns of maize and in case of sunflower after maize, land was the single most factor that greatly influenced the gross returns.

Naik *et al*. (1998) while analyzing the resource use efficiency and productivity at various factors involved in onion production using Cobb-Douglas production function observed that land and farmyard manure were highly significant and positive.

Ganesh (2000) studied resource use efficiency for mixed farming systems in Gazani lands of Karnataka. Results of the study indicated that about 98 per cent of the total variation in gross income was explained by the variables included in the production function. The resources like fish, fingerlings, manure and labour had a significant effect on the gross returns.

Mythilli and Shanmugam (2000) studied technical efficiency of rice growers in Tamil Nadu by using stochastic frontier production function approach. Study was based on panel data. The model was estimated by the maximum likelihood method. The estimated mean technical efficiency was 82 per cent indicating that on an average, the sample farms in Tamil Nadu state tend to realize only 82 per cent of their technical abilities. It meant that approximately 18 per cent potential was not realized. However the technical efficiency was ranging from 46.5 to 96.7 per cent among the various farms.

Mahesh *et al*. (2002) made an attempt to measure the technical efficiency in tea industry on farmer owned as well as corporate farms in west Bengal. The maximum likelihood estimates were calculated and stochastic frontier production function was used to estimate the technical efficiency in production. The stochastic frontier Production function of the Cobb-Douglas type was specified for the study. It was observed that in farmers group mean technical efficiency was 68.72 per cent. Whereas in corporate units, mean technical efficiency was 84.68 per cent. The most efficient farms in farmers group were 11.67 per cent. In short run it is possible to increase the yield by 31.28 per cent in case of farmers and 15.32 per cent in case of corporate farms by using better management practices.

Sunanda and Narender.(2003) studied resource productivity of mesta farms in Srikakulam District of Andhra Pradesh. The cobb-douglas production function was used for study. The coefficient of multiple determination R^2 ranging from 0.86 to 0.95 in different farm size groups. The production elasticities indicated that one percent increase in human labour in small and medium farms would increase the grows output by 0.45 and 0.23 per cent, respectively. Similarly one per cent increase in cattle labour in small and medium farms would increase the gross output by 0.37 and 0.87 per cent, respectively. However negative sign to the co-efficient of input, seed indicated its excessive use it was also revealed study that ratio of MVP to opportunity cost in all farm were less than acquisition costs (1.00) indicating, seed,

manners, and fertilizers, human labour, cattle labour were used inefficiently in all size group of farms, This showed that there was scope for reorganization of resources to achieve higher profits.

Verma (2002) employed Cobb-Douglas production function for evaluating resource use efficiency in onion. The marginal value product of seed, manures and fertilizers, human labour and machine power were positive on small farms while it had negative value of bullock labour, plant protection and irrigation were negative. This implies that the small farms were under utilizing seed, manures and fertilizers, human labour and machine power while bullock labour, plant protection and irrigation were excessively used on the farms. In case of large farms, marginal value product of seed, manures and fertilizers, human labour, bullock labour and plant protection were positive while it had negative value of machine power and irrigation.

Singh (2004) fitted the Cob-Douglas production function to analyse the resource use efficiency in vegetable crops and it was found to explain nearly 87 per cent to 98 per cent of the variation in the dependent variable. The elasticity of production of rental value of land (X_1) was found to be more than one indicating increasing returns for tomato and onion. Remaining variables for okra, brinjal and potato vegetable crops were found less than one indicating decreasing returns to scale. The sum of regression coefficients of variables (Σbi) turned out to be less than one for onion, okra and potato vegetable crops and more for tomato and brinjal crops indicating gross value of these vegetable crops increased proportionally with an increase in the variable factors and vice-versa.

Rajashekharappa *et al.* (2004) made a critical study on technical efficiency in arecanut production. The data envelopment analysis programme DEAP- a non- parametric linear programming approach was used for estimating technical efficiency scores. The extent of overall economic efficiency has been expressed in terms of cost inefficiency. Allocative efficiency was calculated by using cost minimization data envelope analysis. Considering the behavioral objective of cost minimization or revenue maximization. Study revealed that mean efficiency has been found to vary widely from 69 to 90 per cent among the sample farms and across regions, which indicates that on an average, the realized output could be raised by 10 to 31 percent without any additional resources. The results also showed that through proper use of existing technology, there was a huge potential in improving productivity of arecanut which can be exploited.

Shanmugam and Venkataramani (2006) studied technical efficiency in agricultural production and its determinants. A district level data for different states for the year 1990-91 was used for the study. A stochastic frontier production function applied and maximum likelihood estimates were used to estimate the production function. Secondly determinants of technical efficiency were estimated by regressing various socio-economic variables against technical efficiency values obtained. The mean technical efficiency in the sample was found to be roughly 79 per cent, which means sample districts on an average, could increase their output by 21 per cent without additional resources through proper use of existing inputs and technology. Across the entire sample, technical efficiency ranges from a low value of 41.69 per cent (Jaisalmer in Rajasthan) to 92.67 per cent (kodagu in Karnataka). The most states viz; Madhya Pradesh, Rajasthan have the most districts centered below the mean technical efficiency value. The study has shown that health, education and infrastructure could be the powerful drivers of technical efficiency.

The literature reviewed so far under this heading indicated that, majority of researchers have used Cobb- Douglas production function to study the resource efficiency. Among the various inputs human labour, fertilizer were excessively used, where as plant protection, irrigation, were under utilized in most of the studies.

2.3.2 Linear Programming Analysis

Mathematical programming has been considered an efficient way of obtaining optimum production plans when numerous competing activities are associated with a large number of resources and restrictions of various kinds and magnitude. In India, budgeting techniques was used as a tool for farm planning in the beginning, while in recent years linear programming technique is being used for complex farm planning purposes.

Nanaja Reddy (1980) used linear programming technique to examine the income and employment potential of small farmers in Channapatna Block, Bangalore district. He found that the existing cropping pattern was oriented towards subsistence farming with a large proportion of the cropped area allotted under food crops. Relatively less capital intensive crops were accorded priority in land allocation over more capital intensive and profitable crops. The land use and resource allocation was found to be sub-optimal and there existed a scope for increasing profits through reallocation of resources.

Sirohi *et al*. (1980) used linear programming for a sample of 72 farm households in the Union Territory of Delhi and examined the possibilities of increasing income and employment through introduction of dairy and poultry into the existing crop farming system. On optimization with liberal credit facilities, the new enterprise system (crop + dairy + poultry) was found to increase employment besides augmenting the income on small and marginal farms.

Thorve and Galagalikar (1985) used linear programming to study the impact of dairy enterprise on the cost and returns in various farming situations of Akola district of Maharashtra. They concluded that mixed farming with dairy had a positive effect on the income of the farmers of all the size groups.

Singh and Saini (1988) employed linear programming to integrate improved technology of crop and milk production for increasing income and employment. They concluded that the optimization of resources under different farm plans resulted in increased income on all the categories (marginal, small, medium and large farms). Adoption of improved technology of crop and milk production increased the income of the farmers by 116 per cent (small) to 232 per cent (marginal) as compared to the existing plan.

Sankhayan and Cheema (1991) in an expository analysis using linear programming models for generating optimum farm plans, opined that it is indeed a very powerful technique which could efficiently handle a large number of linear constraints and variables (activities) simultaneously. They concluded that it was essential in all the models not to include the cost of those inputs in the working capital coefficients for which separate buying activities are provided in the model. It was optimal to use interest as a component of individual working capital coefficient provided the form of the model used was consistent with such a situation.

Goswamy and Meenakshisundaram (1992) revealed from their study conducted in West Garo hills district of Meghalaya, that by a mere reallocation of existing resources, farmers could increase their net income from Rs. 1,807 to Rs. 2,854 per hectare, an increase of 57.83 per cent. Further, by relaxing the capital constraint, the level of present income could be pushed further to Rs. 4,416, with an increase of 144.41 per cent.

Sastry (1993), in his study to determine the optimum farm plans for the farmers in Chittoor district of Andhra Pradesh used linear programming technique. A total of twenty-four optimum plans were developed for small and large farmers of Chittur, Tirupati and Madanapalli revenue divisions. Rational use of existing technology enabled to realize higher net farm incomes compared to the existing crop and livestock mix and adequate borrowing with recommended technology led to still higher net farm returns. Shadow prices of labour revealed that it was profitable for large farmers to hire male and female labours in both the seasons. The shadow prices of labour on small farms indicated surplus availability of labour. The judicious use of resources were indicated by optimum models for small and large farmers, besides increasing the net farm returns, also facilitated complete repayment of loans in *rabi* season itself.

Ramesh Kumar (1993) undertook a study for developing risk efficient farming system for the development of Eastern Dry Zone of Karnataka. He employed a deterministic linear programming technique to workout the optimal plans for land utilisation, farm returns and labour employment under existing and recommended levels of technology with limited and unlimited availability of capital. Parametric risk programming was used to obtain risk efficient plans. These plans were obtained for small and large farms of watershed area and non-watershed area separately. He concluded that a wide gap existed between the returns of existing and recommended practices. The judicious use of resources as indicated by optimum plans for small and large farms of both watershed area and non-watershed area, besides increasing the net farm returns would be helpful for fuller payment of loans.

Goswamy (1997) attempted to develop optimum farm plans for the Garo hill areas where shifting cultivation was practiced for augmenting the incomes of the hill farmers by eliminating shifting cultivation. He used linear programming model to maximise farm business income under the prevailing level of resources, with capital borrowing and simultaneous hiring of capital and human labour. He indicated the systematic farm planning was a paying proposition under the existing technology and with the existing resource base on the hill farms.

Kiresur et.al. (2004) used linear programming to study the optimum plans for sustainable farming systems in northern eastern dry zone in Karnataka. The sample farmers were post classified into various farming system viz., field crops + Dairy animals (FS I) and field crops + Dairy Animals + Draught Animals (FS II). In farming system II the area under sunflower during Kharif was increased by 77.27 per cent in model – I and 89.78 per cent in model – II. In Rabi season area under bengal gram increased from 0.1 ha to 0.96 ha (model – II) while area under sourghum declined by 87.65 per cent. The cropping intensity was increased from 159.12 per cent in existing plan to 189.78 per cent in optimum plan.In large farms the area of Kharif sunflower was increased by 56.51 per cent. It was concluded that FS-I was found to be more sustainable than FS-II.

Veerkar (2004) employed linear programming to formulate optimum plans. The optimum plans suggested that, in sole cropping of coconut plant population should be reduced by 18 per cent. In system III the optimal plan which accommodated 136 coconut palms along with 600 arecanut palm and 733 black pepper vines per hectare could generate about 24 per cent excess income and 33 per cent more employment

Srinivasa *et al.* (2005) studied optimum cropping pattern for sericulture dominant farms in southern dry zone of Karnataka. The deterministic linear programming technique was used for obtaining optimal combination for different enterprises followed by the sample farmers. The model also suggested maintaining of one crossbred caw and two buffaloes. The model suggested shifting of cropping pattern from subsistence dominated crop like ragi to commercial crop like bivoltine sericulture in Kolar area and cross bred sericulture in Mysore area.

Shalander Kumar et.al (2006) studied farming system in water scarce region of Uttar Pradesh. Optimum farming systems were formulated by incorporating linear programming technique. Integer values for livestock enterprise where as, non integer values for other enterprises were used. Wheat-mustard based and potato based farming systems were identified as a major farming systems. Among the optimum farm plans highest increase in farm income over existing farm situation was 60 per cent in small farms with goat units. It was concluded that increase in net returns due to optimum allocation of resources has been higher on small farms than large farms. The livestock rearing especially buffalo keeping has been highly profitable even under water scarce situation.

Mahendran *et al.* (2006) used Linear Programming techniques to evolve optimal cropping pattern in groundwater overexploited region of perambalur district of Tamil Nadu. Among the constraints imposed, land, capital and irrigation were major constraints The capital was declined from Rs. 62248 per ha Rs. to 61123 per ha. In optimal crop plan the use of majority of inputs were declined as compared to the existing situation indicating the proper use of input could reduce the cost, to obtain the same amount of income.

In view of above findings the profit maximization approach using linear programming technique has been adopted in these studies. The earlier researchers felt that since agriculture is a complex sector, its planning is most difficult, but not impossible. Economic factors like investment, output, prices, market environment and Government policies and programmes; institutional factors like land tenure, size of holdings, cooperation; personal factors like attitude, receptibility, caste, literacy and other factors like management and infrastructure play a vital role in any farming ventures. However, the constraints identified and opportunities proposed are location specific and may not be applicable to other areas. However, the techniques used are worth for developing suitable methodology for study area.

2.4 Constraints and Opportunities in Farming System Approach

Khanna (1983) observed that in northern region of India, general resource base of the farmers has been low. The low income prevented the farmers from investing in soil and plant protection. Due to overgrazing and reckless deforestation, soil erosion and landslides have emerged as a serious problem in hills. He further revealed that lack of cheap and adequate means of transportation and extremely small size of holdings which did not allow the full capacity use of resources. Non availability of even a pair of bullocks was also a main problem of farming in hills.

Thakur and Sharma (1985) have shown that the main bottleneck faced by the farmers in Himachal Pradesh was marketing, that was both for the purchase of inputs required by them and the sale of their output. The results of their study showed that the establishment of Himachal Pradesh Market Committee had some beneficial impacts, saving the farmers from the proverbial exploitations by the traders

Rangaswamy (1986) pointed out the constraints for dry land farming areas namely availability of quality seeds, fertilizers and pesticides. He revealed that the farmers were uncertain about the outcome of crops and farmers felt that they would loose less by investing less. He stressed the need for developing suitable strategies to stabilize the farm income in dry areas.

Abdul and Rao (1987) observed that the modern inputs like tractors, fertilizers and pesticides were distant fruits for the subsistence small farmers due to their social and economic backwardness. They pointed out that the green revolution had benefited mainly the landlords. They suggested that liberal credit facilities, subsidies on costly inputs and group efforts to own the costly farm implements jointly could improve the farming systems.

Chitinis and Bhikgaonkar (1987) investigated the major constraints that caused technological gaps in the process of adoption of dry farming technology. Four types of constraints were identified namely (i) technology, (ii) credit and economic service and (iii) supply and (iv) information transfer. They firmly advocated the adequate supply of inputs, timely advice and training through demonstrations.

Shah and Kute (1987) studied the infrastructural constraints of dry farming. They emphasized that the need for interaction and effective co-ordination among the technical, financial and administrative personnel for developing rainfed agriculture. Moreover, they opined that the adoption of complementary, land-based systems like animal husbandry agro-forestry, poultry *etc.*, would improve the socio-economic wellbeing of the poor farmers.

Naik (1998) while studying economics of farming systems in Uttara Kannada district identified the problems faced by the farmers in all the three agricultural regions of the district. He classified the problem broadly into, production, financial, marketing and extension problems. The major problems faced by the farmers in the production front were shortage of labour during peak season, timely non-availability of chemicals and fertilizers and non-availability of improved breeds of livestock. Exploitation by commission agents and traders were the major constraints under marketing while, lack of extension and training facilities was the main constraint among the infrastructural or extension constraints.

Vivekananda (1999) in his attempt to study the problems and prospects of agricultural development in Karnataka has opined that agricultural development in the state had been hindered by the problems such as, weak inputs research, weak extension network, regional imbalances, stagnation in area under HYV's *etc.*

Ganesh (2000) classified the problems faced by the farmers under four groups *viz.,* production, financial, infrastructural and marketing in Gazani lands of Karnataka. With respect to the production problems, majority of the farmers complained of non-availability of better variety seeds. Regarding financial problems, lack of funds for purchase of improved inputs, Extension problems included non-availability of package of practices. The important problem was absence of market regulation and information.

Vyas and Patel (2001) in a study on constraints faced by milk producers in adoption of dairy technology revealed that non availability of loan facilities for purchase of milch

animals and fodder, non availability of artificial insemination and milk marketing facilities, lack of knowledge of scientific animal feeding as well as preservation practices and no pasture land were the main constraints expressed.

Chandrashekar *et al*. (2001) listed production constraints faced by growers in order of importance. They were lack of technical guidance, more pest and disease, high cost of fertilizers, high cost of plant protection chemicals, non-availability of seed materials and non-availability of fertilizer in time.

Gavisiddappa *et al*. (2001) identified the problems in Gherkin production and trade in Haveri district of Karnataka. The sample farmers were unanimous and cent per cent in their opinion with respect to non-availability of seeds, unawareness potentiality of crop, lack of irrigation facilities, pest and diseases, lack of cheap labour, no market in India and no storage facilities of refrigerated rooms. Irregular payment made by the company (30%) and lack of research support regarding the crop (34%) were some other problems.

Rajkumar and Singh (2002) studied problems in vegetable production. The problems reported were poor quality seeds (42.2 per cent), insufficient availability of seed (40per cent), high cost of seed (31per cent) and non-availability of seed at appropriate time (12.2per cent), insufficient availability of irrigation water and lack of FYM.

Basavaraj and Kunnal (2002) identified the constraints in production, marketing and processing of soyabean in Belgaum district. It was observed that severe problem faced by growers is rust disease leading to heavy loss, high labour wages and, non availability of quality seeds. In marketing, farmers experienced problem of price fluctuation, low price for the produce, problem of transportation and delayed payment of sale when produce was sold out to co-operative society. The other problems were inadequate power supply and non-availability of labour at times faced by the processor.

Wadear (2003) pointed out the problems faced by the sample farmers in production of different crops in selected zones of northern Karnataka. He observed problems like non-availability of seeds in time, lack of storage facility, pest and disease incidence, price fluctuation were severe in many of the crop cultivation. In milk production problem on non-availability of credit, non-availability of pasture land, artificial insemination facility, improved breeds, lack of knowledge of scientific feeding, efficient marketing facility and cost of feed materials were severely confronted.

Ramesh (2003) studied the agricultural research prioritization for agro climatic Zones 1, 2 and 3 of northern Karnataka. He observed that among the socio-economic constraints, fluctuations in prices of output, non-availability of agro chemicals, non-availability of labour during peak season and unawareness of improved technology were the most severe constraints faced by the farmers in the study area.

Nagaraju and Gopal (2003) surveyed in West Godavari district of Andhra Pradesh to study constraints in adoption of improved dairy farming practices. There were serious constraints in adoption of improved dairy farming practices such as non-existence of milk cooperatives in the village, lack of sufficient knowledge in different areas of improved dairy farming practices, exploitation by middleman, distant location of artificial insemination centre or veterinary hospital and lack of good transportation facilities.

Hirala Jana and Verma (2004) conducted a study to know the constraints faced by the growers. He observed that high cost of chemicals, lack of technical guidance, shortage of labour when needed, high labour charge, non availability of paddy weeder and non availability of chemicals in local market.

Rajeshwari (2004) in her attempt to study the problems and prospects of coconut based farming systems in Tumkur district of Karnataka opined that major problems faced by the farmers were mite infestation in coconut gardens (100%), scarcity of family labour, lack of transportation and marketing facilities, fragmentation and division of land, scarcity of funds. The other problems were less reliable market and low yield due to local seeds.

The literature reviewed in this section explains that the constraints faced by the farmers are mainly concerned to infrastructural, unavailability of resources, less price for the produce *etc*.

3. METHODOLOGY

This chapter deals with the description of study area, data base, sampling procedure, analytical framework, models, and explanation of important concepts related to study. The chapter is subdivided in to following sections.

3.1 Profile of the Maharashtra State

3.2 Profile of Konkan region

3.3 Description of study area

3.4 Data base and sampling design

3.5 Analytical techniques employed and terms and concepts related to study

3.1 Profile of the Maharashtra State

Maharashtra is the third largest state (in area) in India after Rajasthan and Madhya Pradesh, situated in the north centre of Indian peninsula. It is bordered by the states of Madhya Pradesh to the north, Chhattisgarh to the east, Andhra Pradesh to the southeast, Karnataka to the south and Goa to the southwest. The state of Gujarat lies to the northwest, with the Union territory of Dadra and Nagar Haveli sandwiched between the borders. The Ar*abi*an Sea makes up Maharashtra's west coast. Maharashtra consists of two major relief divisions. The plateau is a part of the Deccan tableland and the Konkan coastal strip abutting on the Ar*abi*an Sea. The coastal strip, about 720 km long and not more than 80 km wide, is the Konkan region.

The geographical area of Maharashtra is about 307713 Sq. Km and population is about 9.68 crores with population density of 314 peoples per Sq. Km and sex ratio of 922 males per 1000 females. The literacy rate of the state is 76.90 per cent. The Maharashtra state has total road length of 208183 km and length of rail track is about 5440 km.

Maharashtra state falls between 15°37' to 22°00' North latitude and 72°30' to 80.30' East longitudes. At present, it is divided into 35 districts and 326 taluks administratively. There are 41251 inhabited villages and 2613 uninhabited villages. Like most of the other part of India, the climate of Maharashtra state is tropical monsoon type. Generally, there are three distinct seasons within a year viz. summer from March to May, rainy season from June to September with post monsoon rainfall in October and winter from December to February. The major crops grown in state are paddy, jawar, wheat, sugarcane, bajra, groundnut, mango, cashewnut, orange, Banana, Grape, etc.

The state of Maharashtra has the largest economy in the country. Its Gross Domestic Product (GSDP) at current prices stood at Rs.2, 71,406 crores in the year 2001-02. The State roughly accounted for 13 per cent of the national income. The per capita income of the people of the state is Rs.15, 484 which is third in the country. The economy of the state largely depends on agriculture and industries. The urbanization ratio of the state is 42.20 per cent.

3.2 Profile of the Konkan Region

Konkan is the coastal region of Maharashtra state. Konkan region is located on the West coast of India, having narrow strip running from north to south and situated between Sahyadri hills in the east and Ar*abi*an Sea in the west. At the western side the Konkan region has coastal length about 720 km. The annual rainfall is about 2000-4000 mm. The region has hot and humid climate. This region lies between $15^0$37' to $20^0$20' North latitude and $72^0$30' to $74^0$13' East latitude. The soil of the region is mainly of two types medium black in most of northern part while laterite soil in southern part. The major crops grown are paddy, mango, cashewnut, coconut, arecanut, banana, flower crops, finger millet, etc.

3.3 Description of the Study Area

The present study was undertaken in North Konkan region which lies at North-West part of the state and falls under very high rainfall with non lateratic soil Agroclimatic Zone (zone-II). The geographical area of North Konkan region is 17309 sq.kms. It comprises 3 districts namely Greater Mumbai, Thane and Raigad.

3.3.1 The Greater Mumbai district

Mumbai is island city which lies on the west coast of country at North west part of the Maharashtra state. It is separated from the rest of the districts by Ulhas river and creek of Thane and Vasai. To the North of Mumbai there is Thane district and to the South of Mumbai there is an Ar*abi*an Sea. The district has 80 km coastal length. As Greater Mumbai district is urban area, it was excluded from the study.

3.3.2 Thane district

Thane district is located between Sahyadri hills in the east and A*Rabi*an sea in the west. It lies between $18^0$42'to $20^0$20' North latitude and $72^0$30' to $73^0$48' east longitude. East-west spread is maximum at South which is about 100 km. North South length is approximately 140 km. The district has 112 km of coastal length. Thane district is bounded by Gujrat state in north, Nasik, Pune and Ahamadnagar districts at the east, Greater Mumbai district and A*Rabi*an sea in the West and Raigad district at the South.

3.3.3 Raigad district

Raigad district is located between 17°51' and 19°80' north latitude and 72°51' to 73°40' east longitude. Raigad district is surrounded by Sahyadri hills in the east and A*Rabi*an sea in the west. It has 240 km coastal length. Raigad district is bounded by Thane district at north, Pune and Satara district at east, Ratnagiri district at south and A*Rabi*an sea in west.

3.3.4 Soils

A) Thane district:

The major categories of soil in Thane district are as under :

1) Black soil containing sand (Vertisol)

This type of soil is present in Dahanu, Vasai and Palghar tahsils. These soils are fertile and suitable for paddy, vegetables, coconut and sapota cultivation.

2) Red soil (Latisol)

This type of soil found in eastern region mostly on slopes of Mokhada, Talasari and Javhar tahsils.

3) Brownish black soil.

This type of soil is mostly observed in patches lying between the coastal plain and hilly slopes of Bhivandi, Kalyan, Shahapur tahsils. It is suitable for vegetable cultivation.

B) Raigad District

The distribution of major soil types in the district is as follows :

a) coarse soil trap (35.00 per cent)

b) Laterite and Lateritic soils (30.00 per cent)

c) Coastal alluvial and coastal saline soils (35.00 per cent)

In Raigad district the sub soil stratum consist of "Deccan Trap" which is completely impervious to percolation, thereby causing an acute shortage of water in summer though it receives rainfall varying from 2000 to 3500 mm. in different parts. On the hill slopes, the soil is reddish which is used for grasses. The shell sands near the coast are suitable for plantation of coconut and arecanut. The reddish brown and coffee brown soils are excellent for paddy cultivation and are capable of producing a second crop.

3.3.5 Climate and Rainfall

Climatic conditions in the region are strongly influenced by its geographical conditions. It is distinctly different on the coastal strip, where it is very humid and warm. On the other hand, the climate on the eastern slopes and plains, at foot of slopes is comparatively less humid. The humidity of the region ranges from 55 to 90 per cent throughout the year. On an average, temperature ranges from 16.2 to 34 degree celcius.

Rainfall is most dominant single weather parameter that influences plant growth and crop production because of uncertainty and variable nature. The region gets assured rainfall of 2000 to 3500 mm. from south-west monsoon during the months from June to September.

3.3.6 Land Use Pattern

The land use pattern of North Konkan region is presented in Table 3.1. The total geographical area of North Konkan region is 16,21,000 ha. Out of which 35.53 per cent area is net cultivated area, followed by forest (29.55 per cent). Due to less irrigation facilities, the area sown more than once and area under irrigation is meagre. The forest area is more in Thane district as compared to Raigad district, in case of other categories of land, both the district have similar trend.

3.3.7 Cropping Pattern

The cropping pattern followed in North Konkan region is presented in Table 3.2. In North Konkan region, out of total gross cropped area, area under cereals was 54.56 per cent, while area under pulses was 4.56 per cent.

Paddy was observed to be the main crop grown in study area with 45.98 per cent area out of total gross cropped area. However, percentage area under paddy was more in Raigad district than in Thane district. In North Konkan region out of gross cropped area, area under food grains was 59.12 per cent. The similar figures for Thane and Raigad districts were 50.50 per cent and 73.94 per cent, respectively.

3.3.8 Livestock Population

The information on livestock population in North Konkan region is presented in table 3.3. The total number of crossbred and local cows in North Konkan were 7,749 and 2,98,771, respectively indicating less adoption of cross bred animals. It was observed from table that, the livestock population is more in Thane district as compared to Raigad district. The total number of buffalo in North Konkan region was 208936. Out of which 140363 (67.18 per cent) were in Thane district and 68,573 (32.82 per cent) were in Raigad district.

3.4 Database and Sampling Design

Data required for the present study were obtained both from primary and secondary sources. Primary data was collected from farmers by direct interview method with well structured, pre tested schedule prepared exclusively for this study. Multistage sampling method was used to select sample households. The district level data was obtained from District Socio Economic Review and District Statistical Abstract for Raigad and Thane districts and also from Office of Joint Directors of Agriculture, Thane and Raigad.

3.4.1 Selection of District

Thane and Raigad district were selected purposively for the present study. These two districts cover almost all area under agroclimatic Zone 2 namely non lateratic soil with high rainfall area. The Greater Mumbai district was purposively excluded from study as it is a urban area and contains very less agricultural land.

3.4.2 Selection of tahsils

The data regarding area under different crops such as cereals, pulses, plantation crops, forest, rainfall, livestock animals poultry birds etc., were collected for all 30 tahsils of both the districts. Based on these parameters the tahsils were subjected to cluster analysis. The technique and procedure of cluster analysis is described later in this chapter.

The cluster no. 5 consisting tahsils namely Thane, Ulhasnagar, Ambarnath and Kalyan was not considered for study because in these tahsils, the development of agriculture was less, as they were industrially dominated and most part of these tahsils come under urban area. Out of total gross cropped area in study area, the contribution of this cluster was only 6.17 per cent. Whereas, out of total gross cropped area in Thane district this cluster had a share of less than 10 per cent (9.76 %). All the 26 tahsils from remaining four clusters were considered for study.

Table 3.1 Land use pattern

(Area '000' ha)

Sr. No.	Category of land	Thane District	Raigad District	North Konkan region
1.	Total Geographical Area	934 (100.00)	687 (100.00)	1621 (100.00)
2.	Forest	330 (35.33)	149 (21.69)	479 (29.55)
3.	Barren and uncultivable land	39 (4.18)	104 (15.14)	143 (8.82)
4.	Land under non agricultural use	89 (9.53)	52 (7.57)	141 (8.70)
5.	Cultivable waste, pasture, grazing, and miscellaneous trees and grooves	89 (9.53)	125 (18.20)	214 (13.20)
6.	Current fallow	52 (5.57)	28 (4.08)	80 (4.94)
7.	Other fallow	98 (10.49)	24 (3.49)	122 (7.53)
8.	Net sown area	371 (39.72)	205 (29.84)	576 (35.53)
9.	Area sown more than once	36 (3.85)	31 (4.51)	67 (4.13)
10.	Gross cropped area	407 (43.58)	236 (34.35)	643 (39.67)
11.	Area under irrigation	21 (2.25)	14 (2.04)	35 (2.16)

(Figures in the parentheses are percentages of geographical cropped area)

Table 3.2 Cropping pattern

(Area 00 ha.)

Sr. No.	Cropping pattern	Thane District	Raigad District	North Konkan region
1	Cereals			
	a) paddy	1540 (37.87)	1417 (59.94)	2957 (45.98)
	b) Other cereals	352 (8.66)	200 (8.46)	552 (8.58)
	Total cereals	1892 (46.52)	1617 (68.40)	3509 (54.56)
2	Pulses			
	a) Urid	51 (1.25)	10 (0.42)	61 (0.95)
	b) Gram	39 (0.96)	24 (1.02)	63 (0.98)
	c) Tur	34 (0.84)	12 (0.51)	46 (0.72)
	d) Wal	26 (0.64)	66 (2.79)	92 (1.43)
	e) Other pulses	12 (0.30)	19 (0.80)	31 (0.48)
	Total pulses	162 (3.98)	131 (5.54)	293 (4.56)
3	Total food grains	2054 (50.50)	1748 (73.94)	3802 (59.12)
4	Spices, condiments	7 (0.17)	10 (0.42)	17 (0.26)
5	Fruit, Vegetables	356 (8.75)	206 (8.71)	562 (8.74)
6	Total Oilseeds	49 (1.20)	34 (1.44)	83 (1.29)
7	Total Food crops	2466 (60.63)	1998 84.52)	4464 (69.41)
10	Grasses and other miscellaneous	1825 (44.87)	367 (15.52)	2192 (34.08)
11	Total non food crops	1828 (44.95)	367 (15.52)	2195 (34.13)
12	Net cropped area	3714 (91.32)	2051 (86.76)	5765 (89.64)
13	Area sown more than once	353 (8.68)	313 (13.24)	666 (10.36)
14	Gross cropped area	4067 (100.0)	2364 (100.00)	6431 (100.00)

(Figures in the parentheses are percentages to gross geographical area)

Table 3.3 Livestock population

Sr. No.	Particulars	Thane District	Raigad District	North Konkan region
1.	Cow (crossbred)	4137 (53.39)	3612 (46.61)	7749 (100.00)
2.	Bullock (crossbred)	1512 (49.92)	1517 (50.08)	3029 (100.00)
3.	Bullock (local)	255964 (59.49)	174294 (40.51)	430258 (100.00)
4.	Cow (local)	158802 (53.15)	139969 (46.85)	298771 (100.00)
5.	He Buffalo	31936 (54.42)	26748 (45.58)	58684 (100.00)
6.	Buffalo	140363 (67.18)	68573 (32.82)	208936 (100.00)
7.	Goat	257375 (61.73)	159556 (38.27)	416931 (100.00)
8.	Sheep	1084 (61.63)	657 (38.37)	1759 (100.00)
9.	Poultry Birds	1955321 (53.78)	1680401 (46.22)	3635722 (100.00)

(Figures in the parentheses are percentages to total for North Konkan region)

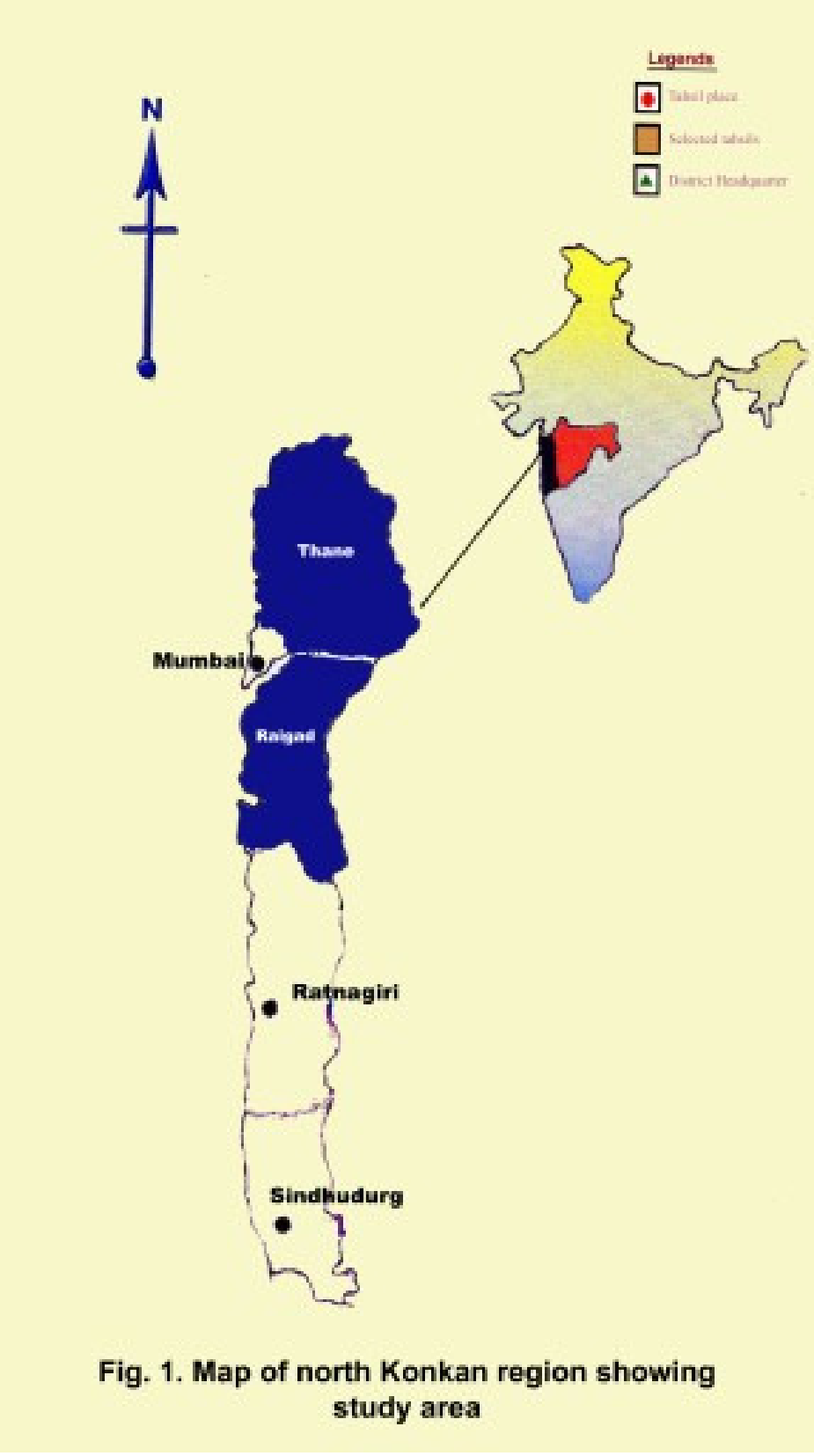


Fig. 1. Map of north Konkan region showing study area

Table 3.4. Distribution of group wise sample households from different clusters

Cluster No.	Tahsil	Proportionate weighatage of the tahsil (%)	Small	Medium	Large	Total
1.	Talasari	13.52	4	4	4	12
	Palghar	29.85	9	9	9	27
	Dahanu	31.69	10	10	10	30
	Vasai	24.93	7	7	7	21
	Total	100.00	30	30	30	90
2.	Vikramgadh	9.71	3	3	3	9
	Javhar	19.83	6	6	6	18
	Mokhada	9.67	3	3	3	9
	Wada	13.49	4	4	4	12
	Bhivandi	10.22	3	3	3	9
	Shahapur	22.92	7	7	7	21
	Murbad	14.18	4	4	4	12
	Total	100.00	30	30	30	90
3.	Poladpur	8.00	2	2	2	6
	Panvel	11.13	3	3	3	9
	Karjat	8.96	3	3	3	9
	Khalapur	7.18	2	2	2	6
	Pen	7.30	2	2	2	6
	Mahad	20.56	6	6	6	18
	Roha	9.47	3	3	3	9
	Sudhagadh	6.17	2	2	2	6
	Mangaon	15.10	5	5	5	15
	Tala	6.18	2	2	2	6
	Total	100.00	30	30	30	90
4.	Alibag	33.33	10	10	10	30
	Murud	17.55	6	6	6	18
	Shrivardhan	30.31	9	9	9	27
	Mhasala	16.28	5	5	5	15
	Uran	2.51	0	0	0	0
	Total	100.00	30	30	30	90
	Grand Total	--	120	120	120	360

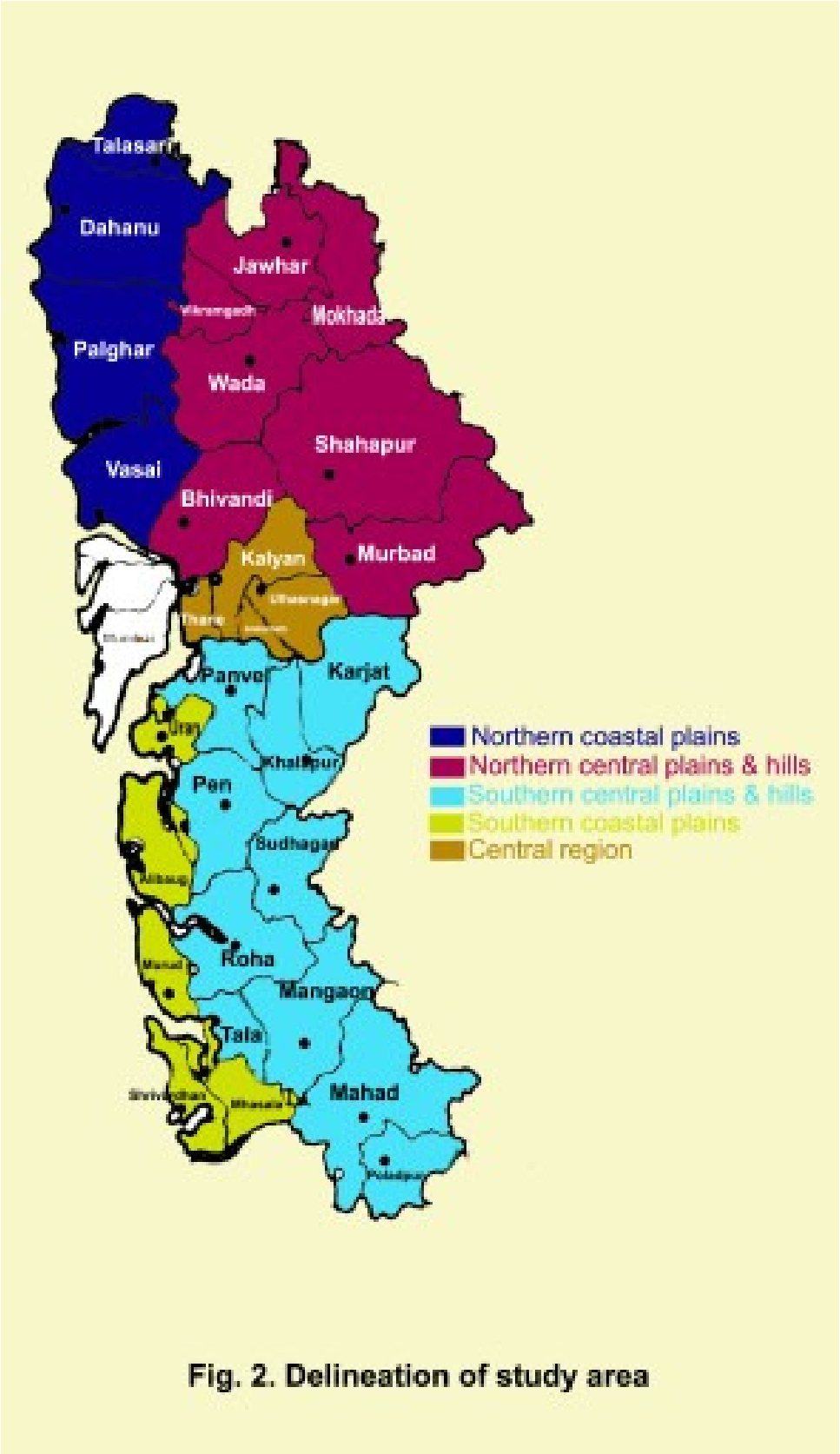


Fig. 2. Delineation of study area

Fig. 2. Delineation of study area

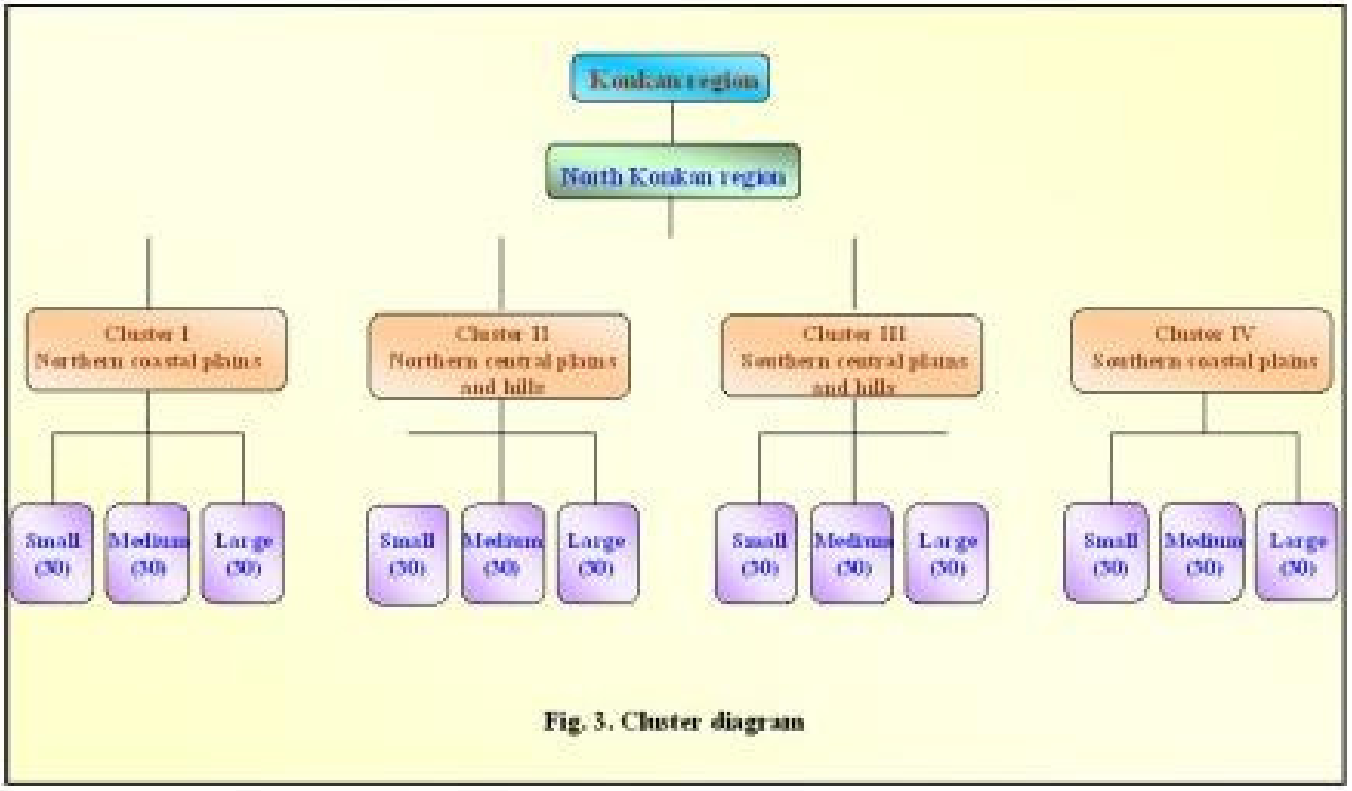


Fig. 3. Cluster diagram

Fig. 3. Cluster diagram

Table 3.5. Distribution of Tahsilwise villages and sample households selected for study

Cluster I			Cluster II			Cluster III			Cluster IV		
Tahsil	Village	Holdings	Tahsil	Village	Holdings	Tahsil	Village	Holdings	Tahsil	Village	Holdings
Talasari	Borigaon	12	Alibag	Revdanda	10	Javhar	Kharamba	9	Poladpur	Charai	6
Palghar	Mahim	9		Choul	10		Kapricha-pada	9	Panvel	Bhokar-pada	9
	Manor	9		Talawade	10	Mokhada	Ghosale	9	Karjat	Vadap	9
	Kelve	9	Murud	Nandgaon	9	Vikram gadh	Dadade	9	Khalapur	Tembri	6
Dahanu	Narpad	10		Khar- amboli	9	Wada	Ainshet	12	Pen	Jite	6
	Gholwad	10	Shrivar dhan	Aravi	9	Bhivandi	Kudus	9	Mahad	Ladawali	9
	Sarani	10		Velas	9	Shahapur	Shendurna	10		Kambale-tarf	9
Vasai	Aghashi	10		Dive agar	9		Thile	11	Roha	Khamb	9
	Arnala	11	Mhasala	Pabre	10	Murbad	Kanhole	12	Sudha gadh	Tiware	6
				Kelte	5				Mangaon	Kurawade	10
										Vadghar	5
									Tala	Vave	6
Total		90			90			90			90

3.4.3 Selection of villages and sample farm holdings

Multistage random sampling procedure was followed for selection of sample villages and farm holdings. All the four clusters were considered as independent group of tahsils. From each cluster 90 sample farm holdings were selected consisting of 30 small farmers (up to 2 ha) 30 medium farmers (2 to 4 ha) and 30 large farmers. (above 4 ha) The total number of sample farm holdings per tahsil were decided on the basis of contribution of a particular tahsil in a respective cluster based on area under different crops, number of of cattles, poultry birds etc.

The proportionate sampling was followed to decide the share of total number of sample households for a particular tahsil in a cluster. From the list of villages in tahsil, the villages were selected randomly. An attempt was made to select around 10 farmers from each village and to distribute the sample households per village equally in the tahsil. However, in a tahsil which is having a share of 12 sample farmers only one village was selected, while in the case of tahsils having 15 sample households two villages were selected, with 10 farmers for first village. Thus, total 360 sample farmers were selected from all clusters, comprising 90 farmers for each cluster. The information on clusters with tahsils, proportionate sample size for each tahsil on the basis of weightage in a cluster is presented in Table 3.4. The information regarding villages and no. farm holdings per village is presented in Table 3.5.

3.5 Analytical Techniques Employed and Economic Concepts and Local Terms Used in Study

3.5.1 Cost and Returns in Field Crop Enterprise

The total costs were divided into two broad classes.

1. Variable or operational costs
2. Fixed costs

Variable costs include costs incurred on seed, manures and fertilizers, plant protection chemicals, labour charges and miscellaneous charges.

Fixed costs include land revenue, depreciation on farm implements and interest on fixed capital investment.

The method adopted for computing the different cost items are described below.

3.5.1.1 Variable Costs

a. Seed: Farm-produced seed has been valued at the prices prevalent at the time of sowing and purchased seeds have been considered at actual rates paid by the sample farmers.

b. Farm yard manure and vermicompost: Farm yard manure was valued at the price prevailing in village. Thus, quantity of farm yard manure, vermicompost, purchased by farmer was valued at actual price paid by sample farmer.

c. Labour: The hired male and female labour was charged at the prevailing wage rates paid per day (eight hours) in the study area. The bullock labour was charged as per hiring rates prevailed in village. For family labour the wages were imputed at the same rates as those paid to hired human labour.

d. Fertilizer and plant protection chemicals: The cost of fertilizers and plant protection chemicals were considered on par with the amounts actually paid by the sample farmers.

e. Miscellaneous costs: Miscellaneous costs include repair charges, cost of *Rabi*ng operation in paddy, paddy husk/straw, (tus) and in the case of poultry, cost of vermicompost, etc. as per rates actually paid by the sample farmers.

3.5.1.2. Fixed Costs

a. Land revenue: Land revenue was calculated at the rates levied by the Government.

b. Rental Value of Land: Rental value of land was calculated as $1/6^{th}$ of the gross value of produce.

c. Depreciation charges: Depreciation on machinery and equipments, farm buildings and sheds was calculated by using straight-line method, and charged to specific crops for which the article was used. In case of articles used for more no of crops, the cost was apportioned on the basis of area.

$$\text{Depreciation} = \frac{\text{Purchase price} - \text{Junk value}}{\text{Expected life of the asset}}$$

d. Interest on fixed capital: Interest on fixed capital was calculated at the rate of 10 per cent on the book value of the machinery, equipments and buildings.

e. Interest on variable costs: Interest on variable cost was calculated at the rate of 12 per cent. The cost was charged for a crop as interest on working capital for a period of crop cultivation.

f. Cropping Intensity

The cropping intensity was calculated by using a following formula (Reddy and Reddy, 2002).

$$\frac{\text{Gross cropped area}}{\text{Net area}} \times 100$$

Gross cropped area – Area under various crops in a year for different seasons

Net area – Area available for cultivation

To eliminate the drawback of cropping intensity calculation in long duration crops, time element was considered. Weight assigned for gross cropped area such as 1, 2 and 3. Area under which crop was grown for only one season one weight was assigned, weight 2 was assigned for area where crop was grown for 2 seasons and in case of perennial crops weight assigned was 3.

g. Amortization

The cost incurred in establishment period of perennial crops was amortized by using following formula and included in fixed cost component as amortized cost.

$$A = \frac{P \times i\,(1 + i)^n}{(1 + i)^n - 1}$$

Where,

A = Amortized cost (Rs./ha)

P = Investment made for establishment of orchard (Rs./ha)

i = Rate of interest (12 % p.a)

n = Economic life of the orchard

3.5.1.4 Returns

The gross returns were calculated by taking the actual output prices obtained by the farmer in the market or at prevailing rates in the village. The same was used for imputing the value of the produce retained for home consumption. Gross returns include values of both the main product and by-product. Net returns were calculated by deducting the total cost of cultivation from gross returns.

3.5.2 Cost and Returns in Other Farm Enterprises

The other farm enterprises included the non crop farm enterprises such as, Poultry, Dairy, Goat keeping etc.

3.5.2.1 Costs

The cost includes fixed cost and variable cost. Fixed cost includes depreciation charges on building, machinery, equipment and other permanent fixtures. In the case of dairy animals, draught animals and goat and the purchase value of animals was also included in fixed cost component as imputed value of animal. The present market value was considered for value of animal born on the farm. Each one of these items was divided by the average expected life of them to arrive at annuities. Variable costs include cost of feed, dry fodder, green fodder, veterinary charges, poultry feed, chicks, husk/straw used (tus) for poultry.

3.5.2.2 Returns

The value received by farmers for farm produced milk, eggs, birds, hiring charges from draught animal, were used to calculate gross returns accordingly. The valuation of by-products, manure in the case of dairy, poultry, goat keeping were added to the total returns. In dairy enterprise, local cows, cross breed cows and buffaloes were clubbed on the basis of their present value, to work out per animal costs and returns for the whole herd of the household.

3.5.2.3 Local Names and Terms Used in Study

a. Rabbing: It is a pre-tillage operation followed by the farmers in paddy cultivation. In this operation the twigs, leaves, cowdung, paddy straw *etc.* are spread over nursery bed and it is burnt. This practice is generally done in the month of April or May in morning or evening hours.

Local names

Nagli – Fingermillet

Vari – Proso millet

Wal – Long yard bean (*Lablab purpureus*)

Mogra – Jasmine (*Jaminum sambac*)

Velvet – Cock's comb

Kagda – *Jasminum multiforum*

Terada – Balsam

Jai – *Jasminum grandiflorum* (Bhujbal,2000)

Sayali – *Jasminum phelophilum*

3.5.3 Analytical Techniques

3.5.3.1 Tabular Analysis

This provides the simplest and most intelligible tool to analyze the existing level of farming. This technique was employed to analyze the demographic features, land use pattern, cropping pattern, input use pattern, livestock production, cost of production, gross returns and net returns from different farm products. The data were analyzed using averages, percentages and ratios. The cropping intensity was worked out to examine the extent of multiple cropping.

3.5.3.2 Cluster Analysis

Cluster analysis is a multivariate statistical procedure that starts with data set containing information about a sample of entities and attempts to reorganize these entities into relatively homogeneous groups or groups of highly similar entities, called as “clusters”. Among the different methods of cluster analysis, Hierarchical agglomerative method was used in present study. A SPSS statistical software (statistical package for social sciences) was used to carry out the analysis. The data for the different variables used for each tahsil was standardized between range of 0 to 1. In hierarchical agglomerative method the analysis was made in two steps, firstly the proximity matrix was formed, and then the clustering was done. A proximity or similarity matrix indicate the association between cases at initial stage. The Pearson’s correlation coefficient was used to form a proximity matrix. The complete linkage method was used for cluster making. In complete linkage method, the cases included in cluster must be within a certain level of similarly to all members of that cluster (Sokal and Michener, 1958). Complete linkage method has tendency to find relatively compact, hyperspherical clusters, composed of highly similar cases.

3.5.3.3 Discriminant Analysis

A correctness or validation of clusters formed was assessed by a discriminant analysis. The cluster membership of cases was used as a grouping variable. The analysis was carried out by using SPSS statistical software.

3.5.3.4 Production Function Analysis

Production function technique was used to examine the effect of different factors namely farmyard manure (FYM), seed, nitrogen (N), phosphorous (P), potash (K), plant protection chemicals (PPC), human labour, bullock labour on crop production. Cobb-Douglas type of production function of the following form was fitted to the data.

3.5.3.4.1 Crops Enterprises

$Y1 = a \cdot x_1^{b1} \cdot x_2^{b2} \cdot x_3^{b3} \cdot x_4^{b4} \cdot x_5^{b5} \ldots\ldots\ldots x_n^{bn} \cdot U$

Y1 = Yield (q/ha)

x_1 = Farm yard manure (q/ha)

x_2 = Seed (kg/ha)

x_3 = Nitrogen (kg/ha)

x_4 = Phosphorous (kg/ha)

x_5 = Potash (kg/ha)

x_6 = Plant protection chemicals (kg/ha)

x_7 = Human labour (male day/ha)

x_8 = Bullock labour (pair days/ha)

x_9 = Organic fertilizers (kg/ha)

u_i = Random error term

a = Intercept

$b_1, b_2, b_3 \ldots\ldots. b_n$ = Regression coefficient or production elasticities.

3.5.3.4.2 Dairy Enterprise

Production function technique was used to examine the effect of different factors namely dry fodder, green fodder, concentrates, human labour, veterinary expenditure, etc. on income. Cobb-douglas type of production function of the following form was fitted to the data.

$Y2 = a \cdot x_1^{b1} \cdot x_2^{b2} \cdot x_3^{b3} \cdot x_4^{b4} \cdot x_5^{b5} \ldots\ldots\ldots x_n^{bn} \cdot U$

Where,

Y2 = Total income (Rs/animal)

x_1 = Green fodder (Rs/animal)

x_2 = Dry fodder (Rs/animal)

x_3 = Concentrates (Rs/animal)

x_4 = Veterinary expenditure (Rs/animal)

x_5 = Human labour (Rs/animal)

a = Intercept

b_1, b_2, b_3 ……. b_n = Regression coefficients or production elasticities

3.5.3.4.3 Poultry Enterprise

Production function technique was used to examine the effect of different factors namely feed, chicks, paddy husk (tus), human labour etc. on income. Cobb-douglas type of production function of the following form was fitted to the data.

$$Y3 = a \cdot x_1^{b1} \cdot x_2^{b2} \cdot x_3^{b3} \cdot x_4^{b4} \ldots\ldots\ldots\ldots x_n^{bn} \cdot U$$

Where,

Y3 = Income (Rs/unit)

x_1 = Feed (Rs/unit)

x_2 = Chicks (Rs/unit)

x_3 = Paddy husk (Rs/unit)

x_4 = Human labour (Rs/unit)

b_1, b_2, b_3 …… b_n = Regression coefficient or production elasticities

a = Intercept

3.5.3.4.4 Goat Enterprise

Production function technique was used to examine the effect of different factors namely, green fodder, concentrates, veterinary expenditure, human labour etc. on income. Cobb-douglas type of production function of the following form was fitted to the data.

$$Y4 = a \cdot x_1^{b1} \cdot x_2^{b2} \cdot x_3^{b3} \cdot x_4^{b4} \cdot x_5^{b5} \ldots\ldots\ldots\ldots x_n^{bn}$$

Where,

Y4 = Income (Rs./animal)

x_1 = Green fodder (Rs./animal)

x_2 = Concentrates (Rs./animal)

x_3 = Veterinary expenses (Rs./animal)

x_4 = Human labour (Rs./animal)

a = Intercept

b_1, b_2, b_3 …… b_n = Regression coefficient or production elasticities

These forms of the Cobb-douglas type of production functions were used in general for assessing resource use efficiency of crops as well as other enterprises followed in major farming systems. However, only those inputs were used for particular enterprise were retained in particular function. Inputs which were not used by majority of farmers in particular enterprise were removed from the production function model fitted to the data. The multicollinearity was tested by using Klein's test.

3.5.3.4.5 Significance of R^2 and Parameters of Estimates

Significance of R^2 was tested by F test (Koutsoyiannis, 2001) and student's (t) test was used for computing significance of parameters of estimates.

3.5.3.5 Linear Programming Formulation

The deterministic linear programming technique was employed to workout the maximum attainable returns by the optimum allocation of various available resources. Optimum allocation of resources was defined as one, which gives physical, technical and resource conditions, showed what activities to be undertaken and how much of each resource to be allocated to each activity so that the net farm returns are maximized in a year. Linear programming technique was chosen because among the various analytical tools available for allocation of available limited farm resources among alternative enterprises, it was the most powerful and efficient tool of analysis. The traditional tool of budgeting becomes less efficient when the number of constraints and real variables are large and unique solutions are desired.

3.5.3.5.1 Selection Process of Activities

On the basis of primary data collected it was observed that, the sample farmers were found to follow crop, dairy, poultry, goat rearing and draught animals enterprises. The crop activities undertaken by them were in following order.

In *Kharif* season, farmers were found to have grown cereal crops namely, paddy, nagli, prosomillet, the pulse crops such as black gram, cowpea, flowers crop such as Sayali and oil seeds like seasame. In *Rabi* season vegetable crops namely bottle gourd, smooth gourd, tomato, arum, ginger, brinjal, lady's finger, chilli, were grown. The flower crop namely cock's comb or velvet was grown in *Rabi* season. In summer season paddy was mainly observed to be grown in (cluster – III) Southern central plains and hills region. The perennial crops included horticultural plantation crops namely mango, cashewnut, arecanut, coconut etc. Flower crops found to be grown were Jasmine, Hibiscus, Heliconia, Yellow champak and cash crop such as betalwine observed to be cultivated in coastal plains and hills (north) region.

3.5.4.1 Mathematical Formulation of the Model

In linear programming analysis, a linear function of a number of variables to be maximized subject to a number of constraints in the form of linear equalities and inequalities was adopted. In mathematical form, one-year (two seasons) linear programming model can be expressed in the following way:

Maximize:

$$Z = \sum_{j=1}^{n} C_j X_j \quad \text{(objective function)}$$

Subject to:

1. $\sum_{j=1}^{n} a_{ij} X_j \geq b_i \qquad (i = 1 \ldots\ldots\ldots\ldots\ldots k)$

2. $\sum_{j=1}^{n} a_{ij} X_j \leq b_i \qquad (i = k+1\ldots\ldots\ldots\ldots m)$

3. $\sum_{j=1}^{n} a_{ij} X_j = b_i \qquad (i = m+1 \ldots\ldots\ldots\ldots n)$

4. $\sum_{j=1}^{n} X_j \geq 0$

Where,

Z = Net returns from all crop activities included in the model

c_j = Net returns from j^{th} activity, measured in rupees per unit of j^{th} activity

X_j = Level of j^{th} activity

a_{ij} = The quantity of i^{th} resource/input required per unit of j^{th} activity

b_i = Total availability of i^{th} resource on the farm.

3.5.4.2 Activities Used in the Model

The activities (X_js) used in the model can be classified as real, disposal and fixed activities.

The real activities also known as production activities constituted the principal alternatives of farming system and individual crop-livestock rotation being followed in a particular zone was considered as an activity. Thus different crop/livestock/ poultry/goat rotations followed by different size groups of farmers of each zone constituted the activities of the model. In case of cattles, drought animals and dairy animals was regarded as separate activity.

The disposal activities were the derived activities to take care of the inequalities of the model. These were needed to convert the inequalities into equalities for the solution of the problem. However, these activities were automatically generated by the computer under QSB Programming Model. The details of the activities for different regions for all major Farming Systems are given in Table-3.6.

3.5.4.3 Resource Levels and Constraints

One of the most important components of the LP model is the identification of resource limitations (b_j) on different sizes of farms in each Farming System.

Land Constraint

The total land owned by the farmer was taken as operational holding of the farmer as none of the farmers leased in any land. Whole land was classified as *Kharif* land and *Rabi* and area under crops grown in summer season.

Labour Constraints

Both human and bullock labour availability were estimated from number of days human labour (both hired and own labour) worked and bullock labour employed on his farm in each production phase i.e., *Kharif, Rabi* and summer. Women labour were converted in to male equivalents by taking 0.70 times and included in the model. The conversion factor of 0.70 was taken based on the ratio of wage paid to the men labour verses women labour.

The restrictions with regard to both human and bullock labour were imposed for all the three seasons, i.e., *Kharif, Rabi* and summer in the Model-I. Hired human labour and bullock labour were relaxed to estimate Model-II.

Capital Constraints

It is a well known fact that capital is the major constraint in Indian farming. Capital constraints specify the resource limitations imposed due to cash availability, credit supply and debt management. Capital is required to meet out the day-to-day expenses on the farm to purchase seeds, fertilizers, manure, pesticides, concentrates and animal fodder. The capital availability with the farmers sometimes may not be sufficient to meet the requirements of different agricultural operations. Nevertheless, it may also limit the scope for adoption of improved production practices.

For the availability of capital in *Kharif, Rabi* and summer, the constraint was set as the cost incurred on variable items of cost in a particular season, which is depending upon the returns from crops of previous season and other own sources. The capital constraint was relaxed for estimating an alternative plan *i.e.* Model–II.

Minimum and Maximum Restrictions

Table 3.6. Activities carried out in major farming systems followed in North Konkan region

Sr. No.	Activities	Cluster – I Northern coastal plains region					Cluster – II Northern central plains and hills region				
		FS-I	FS-II	FS-III	FS-IV	FS-V	FS-I	FS-II	FS-III	FS-IV	FS-V
1.	Sapota	X			X						
2.	Paddy (*Kharif*)	X	X	X		X	X	X	X	X	X
3.	Fingermillet (Nagli)						X	X			
4.	Prosomillet (Vari)						X	X			
5.	Blackgram (*Rabi*)								X		
6.	Cowpea (*Kharif*)								X		
7.	Cowpea (*Rabi*)								X		
8.	Wal (*Rabi*)								X		
9.	Green gram (*Rabi*)								X		
10.	Brinjal									X	
11.	Lady's finger									X	
12.	Grass		X								X
13.	Betalvines					X					
14.	Sayali			X							
15.	Kagda			X							
16.	Yellow champak			X							
17.	Hibiscus			X							
18.	Terada			X							
19.	Jai			X							
20.	Velvet (cocks comb)			X							
21.	Jasmine (Mogara)			X							
22.	Banana	X									
23.	Coconut	X		X	X	X					
24.	Arecanut	X		X	X	X					
25.	Mango						X				
26.	Cashew						X				
27.	Dairy	X	X	X	X	X	X	X	X		X
28.	Goat		X						X		
29.	Poultry									X	

Table 3.6 continued…

Sr. No.	Activities	Cluster – III Southern central plains and hills region					Cluster – IV Southern coastal plains region					
		FS-I	FS-II	FS-III	FS-IV	FS-V	FS-I	FS-II	FS-III	FS-IV	FS-V	FS - VI
1.	Paddy (*Kharif*)	X	X	X	X	X	X	X	X	X		X
2.	Blackgram											
3.	Paddy (*Rabi*)	X	X	X	X	X						
4.	Bottle gourd	X								X		
5.	Brinjal	X								X		
6.	Tomato	X										
7.	Smooth gourd	X								X		
8.	Chilli	X										
9.	Wal (*Rabi*)				X							
10.	Gram				X							
11.	Green gram				X							
12.	Mango					X	X		X			X
13.	Cashew nut					X	X		X			X
14.	Arecanut							X	X	X	X	X
15.	Coconut							X	X	X	X	X
16.	Lady's finger	X										
17.	Cowpea				X							
18.	Dairy	X	X	X	X	X	X	X	X	X	X	
19.	Goat			X								
20.	Poultry				X							X

The details of the various restrictions used in the model are given below.

Land restrictions

b_1 = *Kharif* land (ha)

b_2 = *Rabi* land (ha)

b_3 = Area under rain-fed plantations (ha)

b_4 = Area under irrigated plantations (ha)

b_5 = Area under summer crops (ha)

b_6 = Minimum area under *Kharif* paddy (ha)

Paddy is staple food of the region and it is dominant among all cereal crops grown in the region. In spite of low productivity and cultivation being uneconomical, it is grown in this region on large area over the years as a staple food crop. In study area, it is a general practice that the area suitable for paddy cultivation is termed as paddy land and generally farmers cultivate paddy on these lands to meet their food requirement. Considering above aspects related to paddy crop, a minimum area restriction was imposed in the model. The farming system wise average number of male, female and children were calculated and accordingly per family requirement for rice were worked out. The per day requirement for moderately heavy working adult male and female were 520 g and 440 g. The per day requirement for children was 175 g (1 to 3 years) 270 g (4 to 6 years) and 420 g (10 to 12 years) (Park., 2002). As per productivity of paddy in respective farming system, area required to be grown was estimated and it was imposed as minimum area restriction.

Human labour Restrictions

b_7 = Human labour availability during *Kharif* (Man days)

b_8 = Human labour availability during *Rabi* (Man days)

b_9 = Human labour availability during summer (Man days)

Bullock labour Restrictions

b_{10} = Bullock labour availability in *Kharif* (pair day)

b_{11} = Bullock labour availability in *Rabi* (pair day)

b_{12} = Bullock labour availability in summer (pair day)

Capital Restrictions

b_{13} = Capital available (Rupees)

These are the common restrictions for all systems in all regions. The restrictions which differ from region to region and between the systems are as follows

A) Northern Coastal Plains Region

System I	Minimum Restriction	a) b_{14}	*Kharif* Paddy area (0.33 ha)
	Maximum Restrictions	a) b_{15}	Sapota area (1.66 ha)
		b) b_{16}	Coconut area (1.66 ha)
		c) b_{17}	Arecanut area (1.66 ha)
		d) b_{18}	Banana area (1.66 ha)
System II	Minimum Restriction	a) b_{19}	*Kharif* Paddy area (0.42 ha)
	Maximum Restriction	a) b_{20}	Grass (0.78)
System III	Minimum Restriction	a) b_{21}	*Kharif* Paddy area (0.38 ha)

	Maximum Restrictions	a) b_{22}	Coconut area (1.51 ha)
		b) b_{23}	Arecanut area (1.51 ha)
		c) b_{24}	Sayali flower area (1.51 ha)
		d) b_{25}	Kagda flower area (1.51 ha)
		e) b_{26}	Yellow champak area (1.51 ha)
		f) b_{27}	Hibiscus area (1.51 ha)
		g) b_{28}	Tercala area (1.51 ha)
		h) b_{29}	Jai area (1.51 ha)
		i) b_{30}	Velvet area (1.51 ha)
		j) b_{31}	Jasmine area (1.51 ha)
System IV	Maximum Restrictions	a) b_{32}	Sapota area (1.12 ha)
		b) b_{33}	Coconut area (1.12 ha)
		c) b_{34}	Arecanut area (1.12 ha)
System V	Minimum Restriction	a) b_{35}	*Kharif* paddy area (0.36 ha)
	Maximum Restrictions	a) b_{36}	Coconut area (2.41 ha)
		b) b_{37}	Betelwine area (2.41 ha)
		c) b_{38}	Arecanut area (2.41 ha)
B) Northern Central plains and Hills Region			
System I	Minimum Restriction	a) b_{39}	*Kharif* Paddy area (0.51 ha)
	Maximum Restrictions	a) b_{40}	Coconut (1.27 ha)
		b) b_{41}	Finger millet (Nagli) area (1.27 ha)
		c) b_{42}	Mango area (1.27 ha)
		d) b_{43}	Cashew area (1.27 ha)
		e) b_{44}	Prosomillet area (1.27 ha)
System II	Minimum Restriction	a) b_{45}	Paddy area (0.47 ha)
	Maximum Restrictions	b) b_{46}	Finger millet (Nagli) area (0.94 ha)
		b) b_{47}	Prosomillet area (0.94 ha)
SystemIII	Minimum Restriction	a) b_{48}	Paddy area (0.49 ha)

	Maximum Restrictions	a) b_{49}	Black gram area (1.06 ha)
		b) b_{50}	Cowpea area (1.06 ha)
		c) b_{51}	Wal area (1.06 ha)
		d) b_{52}	Green gram area (1.06 ha)
SystemIV	Minimum Restriction	a) b_{53}	Paddy area (0.51 ha)
	Maximum Restrictions	a) b_{54}	Brinjal area (1.99 ha)
		b) b_{55}	Lady's finger area (1.99 ha)
System V	Minimum Restriction	a) b_{56}	Paddy area (0.43 ha)
	Maximum Restriction	a) b_{57}	Grass area (1.75 ha)
Southern Central Plains and Hills Region			
System I	Minimum Restriction	a) b_{58}	*Kharif* paddy area (0.40 ha)
	Maximum Restrictions	a) b_{59}	*Rabi* paddy area (1.585 ha)
		b) b_{60}	Bottlegourd area (1.585 ha)
		c) b_{61}	Tomato area (1.585 ha)
		d) b_{62}	Brinjal area (1.585 ha)
		e) b_{63}	Lady's finger area (1.585 ha)
		f) b_{64}	Smooth gourd area (1.585 ha)
		g) b_{65}	Chilli area (1.585 ha)
System II	Minimum Restriction	a) b_{66}	*Kharif* paddy area (0.43 ha)
System III	Minimum Restriction	a) b_{67}	*Kharif* paddy area (0.43 ha)
SystemIV	Minimum Restriction	a) b_{68}	*Kharif* paddy area (0.42 ha)
	Maximum Restrictions	a) b_{69}	*Rabi* paddy area (1.15 ha)
		b) b_{70}	*Rabi* cowpea area (1.15 ha)
		c) b_{71}	*Rabi* Wal area (1.15 ha)
		d) b_{72}	*Rabi* Green gram area (1.15 ha)
System V	Minimum Restriction	a) b_{73}	*Kharif* paddy area (0.42 ha)
	Maximum Restrictions	a) b_{74}	*Rabi* paddy (2.66 ha)

		b) b_{75}	Mango area (2.66 ha)
		c) b_{76}	Cashew area (2.66 ha)
Southern Coastal Plains Region			
System I	Minimum Restriction	a) b_{77}	*Kharif* paddy area (0.40 ha)
	Maximum Restriction	a) b_{78}	Mango area (1.04 ha)
		b) b_{79}	Cashewnut area (1.04 ha)
System II	Minimum Restriction	a) b_{80}	*Kharif* Paddy area (0.34 ha)
	Maximum Restriction	a) b_{81}	Coconut area (0.94 ha)
		b) b_{82}	Arecanut area (0.94 ha)
System III	Minimum Restrictions	a) b_{83}	*Kharif* Paddy area (0.41 ha)
	Maximum Restriction	a) b_{84}	Coconut area (2.15 ha)
		b) b_{85}	Arecanut area (2.15 ha)
		c) b_{86}	Mango area (2.15 ha)
System IV	Minimum Restriction	a) b_{87}	*Kharif* Paddy area (0.27 ha)
	Maximum Restrictions	a) b_{88}	Arecanut area (1.85 ha)
		b) b_{89}	Coconut area (1.85 ha)
		c) b_{90}	Brinjal area (1.85 ha)
System V	Maximum Restrictions	a) b_{91}	Coconut area (0.85 ha)
		b) b_{92}	Arecanut area (0.85 ha)
System VI	Minimum Restriction	a) b_{93}	*Kharif* paddy area (0.37 ha)
	Maximum Restrictions	a) b_{94}	Coconut area (1.72 ha)
		b) b_{95}	Arecanut area (1.72 ha)
		c) b_{96}	Area under Mango (1.72 ha)
		d) b_{97}	Area under Cashewnut (1.72 ha)

Technological Matrix

The input-output information on various production activities taken on the farm is very important for constructing the technological matrix for the linear programming model.

The input coefficients included in this study referred to land, labour and capital. Land was classified into *Kharif* land, *Rabi* land and summer land. Labour included both family and hired as well as both human and bullock labour. Capital referred to funds required to meet the cost of seeds, fertilizers, farm yard manure, plant protection chemicals, irrigation charges, dry fodder, green folder, concentrates, veterinary expenses, insurance charges, marketing expenses and wages of hired human, bullock and machinery labour.

The average prices that the sample farmers paid and received were considered as the input-output prices in this study. The input-output coefficients in the model referred to per hectare in the case of crops or per animal in the cases of dairy and goat rearing or per thousand birds in the case of poultry.

Optimum Plans

The linear programming was employed to develop optimum farming systems under different situations. To accomplish the objectives of the study, a few variations in the basic models were incorporated. The following alternative plans were developed.

Existing Plan : These models comprised the existing crop alternatives with existing cultivation practices and the available resources to the farmers.

Model I : These models are similar to the Existing Plan only with the reallocation of existing resources by using Linear programming technique.

Model II : These models was similar to the Model – I but with relaxation in capital and labour availability. These models would help to examine the effect of increased capital and labour availability and consequential effect on net farm incomes. In short, these models were designed to assess the effect of optimum farm plans to maximize the net farm incomes of the farmer.

The model II were worked out with relaxation of capital and labour at 25 per cent, 50 per cent, 75 per cent and 100 per cent and the increase in the net income was observed and it was decided to choose the Model II at 50 per cent enhancing the resources as there was very little difference in net farm income in this model as compared to models designed by relaxing the resources at 75 per cent and 100 per cent. Each of these models were designed for all major farming systems. Thus, total of 105 models were simulated for 21 major farming system and 42 models are presented in study. The Model – I is used to find optimum farming system at existing resource level and Model – II for optimum farming system at enhanced resource level.

4. RESULTS

The results that emerged from analysis of data collected for achieving the set objectives of the study are presented in this chapter under following heads.

4.1 Delineation of study area

4.2 General characteristics of sample respondents

4.3 Existing farming systems

4.4 Per unit profitability of enterprises followed in study area

4.5 Cost and returns structure of farming systems

4.6 Resource use efficiency of enterprises followed under major farming systems

4.7 Optimum farming systems

4.8 Constraints faced by farmers and measures to overcome them

4.1 Delineation of Study Area

The cluster analysis was carried out to bring together the tahsils based on their association among themselves with respect to different indicative variables. A 'Hierarchical agglomerative method' was followed to identify the tahsils of North Konkan region that have similar farming systems. The variables were based on the set of 23 characteristics relating to crop enterprises consisting of annual crops such as paddy, other cereals, pulses, oilseeds, and perennial crops, such as mango, cashew, arecanut, coconut, and forest area, rainfall, livestock etc. The result of cluster analysis is given in Table 4.1 and Figure 4.1. Whereas proximity matrix of various clusters is presented in Table 4.2

The analysis has classified all 30 tahsils of North Konkan region into five distinct clusters. The first cluster included 4 tahsils namely Dahanu, Palghar, Vasai and Talasari, lying on the bank of west coast. The correlation co-efficient between vectors of values of tahsils in this cluster were ranging from 0.54 to 0.927. The cluster – I was named as Northern coastal plains region (NCP). It would be called as Northern coastal plains region specifically for further discussion.

The second cluster consisted of 7 tahsils namely Vikramgadh, Jawhar, Mokhada, Wada, Bhivandi, Shahapur and Murbad. The correlation between vectors of values of tahsils in this cluster were ranging from 0.394 to 0.958. This cluster lies at eastern and northern central area nearer to Sahyadri hills. The cluster was named as Northern central plains and hills region (NCPH). This cluster would be referred to Northern central plains and hills region in further discussion.

The third cluster consisted of 10 tahsils namely Poladpur, Panvel, Karjat, Khalapur, Pen, Mahad, Roha, Sudhagadh, Mangaon and Tala. The correlation between vectors of values of tahsils in this cluster were ranging from 0.362 to 0.948. The tahsils in this cluster lie at southern central part of study area and some area nearer to sahyadri hills at east. The cluster was named as Southern central plains and hills region (SCPH). This cluster would be specifically called as Southern central plains and hills region and will be known by this name in further discussion.

The fourth cluster comprised 5 tahsils namely Alibag, Mhasala, Murud, Shrivardhan and Uran. The correlation between vectors of values of tahsils in this cluster were ranging from 0.652 to 0.986. The tahsils in this cluster lie on the bank of west coast of southern part of study area. The cluster was named as Southern coastal plains (SCP) and will be referred by name in further discussion.

The fifth cluster comprised Thane, Kalyan, Ulhasnagar and Ambarnath. The correlation between vectors of values of tahsils in this cluster were ranging from 0.038 to 0.681. This cluster is dominated by urban and industrial area. This cluster was named as central region (CR).

Table 4.1 Delineation of Study Area on the Basis of Agro-climatic Parameters

Cluster No.	Name of Cluster	Tahsils in respective clusters
1.	Northern coastal plains region (NCP)	Talasari, Dahanu, Palghar, Vasai
2.	Northern central plains and hills region (NCPH)	Vikramgadh, Jawhar, Mokhada, Wada, Bhivandi, Shahapur, Murbad
3.	Southern central plains and hills region (SCPH)	Panvel, Karjat, Khalapur, Pen, Sudhagadh, Mangaon, Tala, Mahad, Poladpur, Roha
4.	Southern coastal plains region (SCP)	Uran, Alibag, Murud, Shrivardhan, Mhasala
5.	Central region (CR)	Thane, Ulhasnagar, Ambarnath, Kalyan

Table 4.2 : Proximity Matrix of Different Clusters

(Correlation coefficients)

Cluster I			
Tahsils	Dahanu	Palghar	Vasai
Talasari	0.927	0.797	0.540
Dahanu	0.0	0.781	0.598
Palghar	--	0.0	0.690
Vasai	--	--	0.0

Cluster – II						
Tahsils	Jawhar	Mokhada	Wada	Bhivandi	Shahapur	Murbad
Vikramgadh	0.661	0.563	0.561	0.394	0.627	0.431
Javhar	0.0	0.696	0.608	0.419	0.713	0.514
Mokhada	--	0.0	0.488	0.229	0.554	0.511
Wada	--	--	0.0	0.586	0.801	0.708
Bhivandi	--	--	--	0.0	0.476	0.958
Shahapur	--	--	--	--	0.0	0.735
Murbad	--	--	--	--	--	0.0

Cluster III									
Tahsils	Karjat	Khalapur	Pen	Roha	Sudhagadh	Mangaon	Tala	Mahad	Poladpur
Panvel	0.692	0.817	0.80	0.620	0.819	0.519	0.512	0.369	0.362
Karjat	0.0	0.721	0.782	0.786	0.784	0.815	0.590	0.405	0.515
Khalapur	--	0.0	0.899	0.578	0.945	0.557	0.816	0.531	0.622
Pen	--	--	0.0	0.674	0.948	0.629	0.694	0.502	0.610
Roha	--	--	--	0.0	0.674	0.847	0.520	0.458	0.421
Sudhagadh	--	--	--	--	0.0	0.660	0.756	0.550	0.640
Mangaon	--	--	--	--	--	0.0	0.577	0.472	0.547
Tala	--	--	--	--	--	--	0.0	0.638	0.774
Mahad	--	--	--	--	--	--	--	0.0	0.786
Poladpur	--	--	--	--	--	--	--	--	0.0

Table 4.2 Contd.....

Cluster IV				
Tahsils	Alibag	Murud	Shrivardhan	Mhasala
Uran	0.652	0.641	0.652	0.620
Alibag	0.0	0.964	0.960	0.959
Murud	--	0.0	0.965	0.950
Shrivardhan	--	--	0.0	0.986
Mhasala	--	--	--	0.0

Cluster V			
Tahsils	Kalyan	Ulhasnagar	Ambarnath
Thane	0.038	0.431	0.230
Kalyan	0.0	0.122	0.414
Ulhasnagar	--	0.0	0.681
Ambarnath	--	--	0.0

4.1.1 Validation of Clusters

The accuracy of clusters formed and appropriateness of the method adopted was tested by discriminant analysis (Aldenderfer and Blashfiled (1984) proposed that the discrimenant analysis method is appropriate for validation of clusters). In discriminant analysis, a cluster membership of a tahsil was used as grouping variables. The result presented in Table 4.3 and it was observed from table that, predicted group (predicted cluster membership) and actual group (actual cluster membership) was same for all tahsils and 100 per cent original cases (tahsils) were correctly classified.

4.2 General Characteristics of Sample Respondents

The general characteristic features of sample respondents are presented in Table 4.4.

4.2.1 Age group

It is observed that, at overall level, the average age of farmers was 43.71 years. The average age was ranging from 39.26 years in cluster – I to 48.49 years in cluster–IV.

4.2.2 Education

Table 4.4 indicate that, at overall level 80.83 per cent farmers were literate, out of which 34.72 per cent farmers have completed primary education while 32.50 per cent farmers have a high school level education. The literacy rate in cluster – II was found to be lower (62.22%) as compared to other clusters.

4.2.3 Family size

It was observed that the family size was ranging from 6.53 members in cluster – IV to 7.39 members in cluster – II.

4.2.4 Occupation

At overall level, majority farmers (78.06%) have their main occupation as agriculture, while agriculture + service was low (9.44%). The farmers having agriculture as their sole occupation were ranging from 71.11 per cent to 88.89 per cent among the clusters studied. The agriculture + service was found to be more (11.11%) in cluster – I and it was lowest in cluster – II (3.33%) among the four clusters delineated.

4.3 Existing Farming Systems

Data collected from sample households were post classified into various farming systems. Each cluster (region) was considered as a separate spatial unit and further analysis was carried out independently. The farming systems were formed by considering the criteria, such as purpose of undertaking a particular enterprise, similarity between various crop enterprises, homogeneity within a farming system and heterogeneity between any two farming systems.

In case of crop enterprises, crops were grouped as a system component or group crop enterprises such as rainfed plantations, irrigated plantations, oil seeds, other cereals, (excluding paddy). Paddy crop was considered as a separate enterprise because it is a staple food crop, cultivated largely in the study area. Out of gross cropped area in a study area, the area under paddy was 48.84 per cent and 82.74 per cent of farmers have cultivated this crop. The non crop farm enterprises (other enterprises) undertaken by sample respondents were dairy, poultry, goat rearing and draught animals rearing.

Out of total (2.6) farming systems identified, 18 farming systems were found to be the major farming systems. A particular farming system followed by at least 10 per cent farmers or more in a cluster was considered to be the major farming system and remaining farming systems were not considered for further analysis. The existing farming systems followed in study area are presented in Table 4.5.

The cost, returns, resource use efficiency and optimality studies are presented only for the major farming systems. So farming systems discussed in the later part are major farming systems in study area.

Table 4.3 Validation of Clusters by Discriminant Analysis

Sr. No.	Name of Tahsil	Predicted Group	Actual Group
1.	Talasari	1	1
2.	Dahanu	1	1
3.	Vikramgadh	2	2
4.	Jawhar	2	2
5.	Mokhada	2	2
6.	Wada	2	2
7.	Palghar	1	1
8.	Vasai	1	1
9.	Thane	5	5
10.	Bhivandi	2	2
11.	Shahapur	2	2
12.	Kalyan	5	5
13.	Ulhasnagar	5	5
14.	Ambarnath	5	5
15.	Murbad	2	2
16.	Uran	4	4
17.	Panvel	3	3
18.	Karjat	3	3
19.	Khalapur	3	3
20.	Pen	3	3
21.	Alibag	4	4
22.	Murud	4	4
23.	Roha	3	3
24.	Sudhagadh	3	3
25.	Mangaon	3	3
26.	Tala	3	3
27.	Shrivardhan	4	4
28.	Mhasala	4	4
29.	Mahad	3	3
30.	Poladpur	3	3

Result : Cent per cent original cases are correctly classified.

Table 4.4. General Information of Sample Respondents in the Study Area

Sl. No.	Particulars	Cluster– I (N = 90)	Cluster–II (N = 90)	Cluster–III (N = 90)	Cluster – IV (N = 90)	Overall (N= 360)
I	Age (years)	39.26	46.75	43.35	48.49	43.71
II	Education (Nos.)					
1.	Illiterate	16 (17.78)	34 (37.78)	13 (14.44)	6 (6.67)	69 (19.17)
2.	Primary	27 (30.00)	39 (43.33)	34 (37.78)	25 (27.78)	125 (34.72)
3.	High school	29 (32.22)	14 (15.56)	37 (41.11)	37 (41.11)	117 (32.50)
4.	College	18 (20.00)	3 (3.33)	6 (6.67)	22 (24.44)	49 (13.61)
	Total	90 (100.00)	90 (100.00)	90 (100.00)	90 (100.00)	360 (100.00)
III	Family size (Nos.)					
1.	Male	2.32 (33.38)	1.91 (25.85)	2.14 (31.52)	1.94 (29.71)	2.0775 (30.04)
2.	Female	2.43 (34.96)	2. 31 (31.26)	2.03 (29.90)	2.16 (33.08)	2.2325 (32.28)
3.	Children	2.2 (31.65)	3.17 (42.90)	2.62 (38.59)	2.43 (37.21)	2.605 (937.67)
	Total	6.95 (100.00)	7.39 (100.00)	6.79 (100.00)	6.53 (100.00)	6.915 (100.00)
IV	Occupation (Nos.)					
1.	Agriculture (only)	64 (71.11)	80 (88.89)	72 (80.00)	65 (72.22)	281 (78.06)
2.	Agriculture+ Business	16 (17.78)	7 (7.78)	10 (11.11)	12 (13.33)	45 (12.50)
3.	Agriculture + Service	10 (11.11)	3 (3.33)	8 (8.89)	13 (14.44)	34 (9.44)
	Total	90 (100.00)	90 (100.00)	90 (100.00)	90 (100.00)	360 (100.00)

(Figures in the parentheses indicate percentages to respect to totals)

4.3.1 Farming Systems in Northern coastal plains region

It was observed from table 4.5 that in this region five farming systems were followed by the farmers. The farming systems followed in this region were 1) Paddy + Irrigated plantations + Dairy (FS-I), 2) Paddy + Grass + Dairy + Goat rearing (FS-II), 3) Paddy + Irrigated plantations + Flowers (FS-III), 4) Irrigated plantations + Dairy (FS-IV) and 5) Paddy + Irrigated plantations + Betalvines (FS-V).

4.3.2 Farming Systems in Northern central plains and hills region

It could be seen from table 4.5 that, the farming system in this region were 1) Paddy + Other cereals + Rainfed plantations + Dairy (FS-I), 2) Paddy + Other cereals + Dairy + Goat rearing (FS-II), 3) Paddy + Pulses + Dairy (FS-III), 4) Paddy + Vegetables + Poultry (FS-IV) and 5) Paddy + Grass + Dairy (FS-V).

4.3.3 Farming Systems in Southern central plains and hills region

It was observed from Table 4.5 that, the farmers in Southern central plains and hills region have followed five major farming systems namely 1) Paddy + Vegetables + Dairy (FS-I), 2) Paddy + Dairy (FS-II), 3) Paddy + Dairy + Goat rearing (FS-III), 4) Paddy + Pulses + Dairy + Poultry (FS-IV) and 5) Paddy + Rainfed plantations + Dairy (FS-V)

4.3.4 Farming Systems in southern Coastal Plains Region

The farming systems followed in this region were namely 1) Paddy + Rainfed plantations + Dairy (FS-I), 2) Paddy + Irrigated plantation + Dairy (FS-II), 3) Paddy + Irrigated plantations + Rainfed plantations + Dairy (FS-III), 4) Paddy + Irrigated plantations + Vegetables + Dairy (FS-IV), 5) Irrigated plantation + Dairy (FS-V) and 6) Paddy + Irrigated plantations + Rainfed plantations + Poultry (FS-VI). It was found that in north Konkan region in each sub-region specific farming system is followed, hence hypothesis no. 1 is proved.

4.3.5 Land Holding Under Existing Farming Systems

The information on land holding is presented in Table 4.6. It is observed from Table 4.6 that, per farm total owned land in cluster-I was ranging from 1.45 hectares in FS-IV to 2.83 hectares in FS-I. The irrigated area in FS-V was observed to be more (95.40% of operational holding) compared to other farming systems in cluster-I.

In the case of Northern central plains and hills region, cluster-II, per farm total owned land was ranging from 1.39 hectare in FS-III to 2.068 hectares in FS-I. The operational holding was same as that of owned land, because there was no land leased in or leased out in all the farming systems in the cluster.

It was observed from Table 4.6, that in (Cluster-III) central plains and hills south region, the per farm owned land was maximum (3.33 ha.) in FS-V. The per farm irrigated land was maximum in FS-I (59.19%). The per farm fallow land including land not suitable for cultivation was found to be maximum (26.13%) in FS-V, while it was negligible (2.70%) in FS-III.

The land holding pattern among the farming systems followed in Southern coastal plains (cluster-IV) depicted in Table 4.6 showed that, land holding was ranging from 1.32 hectare in FS-V to 3.28 hectare in FS-III. The irrigated land was maximum in FS-IV (77.54%) in the cluster.

4.3.6 Cropping Patterns Followed on Sample Farms

The information on cropping pattern adopted by the sample farmers under different farming systems is presented in table 4.7 to table 4.10.

4.3.6.1 Cropping Pattern in Northern Coastal Plains Region

The cropping pattern followed in this region is presented in table 4.7.

It was observed from the table that, the net cultivated area was ranging from 1.12 hectares in FS-IV to 1.99 hectare in FS-I. In the case of FS-I, the area under paddy and sapota was 38.65 per cent and 41.67 per cent, respectively. In FS-II, the maximum area was under paddy (62.61%) followed by grass (37.39%). Regarding FS-III, area under paddy was

Table 4.5 : Existing Farming Systems in North Konkan Region

Cluster	Farming System	No. of farmers		Area		Name
	No.	No.	%	ha	%	
Cluster – I Northern coastal plains region	FS–I	27	30.00	53.73	37.35	Paddy + Irrigated plantations + Dairy
	FS–II	15	16.67	17.25	11.99	Paddy + Grass + Dairy + Goat rearing
	FS-III	14	15.56	26.46	18.39	Paddy + Irrigated plantations + Flowers
	FS-IV	13	14.44	14.56	10.12	Irrigated plantations + Dairy
	FS- V	11	12.22	21.89	15.22	Paddy + Irrigated plantation + Betalvines
	FS- VI	6	6.67	6.78	4.71	Paddy + Irrigated plantation + Poultry
	FS- VII	4	4.44	3.20	2.22	Paddy + Flower + Dairy
	Total	90	100.00	193.87	100.00	
Cluster – II Northern central plains and hills region	FS–I	21	23.34	37.38	25.39	Paddy + Other cereals + Rainfed plantation + Dairy
	FS-II	18	20.00	25.38	17.23	Paddy + Other cereals + Dairy + Goat rearing
	FS-III	15	16.67	23.25	15.79	Paddy + Pulses + Dairy
	FS-IV	13	14.44	19.50	13.24	Paddy + Vegetables + Poultry
	FS-V	12	13.33	26.6	17.77	Paddy + Grass + Dairy
	FS- VI	5	5.55	8.21	5.58	Paddy + Goat rearing
	FS- VII	4	4.44	5.4	3.67	Paddy + Other cereals + Oilseeds
	FS- VIII	2	2.22	1.96	1.33	Paddy + Grass + Goat rearing
	Total	90	100.00	147.24	100.00	
Cluster – III Southern central plains and hills region	FS– I	22	24.44	43.56	26.33	Paddy + Vegetables + Dairy
	FS- II	19	21.11	33.35	20.16	Paddy + Dairy
	FS-III	17	18.89	21.59	13.06	Paddy + Dairy + Goat rearing
	FS-IV	15	16.67	23.55	14.23	Paddy + Pulses + Dairy + Poultry
	FS- V	11	12.22	34.87	21.07	Paddy + Rainfed plantations + Dairy
	FS- VI	6	6.67	8.52	5.15	Paddy + Pulses + Goat rearing
	Total	90	100.00	165.44	100.00	
Cluster – IV Southern coastal plains region	FS– I	23	25.56	33.12	23.30	Paddy + Rainfed plantation + Dairy
	FS- II	18	20.00	23.04	16.22	Paddy + Irrigated plantations + Dairy
	FS-III	13	14.44	34.58	24.33	Paddy + Irrigated plantations + Rainfed plantation + Dairy
	FS-IV	12	13.33	16.80	11.83	Paddy + Irrigated plantations + Vegetables + Dairy
	FS- V	10	11.11	8.50	5.98	Irrigated plantations + Dairy
	FS-VI	9	10.00	19.71	13.87	Paddy + Irrigated plantations + Rainfed plantations + Poultry
	FS- VII	4	4.44	4.92	3.47	Rainfed plantations + Poultry
	FS- VIII	1	1.11	1.43	1.00	Paddy + Irrigated plantations
	Total	90	100.00	192.10	100.00	

Table 4.6 : Land Holding under Existing Farming Systems

(Area in ha.)

Sl. No	Particulars	Cluster -I					Cluster- II				
		FS-I	FS-II	FS-III	FS-IV	FS-V	FS-I	FS-II	FS-III	FS-IV	FS-V
I	Owned Land										
	A) Cultivated land										
	a) Unirrigated land	0.77 (27.50)	1.15 (53.57)	0.44 (23.56)	-	-	1.78 (86.07)	1.41 (59.00)	0.07 (5.04)	0.56 (33.14)	2.18 (73.65)
	b) Irrigated land	1.22 (43.57)	-	1.37 (70.25)	1.12 (77.20)	1.99 (95.40)	-	-	0.74 (53.24)	0.47 (27.81)	-
	B) Current Fallow	0.47 (16.78)	0.32 (14.29)	-	0.25 (16.34)	-	0.028 (1.35)	0.16 (6.69)	0.42 (30.22)	0.24 (14.20)	0.11 (3.72)
	C) Permanent Fallow	0.37 (13.21)	0.72 (32.14)	0.06 (3.07)	0.08 (5.23)	0.096 (4.60)	0.26 (12.57)	0.82 (34.31)	0.16 (11.51)	0.42 (24.85)	0.67 (22.64)
	Total owned land	2.83	2.19	1.87	1.45	2.086	2.068	2.39	1.39	1.69	2.96
II	Land leased in	-	-	0.08 (4.1)	0.08 (5.23)	-	-	-	-	-	-
III	Land leased out	0.03 (1.07)	-	-	-	-	-	-	-	-	-
IV	Operational holding	2.80	2.19	1.95	1.53	2.086	2.068	2.39	1.39	1.69	2.96

(Figures in the parentheses are percentages to operational holding)

Table 4.6 : Continued…

(Area in ha.)

	Particulars	Cluster III					Cluster IV					
		FS-I	FS-II	FS-III	FS-IV	FS-V	FS-I	FS-II	FS-III	FS-IV	FS-V	FS-VI
I	Owned Land											
	A) Cultivated land											
	a) Unirrigated land	0.085 (5.30)	0.54 (39.42)	0.87 (58.78)	1.31 (73.60)	1.47 (44.14)	1.44 (79.12)	0.76 (33.00)	1.83 (55.79)	-	-	0.71 (28.40)
	b) Irrigated land	0.95 (59.19)	0.52 (37.96)	0.2 (13.51)	0.13 (7.30)	0.85 (25.53)	-	0.52 (21.60)	0.83 (25.30)	1.45 (77.54)	0.85 (64.64)	1.48 (59.20)
	B) Current Fallow	0.36 (22.43)	0.17 (12.40)	0.37 (25.00)	0.14 (7.87)	0.14 (4.20)	0.22 (12.09)	0.32 (13.91)	-	0.24 (12.83)	0.37 (28.14)	0.18 (7.20)
	C) Permanent Fallow	0.21 (13.08)	0.06 (4.38)	0.04 (2.70)	0.07 (3.93)	0.87 (26.13)	0.19 (10.44)	0.81 (35.21)	0.62 (18.90)	0.18 (9.63)	0.095 (7.22)	0.13 (5.20)
	Total owned land	1.605	1.29	1.48	1.65	3.33	1.85	2.41	3.28	1.87	1.315	2.5
II	Land leased in	-	0.08 (5.84)	-	0.13 (7.30)	-	-	-	-	-	-	-
III	Land leased out	-	-	-	-	-	0.03 (1.64)	0.11 (4.78)	0.075	-	-	-
IV	Operational holding	1.605	1.37	1.48	1.78	3.33	1.82	2.3	3.205	1.87	1.315	2.5

(Figures in the parentheses are percentages to operational holding)

less (21.65%) as compared to other farming systems. Area under flower crops including perennial flowers and plantation crops in this farming system was the highest (68.32%).

In FS-IV the maximum area was under sapota that is 0.87 hectare (77.67%) followed by Coconut 0.24 hectare (21.43%). It was observed that in FS-V area under coconut was maximum (69.35%) followed by Betelvines 26.63 per cent. The cropping intensity in all farming systems in this region was ranging from 78.23 per cent (FS-II) to 300 per cent (FS-V).

4.3.6.2 Cropping Pattern in Northern Central Plains and Hills Region

The cropping pattern followed in this region is presented in Table 4.8.

It was revealed that net cultivated area among the different farming systems was ranging from 0.81 hectare in FS-III to 2.18 hectares in FS-V. In FS-I substantial area was under paddy (58.99%) followed by mango (16.29%) and cashewnut (7.87%). In FS-II, the area, under paddy was maximum, *i.e.* 1.20 hectares (85.11%). Out of total cultivated area, the area under paddy in FS-III was 0.74 hectare (47.74%). However, in FS-III same amount of area was observed in *rabi* season under pulse crops. In FS-IV and FS-V mainly paddy was grown. However, area under vegetable crops in FS-IV worked out to be 31.33 per cent of gross cropped area.

The cropping intensity in this region was low as compared to other regions in study area. It was ranging from 89.80 per cent (FS-II) to 186.18 per cent (FS-III).

4.3.6.3 Cropping Pattern in Southern Central Plains and Hills Region

The cropping pattern followed in this region is presented in table 4.9.

It is observed that, the net cropped area in this region was ranging from 1.03 hectares in FS-I to 2.32 hectares in FS-V. The area under *Kharif* paddy was maximum in FS-III (84.25%) whereas it was minimum in FS-I (47.86%). The paddy was found to be grown in both the seasons in all the farming systems. The cropping intensity in this region was ranging from 105.59 per unit FS-IV to 216.55 per cent (FS-I).

4.3.6.4 Cropping Pattern in Southern Coastal Plains

The cropping pattern followed by the farmers in this region is presented in table 4.10.

It is observed from table 4.10 that, net cultivated area among the different farming system ranged from 0.85 hectare in FS-V to 2.66 hectares in FS-III. In FS-I, the maximum area was under paddy (49.31%) followed by mango (39.58%). Among the different farming systems, proportion of area under paddy was maximum, that is, 0.76 hectare in FS-II (59.38%).

The per farm gross cropped area was maximum in FS-III (2.66 ha.). The cropping intensity was maximum in FS-IV (262%). It was ranging from 174.70 per cent to 362 per cent across the various farming systems.

4.4 Profitability of Enterprises Followed under Major Farming Systems

The farming system-wise per hectare cost and returns of crops and per unit cost and returns and profitability of other enterprises such as Dairy, Poultry, and Goat rearing were calculated for each region separately. The unit for Poultry was per 1000 birds and for dairy and goat rearing it was per animal. The per unit profitability of enterprises followed in the study area are presented in table 4.11 to 4.14.

Table 4.7 : Cropping Pattern of Sample Farms in Northern coastal plains region (Cluster I)

(Area in ha.)

Sr. No.	Particulars	FS – I	FS – II	FS – III	FS – IV	FS – V
I	*Kharif* season					
1.	Paddy	0.77 (38.65)	0.72 (62.61)	0.41 (21.65)		
2.	Grass		0.43 (37.39)			
3.	Balsam (Terda)			0.11 (5.81)		
	Sub Total	0.77 (38.65)	1.15 (100.00)	0.52 (27.46)		
II	*Rabi* Season					
1.	Cocks comb (velvet)			0.08 (4.22)		
	Sub Total			0.08 (4.22)		
III	Perennial crops					
1.	Jasmine (Mogra)			0.26 (13.73)		
2.	Jai			0.04 (2.11)		
3.	Hibiscus			0.23 (12.14)		
4	Sayali			0.11 (6.02)		
4.	Kagda			0.04 (2.11)		
5.	Yellow champak			0.19 (10.03)		
6.	Sapota	0.83 (41.67)			0.87 (77.67)	
7.	Coconut	0.33 (16.57)			0.24 (21.43)	1.38 (69.35)
8.	Arecanut	0.04 (2.01)		0.41 (21.65)	0.01 (0.90)	0.08 (4.02)
9.	Banana	0.022 (1.10)		0.01 (0.53)		
10.	Betelvines					0.53 (26.63)
	Sub Total	1.22 (61.35)	--	1.29 (68.32)	1.12 (100.00)	1.99 (100.00)
	Gross cropped area	1.99 (100.00)	1.15 (100.00)	1.89 (100.00)	1.12 (100.00)	1.99 (100.00)
	Net cultivated area	1.99	1.15	1.81	1.12	1.99
	Cropping intensity (%)	180.08	78.23	251.38	245.25	300.00

(Figures in the parentheses indicate percentages to gross cropped area)

Table 4.8 : Cropping Pattern of Sample Farms in Northern central plains and hills region (Cluster II)

(Area in ha.)

Sr. No.	Particulars	FS – I	FS – II	FS – III	FS – IV	FS – V
I	*Kharif* season					
1.	Paddy	1.05 (58.99)	1.20 (85.11)	0.74 (47.74)	1.03 (68.67)	1.11 (50.91)
2.	Nagli	0.22 (12.36)	0.16 (11.35)			
3.	Prosomillet	0.08 (4.49)	0.05 (3.55)			
4.	Cowpea			0.07 (4.52)		
5.	Grass					1.07 (49.08)
	Sub Total	1.35 (75.84)	1.41 (100.00)	0.81 (52.25)	1.03 (68.67)	2.18 (100.00)
II	*Rabi* Season					
1.	Black gram			0.02 (1.29)		
2.	Cowpea			0.04 (2.58)		
3.	Long yard bean (Wal)			0.63 (40.65)		
4.	Green gram			0.05 (3.23)		
5.	Brinjal				0.31 (20.67)	
6.	Lady's finger				0.16 (10.66)	
	Sub Total	--	--	0.74 (47.74)	0.47 (31.33)	--
III	Perennial crops					
1.	Mango	0.29 (16.29)				
2.	Cashewnut	0.14 (7.87)				
	Sub Total	0.43 (24.16)	--	--	--	--
	Gross cropped area	1.78 (100.00)	1.41 (100.00)	1.55 (100.00)	1.50 (100.00)	2.18 (100.00)
	Net cropped area	1.78	1.41	0.81	1.03	2.18
	Cropping intensity (%)	141.93	89.80	186.18	113.21	95.19

(Figures in the parentheses indicate percentages to gross cropped area)

Table 4.9 : Cropping Pattern of Sample Farms in Southern central plains and hills region (Cluster III)

(Area in ha)

Sr. No.	Particulars	FS – I	FS – II	FS – III	FS – IV	FS – V
I	*Kharif* season					
1.	Paddy	0.95 (47.86)	1.06 (67.09)	1.07 (84.25)	0.96 (61.15)	1.82 (57.41)
2.	Cowpea				0.10 (6.37)	
3.	Wal				0.16 (10.19)	
4.	Gram				0.10 (6.37)	
5.	Green gram				0.12 (7.64)	
	Sub Total	0.95 (47.86)	1.06 (67.09)	1.07 (84.25)	1.44 (91.72)	1.82 (57.41)
II	Rabbi Season					
1.	Paddy	0.37 (18.64)	0.52 (32.91)	0.20 (15.75)	0.13 (8.24)	0.85 (26.81)
2.	Bottle gourd	0.14 (7.05)				
3.	Tomato	0.04 (2.27)				
4.	Brinjal	0.24 (12.09)				
5.	Lady's finger	0.06 (3.02)				
6.	Smooth gourd	0.03 (1.51)				
7.	Chilli	0.15 (7.56)				
	Sub Total	1.03 (52.14)	0.52 (32.91)	0.20 (15.75)	0.13 (8.24)	0.85 (26.81)
III	Perennial crops					
1.	Mango					0.37 (11.67)
2.	Cashewnut					0.13 (4.10)
	Sub Total	--	--	--	--	0.50 (15.77)
	Gross cropped area	1.98 (100.00)	1.58 (100.00)	1.27 (100.00)	1.57 (100.00)	3.17 (100.00)
	Net cropped area	1.03	1.06	1.07	1.44	2.32
	Cropping intensity (%)	261.55	170.73	102.08	105.59	204.06

(Figures in the parentheses indicate percentages to gross cropped area)

Table 4.10 : Cropping Pattern of Sample Farms in Southern coastal plains region (Cluster IV)

Sr. No.	Particulars	FS – I	FS – II	FS – III	FS – IV	FS - V	FS – VI
I	*Kharif* season						
1.	Paddy	0.71 (49.31)	0.76 (59.38)	0.78 (29.32)	0.67 (31.60)		0.71 (32.42)
	Sub Total	0.71 (49.31)	0.76 (59.38)	0.78 (29.32)	0.67 (31.60)		0.71 (32.42)
II	*Rabi* season						
1.	Brinjal				0.31 (14.62)		
2.	Smooth gourd				0.25 (11.79)		
3.	Bottle gourd				0.16 (7.55)		
	Sub-total	--	--	--	0.72 (33.96)	--	--
III	Perennial crops						
1.	Mango	0.57 (39.58)		0.80 (30.08)			0.63 (28.77)
2.	Cashew	0.16 (11.11)		0.25 (9.40)			0.18 (8.22)
3.	Coconut		0.39 (30.47)	0.63 (23.68)	0.56 (26.42)	0.65 (76.47)	0.47 (21.46)
4.	Arecanut		0.13 (10.16)	0.20 (7.52)	0.17 (8.02)	0.20 (23.53)	0.20 (9.13)
	Sub-total	0.73 (50.69)	0.52 (40.63)	1.88 (70.68)	0.73 (34.44)	0.85 (100.00)	1.48 (67.58)
	Gross cropped area	1.44 (100.00)	1.28 (100.00)	2.66 (100.00)	2.12 (100.00)	0.85 (100.00)	2.19 (100.00)
	Net Cultivated area	1.44	1.28	2.66	1.40	0.85	2.19
	Cropping intensity (%)	174.70	145.00	241.35	262.19	209.01	217.29

(Figures in the parentheses indicate percentages to gross cropped area)

4.4.1 Profitability of Enterprises in Northern Coastal Plains Region

The results of per hectare and per unit profitability in Northern coastal plains region (Cluster – I) are presented in Table 4.11.

a) Paddy : The per hectare gross returns were maximum in farming FS-III (Rs.22321) followed by Rs.22230 in FS-I. The total cost of cultivation in these farming systems was Rs.21972 and Rs.22973, respectively. The per hectare total cost of cultivation of paddy was minimum in FS-II Rs.15339. The returns per rupee invested at total cost were ranging from Rs.0.97 to Rs.1.05.

b) Sapota : It is apparent from the table that per hectare gross returns from sapota cultivation were maximum in FS -IV (Rs.109725) and the total cost was Rs.63416 resulting into returns on per rupee of total cost to Rs.1.73. Whereas, the total cost was minimum (Rs.53369) in FS – I,with gross returns of Rs.103368 resulting into returns per rupee invested to Rs.1.94.

c) Coconut : Coconut was observed to be cultivated in majority of farming systems in this region. The per hectare total cost of cultivation was ranging from Rs.34004 to Rs.58143 among the various systems. The gross returns were maximum in FS -IV to the tune of Rs.72667. The net returns per rupee invested were ranging from Rs.1.25 in FS-IV to Rs.1.53 in FS-I.

d) Arecanut : It is observed from the table that, per hectare total cost of cultivation of arecanut was minimum in FS – III (Rs.34723). The gross returns were maximum (Rs.84000) in case of farmers who have followed irrigated horticulture + Dairy farming system (FS-IV) resulting in to highest returns on per rupee invested (Rs.1.96).

e) Banana : It is observed from Table 4.11 that, per hectare gross returns from banana were Rs.91225, whereas, total cost was Rs.61559. The returns on per rupee invested were Rs.1.48. Banana was cultivated only in FS– I.

f) Grass : The per hectare gross returns and total cost in grass enterprise were Rs.7592 and Rs.6009, respectively, while returns per rupee invested were just Rs.1.05. Grass was cultivated.

g) Sayali (*Jasminum phelophilum*) : It was observed from Table 4.11, that, per hectare gross returns and total cost in sayali flower cultivation were Rs.156750 and Rs.114650 resulting in to net returns to the tune of Rs.42100. Sayali cultivation was restricted only under FS-III in this region.

h) Kagda *(Jasminum multiflorum)*: It is apparent from the table that, per hectare gross returns and total cost of cultivation of Kagda was Rs.166215 and Rs.131059 resulting into per hectare net returns of Rs.35156 and returns per rupee invested was Rs.1.27. Kagda cultivation was included in FS-III.

i) Yellow Champak : The per hectare total cost of cultivation in yellow champak in FS-III was Rs.93507. Out of which Rs.28067 was fixed cost and Rs.65440 was variable cost. The gross returns per hectare were amounted to Rs.139008 per hectare. The return per rupee invested at total cost was Rs.1.49.

j) Hibiscus : The per hectare total variable cost and fixed cost for hibiscus Rs.67,577 and Rs.22,909, respectively in FS-III. The per hectare gross returns was Rs.1,13,845 leading to net returns of Rs.23,409 and return per rupee invested was Rs.1.26.

k) Balsam (Terada) : Balsam flower was cultivated only in FS–III in the region. The per hectare gross returns were amounted to Rs.149505 and per hectare total cost was worked out Rs.106904. The return per rupee invested was Rs.1.40

l) Jai *(Jasminum grandiflorum)* : The per hectare total variable and total fixed cost for jai cultivation were Rs.54052 and Rs.24244 in FS-III. The gross returns were worked out Rs.119280 resulting into per hectare net returns of Rs.40984.

m) Velvet (Cock's comb*)* : Velvet flower crop was a component of farming system – III. The per hectare gross returns and total cost were Rs.104590 and Rs.71597, respectively. The per hectare net returns at total cost were worked out to Rs.32993.

Table 4.11 : Profitability of Crops Grown and Other Enterprises Followed in Major Farming Systems in Northern coastal plains region

(Rs./unit)

Sr. No.	Particulars	FS-I						FS-II			
		Paddy	Sapota	Coconut	Arecanut	Banana	Dairy	Paddy	Grass	Dairy	Goat rearing
1.	Total variable cost (TVC)	18293	30537	29495	26128	43842	17853	11962	4054	11515	649
2.	Total fixed cost (TFC)	4680	22831	15525	14949	17717	2984	3377	1954	2289	335
3.	Total cost (TC)	22973	53369	45020	41077	61559	20837	15339	6009	13804	984
4.	Gross returns	22230	103368	68798	60250	91225	25575	16097	7592	16429	1431
5.	Net returns over TVC	3937	72831	39303	34121	47383	7722	4135	3538	4914	782
6.	Net returns over TC	-743	49999	23778	19173	29666	4738	758	1583	2625	4467
7.	Returns on per rupee invested at TC	0.97	1.94	1.53	1.47	1.48	1.22	1.05	1.26	1.19	1.45

Crops = Rs./ha, Poultry = Rs./1000 birds, Goat rearing = Rs./animal, Dairy = Rs./animal

Table 4.11 continued…

Sr. No.	Particulars	FS-III										
		Paddy *kharif*	Coconut	Arecanut	Sayali	Kagda	Yellow champak	Hibiscus	Balsam (Terada) *Kharif*	Jai	Velvet *Rabi*	Jasmine (Mogra)
1.	Total variable cost (TVC)	16961	25866	23632	84193	98294	65440	67577	80697	54052	52876	60656
2.	Total fixed cost (TFC)	5011	11235	11091	30457	32764	28067	22909	26207	24244	18721	29718
3.	Total cost (TC)	21972	37101	34723	114650	131059	93507	90436	106904	78296	71597	90374
4.	Gross returns	22321	51984	42000	156750	166215	139008	113845	149505	119280	104590	151470
5.	Net returns over TVC	5360	26118	18368	72557	67921	73568	46318	68808	65228	51714	90814
6.	Net returns over TC	349	14883	7277	42100	35156	45501	23409	42601	40984	32993	61096
7.	Returns per rupee invested at TC	1.02	1.40	1.2	1.37	1.27	1.49	1.26	1.40	1.52	1.46	1.68

Crops = Rs./ha, Poultry = Rs./1000 birds, Goat rearing = Rs./animal, Dairy = Rs./animal

Table 4.11 continued…

Sr. No.	Particulars	FS-IV				FS-V			
		Sapota	Coconut	Arecanut	Dairy	Paddy	Coconut	Betalvines	Arecanut
1.	Total variable cost (TVC)	40264	41170	25155	12835	18128	16739	155968	26268
2.	Total fixed cost (TFC)	23152	16972	17707	3000	3526	17264	116291	17551
3.	Total cost (TC)	63416	58143	42862	15835	21654	34004	272259	43820
4.	Gross returns	109725	72667	84000	22566	18222	51560	641866	60250
5.	Net returns over TVC	69461	31497	58845	9731	94	34821	485898	33982
6.	Net returns over TC	46309	14524	41138	6731	-3432	17556	369608	16430
8.	Returns on per rupee invested at TC	1.73	1.25	1.96	1.42	0.84	1.52	2.36	1.37

Crops = Rs./ha, Poultry = Rs./1000 birds, Dairy = Rs./animal

Paddy + Sapota enterprises

Banana + Arum cultivation

Sapota packing

Plate 1. Farming systems enterprises in northern coastal plains

n) asmine (Mogra) *(Jasminum sambac)* : Regarding Jasmine, the per hectare total variable cost was amounted to Rs.60656, while per hectare total fixed cost was Rs.29718 resulting into total cost of cultivation to the tune of Rs.90374 per hectare. The per hectare gross returns was Rs.151470 and net returns at total cost was Rs.61096. The returns on each rupee invested at total cost was Rs.1.68.

o) Betelvines : Betelvines cultivation was most remunerative (FS-V) in this region. It was observed from table that, per hectare total variable cost and total fixed costs were Rs.155968 and Rs.116291, respectively, resulting into total cost Rs.272259. The per hectare gross returns was Rs.641866 and net returns at total cost was Rs.369608. The return on per rupee invested at total cost was Rs.2.36.

p) Dairy : It was observed from the table that, per animal gross returns were maximum (Rs.25575) in FS-I followed by in FS-IV (Rs.22566). The per animal total cost of maintenance was minimum (Rs.11723) in FS-V, while it was maximum (Rs.20837) in FS-I. The return per rupee invested at total cost were ranging from Rs.1.19 in FS-II to Rs.1.53 in FS-V.

q) Goat rearing : The goat rearing enterprise was found to be remunerative in this region (FS-II) in which the gross returns and total cost were Rs.1431 and Rs.984, respectively. The return on each rupee invested at total cost were Rs.1.45.

4.4.2 Profitability of Enterprises in Northern Central Plains and Hills Region

The results of per hectare and per unit profitability of different enterprises in Northern central plains and hills region are presented in Table 4.12.

a) Paddy : It is apparent from Table 4.12 that, the per hectare gross returns were maximum (Rs.15735) in FS-V followed by FS-III, FS-II, I and IV (Rs.13585 and Rs.13283, Rs.12734 and Rs.11530, respectively). The per hectare total cost of cultivation was ranging from Rs.12805 in FS-II to Rs.14982 in FS-V. The return per rupee invested were ranging from Rs.0.89 in FS-IV to 1.05 in FS-V.

b) Finger millet (Nagli) : In case of Finger millet the per hectare gross returns worked out to Rs.13612 in FS-I and Rs.10518 in FS-II. The total cost of cultivation was Rs.12660 in FS-I and Rs.14100 in FS-II. The returns per rupee invested at total cost were Rs.1.08 and 0.75 in FS-I and FS-II, respectively.

c) Proso millet (Vari) : The per hectare gross returns were maximum in FS–II, (Rs.8147) followed by FS-I (Rs.6476). The net returns in FS-II were Rs.553. However the total cost and gross returns in FS-I were worked out to Rs.7857 and 6476, respectively, resulting to loss of Rs.0.18 for per rupee invested. Return at total cost per rupee invested in FS – II were Rs.1.07.

d) Mango : The per hectare gross returns were amounted to Rs.60806 in FS- I. The total variable cost and total fixed cost were observed to be Rs.23275 and Rs.11741, respectively. The per hectare net returns at total cost was estimated as Rs.25789 and return per rupee invested at total cost was to the tune of Rs.1.74.

e) Cashew : It was observed from Table 4.12 that, per hectare total variable cost and total fixed were amounted to Rs.16750 and Rs.8762, respectively. The per hectare gross returns was Rs.44460, resulting into net returns at total cost to Rs.18947.

f) Blackgram : The total cost of cultivation of blackgram in FS-III worked out to Rs.11289, while gross returns were Rs.16043. The per hectare net returns at total cost amounted to Rs.4753.

g) Cowpea : It was observed from Table 4.12 that gross returns in *kharif* cowpea and *rabi* cowpea in FS-III were estimated to Rs.31785 and 31458, respectively. Per hectare total cost of cultivation in *Kharif* and *Rabi* season were Rs.24613 and Rs.21711, respectively. Per hectare net returns at total cost were Rs.7171 and Rs.9746 in *Kharif* and *Rabi* season, respectively.

h) Wal : The per hectare gross returns and total cost in FS – IV amounted to Rs.31547 and Rs 22384, respectively resulting into net returns at total cost to the tune of Rs.9162.

Harvesting of mango

Packaging of mango for transport

Sapota plantation

Plate 2. Farming systems enterprises in northern coastal plains

Table 4.12 : Profitability of Enterprises Followed in Northern central plains and hills region

(Rs. per unit)

Sr. No	Particulars	FS-I						FS-II				
		Paddy *kharif*	Finger-millet (Nagli) *kharif*	Mango	Cashew	Proso-millet (Vari) *kharif*	Dairy	Paddy *kharif*	Finger-millet (Nagli) *kharif*	Proso-millet (Vari) *kharif*	Goat rearing	Dairy
1.	Total variable cost (TVC)	10912	10094	23275	16750	6480	14525	10268	12028	5918	842	17266
2.	Total fixed cost (TFC)	2424	2566	11741	8762	1377	1460	2537	2071	1676	312	1538
3.	Total cost (TC)	13337	12660	35016	25512	7857	15985	12805	14100	7594	1154	18849
4.	Gross returns	12734	13612	60806	44460	6476	19832	13283	10518	8147	1283	23503
5.	Net returns over TVC	1821	3518	37531	27710	-4.24	5307	3015	-1510	2229	441	6237
6.	Net returns over TC	-603	952	25790	18948	-1381	3847	478	-3583	553	129	4654
7.	Returns on per rupee invested at TC	0.95	1.08	1.74	1.73	0.82	1.24	1.04	0.75	1.07	1.11	1.24

Crops = Rs./ha, Poultry = Rs./1000 birds, Goat rearing = Rs./animal, Dairy = Rs./animal

Table 4.12 continued…

Sr No	Particulars	FS – III							FS - IV				FS - V		
		Paddy (*Kharif*)	Black gram (*rabi*)	Cowpea (*Kharif*)	Cowpea (*rabi*)	Wal (*rabi*)	Green gram (*rabi*)	Dairy	Paddy (*kharif*)	Brinjal (*rabi*)	Lady's finger (*rabi*)	Poultry	Paddy *kharif*	Grass	Dairy
1.	Total variable cost (TVC)	10821	8159	18862	16013	16672	13694	12283	9885	44384	27981	28300	11897	3410	13352
2.	Total fixed cost (TFC)	2719	3129	5751	5698	5712	4828	1662	3015	32814	27537	3126	3085	1517	2186
3.	Total cost (TC)	13540	11289	24613	21711	22384	18522	13945	12900	77198	55519	31426	14982	4927	15538
4.	Gross returns	13585	16043	31785	31458	31547	26235	17037	11530	190325	158666	36089	15735	6366	19348
5.	Net returns over TVC	2764	7884	12923	15445	14875	12541	4754	1645	145940	130685	7789	3838	2956	5996
6.	Net returns over TC	45	4754	7172	9747	9163	7713	3092	-1370	113127	103147	4643	753	1439	3810
7.	Returns on per rupee invested at TC	1.00	1.42	1.29	1.45	1.41	1.42	1.22	0.89	2.47	2.80	1.14	1.05	1.29	1.24

Crops = Rs./ha, Poultry = Rs./1000 birds, Dairy = Rs./animal

i) Green gram : The per hectare total variable cost and total fixed cost of green gram in FS-III amounted to Rs.13694 and Rs.4828. The per hectare gross returns were estimated at Rs.26235. The net returns at total cost were Rs.7712 and returns per rupee invested at total cost were Rs.1.42.

j) Brinjal : It was observed that farmers following FS-IV have incurred total cost of Rs.77198 in brinjal cultivation, while per hectare gross returns obtained was Rs.190325, resulting into net income at total cost to Rs.113126.

k) Lady's finger : Per hectare total cost of cultivation worked out to Rs.55519 for FS-IV. The per hectare gross returns was estimated to Rs.158666. The net returns over variable cost and net returns over total cost were amounted at Rs.130685 and Rs.103147, respectively.

l) Grass : Grass was also an enterprise found in this region under FS-V, where only cutting and selling activities were involved. The per hectare gross returns worked out to Rs.6366 and per hectare total cost was Rs.4927, resulting into net returns of Rs.1439 per ha.

m) Dairy : Dairy enterprise was followed by majority of farmers in this region. The per animal maximum gross returns were in FS-II, (Rs.23503) followed by .FS-I. (19832). The annual total cost of maintenance per animal was Rs.18849 in FS-II and Rs.15984 in FS-I. The per animal net returns at total cost was maximum in FS-II (Rs.4654) followed by FS-I (Rs.3846).

n) Goat rearing : Goat rearing was found to be followed in FS-II. The per animal gross returns was Rs.1283 and per animal total annual cost of maintenance was Rs.1154. The net return per rupee invested at total cost was Rs.1.11.

o) Poultry : Poultry was found to be one of the remunerative enterprises in FS-IV of this region. The total cost and gross returns per 1000 birds were worked out to Rs.31426 and Rs.36089, respectively. The per unit net returns over total cost were Rs.4663 and returns per rupee invested at total cost were Rs.1.14.

4.4.3 Profitability of Enterprises in Southern Central Plains and Hills Region

The results of per hectare and per unit profitability in different enterprises in Southern central plains and hills region are presented in Table 4.13.

a) Paddy : Paddy was found to be one of the major crop enterprises followed in this region. Paddy was cultivated in *kharif* as well as in *Rabi* season. In *kharif* paddy, the per hectare gross returns was maximum in FS-V, (Rs.21042) and minimum (Rs.12589) in FS-IV. The per hectare total cost of cultivation of *Kharif* paddy was maximum (Rs.22680) in FS-V and minimum (Rs.12140) in FS-IV. The returns on per rupee invested at total cost was negative in all farming systems except FS-IV. Paddy in *rabi* season found to be more remunerative than in *kharif* season. The per hectare gross returns in FS-IV, was estimated at Rs.18095, followed by FS-I (Rs.18089). The total cost of cultivation in these farming systems amounted to Rs.15340 and 17545, respectively, resulting into net returns at total cost to Rs.2754 and Rs.544, respectively. The returns on per rupee invested at total cost in *Rabi* season were Rs.1.2 in FS-IV and Rs.1.03 in FS-I.

b) Bottle gourd : Bottle gourd was one of the remunerative crop grown under FS–I. Per hectare variable cost was estimated at Rs.28819 and per hectare total fixed cost was Rs.13627. The per hectare gross return amounted to Rs.78333, resulting into net returns over total cost to the tune of Rs.35887 and return on per rupee invested at total cost was Rs.1.80.

c) Tomato : The per hectare gross returns and total cost under FS-I for tomato cultivation were Rs.102500 and Rs.44650, resulting into net returns over total cost to Rs.57850.

d) Brinjal : It was observed from Table 4.13 that, the total cost of cultivation of brinjal in FS-I worked out to Rs.42993 and per hectare gross return was Rs.113603.

Table 4.13 : Profitability of Enterprises Followed in Southern central plains and hills region

(Rs. per unit)

Particulars	FS – I									FS - II		
	Paddy (*Kharif*)	Paddy (*rabi*)	Bottle gourd (*rabi*)	Tomato (*rabi*)	Brinjal (*rabi*)	Lady's finger (*rabi*)	Smooth gourd (*rabi*)	Chilli (*rabi*)	Dairy	Paddy (*kharif*)	Paddy (*rabi*)	Dairy
Total variable cost (TVC)	11778	13958	28819	26995	23488	24252	21026	26431	11843	12526	14025	10902
Total fixed cost (TFC)	2499	3586	13627	17654	19505	24155	12174	21586	2097	2834	34104	1981
Total cost (TC)	14277	17545	42446	44650	42993	48407	33200	48017	13940	15361	17619	12883
Gross returns	11566	18089	78333	102500	113603	141500	69645	126087	17059	14137	17612	14675
Net returns over TVC	-212	4131	49514	75505	90115	117248	48589	99656	5216	1611	3407	3773
Net returns over TC	-2711	544	35887	57850	70610	93093	36415	78070	3119	-1224	-7	1792
Returns on per rupee invested at TC	0.81	1.03	1.80	2.30	2.60	2.90	2.10	2.60	1.22	0.92	0.99	1.13

Crops = Rs./ha, Poultry = Rs./1000 birds, Dairy = Rs./animal

Table 4.13 continued…

Particulars	FS – III				FS - IV								FS - V				
	Paddy *kharif*	Paddy *rabi*	Goat rearing	Dairy	Paddy *kharif*	Paddy *rabi*	Cowpea *kharif*	Wal *kharif*	Gram *kharif*	Green gram *kharif*	Poultry	Dairy	Paddy *kharif*	Paddy *rabi*	Mango	Cashewnut	Dairy
Total variable cost (TVC)	12544	11619	654	11760	9531	11814	20462	17900	18789	19390	15697	10646	18146	11437	26698	13753	9869
Total fixed cost (TFC)	3029	3276	321	1590	2608	3526	6135	4817	5700	6409	1197	1614	4539	2968	12772	9315	1559
Total cost (TC)	15574	14896	975	13350	12140	15340	26597	22718	24490	25800	16894	12260	22680	14406	39472	23068	11428
Gross returns	14009	15762	1396	19636	12589	18095	33750	25844	31140	35394	30244	17207	21042	14426	63451	42032	17015
Net returns over TVC	1446	4143	742	7876	3058	6281	13288	7944	12351	16004	14547	6561	2896	2989	36753	28279	7146
Net returns over TC	-1565	866	421	6286	449	2755	7153	3126	6650	9594	13350	4947	-1638	19	23979	18964	5587
Returns on per rupee invested at TC	0.90	1.06	1.43	1.47	1.00	1.2	1.27	1.1	1.30	1.40	1.70	1.40	0.93	1.00	1.61	1.82	1.49

Crops = Rs./ha, Poultry = Rs./1000 birds, Goat rearing = Rs./animal, Dairy = Rs./animal

e) Lady's Finger : The per hectare total cost of cultivation and per hectare gross returns under FS-I for lady's finger worked out to Rs.48407 and Rs.117247, respectively. The per hectare net returns over total cost Rs.93092.

f) Smooth gourd : Smooth gourd was another important vegetable crop grown under FS-I. The per hectare total variable cost and total fixed cost were Rs.21026 and Rs.12174, respectively. The per hectare gross returns were Rs.69645. The return on per rupee invested at total cost was worked out to Rs.2.10.

g) Chilli : The per hectare total cost of cultivation of chilli under FS-I worked out to Rs.48017. The per hectare gross returns was Rs.126087. The net return over total cost worked out to Rs.78070.

h) Cowpea : The per hectare gross returns from cowpea under FS-IV was estimated at Rs.33750. The per hectare total cost worked out to Rs.26597, and return on per rupee invested at total cost was Rs.1.27.

i) Wal : Per hectare total cost and gross returns in wal under FS-IV were Rs.22718 and Rs.25844, respectively. The per hectare net returns over total cost was Rs.3125.

j) Gram : The per hectare gross returns from gram cultivation under FS-IV was worked out to Rs.31140. The total cost of cultivation was Rs.24490. The per hectare net return over total cost was Rs.6649.

k) Green gram : Per hectare total variable cost for greengram under FS-IV Rs.19390. The total cost of cultivation was Rs.25800. The per hectare gross returns was Rs.35394 and net return per rupee invested at total cost was Rs.9593.

l) Mango : Mango was found to be grown (FS-V) in this region. The per hectare gross returns was Rs.63451 and total cost was Rs.39472. The per hectare net returns at total cost was Rs.23979. The return on per rupee invested at total cost was Rs.1.61.

m) Cashewnut : The per hectare gross returns and total cost of cultivation of cashewnut under FS-V were Rs.42032 and Rs.23068, respectively. The net returns over total variable cost worked out to Rs.28279 and net returns over total cost was Rs.18964. The return on each rupee invested at total cost worked out to Rs.1.82.

n) Dairy : Dairy was also important enterprise in this region followed by majority of the farmers. The per animal gross returns was Rs.19636 in FS -III, followed by Rs.17207 in FS-IV. The returns per rupee invested were ranging from Rs.1.13 in FS-II to Rs.1.49 in FS-V.

o) Goat rearing : Goat rearing was followed in this region only under FS-III. The per animal gross returns and total cost were worked out to Rs.1396 and Rs.975, respectively resulting into per animal net income over total cost to the tune of Rs.420.

p) Poultry : Poultry was found to be one of the very remunerative enterprises followed in this region (FS-IV). The per unit (1000 birds) gross return was Rs.30244. The per unit total cost worked out to Rs.16894. The return on each rupee invested at total cost was Rs.1.70.

4.4.4 Profitability of Enterprises in Southern Coastal Plains

The results of per hectare and per unit profitability of enterprises in Southern coastal plains are presented in Table 4.14.

a) Paddy : paddy was grown by majority of the farmers in this region. The per hectare gross returns worked out to Rs.19003 in FS-VI, Rs.18205 in FS-IV, Rs.17929 in FS-II and Rs.17046 in FS-I. The per hectare total cost of cultivation was ranging from Rs.17304 in (FS-I) to Rs.19168 (FS-III). The net returns per rupee invested were less than one in all farming systems except in FS – VI (Rs.1.09).

b) Mango : The per hectare gross returns in mango cultivation was Rs.49758 in FS-I followed by Rs.49670 in FS-VI and Rs.42409 (FS-III). The per hectare net returns were ranging from Rs.15344 (FS-III) to Rs.23038 (FS-I).

Table 4.14 : Profitability of Enterprises Followed in Southern coastal plains region

(Rs. per unit)

Sr No	Particulars	FS – I				FS – II				FS – III					
		Paddy *kharif*	Mango	Cashe-w nut	Dairy	Paddy *kharif*	Coco-nut	Areca-nut	Dairy	Paddy *kharif*	Coco nut	Areca-nut	Mango	Cashew-nut	Dairy
1.	Total variable cost (TVC)	13956	15985	12101	11577	12856	20462	30317	15093	13625	19211	26006	16676	10161	14742
2.	Total fixed cost (TFC)	3407	10733	6742	1385	5067	14214	13880	1728	5543	16350	14994	10387	7428	1593
3.	Total cost (TC)	17364	26719	18844	12962	17923	34676	44198	16821	19168	35561	41000	27064	17589	16335
4.	Gross returns	17046	49758	27280	18050	15633	64930	61980	23231	17929	77184	68100	42409	26121	24097
5.	Net returns over TVC	3090	33772	15178	6473	2777	44468	31662	8137	4304	57973	42094	25733	15960	9355
6.	Net returns over TC	-318	23039	8436	5088	-2290	30254	17782	6410	-1239	41623	270100	15345	8532	7762
7.	Returns on per rupee invested at TC	0.98	1.86	1.45	1.39	0.87	1.87	1.40	1.38	0.94	2.17	1.66	1.57	1.49	1.47

Crops = Rs./ha, Poultry = Rs./1000 birds, Dairy = Rs./animal

Table 4.14 continued…

Sr No	Particulars	FS - IV							FS – V			System VI					
		Paddy *kharif*	Areca nut	Coco-nut	Brinjal *rabi*	Smoth-gourd *rabi*	Bottle-gourd *rabi*	Dairy	Coco-nut	Areca nut	Dairy	Paddy *kharif*	Coco-nut	Areca nut	Mango	Cashew nut	Poultry
1.	Total variable cost (TVC)	14887	27276	31109	46271	34133	39853	13905	19142	23309	14334	13523	19390	28308	16084	14530	27989
2.	Total fixed cost (TFC)	4317	10730	12062	20666	25600	16344	886	12295	11509	1805	3977	11407	12094	10950	7020	1290
3.	Total cost (TC)	19205	38006	43171	66938	59734	56198	14790	31437	34819	16139	17500	30797	40402	27035	21551	29279
4.	Gross returns	18204	50146	59091	116299	145903	90366	22430	53633	47973	19073	19003	51416	54606	49678	27560	32976
5.	Net returns over TVC	3316	22870	27982	70028	111770	50513	8525	34491	24664	4739	5480	32026	26298	33594	13030	4987
6.	Net returns over TC	-1001	12140	15920	49361	86169	34168	7640	22196	13154	2934	1503	20619	14204	22643	6009	3697
7.	Returns on per rupee invested at TC	0.95	1.32	1.37	1.74	2.44	1.61	1.51	1.71	1.38	1.18	1.09	1.67	1.35	1.84	1.28	1.12

Crops = Rs./ha, Poultry = Rs./1000 birds, Dairy = Rs./animal

c) Cashewnut : The per hectare total cost of cultivation of cashewnut was Rs.17589 in FS-III, Rs.18844 in FS-I and Rs.21551 in FS-VI. The per hectare gross returns were observed to be maximum in FS-VI (Rs.27560) followed by in FS-I (Rs.27280) and FS-III (Rs.26121). The return on each rupee invested was ranging from Rs.1.28 in FS-VI to Rs.1.49 in FS-III.

d) Coconut : The total variable cost in coconut worked out to Rs.20462, Rs.19211, Rs.31109, Rs.19142 and Rs.19390, in FS-II, FS-III, FS-IV, FS-V and FS-VI, respectively. The gross returns was maximum in FS-II (Rs.64930) followed by in FS-V (Rs.53633) and FS-VI (Rs.51416). The per hectare net returns at total cost was ranging from Rs.15920 in FS-IV to Rs.41622 in FS-III.

e) Arecanut : The per hectare gross returns from arecanut was maximum (Rs.68100) in FS-III followed by (Rs.61980) in FS-II. The per hectare total cost of cultivation was ranging from Rs.34819 in FS-V to Rs.50146 in FS-IV. The net returns over total cost worked out to Rs.30254, Rs.41623, Rs.12140, Rs.13154 and Rs.20619 in FS-II, FS-III, FS-IV, FS-V and FS-VI, respectively.

f) Brinjal : Brinjal was found to be grown by farmers who have followed FS-IV. The per hectare gross returns and per hectare total cost were Rs.116299 and Rs.66938, respectively, resulting into net returns over total cost to Rs.49361. The returns on per rupee invested was Rs.1.74.

g) Smoothgourd : Smooth gourd was grown under FS-IV in *Rabi* season with a per hectare total cost Rs.59734 and per hectare gross returns of Rs.145903.

h) Bottlegourd : The per hectare gross returns from bottle gourd in FS-IV worked out to Rs.90366. The per hectare total cost of cultivation was Rs.56198. The returns on per rupee invested at total cost was Rs.1.61.

i) Dairy : It was observed from Table 4.14 that, under dairying, per animal gross returns was maximum in FS-III (Rs.24097), followed by FS -II (Rs.23231) and FS-IV (Rs.22430). The per animal net return over total cost was ranging from Rs.2935 in FS-V to Rs.7762 in FS-III.

j) Poultry : The results of per unit (1000 birds) cost and returns from poultry indicated that, the per unit gross returns and total cost were Rs.32976 and Rs.29279, respectively resulting into net income at total cost to Rs.3697 in FS-VI.

4.5 Cost and Returns Structure of Major Farming Systems

The per farm cost and return structure in major farming systems followed by farmers were estimated for each region (clusters) independently and they are presented in Table 4.15 to Table 4.18.

4.5.1 Cost and Returns of Major Farming Systems in Northern coastal plains region

The results of farming systemwise per farm cost and returns profile in Northern coastal plains region are presented in Table 4.15.

In this region 5 major farming systems were observed. The farming systems in this region were 1) Paddy + Irrigated plantations + Dairy (FS-I), 2) Paddy + Grass + Dairy + Goat rearing (FS-II), 3) Paddy + Irrigated plantations + Flowers (FS-III), 4) Irrigated plantations + Dairy (FS-IV), and 5) Paddy + Irrigated plantations + Betalvines (FS-V).

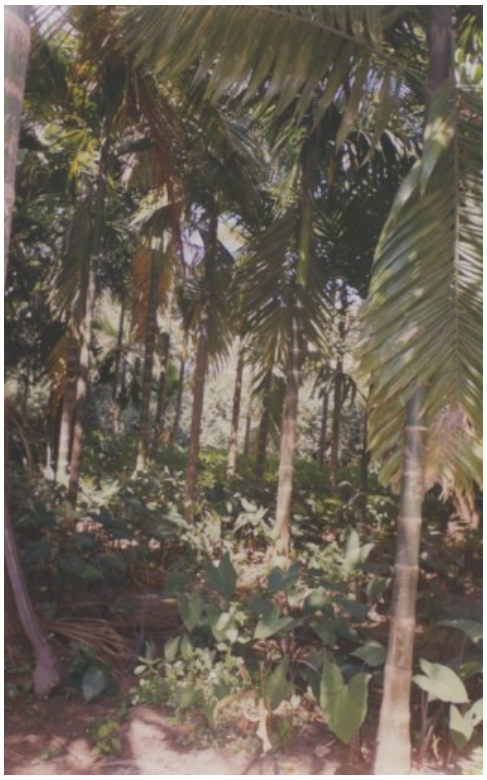
The enterprises followed in FS-I were paddy, sapota, coconut arecanut, banana and dairy. Per farm total labour used in this system worked out to 593 man days. The per farm total variable cost was Rs.77062. Total fixed cost was Rs.32991. Per farm total cost and gross returns were Rs.110053 and Rs.167116, respectively. The net returns over total variable cost was worked out to Rs.90054. The net returns at total cost was Rs.57062 resulting into returns on per rupee invested at total cost to Rs.1.52.

It was observed from Table 4.15 that, the components of FS-II were paddy, grass, dairy and goat rearing. The per farm total variable cost was worked out to Rs.38439. The total cost was Rs.58176. The per farm gross returns was amounted to Rs.59374. The net returns

Table 4.15 : Cost and Returns Structure of Major Farming Systems Followed in Northern coastal plains region

(Value in Rs./farm)

Sr. No	Particulars	Unit	FS – I		FS – II		FS – III		FS – IV		FS - V	
			Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
I	Variable cost											
1.	Human labour	MD	593.00	35972.96	355.02	13455.17	1197.12	39137.00	504.93	31981.05	1019.03	64320.74
2.	Bullock labour	BD	19.75	728.23	20.17	889.04	17.52	736.35	0.00	0.00	44.66	2648.91
3.	Seed	KG		978.60		784.75	39.83	3233.50	0.00	0.00	163.10	2105.87
4.	FYM	CL	25.95	7153.65	5.69	1152.67	132.79	13633.40	19.12	6471.32	43.81	10757.37
5.	Fertilizer	KG	692.37	4139.05	36.50	226.30	1933.78	8017.03	797.94	4738.77	4937.70	25348.51
6.	PPC	KG	1.25	358.40	0.00	0.00	80.70	13032.65	0.96	339.51	3.81	1238.49
7.	Chicks (poultry)	No	0.00	0.00	0.00	0.00		0.00	0.00	0.00		0.00
8.	Feed poultry	Bag	0.00	0.00	0.00	0.00		0.00	0.00	0.00		0.00
9.	Dry fodder	No	40.77	4392.05	38.00	3815.61		0.00	38.38	4866		0.00
10.	Green fodder	No	6.41	5289.60	307.23	6575.33		0.00	7.22	7890		0.00
11.	Concentrate	KG	935.25	6993.35	1036.86	7505.37		0.00	552.00	4090		0.00
12.	Irrigation charges			707.47		0.00		1253.90		760.012		1257.55
13.	Miscellaneous charges			2803.95		839.97		807.43		2033.42		1970.13
14.	Interest on working capital			7544.77		3195.55		9331.55		7580.41		12357.33
	Total Variable Cost(TVC)			77062.08		38439.76		89182.80		70750.52		122004.90
II	Fixed Cost (FC)											
1.	Land revenue and taxes			21.68		10.04		24.79		11.45		26.22
2.	Depreciation charges			2078.32		1544.89		1173.65		1659.63		4523.41
3.	Rental value			21672.14		2502.56		29512.86		18932.58		71729.22
4.	Amortization cost			2598.90		0.00		1635.92		2672.90		5017.30
5.	Imputed value of Animal			2237.35		4990.06		0.00		3832		0.00
6.	Interest on fixed capital			4383.50		10688.84		2911.87		3250.82		9058.61
	Total Fixed Cost (TFC)			32991.88		19736.40		35259.08		30359.40		90354.76
III	Total Cost (TC)			110053.96		58176.15		124412.00		101109.90		212359.70
IV	Output/Returns											
1.	Returns from crops			130032.83		15015.37		177077.13		113595.5		430375.30
2.	Dairy			37083.75		31707.97		0.00		45132.00		0.00
3.	Poultry			0.00		0.00		0.00		0.00		0.00
4.	Goat rearing			0.00		12650.92		0.00		0.00		0.00
	Gross returns			167116.58		59374.26		177077.13		158727.50		430375.30
	Net returns at TVC			90054.50		20934.51		87894.33		87976.98		308370.40
	Net returns at TC			57062.62		1198.11		52635.25		57617.58		218015.60
	Returns on per rupee invested at TVC			2.17		1.54		1.99		2.24		3.52
	Returns on per rupee invested at TC			1.52		1.02		1.42		1.56		2.02



Arecanut + Arum enterprises

Harvesting of hibiscus

Plate 3. Farming systems enterprises in northern coastal plains

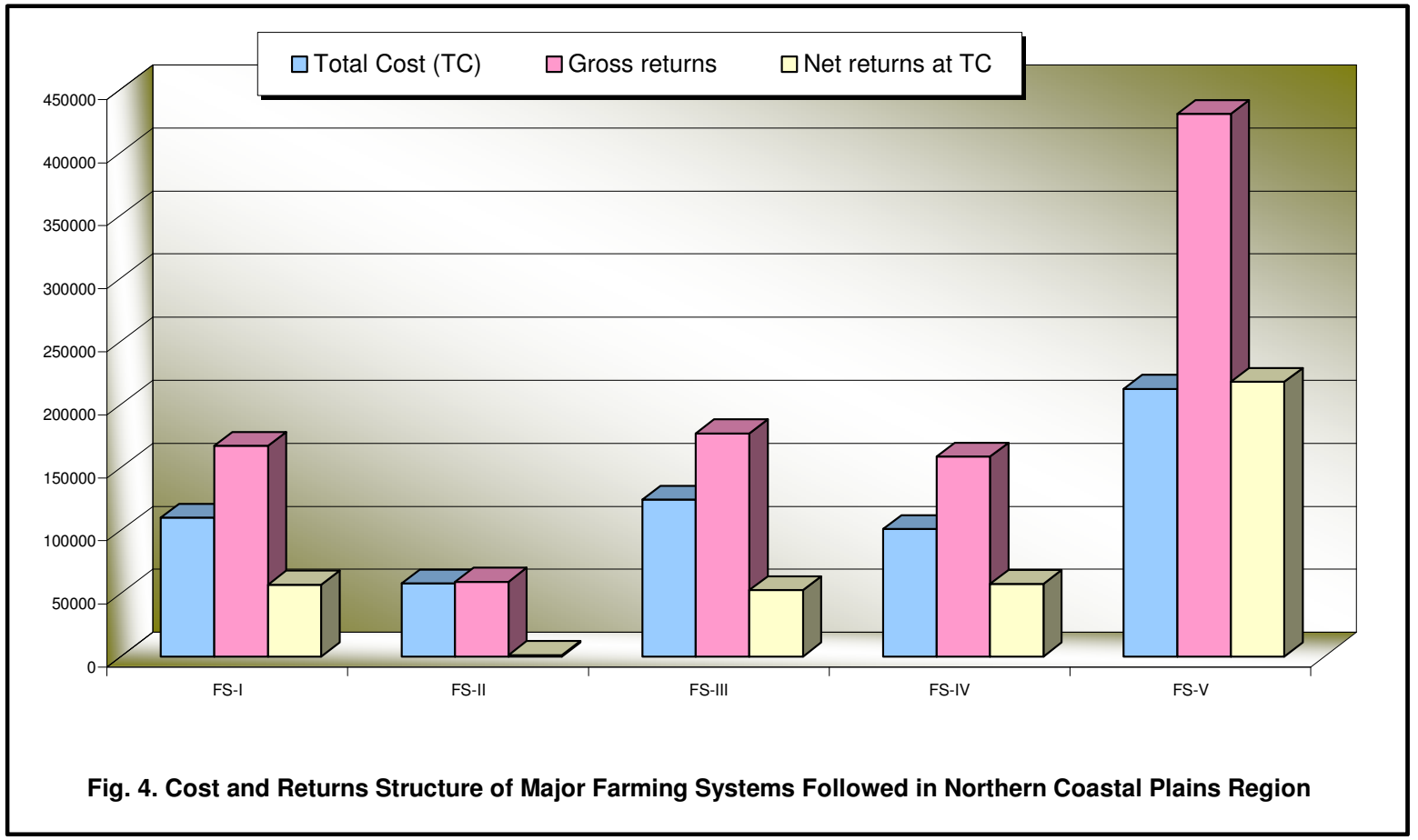


Fig. 4. Cost and Returns Structure of Major Farming Systems Followed in Northern Coastal Plains Region

Fig. 4. Cost and Returns Structure of Major Farming Systems Followed in Northern Coastal Plains Region

Jasmine cultivation

Coconut + Arecanut cultivation

Dairy + Banana + Coconut enterprises

Plate 4. Farming systems enterprises in northern coastal plains

over total cost was just Rs.1198 resulting into low returns on per rupee invested at total cost (Rs.1.02).

In case of FS-III enterprises such as paddy, coconut, arecanut and eight types of flower crops were grown. The per farm labour requirement was 1197 man days. The per farm total variable cost was amounted to Rs.89183. The total cost was worked out to Rs.124442. The per farm net returns over variable cost and over total cost were Rs.87894 and Rs.52635, respectively. The return on per rupee invested at total cost was Rs.1.42.

The farmers following FS-IV were engaged in cultivation of sapota, coconut, arecanut crops along with maintaining the dairy animals. Per farm total employment generated was 505 man days. The per farm total variable cost was Rs.70750 and total cost was Rs.101110. The per farm gross return was worked out to Rs.158728. The net returns over total cost was amounted to Rs.57618. The return on per rupee invested at total cost was Rs.1.56.

Regarding FS-V, it was observed that, the enterprises followed under this system were paddy, coconut, betalvines and arecanut. The per farm labour used were 1019 man days. The per farm total variable cost was Rs.122005. The total cost was worked out to Rs.212360. The per farm gross return was amounted to Rs.430375 and returns on per rupee invested at total cost was Rs.2.02.

Among the farming systems followed in Northern coastal plains region maximum per farm labour were used in FS -III (1197 man days) followed by FS -V (1019 man days) and FS -I (593 man days). The per farm net returns over total cost was maximum in FS-V (Rs.218016) followed by FS -IV (Rs.57618), FS -I (Rs.57062), FS -III (Rs.52637) and FS -II (Rs.1198). The net return per rupee invested at total cost were worked out to Rs.2.02 in FS -V, followed by Rs.1.56, Rs.1.52, Rs.1.42 and Rs.1.02 in FS – I, FS-III and FS-II respectively.

4.5.2 Cost and Returns of Major Farming Systems in Northern Central Plains and Hills Region

The results of farming system wise per farm cost and returns in Northern central plains and hills region are presented in Table 4.16

It was observed that sample farmers in this region have followed farming systems such as 1) Paddy + Other cereals + Rainfed plantations + Dairy (FS-I), 2) Paddy + Other cereals + Dairy + Goat rearing (FS-II), 3) Paddy + Pulses + Dairy (FS-III), 4) Paddy + Vegetables + Poultry (FS-IV) and 5) Paddy + Grass + Dairy (FS-V).

It is observed from Table 4.16 that the enterprises followed in FS-I were *Kharif* paddy, finger millet (nagli), mango, cashewnut, prosomillet (vari) and dairy. The per farm total labour used in this system were 320 man days. The total variable cost incurred worked out to Rs.40814 and the total fixed cost was Rs.9629. The per farm gross returns obtained from various enterprises amounted to Rs.64911. The returns on per rupee invested at total cost was Rs.1.29.

In FS-II, the enterprises included in this system were *Kharif* paddy, finger millet (nagli), prosomillet (vari), goat rearing and dairy. The per farm total human labour used in this system was 350 man days. The total expenditure incurred on all variable items (TVC) worked out to Rs.48427. Per farm total cost and gross returns worked out to Rs.57212 and Rs.65894, respectively, resulting into net returns of Rs.8683. The return on per rupee invested at total cost was Rs.1.15.

FS-III consisted enterprises such as paddy, black gram, cowpea, wal, green gram and dairy. The per farm total labour used worked out to 313 man days. The per farm total variable cost amounted to Rs.35323 and per farm total cost and gross returns were Rs.43763 and Rs.54465, respectively. The net returns at total cost worked out to Rs.10702 resulting into returns on per rupee invested at total cost to Rs.1.24.

In FS-IV, enterprises such as paddy, vegetables and poultry were observed. The vegetable crops grown were brinjal and lady's finger. The total per farm employment created in this farming system was 471 man days. The total variable cost and total fixed cost were amounted to Rs.301231 and Rs.47819, respectively. The gross returns was worked out to Rs.444161. The net returns at total cost were Rs.95111. The return on per rupee invested was worked out to Rs.1.27.

Jasmine + Yellow champak enterprises

Betel vine cultivation

Grading of betel leaves

Plate 5. Farming systems enterprises in northern coastal plains

Table 4.16 : Cost and Returns Structure of Major Farming Systems Followed in Northern central plains and hills region

(Value in Rs./farm)

Sr. No.	Particulars	Unit	FS – I		FS – II		FS – III		FS – IV		FS - V	
			Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
I	Variable Cost											
1.	Human labour	MD	320.97	16366.08	350.45	16829.18	313.18	14821.70	471.03	22337.63	302.96	16615.58
2.	Bullock labour	BD	18.97	1242.84	21.69	1491.86	26.27	1685.28	45.55	3818.84	24.31	1390.08
3.	Seed	KG	75.55	955.86	94.53	1004.08	179.47	1540.61	81.61	2829.67	83.35	1112.22
4.	FYM	CL	17.96	3916.34	10.16	2344.75	22.24	3023.63	17.21	4048.31	8.46	2205.57
5.	Fertilizer	KG	307.68	1995.47	134.23	661.36	7.11	1566.37	404.48	2461.55	186.79	813.63
6.	PPC	KG	0.64	342.65	0.00	0.00	119.10	1048.87	0.86	324.91	0.00	0.00
7.	Chicks (poultry)	No	0.00	0.00	0.00	0.00	0.00	0.00	9861.72	108575.32	0.00	0.00
8.	Feed poultry	KG	0.00	0.00	0.00	0.00	0.00	0.00	10806.44	117887.56	0.00	0.00
9.	Dry fodder	QT	29.02	3363.54	47.41	5255.48	23.64	2537.64		0.00	74.37	7493.27
10.	Green fodder	QT	5.18	4964.18	152.64	9508.62	31.81	3007.32		0.00	65.99	5958.75
11.	Concentrate	KG	614.20	3749.06	1068.45	6287.62	530.89	3258.12		0.00	995.35	6887.18
12.	Irrigation Charges		0.00	0.00		0.00	0.00	200.00		90.05		0.00
13.	Miscellaneous charges			1124.76		853.92		313.60		8537.97		791.32
14.	Interest on working capital			2793.68		4189.71		2319.52		30319.55		3895.56
	Total Variable Cost (TVC)			40814.46		48426.58		35322.66		301231.36		47163.16
II	Fixed Cost (FC)											
	Land revenue and taxes			17.78		14.87		17.07		17.17		18.65
1.	Depreciation charges			697.11		934.55		676.16		12066.42		1203.06
2.	Rental value			6786.03		3004.97		5840.57		16043.87		4046.25
3.	Amartization cost			275.18		0.00		0.00		0.00		0.00
4.	Imputed value of Animal			1058.96		4608.48		1155.96		0.00		3084.93
5.	Interest on fixed capital			793.65		222.78		750.76		19691.22		1657.41
	Total Fixed Cost (TFC)			9628.70		8785.65		8440.51		47818.68		10010.30
III	Total Cost (TC)			50443.16		57212.23		43763.17		349050.04		57173.45
IV	Output/Returns											
1.	All crops			40716.18		18029.83		35043.39		96263.21		24277.47
2.	Dairy			24194.81		31494.02		19422.18		0.00		43919.96
3.	Poultry			0.00		0.00		0.00		347897.96		0.00
4.	Goat rearing			0.00		16371.08		0.00		0.00		0.00
	Gross returns			64910.98		65894.93		54465.57		444161.17		68197.43
	Net returns at TVC			24096.52		17468.35		19142.91		142929.81		21034.27
	Net returns at TC			14467.82		8682.70		10702.40		95111.13		11023.98
	Returns on per rupee invested at TVC			1.59		1.36		1.54		1.47		1.45
	Returns on per rupee invested at TC			1.29		1.15		1.24		1.27		1.19

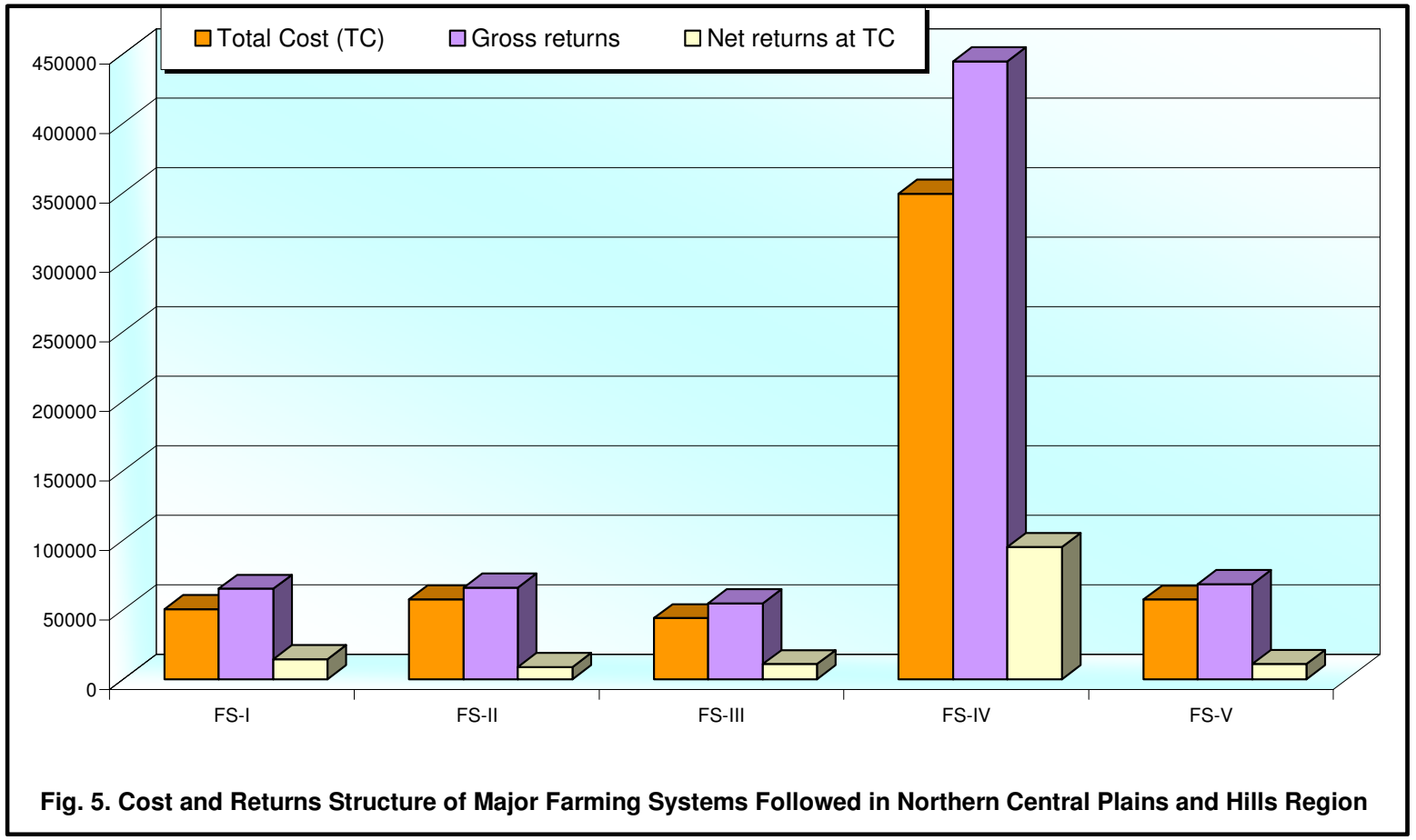


Fig. 5. Cost and Returns Structure of Major Farming Systems Followed in Northern Central Plains and Hills Region

Fig. 5. Cost and Returns Structure of Major Farming Systems Followed in Northern Central Plains and Hills Region

Goat rearing enterprise

Prosomillet cultivation

Wal cultivation

Plate 6. Farming systems enterprises in northern central plains and hills

The FS-V consisted of paddy, grass and dairy. The per farm total cost was Rs.57173 and gross returns was worked out to Rs.68197, resulting into net returns at total cost to Rs.11024. The return on per rupee invested at total cost was Rs.1.19.

Among all farming systems followed in the region FS-IV required maximum labour (471 man days). The per farm gross returns was maximum in FS-IV (Rs.444161) followed by FS-V (Rs.68197), FS-II (Rs.65895) FS-I (Rs.64910) and FS-III (Rs.54465). The net returns at total cost was maximum in FS–IV (Rs.95111) followed by FS-I (Rs.14467).

4.5.3 Cost and Returns of Major Farming Systems in Southern Central Plains and Hills Region

The results of farming systemwise per farm cost and returns structure in Southern central plains and hills region are presented in Table 4.17.

In this region five major faming systems were observed to be followed by the farmers. These systems were 1) Paddy + Vegetables + Dairy (FS-I), 2) Paddy + Dairy (FS-II), 3) Paddy + Dairy + Goat rearing (FS-III), 4) Paddy + Pulses + Dairy + Poultry (FS-IV) and 5) Paddy + Rainfed plantations + Dairy (FS-V).

It was observed from Table 4.17 that, farmers following FS-I have undertaken farm enterprises such as *Kharif* paddy, *Rabi* paddy, bottle gourd, tomato, brinjal, smooth gourd, lady's finger, chilli and dairy. The total per farm employment generated worked out to 425.17 man days. The per farm total variable cost and total cost worked out to Rs.54608 and Rs.74520, respectively. The per farm gross returns was amounted to Rs.120722. The return on per rupee invested at total cost were Rs.1.62.

In FS-II *Kharif* paddy and dairy enterprise were under taken. Regarding cost and returns in FS-II, it was observed that per farm total cost and gross returns were Rs.42966 and Rs.44101, respectively. The per farm net returns at total cost was Rs.1135.

The enterprise followed under FS-III were *kharif* paddy, dairy and goat rearing. The per farm total variable cost was Rs.38626. The per farm total cost incurred was Rs.47195. The net returns over total cost worked out to Rs.11814. The returns on per rupee invested at variable cost and total cost were Rs.1.53 and Rs.1.25, respectively.

It was observed that in FS-IV, the farm enterprises such as paddy, cowpea, wal, gram, green gram, dairy and poultry were followed. The per farm human labour used worked out to 713 man days. The per farm total cost worked out to Rs.266949. The gross returns amounted to Rs.465062. The net returns over total cost was Rs.198113. The returns on per rupee invested at total cost was Rs.1.74.

The farming system (FS-V) consisted of enterprises such as paddy, mango, cashew and dairy. The per farm total cost worked out to Rs.89444. The gross returns amounted to Rs.117204. The per farm net return over total cost worked out to Rs.27760, resulting into returns on per rupee invested at total cost to the tune of Rs.1.31.

Among different farming systems in the region, it was found that per farm gross returns (Rs.465062), net returns over total cost (Rs.198113) and returns per rupee invested at total cost were maximum (Rs.1.72) in FS -IV.

4.5.4 Cost and Returns of Major Farming Systems in Southern Coastal Plains

The results of farming system wise per farm cost and returns profile in Southern coastal plains are presented in Table 4.18.

The farming systems followed in this region were 1) Paddy + Rainfed plantations + Dairy (FS-I) 2) Paddy + Irrigated plantations + Dairy (FS-II) 3) Paddy + Irrigated plantations + Rainfed plantations + Dairy (FS-III) 4) Paddy + Irrigated plantations + Vegetables + Dairy (FS-IV) 5) Irrigated plantations + Dairy and 6) Paddy + Irrigated plantations + Rainfed plantations + Poultry (FS-V).

The farmers following FS -I had undertaken farm enterprises such as paddy, mango, coconut and dairy. The per farm human labour used in this system were 384 man days. The per farm total variable cost and total fixed cost were Rs.42888 and Rs.12234, respectively.

Table 4.17 : Cost and Returns Structure of Major Farming Systems Followed in Southern central plains and hills region

(Value in Rs./farm)

Sr. No.	Particulars	Unit	FS – I		FS – II		FS – III		FS – IV		FS - V	
			Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
I	Variable Cost											
1.	Human labour	MD	425.17	22542.85	457.02	14825.76	505.85	14527.16	713.57	31696.14	606.26	26876.49
2.	Bullock labour	BD	39.58	2385.11	26.98	1662.00	20.70	992.91	32.60	2000.97	39.93	2337.44
3.	Seed	KG	114.73	2976.75	124.46	1635.82	96.41	1177.95	97.69	1626.69	207.80	2876.67
4.	FYM	CL	41.23	2583.07	14.72	3951.54	8.25	1846.50	11.23	2955.22	24.52	6064.80
5.	Fertilizer	KG	330.75	1912.99	302.44	1060.94	165.71	774.45	230.09	1375.73	481.59	3001.24
6.	PPC	KG	1.97	743.90	0.00	124.80	0.00	0.00	1.94	623.00	3.64	1052.05
7.	Chicks (poultry)	No	0.00	0.00	0.00	0.00	0.00	0.00	13330.00	15076.23	0.00	0.00
8.	Feed poultry	KG	0.00	0.00	0.00	0.00	0.00	0.00	143.70	143764.05	0.00	0.00
9.	Dry fodder	QT	51.95	5533.20	36.86	5023.84	44.15	4806.54	44.39	5446.36	66.96	7619.57
10.	Green fodder	QT	125.64	3794.40	45.15	2166.48	63.52	5846.68	45.06	4647.36	78.13	7354.51
11.	Concentrate	KG	795.24	4878.00	463.37	2434.40	872.38	5189.63	783.64	4444.32	1243.52	7764.92
12.	Irrigation Charges			273.14		0.00		80.00		55.12		135.15
13.	Miscellaneous charges			730.50		223.04		270.44		3179.33		1399.22
14.	Interest on working capital			3554.53		2383.40		3114.30		25329.56		4930.91
	Total Variable Cost (TVC)			54608.43		35492.02		38626.56		242220.08		71413.17
II	Fixed Cost (FC)											
	Land revenue and taxes			22.83		18.17		14.61		18.29		35.92
1.	Depreciation charges			972.23		897.98		1211.29		7752.83		1499.07
2.	Rental value			15002.66		4023.91		2860.32		4926.82		10374.33
3.	Amartization cost			0.00		0.00		0.00		0.00		277.88
4.	Imputed value of Animal			2253.60		1214.48		2550.88		1723.96		3527.16
5.	Interest on fixed capital			1660.37		1319.56		1931.88		10306.95		2316.35
	Total Fixed Cost (TFC)			19911.69		7474.10		8568.97		24728.84		18030.71
III	Total Cost (TC)			74520.12		42966.12		47195.53		266948.92		89443.88
IV	Output/Returns											
1.	All crops			90015.97		24143.46		17161.91		29560.89		62245.97
2.	Dairy			30706.20		19958.00		31810.32		32349.16		54958.45
3.	Poultry			0.00		0.00		0.00		403152.52		0.00
4.	Goat rearing			0.00		0.00		10037.24		0.00		0.00
	Gross returns			120722.17		44101.46		59009.47		465062.57		117204.42
	Net returns at TVC			66113.74		8609.44		20382.91		222842.49		45791.25
	Net returns at TC			46202.05		1135.34		11813.94		198113.65		27760.54
	Returns on per rupee invested at TVC			2.21		1.24		1.53		1.92		1.64
	Returns on per rupee invested at TC			1.62		1.03		1.25		1.74		1.31

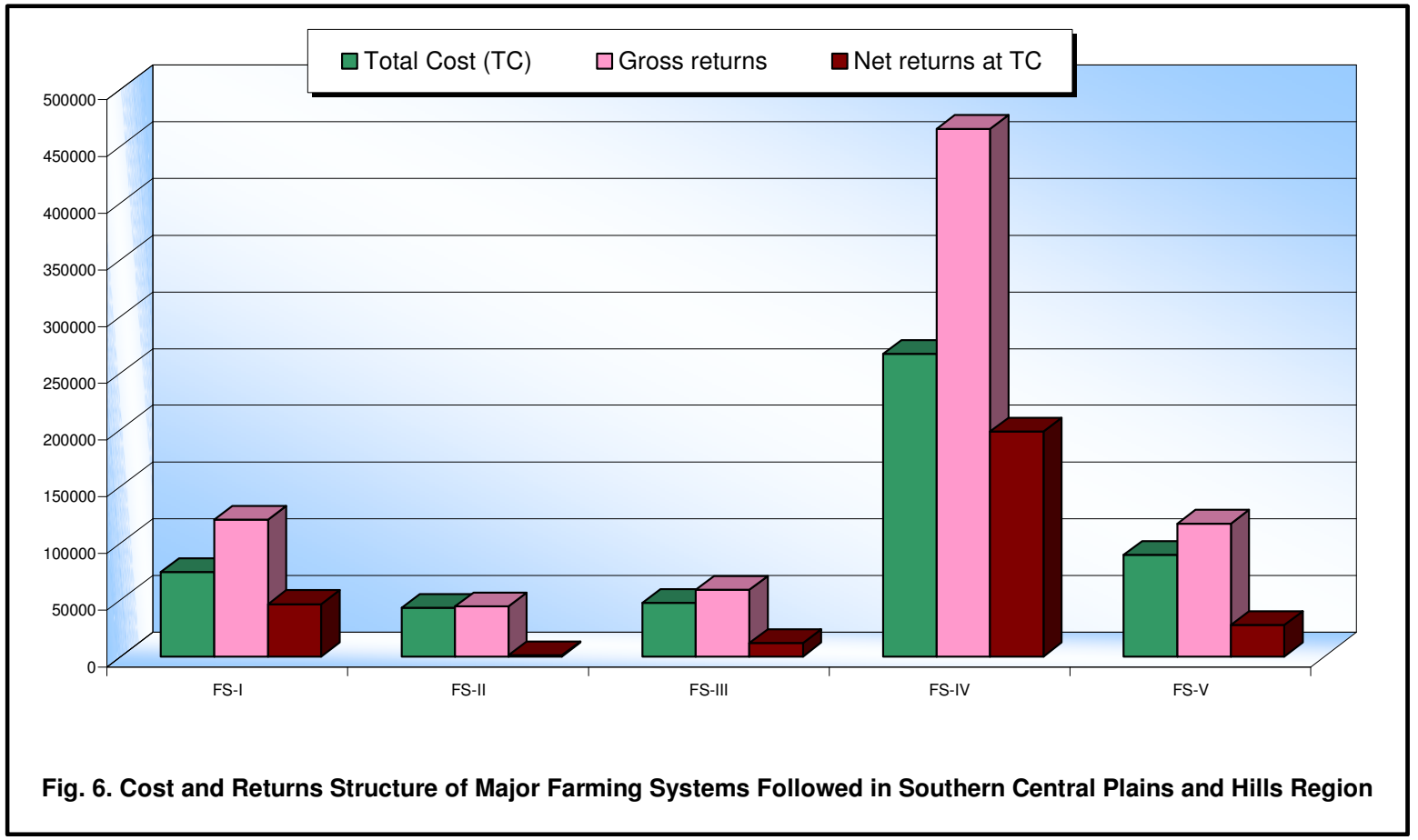


Fig. 6. Cost and Returns Structure of Major Farming Systems Followed in Southern Central Plains and Hills Region

Fig. 6. Cost and Returns Structure of Major Farming System Followed in Southern Central Plains and hills Region

Paddy nursery

Paddy cultivation

Poultry enterprise

Plate 7. Farming systems enterprises in southern central plains and hills

Table 4.18 : Cost and Returns Structure of Major Farming Systems Followed in Southern coastal plains region

(Value in Rs./farm)

Sr. No.	Particulars	Unit	FS – I		FS – II		FS – III		FS – IV		FS - V		FS - VI	
			Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
I	Variable Cost													
1.	Human labour	MD	384.17	17724.01	401.33	19331.51	554.51	29553.21	705.81	42543.45	244.64	14305.29	614.17	35849.72
2.	Bullock labour	BD	15.29	767.51	26.92	663.48	15.06	785.46	38.30	1855.04	0.00	0.00	13.18	732.01
3.	Seed	KG	57.29	902.41	54.39	791.92	49.66	664.56	51.63	4408.78	0.00	0.00	56.02	770.35
4.	FYM	CL	15.09	3882.83	10.92	2958.75	32.58	9936.25	27.21	8023.60	10.93	2925.80	28.12	7343.54
5.	Fertilizer	KG	351.33	2207.01	383.39	2327.31	931.31	5810.48	1036.10	5829.67	114.24	2037.30	743.30	4470.72
6.	PPC	KG	0.67	136.39	2.32	695.04	5.64	479.22	9.31	1274.32	1.40	476.90	2.97	1128.31
7.	Chicks (poultry)	No	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14750	163990.5
8.	Feed poultry	KG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	150.75	176675.50
9.	Dry fodder	QT	37.06	3685.50	45.06	5265.88	57.23	6827.08	32.00	3078.00	26.16	2753.10		0.00
10.	Green fodder	QT	71.25	4830.84	91.37	6986.08	76.08	6350.37	79.40	7548.00	48.13	5138.28		0.00
11.	Concentrate	KG	725.76	4328.10	1007.68	5399.36	1588.21	10438.22	1378.00	8708.00	817.07	6141.24		0.00
12.	Irrigation Charges			0.00		220.09		249.22		271.64		154.15		134.00
13.	Miscellaneous charges			464.94		758.64		1294.35		1702.96		398.77		11965.38
14.	Interest on working capital			3909.29		4669.75		7839.19		7190.83		4101.20		46916.58
	Total Variable Cost (TVC)			42883.83		50067.81		80227.61		92434.29		38432.03		449976.61
II	Fixed Cost (FC)													
	Land revenue and taxes			14.37		14.72		27.44		24.38		9.78		21.88
1.	Depreciation charges			620.58		1714.32		2973.88		1383.12		1333.43		6422.85
2.	Rental value			7471.59		7543.53		19448.00		23466.58		7409.34		14139.47
3.	Amortization cost			520.83		504.57		1548.47		706.37		822.81		1232.55
4.	Imputed value of Animal			1672.65		2374.44		2758.99		885.00		1496.88		0.00
5.	Interest on fixed capital			1933.92		2295.88		4968.88		4419.52		1495.89		15978.02
	Total Fixed Cost (TFC)			12233.94		14447.46		31725.66		30884.96		12568.12		37794.77
III	Total Cost			55072.76		64515.27		111953.27		123319.26		51000.15		487771.38
IV	Output/Returns													
1.	All crops			44829.52		45261.18		116687.99		140799.46		44456.05		84836.79
2.	Dairy			34114.50		43674.28		59519.59		44860.00		24031.98		0.00
3.	Poultry			0.00		0.00		0.00		0.00		0.00		486396.00
4.	Goat rearing			0.00		0.00		0.00		0.00		0.00		0.00
	Gross returns			78944.02		88935.46		176207.58		185659.46		68488.03		571232.79
	Net returns at TVC			36105.19		38867.65		95979.97		93225.17		30056.00		121256.18
	Net returns at TC			23871.26		24420.19		64524.31		62340.20		17487.88		83461.41
	Returns on per rupee invested at TVC			1.84		1.78		2.20		2.01		1.78		1.27
	Returns on per rupee invested at TC			1.43		1.38		1.57		1.51		1.34		1.17

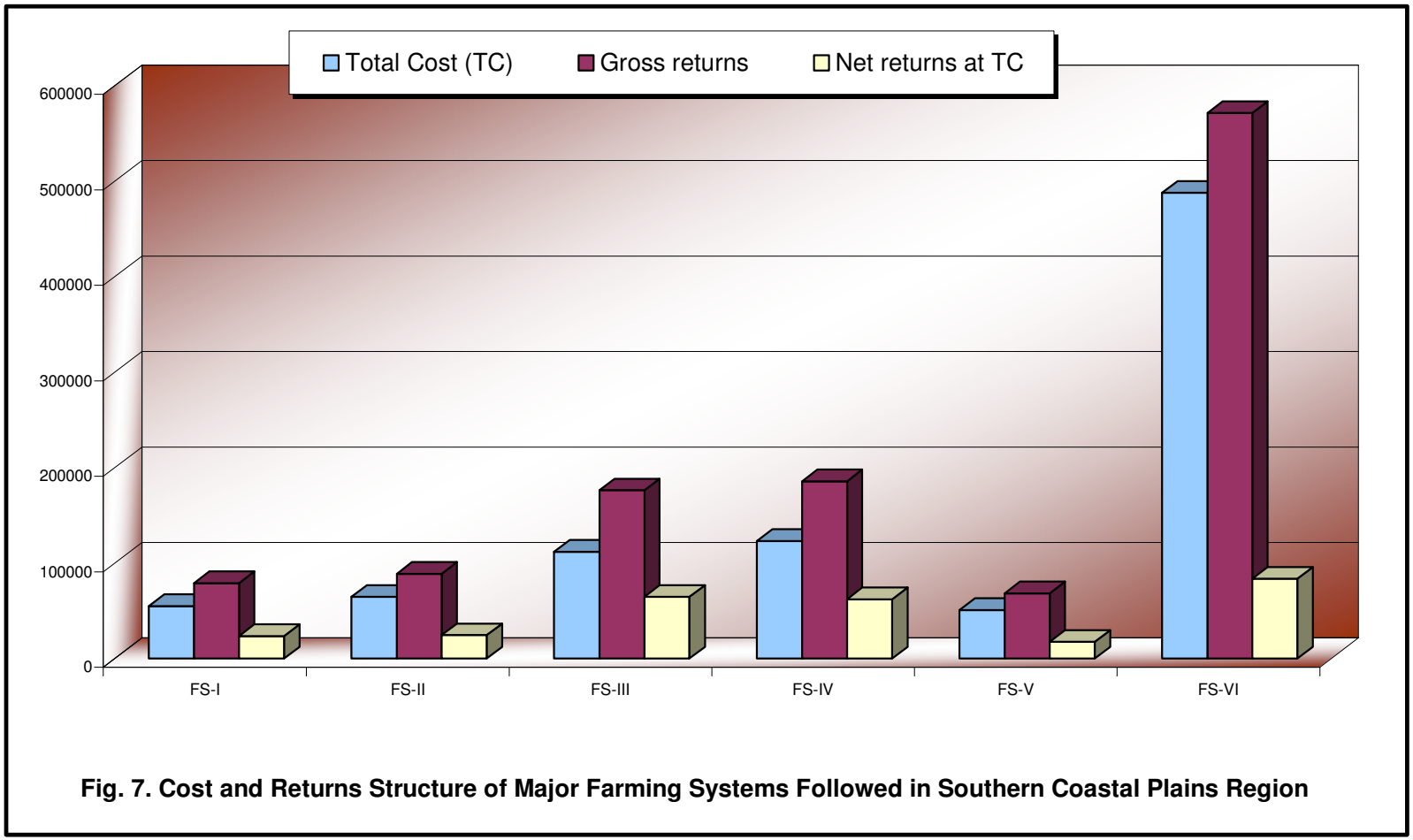


Fig. 7. Cost and Returns Structure of Major Farming Systems Followed in Southern Coastal Plains Region

Fig. 7. Cost and Returns Structure of Major Farming Systems Followed in Southern Coastal Plains Region

Arecanut enterprise

Coconut + Banana + Arecanut enterprises

Mango plantation

Plate 8. Farming systems enterprises in southern coastal plains

The gross return was Rs.78944. The return on per rupee invested at total cost amounted to Rs.1.43.

In case of FS-II, the enterprises such as paddy, coconut, arecanut and dairy were undertaken by the farmers. The per farm total variable cost amounted to Rs.50068. The total fixed cost worked out to Rs.14447. The per farm gross returns obtained from various enterprises was estimated at Rs.88935. The net returns over total cost was Rs.24420 and the return per rupee invested at total cost was Rs.1.38.

In FS-III, it was found that the farmers following this farming system had undertaken enterprises such as paddy, coconut, arecanut, mango, cashew and dairy. The per farm total variable cost worked out to Rs.80228. The total fixed cost was Rs.31725 resulting into a total cost of Rs.111953. The per farm gross returns amounted to Rs.176207. The return on per rupee invested at total cost was Rs.1.57.

The FS-IV consisted of enterprises such as paddy, arecanut, coconut, brinjal, smooth gourd, bottle gourd and dairy. The per farm total cost and gross returns were Rs.123319 and Rs.185659, respetively, resulting into per farm net income Rs.62340.

The components of FS-V were coconut, arecanut and dairy. The per farm total variable cost worked out to Rs.38432, while the total fixed cost was Rs.12568. The per farm gross returns was Rs.68488. The return on per rupee invested at total cost was Rs.1.34.

The farmers following farming system, FS-VI had undertaken farm enterprises such as paddy, coconut, arecanut, mango, cashew and poultry. The per farm total variable cost was Rs.449977 and total fixed cost was Rs.37795. The per farm gross returns obtained from various enterprises undertaken amounted to Rs.571233. The net returns over total cost was Rs.83462 and return on per rupee invested at total cost was Rs.1.17.

Among the different farming systems studied, maximum employment was created in FS -IV (705 man days), followed by FS-VI (614 man days) and FS -III (554 man days). The per farm gross return was maximum in FS -VI (Rs.571232), followed by FS -IV (Rs.185659) and FS-III (Rs.176207). The returns on per rupee invested were maximum in FS -III (Rs.1.57) followed by FS -IV (Rs.1.51) FS -I (Rs.1.43), FS -II (Rs.38), FS -V (Rs.1.34) and FS -VI (Rs.1.17).

4.5.5 Cost and Return Structure of Farming Systems in North Konkan Region

Table 4.19, depicts the birds eye view of economics of farming systems followed in different identified clusters of the study area. However, the profitability as well cost and returns structure can not be compared between the regions because the enterprises encompassing a farming system of the region do not coincide with the farming systems of other regions. Still a critical look at the enterprises followed in different farming systems suggest that the enterprises in farming system of northern coastal plains are identical with FS-2 of southern coastal plains. Similarly, FS-4 of northern coastal plains have identical enterprises with FS-5 of southern coastal plains. The FS-5 of southern central plains and hills has identical enterprises with FS-I of southern coastal plains.

A comparison of economics of these identical farming systems across the regions suggested that FS-I and FS-IV northern coastal plains are more profitable compared to their counterparts in southern coastal plains, with a net return of Rs.32623 and Rs.40130, respectively. Similarly FS-5 of southern central plains and hills has net returns higher by Rs.3890 over FS-1 southern coastal plains, hence hypothesis of similarity of returns across different farming systems is disproved.

The region wise specific farming systems which need to be promoted are such as in Northern coastal plains region 1) Paddy + Irrigated plantations + Dairy, 2) Paddy + Irrigated plantations + Flowers and 3) Irrigated plantations + Dairy are suggested for implementation on larger area. In Northern central plains and hills region farming systems such as 1) Paddy + Other cereals + Rainfed plantation + Dairy and 2) Paddy + Vegetables + Poultry needs to be promoted and implemented on large scale. In Southern central plains and hills region farming systems such as 1) Paddy + Vegetables + Dairy 2) Paddy + Pulses + Dairy + Poultry and 3) Paddy + Rainfed plantations + Dairy these farming systems needs to be promoted and implemented on large scale and in Southern coastal plains 1) Paddy + Rainfed plantation + Dairy 2) Paddy + Irrigated plantations + Rainfed plantation + Dairy, 3)

Table 4.19 Cost and Return Structure of Farming Systems in North Konkan Region

Figures in Rs

A) Northern Coastal Plains (NCP)							
Sr. No	Particulars	FS-1	FS-2	FS-3	FS-4	FS-5	
1	Total Variable Cost (TVC)	77062	38440	89183	70751	122005	
2	Total fixed cost (TFC)	32992	19736	35259	30359	90355	
3	Total cost	110054	58176	124442	101110	212360	
4	Gross returns	167117	59374	177077	158727	430375	
5	Net returns at TC	57063	1198	52635	57618	218016	
6	Returns per rupee at TC	1.52	1.02	1.42	1.57	2.03	
B) Northern Central Plains and Hills (NCPH)							
Sr. No	Particulars	FS-1	FS-2	FS-3	FS-4	FS-5	
1	Total Variable Cost (TVC)	40814	48427	35323	301231	47163	
2	Total fixed cost (TFC)	9629	8786	8441	47819	10010	
3	Total cost	50443	57212	43763	349050	57173	
4	Gross returns	64911	65895	54466	444161	68197	
5	Net returns at TC	14468	8683	10702	95111	11024	
6	Returns per rupee at TC	1.29	1.15	1.24	1.27	1.19	
C) Southern Central Plains and Hills (SCPH)							
Sr. No	Particulars	FS-1	FS-2	FS-3	FS-4	FS-5	
1	Total Variable Cost (TVC)	54608	35492	38627	242220	71413	
2	Total fixed cost (TFC)	19912	7474	8569	24729	18031	
3	Total cost	74520	42966	47196	266949	89444	
4	Gross returns	120722	44101	59009	465063	117204	
5	Net returns at TC	46202	1135	11814	198114	27761	
6	Returns per rupee at TC	1.62	1.03	1.25	1.74	1.31	
D) Southern Coastal Plains Region (SCP)							
Sr. No	Particulars	FS-1	FS-2	FS-3	FS-4	FS-5	FS-6
1	Total Variable Cost (TVC)	42839	50068	80228	92434	38432	449977
2	Total fixed cost (TFC)	12234	14447	31726	30885	12568	37795
3	Total cost	55073	64515	111953	123319	51000	487771
4	Gross returns	78944	88935	176208	185659	68488	571233
5	Net returns at TC	23871	24420	64254	62340	17488	83461
6	Returns per rupee at TC	1.43	1.38	1.57	1.51	1.34	1.17

Paddy + Irrigated plantations + Vegetables + Dairy and 4) Paddy + Irrigated plantations + Rainfed plantations + Poultry are suggested for implementation on extended area.

4.6 Resource Use Efficiency in Major Farming Systems

A Cobb-douglas type production function was fitted to data to study the resource productivity and allocative efficiency in farming systems, by comparing marginal value product (MVP) and marginal factor cost (MFC) or opportunity cost of respective resources. The production functions were estimated by using log linear model, by ordinary least square method separately for enterprises in major farming systems. The functions were estimated only for those crops which have got the sufficient samples. The results are presented from Table 4.20 to Table 4.26.

4.6.1 Resource Use Efficiency in Northern Coastal Plains Region

4.6.1.1 Crop Production

The efficiency in the use and allocation of resources for crop enterprises are presented separately for different farming systems in Table 4.20.

It could be observed from Table 4.20 that, the Cobb-douglas production function used to study the resource use efficiency was found to be good fit to the data. The F value was statistically significant ranging from 8.12 in betelvines to 34.18 in Jasmine (Jasmine). The independent variables considered were F.Y.M. (q), seed (kg.), nitrogen (kg), phosphorus (kg), plant protection chemicals (kg), human labour (days) and bullock labour (days). It could be observed from table, that the R^2 values were ranging from 0.80 in betelvines to 0.89 in case of coconut in (FS-I). This indicated that 80 to 89 per cent variation in dependent variable was explained by the independent variables included in the function.

In case of paddy (FS-I), the output elasticity coefficient of different inputs suggested that, seed was the most important input conditioning paddy production as indicated by magnitude of its regression coefficient (0.52) which was positive and significant at 5 per cent. F.Y.M. was next important variable influencing paddy production as its coefficient was positively significant at five per cent (0.24). In addition to above two variables nitrogen and phosphorous were found to be positive and statistically significant at 5 per cent. The sum of regression coefficients value was 1.042 indicating constant returns to scale.

The ratios of value of marginal product (MVP) to marginal factor cost (MFC) were less than unity in case of all inputs used. The ratio was ranging from 0.20 in nitrogen to 0.93 in case of seed.

In case of coconut the R^2 was 0.95 in FS-I and 0.87 in FS-V, indicating 87 to 95 per cent variation in dependent variables explained by independent variables. It could be observed from the table that, in FS-I, F.Y.M., nitrogen and human labour had positive influence on coconut production and they were statistically significant and the regression coefficient of F.Y.M., nitrogen and human labour were 0.37, 0.25 and 0.62, respectively. The F.Y.M. and nitrogen were significant at 5 per cent while human labour was significant at 1 per cent. The MVP to MFC ratio was 1.23, 1.77 and 4.28 for F.Y.M., nitrogen and human labour, respectively. In FS-V, the F.Y.M. nitrogen and human labour were influencing coconut production positively and they were statistically significant, and MVP to MFC ratios were 0.87, 2.12 and 2.16 for these resources, respectively. This revealed that, the farmers have used these resources less than necessary except F.Y.M. The sum of regression coefficients were 1.08 and 1.43 in FS-I and FS-V, respectively indicating constant returns to scale in FS-I and increasing returns to scale in FS-V.

In case of Jasmine (FS-III), the regression coefficients F.Y.M., phosphorous and human labour were 0.66, 0.02 and 0.30, respectively and were positive and statistically significant except for nitrogen which was statistically significant at 5 per cent but had negative coefficient (-0.16). The MVP to MFC ratios were less than one in all of these resources indicating more use than desired level.

It could be observed from Table 4.20 that, in case of sapota (FS IV) the R^2 value was 0.80 indicating 80 per cent variation sapota production was explained by the independent variables. The regression coefficient of F.Y.M., potash and human labour were 0.43, 0.39 and 0.45, respectively. These resources were positive and significant at 5 per cent, 5 per cent and

Table 4.20: Production Function Estimates for Crops Grown Under Major Farming Systems in Costal Plains (North) Region

Sr. No.	Particulars	Parameters	FS - I				FS - III	
			Paddy		Coconut		Jasmine (Mogra)	
			Coefficient	MVP/ MFC	Coefficient	MVP/ MFC	Coefficient	MVP/ MFC
1.	Intercept	a	-0.34 (0.63)	--	3.71 (0.65)	--	3.92 (0.75)	--
2.	F.Y.M. (q./ha)	b_1	0.24** (0.07)	0.09	0.37** (0.18)	1.23	0.66* (0.10)	0.33
3.	Seed (Kg./ha.)	b_2	0.52** (0.017)	0.93	--	--	--	--
4.	N (Kg./ha)	b_3	0.19** (0.03)	0.20	0.25** (0.09)	1.77	-0.16** (0.05)	0.94
5.	P (Kg./ha)	b_4	0.08** (0.04)	0.87	-0.12 (0.12)	0.42	0.02*** (0.02)	0.86
6.	K (Kg./ha)	b_5	-0.06 (0.04)	0.79	0.14 (0.10)	0.63	0.16 (0.27)	1.89
7.	PPC (Kg./ha)	b_6	-0.01 (0.42)	0.01	-0.09 (0.75)	0.32	--	--
8.	Human labour (days/ha)	b_7	0.19 (0.21)	0.06	0.62* (0.22)	4.28	0.30*** (0.12)	0.32
9.	Bullock labour (days/ha)	b_8	-0.14 (0.06)	0.13	--	--	--	--
10.	R square	R^2	0.87	--	0.95	--	0.87	--
11.	Adjusted R Square	$\bar{R}^2$	0.81	--	0.89	--	0.84	--
12.	No. of observations	No.	27	--	12.00	--	10	--
13.	Returns to scale	Σbi	1.04	--	1.08	--	1.09	--
14.	F. Value	F	15.08*	--	16.57*	--	34.18*	--

(Figures in the parentheses indicate standard errors of respective variable)

*, **, *** significance at 1%, 5% and 10% levels, respectively.

Table 4.20 continued…

Sr. No.	Particulars	Para meters	FS – IV		FS - V			
			Sapota		Betelvines		Coconut	
			Coeffi cient	MVP/ MFC	Coeffi cient	MVP/ MFC	Coeffi cient	MVP/ MFC
1.	Intercept	a	1.82 (1.32)	--	0.67 (2.13)	--	0.40 (1.93)	--
2.	F.Y.M. (q./ha)	b_1	0.43** (0.18)	0.013	0.28*** (0.11)	0.66	0.56** (0.22)	0.87
4.	N (Kg./ha)	b_2	0.12 (0.13)	0.83	--	--	0.05*** (0.001)	2.12
5.	P (Kg./ha)	b_3	0.11 (0.15)	0.41	--	--	0.16 (0.04)	1.61
6.	K (Kg./ha)	b_4	0.39** (0.11)	0.97	--	--	-0.01 (0.01)	0.69
7.	PPC (Kg./ha)	b_5	--	--	0.12** (0.02)	0.70	--	--
8.	Human labour (days/ha)	b_6	0.45* (0.27)	0.36	0.63** (0.26)	0.29	0.68* (0.31)	2.16
9.	Bullock labour (days/ha)	b_7	--	--	--		--	--
10.	Organic fertilizer	b_8			0.26*** (0.11)	1.33		
	R square	R^2	0.80	--	0.80	--	0.87	--
11.	Adjusted R Square	$\bar{R}^2$	0.72	--	0.70	--	0.75	--
12.	No. of observations	No.	18	--	13	--	11	--
13.	Returns to scale	Σbi	1.52	--	0.30	--	1.43	--
15.	F. Value	F	10.18*	--	8.12**	--	17.11**	--

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

1 per cent, respectively, while other variables were not significant. The ratios of marginal value product to marginal factor cost were less than one for resources like F.Y.M., potash and human labour (0.013, 0.97 and 0.36, respectively) which showed that these resources had been used at more than desired level. The sum of output elasticities was higher than one (1.52) indicating increasing returns to scale.

In case of betelvines in FS-V, calculated R^2 was 0.80 and F value 8.12 which was significant at 5 per cent. The F.Y.M., plant protection chemicals human labour and organic fertilizers (with regression efficient of (0.28, 0.12, 0.63 and 0.26, respectively) were the important variables influencing positively on betelvines production and they were statistically significant. The ratio of MVP to MFC was higher than unity in organic fertilizer (1.33) indicating less use while it was less than unity in F.Y.M., P.P.C. and human labour (0.66, 0.70, 0.29 respectively) indicating the excessive use of these inputs than the desired level.

4.6.1.2 Other Enterprises

a) Dairy : To study the resource use efficiency in dairy enterprise the values of independent variables such as dry fodder (Rs.), green fodder (Rs.) concentrates (Rs.), veterinary expenses (Rs.) and human labour (Rs.) were included in the function.

The results (Table 4.21) of the regression analysis revealed that the Cobb-douglas production function was found to be good fit to the data as revealed by high value of F statistic. It was ranging from 11.53 in case of FS-II to 65.74 in case of FS-I, for dairy enterprise. These were significant at 1 per cent.

The R^2 values in FS-I and FS-II were 0.91 and 0.80 indicating 91.9 per cent and 80.7 per cent variation in gross returns was explained by independent variables included in the function. In both the systems, dry fodder and green fodder had positive significant influence on the gross returns. In case of FS-I regression coefficient of dry fodder and green fodder were 0.55 and 0.082 and they were significant at 1 and 5 per cent, respectively.

In case of FS-II, the regression coefficients of dry fodder, green fodder and concentrates were 0.36, 0.10 and 0.87, respectively and they were significant at 1 per cent. In FS-II concentrate was found to have higher output elasticity as its coefficient was 0.87 which indicated that one per cent increase in concentrate will result in 0.87 per cent increase in production. The ratio of value of marginal product to marginal factor cost in FS-I was greater than unity for green fodder (2.91) while it was less than unity in dry fodder (0.34) and concentrates (0.68). In case of FS-II the ratio were more than unity in green fodder and concentrates (1.65 and 1.42 respectively) while it was less than unity in dry fodder (0.34). The sum of elasticities was 1.01 and 1.41 in FS-I and FS-II indicating constant returns to scale in FS-I and increasing returns to scale in FS-II.

b) Goat rearing : To study the resource use efficiency in goat rearing farming Cobb-douglas type production function was fitted. The function was found to be 'good fit' as it was revealed from higher value of 'F' statistic and it was significant at 1 per cent. The green fodder was found to be the most influencing important variable as the regression coefficient was higher (0.50) and it was significant at 10 per cent. The MVP to MFC ratio for green fodder was less than unity (0.22) indicating its more use than the desired level. The sum of output elasticities (1.03) had indicated a constant returns to scale.

4.6.2 Resource Use Efficiency in Northern Central Plains and Hills Region

The results of Cobb-douglas production function analysis are presented in Table 4.22 and Table 4.23 for crop enterprises and non crop farm (other) enterprises, respectively.

4.6.2.1 Crop Production Enterprises

The production function estimates are presented in Table 4.22. It was observed from table that, in various crop enterprises coefficient of multiple determination (R^2) in case of paddy was ranging from 0.71 in FS-II to 0.96 in paddy in FS-V. The R^2 value in mango (FS-I), cashewnut (FS-I) and brinjal (FS-IV) were 0.74, 0.77 and 0.88, respectively. It was revealed that the independent variables have explained the variation in crop production from 71 per cent to 95 per cent across all crop enterprises in the region. The calculated 'F' value was higher than the table 'F' value for paddy and it was ranging from 3.10 in FS-II to 39.91 in FS-I and were significant in all set functions indicating a good fit of data for the production function.

Table 4.21 : Production Function Estimates for Other Enterprises Followed Under Major Farming Systems in Northern coastal plains region

Sr. No.	Particulars	Parameters	FS - I		FS - II	
			Coeffi cient	MVP/ MFC	Coeffi cient	MVP/ MFC
I	Dairy					
1.	Intercept	a	2.87 (0.68)	--	5.41 (1.12)	--
2.	Dry fodder (Rs./Unit)	b_1	0.55* (0.09)	0.34	0.36* (0.11)	0.34
3.	Green fodder (Rs./Unit)	b_2	0.082** (0.09)	2.91	0.10* (0.04)	1.65
4.	Concentrates (Rs./Unit)	b_3	0.09 (0.019)	0.68	0.87* (0.05)	1.42
5.	Veterinary Exp. (Rs./Unit)	b_4			II	
6.	Human labour (Rs./Unit)	b_5	0.28 (0.10)	0.47	0.07 (0.10)	0.34
7.	R square	R^2		0.91		0.80
8.	Adjusted R Square	$\bar{R}^2$		0.90		0.73
9.	No. of observations	No.		28		16
10.	Returns to scale	Σbi		1.01		1.41
11.	F Value	F*		65.74*		11.53*
II	Goat rearing					
1.	Intercept	a			2.29 (1.02)	--
2.	Green fodder (Rs./Unit)	b_1			0.50** (.022)	0.228
3.	Concentrates (Rs./Unit)	b_2			0.03 (0.03)	0.05
4.	Veterinary Exp. (Rs./Unit)	b_3			0.18 (0.14)	1.17
5.	Human labour (Rs./Unit)	b_4			0.32 (0.20)	0.20
6.	R square	R^2				0.85***
7.	Adjusted R Square	$\bar{R}^2$				0.80
8.	No. of observations	No.				15
9.	Returns to scale	Σbi				1.03
10.	F Value	F*				15.19*

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

In case of paddy in FS-I it was observed that, seed, phosphorous and plant protection chemicals were found to be positively influencing inputs on paddy production. The regression coefficients of these inputs were 0.50, 0.04 and 0.86, respectively. The seed and phosphorous were significant at 5 per cent while plant protection chemicals was significant at 1 per cent level. The influence of other variables were not significant. MVP to MFC ratio in case of seed, phosphorous and plant protection chemicals were higher than unity. Sum of output elasticities was 1.51 indicating increasing returns to scale.

Regarding paddy grown under FS-II, F.Y.M., seed and human labour had exerted positive influence and they were statistically significant at 10 per cent, 5 per cent and 1 per cent, respectively. The MVP to MFC ratio in case of F.Y.M., seed and human labour were (0.79, 0.33 and 0.67, respectively) less than unity. The sum of output elasticity was less than one (0.75) showing decreasing returns to scale.

In respect of paddy in FS-V, it was observed that the F.Y.M. (0.19), seed (0.73), nitrogen (-0.08) and human labour (-0.45) were influencing production of paddy. Seed was the most contributing factor in paddy production as it was positive and significant at 1 per cent level. However, it was observed that the nitrogen and human labour had negative coefficients and were statistically significant indicating their negative influence on production. The returns to scale was increasing as indicated by the sum of output elasticities (1.46). The MVP to MFC ratio in nitrogen (0.36) and human labour (0.24) were less than unity and in F.Y.M. and seed they were higher than unity (1.05, and 1.88, respectively).

In case of mango crop (FS-I), the F.Y.M., phosphorous, potash and human labour were contributing positively and significantly to production. The regression coefficients of these resources were 0.33, 0.14, 0.55 and 0.19, respectively and they were significant at 5 per cent level. The ratio of MVP to MFC was higher than unity in potash and human labour (1.15 and 1.16 respectively), while it was less than unity in phosphorous (0.42). The sum of output elasticities was 1.39 indicating increasing returns to scale.

It was observed from Table 4.22 that, in cashewnut production, the F.Y.M., human labour, phosphorous were significantly contributing to yield. While nitrogen has positive coefficient but it was not statistically significant. The regression coefficient of F.Y.M. (0.40), phosphorous (0.33) and human labour (0.51) were significant at 1 per cent, 5 per cent and 5 per cent levels, respectively. The sum of elasticities of output (1.12) indicated increasing returns to scale.

In case of brinjal crop (FS-IV), it was observed from table that, seed was most significantly contributing input to the production of brinjal. The output elasticity of seed was positive (0.60) and it was significant at 5 per cent. The potash and human labour were other two inputs which had positive regression coefficients (0.18 and 0.55, respectively) significant at 5 per cent. The phosphorous had a negative coefficient (-0.68) and it was also statistically significant.

The sum of output elasticities (1.36) was more than one indicating the increasing returns to scale. The MVP to MFC ratio were higher than unity in seed (2.32) while it was less than unity in phosphorous, (0.33) and human labour (0.55).

4.6.2.1 Other Enterprises

To study the resource use efficiency in other enterprises such as dairy, goat rearing, poultry, and Cobb-douglas type of production function was used. The results are presented in Table 4.23. The data was found to be good fit as it was revealed from higher value of 'F' statistics. Across the various enterprises the F value was ranging from 5.51 to 29.34.

In case of dairy in FS-I, the R^2 value was 0.88 indicating 88 per cent variation is explained by the independent variables. The regression coefficient of dry fodder, green fodder concentrates and human labour were 0.26, 0.62, 0.07 and -0.02, respectively and they were significant at 5 per cent, 5 per cent, 1 per cent and 5 per cent, respectively). The green fodder was found to be contributing positively and significantly at greater extent on gross returns. The MVP to MFC ratio was less than unity in dry fodder, (0.08), while it was more than unity in case of, green fodder (1.50) concentrates (3.14) and human labour (1.04). The sum of output elasticities (1.01) indicated constant returns to scale.

Table 4.22 : Production Function Estimates for Crops Grown Under Major Farming Systems in Northern central plains and hills region

Sr. No.	Particulars	Para meters	FS - I						FS - II	
			Mango		Cashewnut		Paddy		Paddy	
			Coeffi cient	MVP/ MFC	Coeffi cient	MVP/ MFC	Coeffi cient	MVP/ MFC	Coeffi cient	MVP/ MFC
1.	Intercept	a	0.95 (1.56)	--	-1.54 (1.28)	--	-3.84	--	0.72 (0.95)	--
2.	F.Y.M. (q./ha)	b_1	0.33** (0.18)	0.36	0.40* (0.11)	0.95	0.12 (0.08)	1.50	0.03*** (0.01)	0.79
3.	Seed (Kg./ha.)	b_2	--	--	--	--	0.50** (0.15)	1.06	0.39** (0.18)	0.33
4.	N (Kg./ha)	b_3	0.15 (0.42)	0.84	0.04 (0.11)	0.62	0.02 (0.03)	3.20	0.01 (0.01)	5.22
5.	P (Kg./ha)	b_4	0.14** (0.42)	0.42	0.33** (0.14)	2.12	0.04** (0.02)	1.34	--	--
6.	K (Kg./ha)	b_5	0.55** (0.43)	1.15	-0.18 (0.11)	1.30	-0.01 (0.04)	0.43	--	--
7.	PPC (Kg./ha)	b_6	--	--	--	--	0.86* (0.22)	2.81	--	--
8.	Human labour (days/ha)	b_7	0.19** (0.35)	1.16	0.51** (0.21)	1.90	-0.04 (0.06)	--	0.13** (0.07)	0.67
9.	Bullock labour (days/ha)	b_8	--	--	--	--	--	--	-0.07 (0.05)	2.56
10.	R square	R^2	0.74	--	0.77	--	0.95	--	0.71	--
11.	Adjusted R Square	$\bar{R}^2$	0.68	--	0.69	--	0.93	--	0.68	--
12.	No. of observations	No.	17	--	20	--	21	--	21	--
13.	Returns to scale	Σbi	1.39	--	1.12	--	1.51	--	0.75	--
14.	F. Value	F*	3.91**	--	9.53*	--	39.91*	--	3.10**	--

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

Table 4.22 continued…

Sr. No.	Particulars	Para meters	FS - IV		FS - V	
			Brinjal		Paddy	
			Coeffi cient	MVP/ MFC	Coeffi cient	MVP/ MFC
1.	Intercept	a	-1.49 (1.76)	--	8.06 (1.07)	--
2.	F.Y.M. (q./ha)	b_1	0.13 (0.25)	0.70	0.19* (0.04)	1.05
3.	Seed (Kg./ha.)	b_2	0.60** (0.55)	2.32	0.73* (0.18)	1.88
4.	N (Kg./ha)	b_3	0.11 (0.20)	1.19	-0.08** (0.02)	0.36
5.	P (Kg./ha)	b_4	-0.63** (0.21)	0.33	0.49* (0.11)	2.89
6.	K (Kg./ha)	b_5	0.18** (0.07)	0.37	0.50 (0.14)	13.15
7.	Human labour (days/ha)	b_6	0.55** (0.14)	0.55	-0.45* (0.09)	0.24
8.	Bullock labour (days/ha)	b_7			0.073 (0.08)	1.00
9.	R square	R^2	0.88		0.96	
10.	Adjusted R Square	$\bar{R}^2$	0.72		0.92	
11.	No. of observations	No.	13		12	
12.	Returns to scale	Σbi	1.36		1.46	
13.	F. Value	F*	5.37***		6.54**	

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

Table 4.23: Production Function Estimates for Other Enterprises followed under Major Farming Systems in Northern central plains and hills region

Sr. No.	Particulars	Parameters	FS - I		FS - II		FS – III	
			Coefficient	MVP/ MFC	Coefficient	MVP / MFC	Coefficient	MVP/ MFC
I	Dairy							
1.	Intercept	a	3.13 (1.95)	--			2.63 (3.57)	--
2.	Dry fodder (Rs./Unit)	b_1	0.26** (0.12)	0.08			0.16*** (0.069)	0.16
3.	Green fodder (Rs./Unit)	b_2	0.62** (0.11)	1.50			0.0384** (0.01)	1.03
4.	Concentrates (Rs./Unit)	b_3	0.073* (0.01)	3.14			0.58*** (0.27)	2.68
5.	Veterinery Exp. (Rs./Unit)	b_4	0.0747 (0.16)	0.13			0.12 (0.34)	1.63
6.	Human labour (Rs./Unit)	b_5	-0.021** (0.01)	1.04			0.21** (0.12)	0.29
7.	R square	R^2		0.91				0.7
8.	Adjusted R Square	$\bar{R}^2$		0.88				0.63
9.	No. of observations	No.		20				14
10.	Returns to scale	Σbi		1.01				1.12
11.	F. Value	F*		29.34*				5.51*
II	Goat rearing							
1.	Intercept	a			3.12 (2.68)	--		
2.	Green fodder (Rs./Unit)	b_1			0.54* (0.14)	0.51		
3.	Concentrates (Rs./Unit)	b_2			0.32** (0.01)	1.02		
4.	Veterinary Exp. (Rs./Unit)	b_3			0.23** (0.12)	-5.26		
5.	Human labour (Rs./Unit)	b_4			0.42 (0.27)	0.56		
6.	R square	R^2				0.72		
7.	Adjusted R Square	$\bar{R}^2$				0.62		
8.	No. of observations	No.				21		
9.	Returns to scale	Σbi				1.05		
10.	F. Value	F*				6.63		

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

Table 4.23 continued…

Sr. No.	Particulars	Parameters	FS - IV	
			Coefficient	MVP/ MFC
I	Poultry			
1.	Intercept	a	2.07 (1.26)	--
2.	Chicks (Rs/unit)	b_1	-0.25 (0.36)	0.35
3.	Feed (Rs./Unit)	b_2	0.81* (0.36)	1.24
4.	Paddy straw husk(Rs./Unit)	b_3	0.15 (0.017)	4.81
5.	Veterinary Exp. (Rs./Unit)	b_4	0.026 (0.045)	2.41
6.	Human labour (Rs./Unit)	b_5	0.040* (0.09)	0.61
7.	R square	R^2	0.98	
8.	Adjusted R Square	$\bar{R}^2$	0.97	
9.	No. of observations	No.	12	
10.	Returns to scale	Σbi	0.97	
11.	F. Value	F*	9.63*	

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

In case of dairy enterprise in FS-III, the dry fodder (0.16), green fodder (0.038), concentrates (0.58) and human labour (0.21) have positive and significant effect on the gross returns. The concentrates was found to be most important input contributing maximum to the gross return. The MVP to MFC ratio values were less than unity in dry fodder (0.16) and human labour, while more than unity in green fodder (1.03), concentrates (2.68) and veterinary expenditure (1.63), respectively.

In case of goat rearing under FS-II, it was revealed that coefficient of multiple determination (R^2) was 0.72 indicating 72 per cent variation was explained by the independent variables included in the function. The variable such as green fodder (0.54) and concentrates (0.32) have positive influence on gross return and they were statistically significant at one and five per cent, respectively. The sum of elasticity of output (1.05) indicated the constant returns to scale.

It was revealed from Table 4.23 that, in poultry enterprise (FS-IV).,the feed and human labour have positive influence on the gross returns. The regression coefficients of feed and human labour were 0.81 and 0.04, respectively, and they were significant at 1 per cent. The MVP to MFC ratio was higher than unity for feed (1.24) and less than the unity in case of human labour (0.61). The returns to scale was approaching to 1 (0.97) as indicated by sum of output elasticities, revealing that there was constant returns to scale.

4.6.3 Resource Use Efficiency in Southern Central Plains and Hills Region

4.6.3.1 Crop Production Enterprises

To Study the resource use efficiency in Southern central plains and hills region, Cobb-douglas type production function was found to be good fit to the data as revealed by the significant 'F' value for all the set functions. In crop enterprises, it ranged from 8.42 for *kharif* paddy in FS-IV to as high as 663 for *kharif* paddy in FS-III.

In order to analyse the allocative efficiency of crop enterprises under various farming systems the ratio of marginal value product (MVP) and marginal factor cost (MFC) were worked out and are presented in Table 4.24.

It was observed from Table 4.24 that, the coefficient of multiple determination was 0.85 which indicated that 85 per cent of variation in *kharif* paddy production in FS-I was explained by independent variable included in the function.

Seed, human labour and bullock labour were influencing positively and significantly on paddy production. The regression coefficients of seed, human labour and bullock labour were 0.58, 0.33 and 0.20, respectively and these inputs were significant at 1 per cent, 10 per cent and 5 per cent, respectively. The MVP to MFC ratio in case of bullock labour (1.11) was higher than unity indicated its use was less than the desired level. The MVP to MFC ratio in case of F.Y.M. (0.22) and human labour (0.31) and seed (0.34) were less than unity, indicating more use of these resources. The sum of output elasticities was higher than one (1.25) indicated increasing returns to scale.

The coefficient of multiple determination was 0.81 for *kharif* paddy in FS-II which indicated that 81 per cent of variation in paddy production was explained by independent variables included in function. F.Y.M., seed and human labour had contributed positively and significantly on paddy production. The regression coefficients of these inputs were 0.53, 0.42 and 0.51 respectively. It was observed that, the F.Y.M. was more used than the desired level as revealed from MVP to MFC ratio which was less than unity.

It was observed from table, that MVP to MFC ratio for human labour (2.86) was more than one which indicated the lesser use of this input than the optimum level. However, it was less than one in case of seed (0.38). The returns to scale were found to be increasing as it was revealed from sum of regression coefficients which was more than one (1.23).

With respect to *kharif* paddy grown under FS-III, it was found that F.Y.M. and seed have positive influence on paddy production. The regression coefficients of these inputs were 0.04 and 0.41 respectively and they were statistically significant at 1 per cent level. However, the phosphorus and human labour had negative coefficients and they were significant at 5 per cent. The MVP to MFC ratio in case of F.Y.M. (1.09) and phosphorous (3.23) were more than one which indicated that the farmers following paddy in FS-III had used less quantity of these

Table 4.24 : Production Function Estimates for Crops Grown Under Major Farming Systems Southern central plains and hills region

Sr. No.	Particulars	Para meters	FS – I						FS – II	
			Brinjal		*Kharif* Paddy		Rabi Paddy		*Kharif* Paddy	
			Coefficient	MVP/ MFC	Coefficient	MVP/ MFC	Coefficient	MVP/ MFC	Coefficient	MVP/ MFC
1.	Intercept	a	11.54 (2.00)	--	-2.30 (0.56)	--	-0.10 (0.80)	--	-1.98 (0.65)	--
2.	F.Y.M. (q/ha)	b_1	0.34** (0.14)	0.11	0.09 (0.089)	0.22	0.09*** (0.01)	0.979	0.53* (0.11)	0.17
3.	Seed (Kg./ha)	b_2	0.53* (0.30)	0.32	0.58* (0.14)	0.34	0.21* (0.18)	5.08	0.42*** (0.13)	0.38
4.	N (Kg./ha)	b_3	-0.14 (0.37)	0.10	0.02 (0.03)	1.41	0.06*** (0.02)	1.22	0.04 (0.12)	0.051
5.	P (Kg./ha)	b_4	1.81** (0.76)	1.93	--	--	0.01 (0.05)	0.30	0.171 (0.150)	0.88
6.	K (Kg./ha)	b_5	-1.80*** (0.88)	0.98	--	--	0.48** (0.20)	0.91	0.021 (0.10)	0.28
7.	Human labour (days/ha)	b_7	-0.07 (0.30)	0.01	0.33*** (0.18)	0.31	0.06 (0.12)	0.17	0.518** (0.23)	2.86
8.	Bullock labur (days/ha)	b_8	--	--	0.20** (0.09)	1.11	0.26 (0.13)	3.96	-0.04 (0.19)	0.33
9.	R square	R^2	0.93	--	0.85	--	0.96	--	0.81	--
10.	Adjusted R Square	$\overline{R}^2$	0.85	--	0.80	--	0.92	--	0.72	--
11.	No. of observations	No.	13	--	21	--	17	--	18	--
12.	Returns to Scale	Σbi	1.68	--	1.25	--	1.184	--	1.23	--
13.	F. Value	F*	12.94*	--	17.72*	--	30.96*	--	35.98*	--

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

Table 4.24 continued…

Sr. No.	Particulars	Para meters	FS – III		FS – IV		FS – V	
			Kharif Paddy		*Kharif* Paddy		Mango	
			Coeffi cient	MVP/ MFC	Coeffi cient	MVP/ MFC	Coeffi cient	MVP/ MFC
1.	Intercept	a	-1.04 (0.06)	--	-2.41 (0.80)	--	3.20 (0.81)	--
2.	F.Y.M. (q/ha)	b_1	0.047* (0.016)	1.09	0.06 (0.15)	0.758	0.24*** (0.11)	0.57
3.	Seed (Kg./ha)	b_2	0.41* (0.025)	0.04	0.68*** (0.30)	0.24	--	--
4.	N (Kg./ha)	b_3	0.001 (0.01)	0.12	0.01** (0.01)	0.36	-0.08 (0.046)	3.90
5.	P (Kg./ha)	b_4	-0.03** (0.01)	3.32	0.03 (0.21)	3.36	-0.15 (0.08)	-0.99
6.	K (Kg./ha)	b_5	--	--	-0.01 (0.002)	-6.70	0.68** (0.20)	1.93
7.	PPC (Kg./ha)	b_6	--	--	--	--	0.18 (0.181)	3.10
8.	Human labour (days/ha)	b_7	-0.01** (0.01)	0.08	0.14*** (0.071)	0.87	0.33 (0.21)	0.25
9.	Bullock labur (days/ha)	b_8	0.01 (0.02)	0.40	0.54 (0.36)	2.11	--	--
10.	R square	R^2	0.99	--	0.90	--	0.99	--
11.	Adjusted R Square	$\bar{R}^2$	0.94	--	0.79	--	0.98	--
12.	No. of observations	No.	17	--	14	--	11	--
13.	Returns to Scale	Σbi	1.01	--	1.44	--	1.20	--
14.	F. Value	F*	663*	--	8.42*	--	116.35*	--

(Figures in the parentheses indicate standard errors of respective variable)

*, **, *** significance at 1%, 5% and 10% levels, respectively.

inputs. In case of seed and human labour (0.04 and 0.08), it was observed that, these inputs were excessively used than required quantity. The constant returns to scale was observed as the sum of output elasticities (1.01) was nearer to one.

Kharif paddy grown under FS-IV, it was observed from table 4.24 that the R^2 was 0.90 indicating 90 per cent variation in paddy production was explained by the independent variables in the function. It could be observed from table that, the seed, nitrogen and human labour were positively and significantly contributing on paddy production. The MVP to MFC ratio for nitrogen and seed, human labour were lower than unity (0.24, 0.30 and 0.87 respectively). The sum of output elasticities was 1.44 which indicated increasing returns to scale.

In case of *rabi* paddy grown under FS-I, it was observed from the table that, the coefficient of multiple determination (R^2) was 0.96 indicating 96 per cent, variation in dependent variable was explained by independent variables included in the function. The regression coefficient for input such as F.Y.M., seed, nitrogen and potash were 0.09, 0.21, 0.06 and 0.48, respectively. These inputs have positive influence on paddy production and they were statistically significant at 1 per cent, 10 per cent, 5 per cent level, respectively. The allocative efficiency was observed by MVP to MFC ratio and it was observed from table that, values of MVP to MFC ratio for nitrogen and seed were 1.22 and 5.08, respectively. However, the ratio was less than unity for potassium (0.91) and F.Y.M. (0.97).

In case of brinjal crop grown under FS-I, the R^2 was 0.93 and the calculated 'F' value (12.84) was statistically significant at 1 per cent. Among the various variables in the function F.Y.M., seed and phosphorus have positive and significant influence on brinjal production. However, in case of potassium the coefficient was negative and it was statistically significant at 10 per cent. It was observed from table that, in case of inputs such as F.Y.M. (0.116), seed (0.32), potassium (0.98), the MVP to MFC ratio was less than one which revealed that these inputs were more used than desired level. The MVP to MFC ratio of phosphorus was more than one (1.934). The sum of output elasticities was higher than one (1.68) which indicated increasing returns to scale.

4.6.3.2 Other Enterprises

To study resource use efficiency in other enterprises undertaken under various farming systems in Southern central plains and hills region, Cobb-douglas type of production function was fitted to data. The results of production function estimates are presented in Table 4.25. The production function was found to be 'good fit' to data as it was revealed from significant 'F' value in all the set functions. The 'F' value was ranging from 9.20 in goat rearing (FS-III) to 666.54 in poultry (FS-IV).

Table 4.25 : Production Estimates for Other Enterprises Followed under Major Farming Systems in Southern central plains and hills region

Sr. No.	Particulars	Parameters	FS - I		FS – II		FS – III	
			Coefficient	MVP/ MFC	Coefficient	MVP/ MFC	Coefficient	MVP/ MFC
I	Dairy							
1.	Intercept	a	1.66 (1.49)	--	-2.12 (1.32)	--	-2.92 (2.11)	--
2.	Dry fodder (Rs./Unit)	b_1	0.36* (0.12	0.26	0.47* (0.17)	0.55	0.82* (0.27)	1.19
3.	Green fodder (Rs./Unit)	b_2	0.16*** (0.075)	1.24	0.007 (0.032)	0.03	-0.13 (0.09)	0.68
4.	Concentrates (Rs./Unit)	b_3	0.35** (0.14)	0.43	0.29* (0.09)	0.88	0.26* (0.08)	0.91
5.	Veterinery Exp. (Rs./Unit)	b_4	0.13 (0.11)	2.54	-0.06 (0.06)	2.29	0.05 (0.08)	3.16
6.	Human labour (Rs./Unit)	b_5	0.05 (0.28)	0.04	0.72* (0.25)	1.06	0.59* (0.31)	1.06
7.	R square	R^2		0.93		0.90		0.89
8.	Adjusted R Square	$\bar{R}^2$		0.90		0.86		0.85
9.	No. of observations	No.		21		19		17
10.	Returns to scale	Σbi		1.25		1.44		1.59
11.	F. Value	F*		32.91*		24.24*		19.27*
II	Goat rearing							
1.	Intercept	a					4.43 (1.54)	--
2.	Green fodder (Rs./Unit)	b_1					0.58* (0.10)	0.64
3.	Concentrates (Rs./Unit)	b_2					0.21** (0.11)	0.31
4.	Veterinary Exp. (Rs./Unit)	b_3					0.07 (0.09)	-1.43
5.	Human labour (Rs./Unit)	b_4					0.31** (0.14)	0.32
6.	R square	R^2						0.82
7.	Adjusted R Square	$\bar{R}^2$						0.73
8.	No. of observations	No.						13
9.	Returns to scale	Σbi						1.04
10.	F. Value	F*						9.20*

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

Table 4.25 continued…

Sr. No.	Particulars	Parameters	FS – IV	
			Coefficient	MVP/ MFC
I	Poultry			
1.	Intercept	a	0.04 (1.17)	--
2.	Chicks (Rs/unit)	b_1	0.86* (0.13)	1.13
3.	Feed (Rs./Unit)	b_2	0.11** (0.09)	0.48
4.	Paddy straw husk(Rs./Unit)	b_3	-0.09* (0.09)	0.12
5.	Human labour (Rs./Unit)	b_4	0.29 (0.09)	5.01
6.	R square	R^2		0.89
7.	Adjusted R Square	$\bar{R}^2$		0.86
8.	No. of observations	No.		19
9.	Returns to scale	Σbi		1.35
10.	F. Value	F*		666.54

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

In case of dairy enterprise under FS-I, it was observed that, (Table 4.25) dry fodder (0.36), green fodder (0.16) and concentrates (0.35) had positive and significant regression coefficients. The coefficient of multiple determination (R^2) was 0.93 indicating 93 per cent variation in dependent variable was explained by the independent variables included in the function. The MVP to MFC ratio for dry fodder and concentrates (0.26, 0.43, respectively) were less than unity. The sum of output elasticities (1.25) indicated increasing returns to scale.

In case of dairy (FS-II) the R^2 value was 0.86 indicating 86 per cent variation in dependent variable was explained by independent variable in the function. The resource use efficiency of dairy enterprise under FS-II was mainly influenced by dry fodder, concentrates and human labour and the regression coefficient were positive (0.47, 0.29 and 0.72 respectively) and they were significant at 1 per cent. Other variables in the function were non significant. The MVP to MFC ratio was less than unity in case of dry fodder and green fodder (0.55 and 0.88, respectively). However, it was more than one in human labour (1.06). The sum of regression coefficients was more than one (1.44) indicated increasing returns to scale.

It was observed from Table 4.25 that, in case of dairy under FS-III, the coefficient of multiple determination was 0.89 indicating 89 per cent variation in dependent variable was explained by the independent variables included in the function. The dry fodder, concentrates and human labour had contributed to gross return positively and significantly. The green fodder failed to exert its influence on the gross returns as its coefficient was negative but it was statistically not significant. The MVP to MFC ratios for inputs such as dry fodder, concentrates and human labour were 1.19, 0.91 and 1.06, respectively.

To study the resource use efficiency in goat rearing enterprise, the Cobb-douglas production function was fitted to the data. The 'F' value was significant, indicating good fit to data. The coefficients multiple determination (R^2) was 0.82 which revealed that, the 82 per cent variation in dependent variable was explained by independent variables such as green fodder, concentrates, veterinary expenses, human labour which were included in the function. Green fodder was found to be positively and significantly contributing to gross returns. The regression coefficient for green fodder was 0.58 significant at 1 per cent indicated that the one per cent increase in quantity of green fodder will result in to 0.58 per cent increase in the gross return. The inputs such as concentrates (0.21) and human labour (0.31) were also positive and significant. The MVP to MFC ratio for green fodder, concentrate and human labour (0.64, 0.31 and 0.32, respectively) were less than unity. The constant return to scale was observed from the sum of output elasticities (1.04) was nearer to one.

With respect to poultry (FS-IV), it was observed that the coefficient of multiple determination was 0.89, indicating 89 per cent variation in gross returns in poultry was explained by the independent variable in the function. Among the various independent variables, expenditure on chicks and poultry feed had positive regression coefficients (0.86 and 0.11, respectively) and they were statistically significant at 1 per cent and 5 per cent, respectively. The paddy straw husk had negative influence on the gross income (0.092) and was significant at 1 per cent. The human labour, failed to exert any influence on the gross return as its coefficient was positive but statistically non significant.

The MVP to MFC ratio in chicks, feed and paddy straw husk were 1.13, 0.48 and 0.12, respectively. The sum of output elasticities was higher than unity (1.35) which indicated the increasing returns to scale.

4.6.4 Resource Use Efficiency in Southern Coastal Plains

4.6.4.1. Crop Production Enterprises

To study the resource use efficiency in crop enterprises seven variables were included in the analysis. The results are presented in Table 4.26. The Cobb-douglas type of production function was found to be good fit to data as it was revealed from significant 'F' value in all the set functions. The 'F' value was ranging from 4.97 in coconut (FS-II) to 64.91 in mango (FS-III).

In case of *kharif* paddy grown under FS-II, the coefficient of multiple determination (R^2) was 0.90, indicating about 90 per cent variation in paddy production was explained by the independent variables included in the function. The regression coefficient of F.Y.M.,

Table 4.26 : Production Function Estimates for Crops Grown Under Major Farming Systems in Costal Plains South Region

Sr. No.	Particulars	Para meters	FS – I		FS - II					
			Mango		Paddy		Coconut		Arecanut	
			Coefficient	MVP/ MFC	Coefficient	MVP/ MFC	Coefficient	MVP/ MFC	Coefficient	MVP/ MFC
1.	Intercept	a	2.77 (0.78)	--	-4.88 (0.985)	--	0.38 (1.57)	--	2.35 (1.96)	--
2.	F.Y.M. (q/ha)	b_1	0.22* (0.08)	0.52	0.44*** (0.24)	3.07	0.33** (0.16)	0.12	0.53** (0.20)	1.45
3.	Seed (Kg./ha.)	b_2	--	--	0.44 (0.13)	4.96	--	--	--	--
4.	N (Kg./ha)	b_3	0.52 (0.18)	-0.09	0.07*** (0.01)	0.21	0.60* (0.236)	1.59	-0.34 (0.10)	0.70
5.	P (Kg./ha)	b_4	-0.02 (0.19)	-0.10	0.13 (0.13)	1.03	-0.22 (0.22)	0.33	-0.14 (0.15)	1.12
6.	K (Kg./ha)	b_5	0.12 (0.12)	2.00	--	--	0.08* (0.004)	1.05	0.36 (0.19)	1.9
7.	PPC (Kg./ha)	b_6	0.30** (0.15)	0.88	--	--	0.25 (0.44)	0.09	0.49* (0.10)	1.77
8.	Human labour (days/ha)	b_7	0.097** (0.03)	0.55	0.81* (0.24)	0.08	0.054** (0.01)	0.05	0.25* (0.18)	0.13
9.	Bullock labour (days/ha)	b_8	--	--	0.04 (0.22)	0.41	--	--	--	--
10.	R square	R^2	0.80	--	0.90	--	0.77	--	0.84	--
11.	Adjusted R Square	$\bar{R}^2$	0.70	--	0.84	--	0.61	--	0.75	--
12.	No. of observations	No.	19	--	17	--	16	--	17	--
13.	Returns to scale	Σbi	1.24	--	1.06	--	1.11	--	1.76	--
14.	F. Value	F*	8.16*	--	15.39*	--	4.97*	--	9.20*	--

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

Table 4.26 continued…

Sr No	Particulars	Parameters	FS – III						FS – IV	
			Mango		Coconut		Paddy		Arecanut	
			Coefficient	MVP/ MFC	Coefficient	MVP/ MFC	Coefficient	MVP/ MFC	Coefficient	MVP/ MFC
1.	Intercept	a	2.49 (0.40)	--	1.036 (2.50)	--	-1.17 (1.22)	--	2.75 (1.28)	--
2.	F.Y.M. (q/ha)	b_1	0.10** (0.037)	0.04	0.380* (0.01)	1.91	0.26* (0.06)	0.22	0.17* (0.09)	1.40
3.	Seed (Kg./ha.)	b_2	--	--	--	--	0.61* (0.20)	0.59	--	--
4.	N (Kg./ha)	b_3	0.85* (0.25)	2.98	0.15** (0.01)	2.79	0.20*** (0.10)	0.37	0.09 (0.19)	0.27
5.	P (Kg./ha)	b_4	0.01** (0.01)	0.01	0.30 (0.14)	1.65	0.52** (0.20)	1.45	-0.01 (0.14)	-0.32
6.	K (Kg./ha)	b_5	0.02* (0.01)	0.31	0.32** (0.14)	1.28	0.32** (0.14)	1.33	0.56** (0.26)	1.41
7.	PPC (Kg./ha)	b_6	0.05** (0.014)	0.01	--	--	--	--	0.48* (0.16)	1.58
8.	Human labour (days/ha)	b_7	0.018 (0.05)	0.01	0.16 (0.74)	0.68	-0.28 (0.46)	2.08	0.49 (0.29)	0.36
9.	Bullock labour (days/ha)	b_8	--	--	--	--	0.47 (0.20)	0.27	--	--
10	R square	R^2	0.98	--	0.76	--	0.98	--	0.92	--
11	Adjusted R Square	$\bar{R}^2$	0.86	--	0.59	--	0.84	--	0.82	--
12	No. of observations	No.	13	--	13	--	13	--	12	--
13	Returns to scale	Σbi	1.05	--	1.33	--	1.05	--	1.80	--
14	F. Value	F*	64.91*	--	4.5**	--	50.31*	--	9.60**	--

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

nitrogen and human labour were 0.44, 0.07 and 0.81, respectively and they were significant. The MVP to MFC ratios for F.Y.M., nitrogen and human labour were 3.07, 0.21 and 0.08. The sum of output elasticities was 1.06 indicated constant returns to scale.

Regarding *kharif* paddy grown under FS-III, it was observed from table that, the coefficient of multiple determination (R^2) was 0.98, implying that the 98 per cent of variation in paddy production is explained by the independent variables included in the function. The variables such as F.Y.M., seed, nitrogen, phosphorous, and potash have exerted a positive influence on the paddy production. Among the independent variables seed was found to be contributing at more extent with the elasticity coefficient of 0.61 significant at 1 per cent, indicating one per cent change in quantity of seed would result into 0.69 per cent change in the production. The other positive and significant inputs were nitrogen (0.20), phosphorus (0.52), potash (0.322) and F.Y.M. (0.26). The MVP to MFC ratio in case of phosphorous and potash were more than unity (1.45 and 1.33, respectively) and for variables such as seed, F.Y.M. and nitrogen it was less than unity (0.59, 0.22 and 0.37 respectively). The sum of output elasticities (1.05) indicated constant returns to scale.

It was observed from Table 4.26 that, in case of mango (FS-I), the coefficient of multiple determination was 0.80 indicating the about 80 per cent variation in the dependent variable was explained by the independent variables included in the function. It was found that F.Y.M., plant protection chemicals and human labour were contributing positively and significantly to the mango production. The regression coefficients of these variables were 0.22, 0.30 and 0.09, respectively and they were significant at 1 per cent, 5 per cent and 5 per cent levels. The MVP to MFC ratio for F.Y.M., plant protection chemicals and human labour were 0.52, 0.88 and 0.55, which were found to be less than unity. The return to scale was found to be increasing as it was revealed from sum of output elasticities (1.24).

In case of mango grown under FS-III, it was observed that coefficient of multiple determination (R^2) was 0.98 indicating 98 per cent variation is explained by the independent variables included in the function, the adjusted $\overline{R}^2$ was also high as 0.86. The variables such as F.Y.M. (0.10, phosphorous (0.01), potash (0.02) and plant protection chemicals (0.05) were contributing to mango production positively and significantly. The MVP to MFC ratio was higher than unity for nitrogen (2.98, while in case of F.Y.M., phosphorous, potash and plant protection chemicals the ratios were (0.04, 0.01, 0.31, 0.01, respectively) they were less than unity.

Regarding resource use efficiency in coconut crop grown under (FS-II), it was observed from Table 4.25 that, the R^2 value was 0.77 indicating 77 per cent variation in dependent variable was explained by independent variables in the function. The variables such as F.Y.M., nitrogen, potash and human labour were (0.33, 0.60, 0.08 and 0.05, respectively) positively and significantly influencing on the production. Among the inputs, nitrogen had high elasticity coefficient, (0.60) implying one per cent increase in nitrogen applied will result in to 0.60 per cent increase in output. The MVP to MFC ratio was found to be higher than unity in case of F.Y.M. (1.12), nitrogen (1.59) and potash (1.05) while it was less than one in human labour (0.05). The sum of elasticity was (1.11), which indicated increasing returns to scale.

In the case of coconut under FS-III, production was positively and significantly influenced by F.Y.M. (0.38), nitrogen (0.15) and potash (0.32). The other variables were statistically non significant. The coefficient of multiple determination was 0.76 indicating 76 per cent of variation in coconut production was explained by the variables included in the function. The sum of regression coefficients ($\sum bi$) was more than one (1.33) which indicated increasing returns to scale. The MVP to MFC ratio was less than one for human labour (0.68) while it was higher than unity in case of nitrogen (2.79), potash (1.28) and FYM (1.91).

Regarding arecanut (FS-II), it was observed from the table that coefficient of multiple determination (R^2) was 0.84, which indicated that the 84 per cent of variation in production were explained by the independent variables included in the function. The F.Y.M. (0.53), plant protection chemicals (0.49) and human labour (0.25) were positively and significantly influencing the arecanut production. The sum of output elasticities (1.76) was more than one which indicated increasing returns to scale. The MVP to MFC ratio was higher than one for F.Y.M. (1.45) and plant protection chemicals (1.77). While in case of nitrogen (0.77), and human labour (0.13) it was less than unity.

In case of FS-IV, the resource use efficiency of arecanut production was positively and significantly influenced by F.Y.M., potash and plant protection chemicals. The potash was the most important contributing variable with regression coefficient of 0.56, and it was significant at 5 per cent. F.Y.M. (0.17) and plant protection chemicals (0.48) were also positive and significant at 1 per cent. The coefficient of multiple determination was 0.92 indicating 92 per cent of variation in dependent variable is explained by independent variables included in the function. The MVP to MFC ratios were higher than unity for F.Y.M. (1.40), potash (1.41) and plant protection chemicals (1.58). The increasing returns to scale was observed as it was revealed from sum of elasticities (1.45) which was higher than one.

4.6.4.2 Other Enterprises

To study the resource use efficiency in other enterprises undertaken under various farming systems in Southern coastal plains, the Cobb-douglas type production function was fitted to the data. The results of production function estimates are presented in Table 4.27. The Cobb-douglas type production function was found to be 'good fit' to data as it was revealed from significant 'F' value in all the set functions. The 'F' value was ranging from 6.64 for dairy in FS-IV as high as 184.8 in case of poultry (FS-VI).

In order to analyze the allocative efficiency of resources used for various farming systems, the marginal value product was worked out using geometric mean levels of resources and they were compared with the marginal factor cost or opportunity cost of resources.

It was observed from Table 4.27, that in case of dairy (FS-I) the coefficient of multiple determination was 0.79, indicating 79 per cent variation in dependent variable was explained by independent variables included in the function. The inputs such as dry fodder, green fodder, concentrates were influencing on the gross return positively and significantly. The regression coefficients for dry fodder, green fodder were 0.46 and 0.12 respectively and they were significant at 5 per cent. The coefficient for concentrates and human labour were 0.05 and 0.48, respectively and they were significant at 1 per cent. The MVP to MFC ratios for dry fodder and human labour were (0.62, and 0.41, respectively) less than unity, while green fodder (1.19) and concentrate (2.56) were more than one. The increasing return to scale was observed as sum of output elasticities was higher than one.

In case of dairy enterprise under taken in FS-II, it was observed that, the coefficient of multiple determination (R^2) was 0.76 indicating 76 per cent of variation in independent variable was explained by independent variables included in the function. The dry fodder, green fodder and human labour were found to be contributing positively and significantly to

Table 4.27 : Production Function Estimates for Other Enterprises followed Under Major Farming Systems in Costal Plains South Region

Sr. No.	Particulars	Parameters	FS - I		FS – II	
			Coefficient	MVP/ MFC	Coefficient	MVP/ MFC
I	Dairy					
1.	Intercept	a	1.18 (1.59)	--	-0.20 (2.67	--
2.	Dry fodder (Rs./Unit)	b_1	0.46** (0.19)	0.62	0.20** (0.09)	0.38
3.	Green fodder (Rs./Unit)	b_2	0.12** (0.05)	1.19	0.14*** (0.085)	1.29
4.	Concentrates (Rs./Unit)	b_3	0.05* (0.01)	2.56	-0.07 (0.01)	-0.40
5.	Veterinery Exp. (Rs./Unit)	b_4	-0.01 (0.01)	-0.08	0.08 (0.11)	2.82
6.	Human labour (Rs./Unit)	b_5	0.48* (0.15)	0.41	0.89* (0.30)	1.00
7.	R square	R^2	0.79		0.76	
8.	Adjusted R Square	$\bar{R}^2$	0.72		0.66	
9.	No. of observations	No.	20		18	
10.	Returns to scale	Σbi	1.12		1.26	
11.	F. Value	F*	10.88*		7.73*	

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

Table 4.27 continued…

Sr. No.	Particulars	Parameters	FS - IV		FS – VI	
			Coefficient	MVP/ MFC	Coefficient	MVP/ MFC
I	Dairy					
1.	Intercept	a	4.19 (3.92)	--		
2.	Dry fodder (Rs./Unit)	b_1	0.49* (0.20)	0.94		
3.	Green fodder (Rs./Unit)	b_2	0.26** (0.09)	0.21		
4.	Concentrates (Rs./Unit)	b_3	0.035 (0.05)	0.045		
5.	Veterinery Exp. (Rs./Unit)	b_4	0.01 (0.25)	0.145		
6.	Human labour (Rs./Unit)	b_5	0.25** (0.11)	0.16		
7.	R square	R^2		0.74		
8.	Adjusted R Square	$\bar{R}^2$		0.63		
9.	No. of observations	No.		12		
10.	Returns to scale	Σbi		1.06		
11.	F. value	F*		6.64*		
II	Poultry					
1.	Intercept	a			1.45 (0.20)	--
2.	Chicks (Rs/unit)	b_1			0.93* (0.04)	0.89
3.	Feed (Rs./Unit)	b_2			0.02** (0.00)	0.02
4.	Paddy straw husk(Rs./Unit)	b_3			0.01 (0.04)	0.36
5.	Human labour (Rs./Unit)	b_4			0.01*** (0.001)	0.60
6.	R square	R^2				0.98
7.	Adjusted R Square	$\bar{R}^2$				0.92
8.	No. of observations	No.				11
9.	Returns to scale	Σbi				1.03
10.	F. Value	F*				184.8*

(Figures in the parentheses indicate standard errors of respective variable)
*, **, *** significance at 1%, 5% and 10% levels, respectively.

the gross return. The regression coefficients of these inputs were 0.20, 0.14, 0.89 and they were significant at 5 per cent, 10 per cent and 1 per cent, respectively. The MVP to MFC ratios for dry fodder and green fodder were 0.38 and 1.29, respectively and it was one for human labour. The sum of output elasticities (∑bi) was more than one which indicated increasing returns to scale.

Regarding dairy enterprise followed under FS-IV, it was observed from the table that the R^2 was 0.74 indicating 74 per cent variation in dependent variable was explained by independent variables included in the function. The input such as dry fodder, green fodder and human labour were found to be contributing positively and significantly to be gross returns. The elasticity coefficients of these inputs were 0.49, 0.26 and 0.25, respectively. The MVP to MFC ratios in case of dry fodder (0.94), green fodder (0.21) and human labour (0.16) were less than unity. The sum of output elasticities was 1.06, which indicated a constant returns to scale.

In case of poultry enterprise (FS-IV) the coefficient of multiple determination was 0.98, which indicated that 98 per cent variation in dependent variable was explained by independent variables included in the function. It was found that number of chicks, feed and human labour were positively and significantly contributing to the gross returns. The production function estimates for chicks (0.93), feed (0.02) and human labour (0.01) were significant at 1 per cent, 5 per cent 10 per cent levels, respectively. Other variables were statistically non significant. The MVP to MFC ratios for chicks (0.89), feed (0.02) and human labour (0.60) were less than unity. The constant returns to scale was observed as it was revealed that sum of output elasticities was nearer to one (1.03).

4.7 Optimum Plans for Major Farming Systems

In order to study the optimum plans for different farming systems followed by the farmers in the study area two types of models were developed such as a) optimum plans at existing resource levels b) optimum plans at enhanced resource levels. The optimum plan for each farming system in all the regions were simulated through linear programming technique and the results are presented in Table 4.28 to 4.31.

4.7.1 Northern Coastal Plains Region

The optimum models M-I and M-II were obtained for the existing farming systems to explore the possibilities of increasing income through reorganizing the farm resources.

In case of FS-I the plan M-I suggested that, the area under sapota should be increased from 0.83 ha (41.67%) to 1.66 ha (83.42%). It was observed that, area under paddy was decreased from 0.77 ha. (38.05%) in existing model to 0.33 ha. (16.58%) in model M-I. The number of dairy animals were also found to be decreased from 1.45 to 1.07. The net returns in plan M-I were increased by 54 per cent. In plan M-II the area under paddy and sapota were unchanged while number of dairy animals were increased from 1.07 to 1.15 resulting into very meager increase in net income earnings over plan M-I (0.4%).

As regards FS-II it was observed that in optimum plan M-I that, the area under paddy was reduced from 0.72 ha to 0.42 ha while, the grass enterprise was eliminated from the optimum farming system. The number of dairy animals were increased from 1.2 in existing farming system to 2.38 in optimum plan, M-I. The net income was increased by 14 per cent in optimum plan M-I, while it was increased by 78.92 per cent in optimum plan M-II over existing farming system. In optimum plan M-II, the per cent increase in net income over optimum plan M-I was 56.73 per cent. The optimum plan M-II suggested that the paddy area should be kept unchanged as in optimum plan M-I and number of dairy animals has to be increased to 3.77 as compared to 2.38 in optimum plan M-I.

It was observed that in FS-III, the area under paddy was slightly reduced by 1.5 per cent whereas the area under flower crops other than the jasmine, arecanut and banana were eliminated. The area under Jasmine was increased from 0.26 ha. (13.73%) in existing model to 1.51 ha (78.89%) in each of the optimum plan (M-I and M-II). As regards optimum plan M-II the area under crops remained unchanged and net increase in income was 77.62 per cent in optimum in plan M-I over existing plan and 18.76 per cent in plan M-II over plan M-I.

Table 4.28 : Optimum Plans for Farming Systems in Northern coastal plains region

Particulars	FS – I						FS – II					
	Existing		M – I		M – II		Existing		M – I		M – II	
	Area,No.	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops												
Paddy	0.77	38.65	0.33	16.58	0.33	16.58	0.72	62.61	0.42	100	0.42	100
Grass							0.43	37.39				
Rabi Crops												
Perennial Crops												
Sapota	0.83	41.67	1.66	83.42	1.66	83.42						
Coconut	0.33	16.57										
Arecanut	0.04	2.01										
Banana	0.022	1.10										
Gross cropped area	1.991	100.00	1.99	100.00	1.99	100.00	1.15	100.00	0.42	100	0.42	100
Dairy	1.45		1.07		1.15		1.2		2.38		3.77	
Goat rearing							8.84		11.55		18.27	
Net Income (Rs.)	57062		87954		88304		10272		11726		18379	
Net returns (%) Over existing				54.14		54.75				14.15		78.92
Net returns (%) Over M-I						0.40						56.73
Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.												

Table 4.28 : Continued…

Particulars	FS – III						FS – IV					
	Existing		M – I		M – II		Existing		M – I		M – II	
	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops												
Paddy	0.41	21.65	0.38	20.11	0.38	20.11	--					
Terda	0.11	5.81										
Rabi Crops												
Cocks Comb (Velvet)	0.08	4.22										
Perennial Crops												
Jasmine	0.26	13.73	1.51	79.89	1.51	79.89						
Jai	0.04	2.11										
Hibiscus	0.23	12.14										
Sayali	0.114	6.02										
Kagda	0.04	2.11										
Yellow Champak	0.19	10.03										
Sapota							0.87	77.68				
Coconut	0.41	21.65					0.24	21.43				
Arecanut	0.01	0.53					0.01	0.89	1.12		1.12	
Gross cropped area	1.894	100.00	1.89	100.00	1.89	100.00	1.12	100.00	1.12		1.12	
Dairy							2		3.32		5.79	
Net Income (Rs.)	57603		102315		121515		57645		68440		85053	
Net returns (%) Over existing				77.62		109.5				18.73		47.55
Net returns (%) Over M-I						18.76						24.27

Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

Table 4.28 : Continued…

Particulars	FS – V					
	Existing		M – I		M – II	
	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops						
Paddy	0.78	28.16	0.36	28.96	0.36	22.81
Rabi Crops						
Perennial Crops						
Coconut	1.38	49.82	0.133	10.70	0.018	1.14
Arecanut	0.08	2.89		0.00		0.00
Betelvines	0.53	19.13	0.75	60.34	1.2	76.05
Gross cropped area	2.77	100.00	1.243	100.00	1.578	100.00
Net Income (Rs.)	227128		285507		449620	
Net returns (%) Over existing				25.70		97.96
Net returns (%) Over M-I						57.48

Area = ha, Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

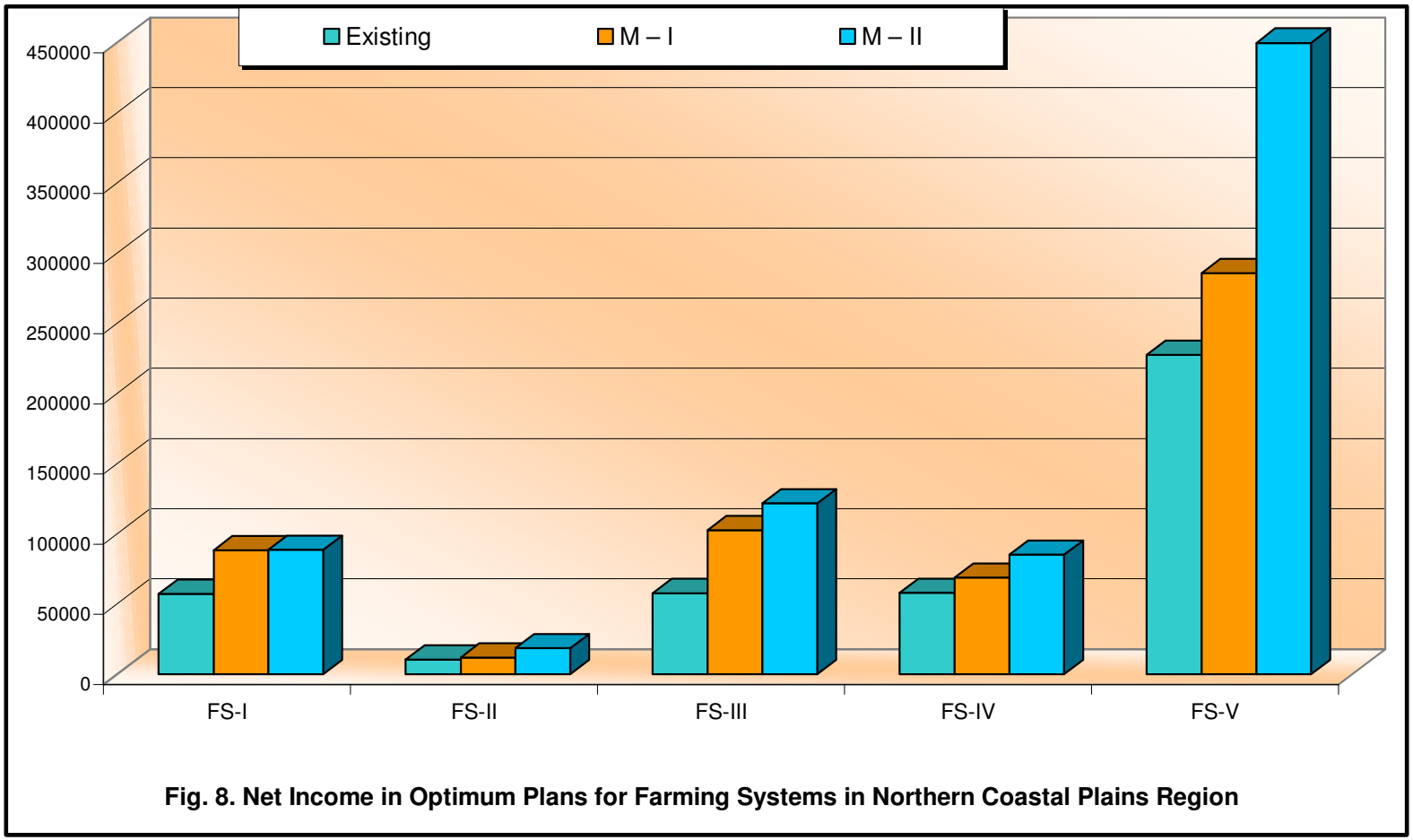


Fig. 8. Net Income in Optimum Plans for Farming Systems in Northern Coastal Plains Region

Fig. 8. Net Income in Optimum Plans for Farming Systems in Northern Coastal Plains Region

Table 4.29 : Optimum Plans for Farming Systems in Northern central plains and hills region

Particulars	FS – I						FS – II					
	Existing		M – I		M - II		Existing		M – I		M - II	
	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops												
Paddy	1.05	58.99	0.51	33.55	0.51	28.65	1.2	85.1	0.47	100	0.47	
Nagli	0.22	12.36					0.16	11.3				
Prosomillet (Vari)	0.08	4.49					0.05	3.55				
Rabi Crops												
Perennial Crops												
Mango	0.29	16.29	0.57	37.5	1.27	71.35						
Cashewnut	0.14	7.87	0.44	28.95								
Gross cropped area	1.78	100.00	1.52	100.00	1.78	100.00	1.41	100.00	0.47	100.00	0.47	100.00
Goat rearing (Nos.)							12.76		2.52		4.67	
Dairy	1.22		1		1.81		1.34		1		1	
Net Income (Rs.)	14296		26605		39432		7909		12080		22095	
Net returns (%) Over existing				86.10		175.82				52.70		179.36
Net returns(%) Over M-I						48.20						82.91

Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

Table 4.29 : Continued…

Particular	FS – III						FS – IV					
	Existing		M – I		M - II		Existing		M – I		M - II	
	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops												
Paddy	0.74	47.74	0.49	31.61	0.49	31.61	1.03	68.67	0.51	34.00	0.51	34
Cowpea	0.07	4.51										
Rabi Crops												
Blackgram	0.02	1.29										
Cowpea	0.04	2.58	1.06	68.39	1.06	68.39						
Wal	0.63	40.64										
Green gram	0.05	3.22										
Brinjal							0.31	20.67	0.24	16.00	0.99	66
Ladys finger							0.16	10.67	0.75	50.00		
Perennial Crops												
Gross cropped area	1.55	100	1.55	100	1.55	100	1.5	100	1.5	100.00	1.5	100
Poultry							9.64		8.64		14.21	
Dairy	1.14		1.53		3.82							
Net Income (Rs.)	10701		15088		22174		95168		143955		177614	
Net returns (%) Over existing				41.00		107.21				51.26		86.63
Net returns(%) Over M-I						46.96						23.38

Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

Table 4.29 : Continued…

Particular	FS - V					
	Existing		M – I		M - II	
	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops						
Paddy	1.11	50.92	0.43	21.29	0.43	21.29
Grass	1.07	49.08	1.59	78.71	1.59	78.71
Rabi Crops						
Perennial Crops						
Gross cropped area	2.18	100.00	2.02	100	2.02	100.00
Goat rearing	2.22		2.72		4.51	
Net Income (Rs.)	10832		13009		19829	
Net returns (%) Over existing				12.10		83.06
Net returns(%) Over M-I						52.43

Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

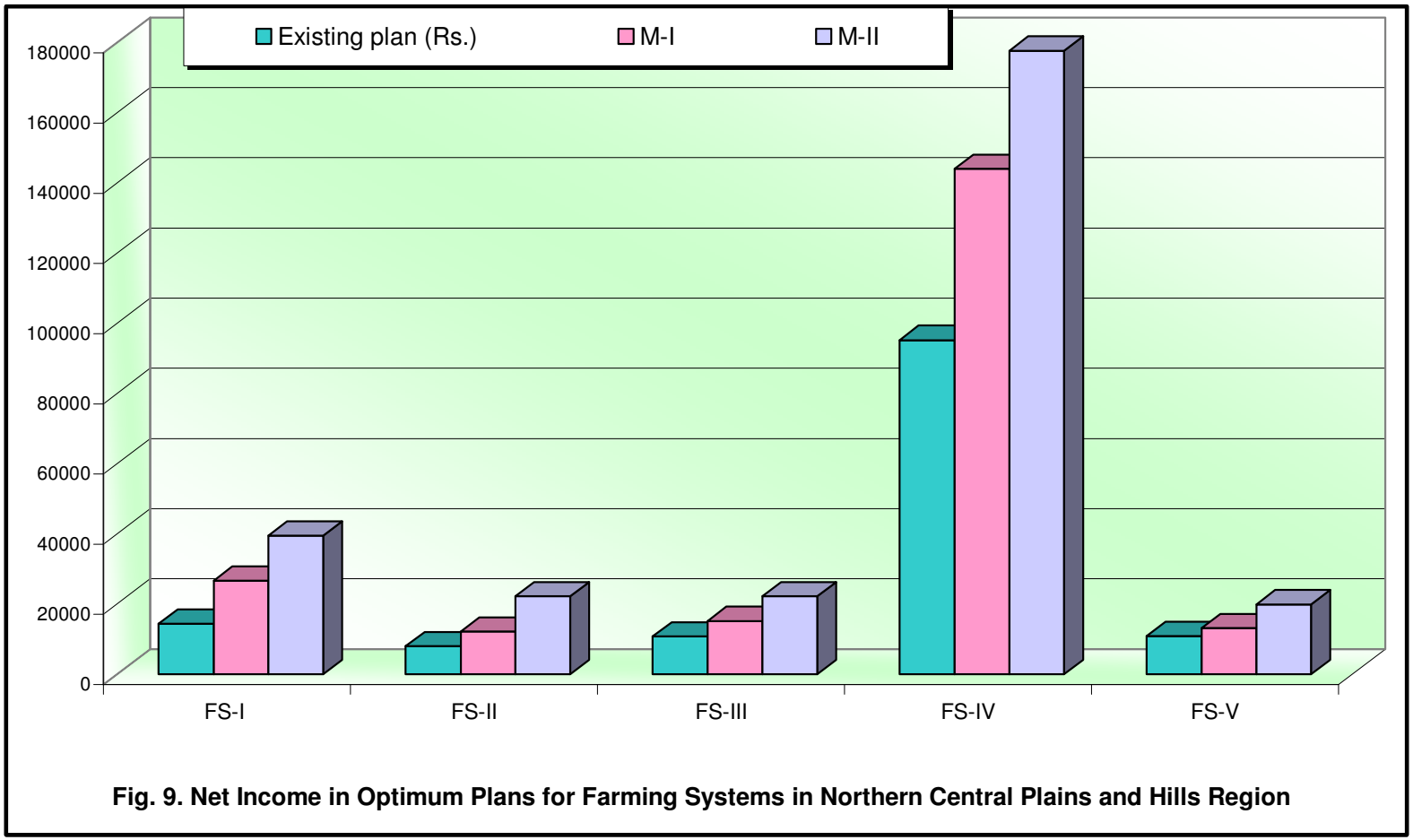


Fig. 9. Net Income in Optimum Plans for Farming Systems in Northern Central Plains and Hills Region

Fig. 9. Net Income in Optimum Plans for Farming Systems in Northern Central Plains and Hills Region

Regarding FS-IV, it was observed that, the area under arecanut was increased substantially from 0.89 per cent to 100 per cent in optimum plan M-I and it was retained in optimum plan M-II, whereas the area under sapota and coconut were eliminated in optimum plan M-I and M-II. The number of dairy animals were increased from 2.00 in existing model to 3.32 in optimum plan M-I and further increased to 5.79 in optimum plan M-II. The net income in optimum plan M-II was increased by 47.55 per cent and 24.27 per cent as compared to existing model and optimum plan M-I, respectively.

Regarding FS-V, the optimum plan M-I, suggested the decrease in area under paddy and coconut. However, the area under betelvines increased from 0.53 ha in existing plan to 0.75 ha (60.34%) in optimum plan M-I and 1.2 ha in (76.05%) in optimum plan M-II. The net income was increased in optimum plan M-I by 25.70 per cent than existing model. The per cent increase in net income was 57.48 per cent in optimum plan M-II over optimum plan M-I.

4.7.2 Northern Central Plains and Hills Region

The optimum plans M-I and M-II were designed to study the possibility of increase in net income by reallocating the resources. In case of FS-I, the area under paddy was decreased from 1.05 ha. (58.98%) to 0.51 ha. (33.53%) in optimum plan M-I and 0.51 ha. (28.65%) in optimum plan M-II. The *Kharif* crops such as finger millet and prosomillet were eliminated in optimum plan M-I and optimum plan M-II. The area under mango was increased from 0.29 ha. (16.29%) to 0.57 (37.50%) in optimum plan M-I and to 1.27 ha. (71.34%) in optimum plan M-II. The cashewnut area was found to increase to 28.94 per cent in optimum plan M-I over existing plan. However, cashewnut was eliminated in optimum plan M-II. The dairy animals were increased from 1.22 in existing plan to 1.81 in optimum plan M-II. The net income in existing plan amounted to Rs.14296, which was increased to Rs.26605 (86.10%) in optimum plan M-I. The net income in optimum plan M-II was Rs.39432, which indicated an increase by 175.82 per cent over existing plan and 48.20 per cent over optimum plan M-I.

As regards FS-II, it was observed that paddy area was decreased from 1.2 ha in existing model to 0.47 ha each in optimum plan M-I and optimum plan M-II. The area under nagli and prosomillet was eliminated. The number of goats were decreased from 12.76 in existing model to 2.52 in optimum plan M-I, where as in optimum plan M-II it was increased to 4.67. The one dairy animal was retained in optimum plan M-I and M-II as compared to 1.34 in the existing plan. The net income was increased from Rs.7909 in existing plan to Rs.12080 in optimum plan M-I and Rs.22095 in optimum plan M-II.

It was observed from Table 4.29 that in FS-III, the area under *Rabi* cowpea was substantially increased from 0.04 ha. in existing model to 1.06 ha. in optimum plan M-I and it was unchanged in optimum plan M-II (1.06 ha.). The paddy area was observed to decrease from 0.74 ha. (47.74 per cent) in existing plan to 0.49 ha. (31.61%) in optimum plan M-I and optimum plan M-II. The crop enterprises under existing model such as *Kharif* cowpea, blackgram, wal and greengram were eliminated in both the optimum plans. It was observed that, the dairy animals were increased from 1.14 in existing model to 1.53 in optimum plan M-I and 3.82 in optimum plan M-II. It was also observed from the table that, the net income in FS-III was increased by 41 per cent and 107.21 per cent compared to existing model in optimum plan M-I and optimum plan M-II, respectively.

In case of FS-IV, it was observed that the area under paddy was reduced from 1.03 ha. (68.67%) in existing plan to 0.51 ha (34%) in optimum plan M-I and optimum plan M-II. The area under brinjal was observed to reduce from 0.31 ha in the exiting plan to 0.24 ha in the optimum plan M-I. However, it was revealed that the brinjal area was substantially increased (0.99 ha) in optimum plan M-II. The area under lady's finger was increased from 0.16 ha (10.66%) in existing plan to 0.75 ha (50%) in optimum plan M-I. However it was also observed that, the lady's finger was eliminated in optimum plan M-II. The number of poultry unit were decreased from 9.64 in existing plan to 8.64 in optimum plan M-I. However, it was observed that the poultry unit were increased to 14.21 in optimum plan M-II. The net income was observed to increase from Rs.95168 in existing model to Rs.1,43,955 in optimum plan M-I and Rs.1,77,614 in optimum plan M-II.

In case of FS-V it was observed that the area under paddy was reduced from 1.11 ha (50.92%) to 0.43 ha (21.29%) in optimum plan M-I which was unchanged in optimum plan M-II. The area under grass was increased from 1.07 ha in existing model to 1.59 ha in plan M-I

and M-II. The gross cropped area was found to decrease from 2.18 ha in existing model to 2.02 ha in optimum plan M-I and M-II. The number of goat rearing animal was observed to increase substantially. The number of goat rearing animals in existing, optimum plan M-I and optimum plan M-II was 2.22, 2.72 and 4.51, respectively. The net income was increased by 20 per cent in optimum plan M-I and by 83.06 per cent in optimum plan M-II than in existing model. The per cent increase in optimum plan M-II over optimum plan M-I was 52.43.

4.7.3 Southern Central Plains and Hills Region

It was observed from Table 4.30 that in case of FS-I paddy area was reduced from 0.95 ha (47.86%) to 0.40 ha (21.62%) in optimum plan M-I and optimum plan M-II. It was also observed from the table that, area under lady's finger was increased from 0.06 ha (3.02%) in existing model to 0.5 ha (27.03%) in optimum plan M-I and 0.97 ha (48.99%) in optimum plan M-II. The area under chilli was 0.15 ha (7.55%), 0.95 ha (51.35%) and 0.61 ha (30.81%) in existing model, optimum plan M-I and optimum plan M-II, respectively. The gross cropped area was decreased in optimum plan M-I as compared to existing model. The numbers of dairy animals were 1.8, I and 1.77 in existing model, optimum plan M-I and optimum plan M-II, respectively. The net returns were observed to be increased by 166.78 per cent in optimum plan M-I and 209.08 per cent in optimum plan M-II over existing model. The net returns were increased by 15.85 per cent in optimum plan M-II over optimum plan M-I.

As regards FS-II, it was observed from Table 4.30 that, the area under paddy decreased from 1.06 ha. (67.09%) to 0.43 ha. in optimum plan M-I which was remained unchanged in optimum plan M-II. The area under paddy in *rabi* season was eliminated in both the optimum plans. The dairy animals were increased from 1.36 in existing model to 2.42 in optimum plan M-I and 4.24 in optimum plan M-II. The net returns in existing model, optimum plan M-I, and optimum plan M-II were Rs.1142 Rs.3821 and Rs.7080, respectively.

In case of FS-III, it was observed from table 4.30 that, the area under paddy was reduced substantially in optimum plans as compared to existing model. The area under paddy were 1.07 ha. 0.39 ha. 0.39 ha. in existing model, optimum plan M-I and optimum plan M-II respectively. The number of goats were found to increase from 7.19 in existing model to 9.75 in optimum plan M-I and 15.15 in optimum plan M-II. Similarly the number of dairy animals were 1.62, 2.42 and 3.8 in existing model, optimum plan M-I and optimum plan M-II respectively. The net returns in existing model, optimum plan M-I and optimum plan M-II were 11812, Rs.18740 and Rs.29748 respectively.

It was observed from Table 4.30 that, incase of FS-IV, the net income was Rs.191075, Rs.205530 and Rs.312088 in existing model, optimum plan M-I and optimum plan M-II, respectively. It was observed that the per cent increase in net income in plan M-I over existing model was 7.57. However the net income was increased by 51.85 per cent in optimum plan M-II over optimum plan M-I. It was also observed that the area under paddy was substantially reduced from 0.96 ha. in existing model to 0.42 ha. in optimum plan M-I and plan optimum plan M-II. The number of dairy animals was reduced to 1.88 in existing model to 1 in optimum plan M-I. However, dairy enterprise was eliminated in optimum plan M-II. It was observed that the number of poultry units were substantially increased in optimum plans. The number of poultry units were 13.33, 15.01, 22.99 in existing model, plan M-I and plan M-II, respectively.

As regards FS-V, it could be seen from Table 4.30 that, the area under mango and cashewnut were increased in optimum plans while area under *kharif* as well as *rabi* paddy was decreased. The area under *kharif* paddy was 1.82 ha (51.41%), 0.51 ha (16.56%) and 0.51 (16.14%) in existing model, optimum plan M-I and optimum plan M-II respectively. The *rabi* paddy was found to be eliminated in both optimum plans. The area under mango was 0.37 ha. (11.67%), 1.49 ha (48.38%), 0.52 ha (16.46%) in existing model, optimum plan M-I and optimum plan M-II respectively. The area under cashewnut was increased from 0.13 ha (4.10%) in existing model to 1.08 ha (35.06%) in optimum plan M-I and 2.13 ha (67.40%) in optimum plan M-II. It was observed that the dairy animals were found to decrease from 3.23 in existing model to 1 in optimum plan M-I and it was substantially increased to 6.03 in optimum plan M-II. The net income were Rs.28038 in existing model, Rs.63085 in optimum plan M-I and Rs.87942 in optimum plan M-II.

Table 4.30 : Optimum Plans for Farming Systems in Southern central plains and hills region

Particulars	FS – I						FS – II					
	Existing		M – I		M - II		Existing		M – I		M - II	
	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops												
'Paddy	0.95	47.86	0.40	21.62	0.4	20.2	1.06	67.09	0.43	100	0.43	100
Rabi Crops												
Paddy	0.37	18.64					0.52	32.91				
Bottle gourd	0.14	7.05										
Tomato	0.04	2.26										
Brinjal	0.24	12.0										
Lady's Finger	0.06	3.02	0.50	27.03	0.97	48.99						
Smooth gourd	0.03	1.51										
Chilli	0.15	7.55	0.95	51.35	0.61	30.81						
Perennial Crops												
Gross cropped area	1.98	100	1.85	100	1.98	100	1.58	100	0.43	100	0.43	100
Dairy	1.80		1.00		1.77		1.36		2.42		4.24	
Net Income (Rs.)	46201		123258		142800		1142		3821	334.6	7080	
Net returns (%) Over existing				166.78		209.08				234.59		519.96
Net returns(%) Over M-I						15.85						85.30

Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

Table 4.30 : Continued…

Particulars	FS – III						FS – IV					
	Existing		M – I		M - II		Existing		M – I		M - II	
	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops												
Paddy	1.07	84.25	0.39	100.00	0.39	100.00	0.96	61.14	0.42	0.42	100.00	100.00
Cowpea							0.1	6.36				
Wal							0.16	10.19				
Gram							0.1	6.36				
Greengram							0.12	7.67				
Rabi Crops												
Paddy	0.2	15.75					0.13	8.28				
Gross cropped area	1.27	1.27	0.39	100.00	0.39	100.00	1.57	1.57	0.42	100.00	0.42	100.00
Goat rearing	7.19		9.75		15.15							
Dairy	1.62		2.42		3.8		1.88		1			
Poultry							13.33		15.01		22.99	
Net Income (Rs.)	11812		18740		29748		191075		205530		312088	
Net returns (%) Over existing				58.65		151.84				7.57		63.33
Net returns(%) Over M-I						58.74						51.85

Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

Table 4.30 : Continued…

Particulars	FS - V					
	Existing		M – I		M - II	
	Area,No	%	Area,No	%	Area,No	%
Kharif Crops						
Paddy	1.82	57.41	0.51	16.56	0.51	16.14
Rabi Crops						
Paddy	0.85	26.81				
Perennial Crops						
Mango	0.37	11.67	1.49	48.38	0.52	16.46
Cashewnut	0.13	4.10	1.08	35.06	2.13	67.40
Gross cropped area	3.17	100.00	3.08	100.00	3.16	100.00
Dairy	3.23		1.00		6.03	
Net Income (Rs.)	28038		63085		87942	
Net returns (%) Over existing				125.00		213.65
Net returns(%) Over M-I						39.40

Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

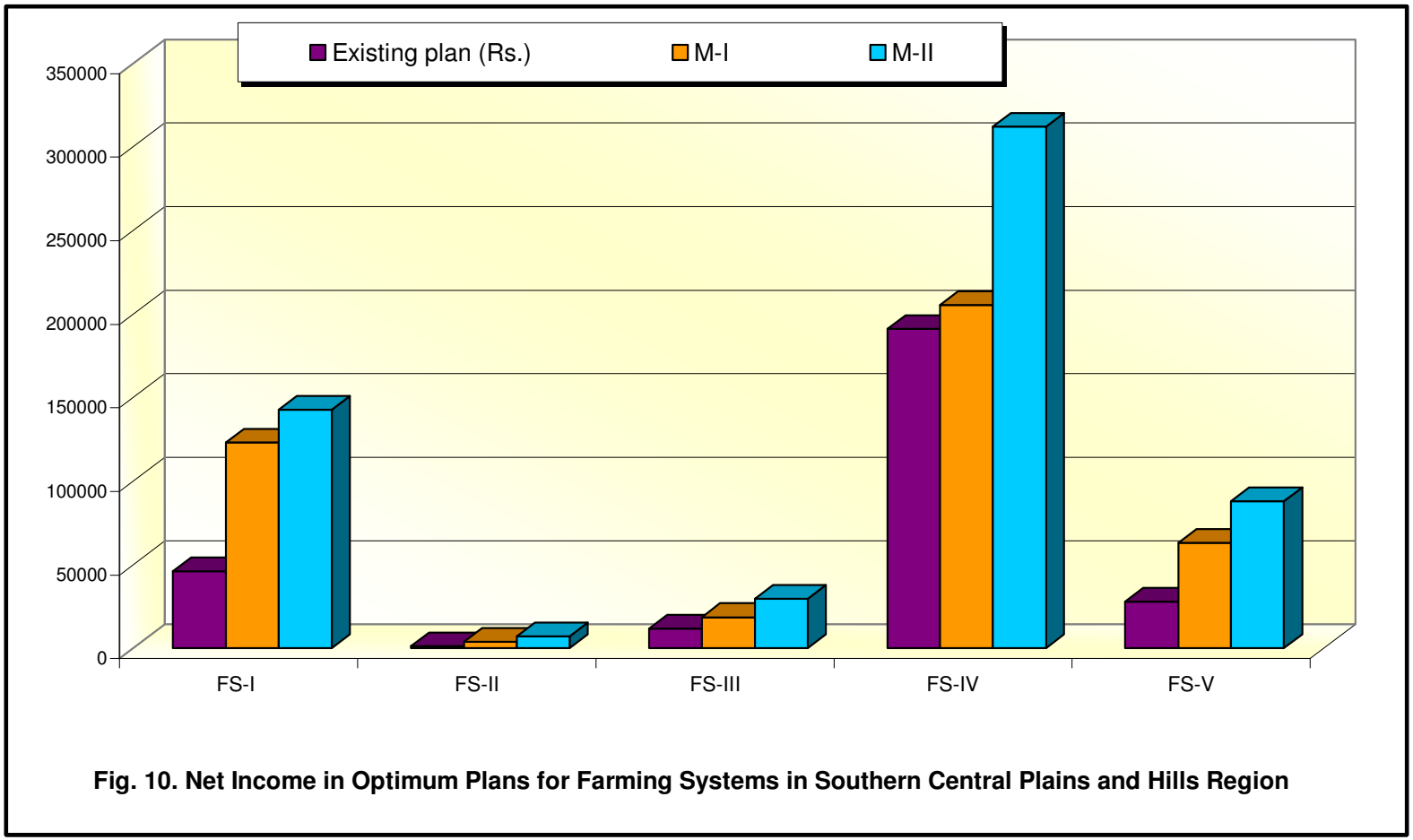


Fig. 10. Net Income in Optimum Plans for Farming Systems in Southern Central Plains and Hills Region

Fig. 10. Net Income in Optimum Plans for Farming Systems in Southern Central Plains and Hills Region

Table 4.31 : Optimum Plans for Farming Systems in Southern Coastal Plains Region

Particulars	FS – I						FS – II					
	Existing		M – I		M – II		Existing		M – I		M - II	
	Area,No	Per cent	Area, No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops												
Paddy	0.71	49.31	0.4	27.78	0.4	27.78	0.76	59.38	0.34	26.56	0.34	26.56
Rabi Crops												
Perennial Crops												
Mango	0.57	39.58	1.04	72.22	1.04	72.22						
Cashew nut	0.16	11.11										
Coconut							0.39	30.47	0.94	73.44	0.94	73.44
Arecanut							0.13	10.16				
Gross cropped area	1.44	100	1.44	100	1.44	100	1.28	100	1.28	100	1.28	100
Dairy	1.89		1.81		3.69		1.88		1.78		3.46	
Net Income (Rs.)	24390		33841		43419		28773		41669		52465	
Net returns (%) Over existing				38.70		78.02				44.80		82.34
Net returns(%) Over M-I						28.30						25.90

Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

Table 4.31 : Continued…

Particulars	FS – III						FS – IV					
	Existing		M – I		M - II		Existing		M – I		M - II	
	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops												
Paddy	0.78	29.32	0.41	15.41	0.41	15.41	0.67	31.60	0.27	29.03	0.27	20.61
Rabi Crops												
Brinjal							0.31	14.62				
Smooth gourd							0.25	11.79	0.66	70.97	1.04	79.39
Bottle gourd							0.16	7.55				
Perennial Crops												
Mango	0.8	30.08										
Cashew nut	0.25	9.40										
Coconut	0.63	23.68	2.25	84.59	2.25	84.59	0.56	26.42				
Arecanut	0.2	7.52					0.17	8.02				
Gross cropped area	2.66	100.00	2.66	100.00	2.66	100.00	2.12	100.00	0.93	100.00	1.31	100.00
Dairy	2.43		2.11		4.84		2.00		4.85		4.65	
Net Income (Rs.)	65491		111670	1	132855		68604		94456		125321	
Net returns (%) Over existing				70.51		102.85				37.68		82.67
Net returns(%) Over M-I						18.97						32.68

Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

Table 4.31 : Continued…

Particulars	FS - V						FS – VI					
	Existing		M – I		M - II		Existing		M – I		M – II	
	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent	Area,No	Per cent
Kharif Crops												
Paddy							0.71	32.42	0.37	16.89	0.37	16.89
Rabi Crops												
Perennial Crops												
Mango							0.63	28.77	1.82	83.11	1.82	83.11
Cashew nut							0.18	8.22				
Coconut	0.65	76.47	0.85	100.00	0.85	100.00	0.47	21.46				
Arecanut	0.2	23.53					0.2	9.13				
Gross cropped are	0.85	100.00	0.85	100.00	0.85	100.00	2.19	100.00	2.19	100.00	2.19	100.00
Dairy	1.26		1.31		2.56							
Poultry							14.75		14.88		22.95	
Net Income (Rs.)	21577		23513		27168		84691		98193		127997	
Net returns (%) Over existing				8.97		25.91				15.94		51.13
Net returns (%) Over M-I						15.54						30.35

Area = ha., Dairy = No. of animal, Poultry = No. of unit (1000 birds), Goat = No. of animal.

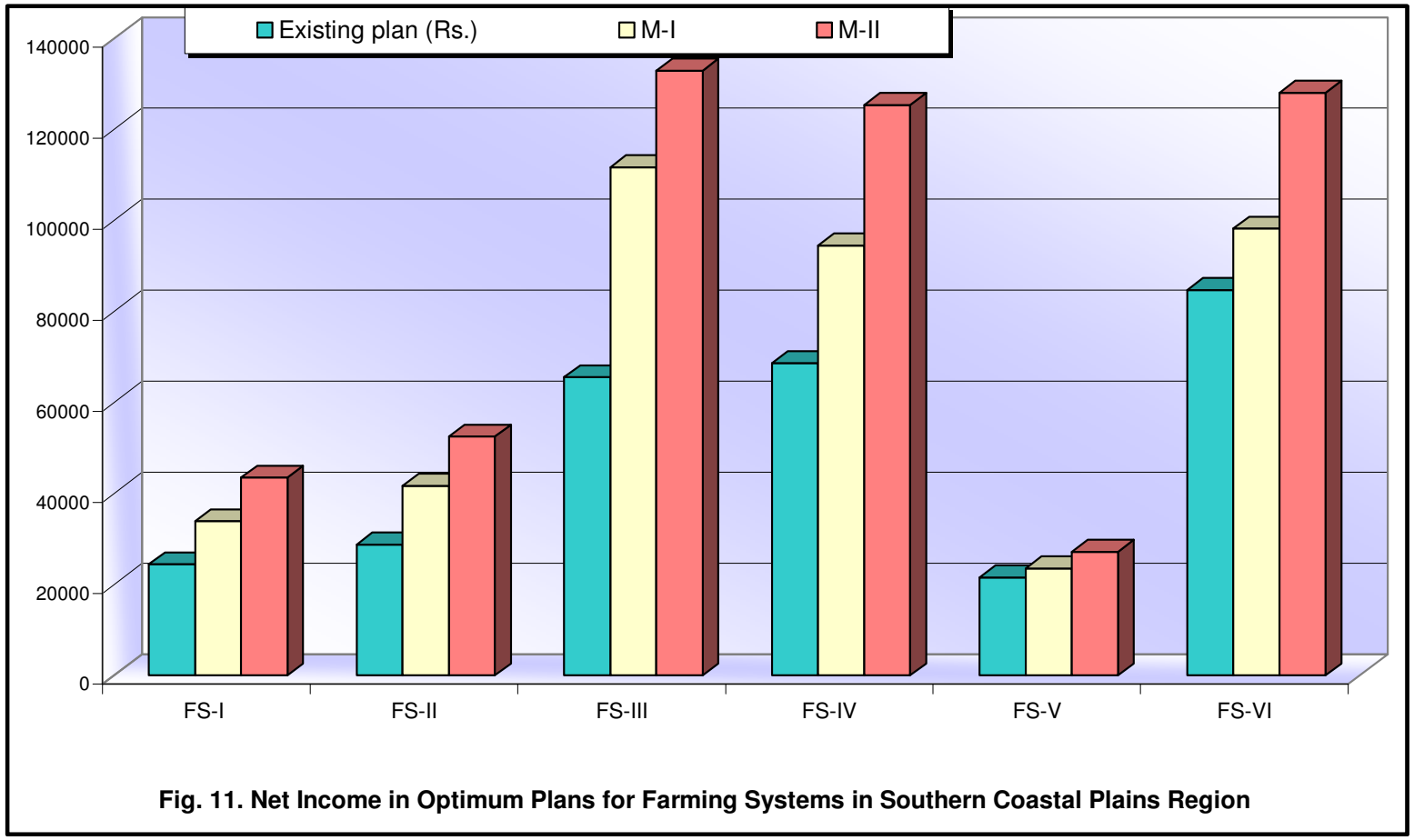


Fig. 11. Net Income in Optimum Plans for Farming Systems in Southern Coastal Plains Region

Fig. 11. Net Income in Optimum Plans for Farming Systems in Southern Coastal Plains Region

4.7.4 Southern Coastal Plains

In order to study the possibilities of increasing the income in Southern coastal plains through reallocation of resources the optimum plans were designed at existing resource level and enhanced resource level and results are presented in Table 4.31.

It was observed from Table 4.31 that, in case of FS-I the area under paddy was reduced from 0.71 ha (49.31%) to 0.40 ha (27.78%) in plan M-I, which was found to be unchanged in plan M-II. The area under mango was increased from 0.57 ha in existing model to 1.04 ha (72.22%) in optimum plan M-I and it was remained at same level in optimum plan M-II. The number of dairy animals were slightly decreased, from 1.89 in existing model to 1.81 in optimum plan M-I and it was substantially increased to 3.69 in optimum plan M-II. It was observed from the table that the net income earned in existing model under this farming system was Rs.24,390 which could be increased to Rs.33,841 in optimum plan M-I and Rs.43,419 in optimum plan M-II. It was also observed that cashewnut was eliminated in optimum plans.

As regards FS-II it was observed from the table that, paddy area was 0.76 ha (59.38%) in existing model, 0.34 ha. (26.56%) in optimum plan M-I which was unchanged in optimum plan M-II. The area under arecanut was eliminated in optimum plans. However the area under coconut was increased from 0.39 ha (30.47%) in existing model to 0.94 ha (73.44%) in optimum plan M-I and 0.94 ha (73.44%) in optimum plan M-II. The numbers of dairy animals were 1.88, 1.78, 3.46 in existing models optimum plan M-I and optimum plan M-II, respectively. The net income was increased by 44.80 per cent in optimum plan M-I over in existing model and 82.34 per cent in optimum plan M-II over existing model. The change in net income in optimum plan M-II over optimum plan M-I was 25.90 per cent.

It was observed that, in FS-III, paddy area was substantially decreased from 0.78 ha. (29.32%) in existing model to 0.41 ha (15.41%) in optimum plan M-I as well as in optimum plan M-II. The area under coconut was increased to a large extent in optimum plans. The area under coconut was 0.63 ha. (23.68%), 2.25 ha. (84.59%) 2.25 ha (84.59%) and in existing model, optimum plan M-I and optimum plan M-II, respectively. It was also observed that the area under mango, cashewnut, arecanut were eliminated in optimum plans. The net income was Rs.65,491, Rs.1,11,670 and Rs.1,32,855 in existing model, optimum plan M-I and optimum plan M-II, respectively.

In case of FS-IV it was observed that, the net income was increased from Rs 68,604 in existing model to Rs.94,456 in optimum plan M-I and Rs.1,25,321 in optimum plan M-II (Table 4.30). Among the various crop enterprises grown under this system it was observed that the paddy area was decreased from 0.67 (31.60%) to 0.27 ha. in optimum plan M-I and M-II. The area under smooth gourd was increased from 0.25 ha (11.79%) in existing model to 0.66 ha (70.96%) in optimum plan M-I and 1.04 ha (79.39%) in optimum plan M-II. The crop such as brinjal, bottle gourd, coconut and arecanut which were observed to be grown in existing model were found to be eliminated in optimum plans. The number of dairy animals were 2, 4.85 and 4.65 in existing model, optimum plan M-I and optimum plan M-II, respectively.

As regards to FS-V it was observed that, the area under coconut was increased from 0.65 ha (76.47%) in existing model to 0.85 ha (100.00%) in optimum plan M-I and it was found that the area under coconut was same in both optimum plans. The number of dairy animals were increased from 1.26 in existing model to 1.31 in optimum plan M-I and 2.56 in optimum plan M-II. The net income was increased from Rs.21,577 in existing model to Rs.23,513 in optimum plan M-I and Rs.27,168 in optimum plan M-II.

In case of FS-VI, it was observed (Table 4.31) that, the area under *kharif* paddy was 0.71 ha (32.42%), 0.37 ha (16.89%) and 0.37 ha. (16.89%) in existing, optimum plan M-I and optimum plan M-II respectively. The area under mango was increased from 0.63 ha (28.77%) in existing plant of 1.82 ha (83.11%) and 1.82 ha (83.11%) in optimum plan M-I and optimum plan M-II, respectively. The number of poultry birds were increased from 14.75 in existing model to 14.88 in optimum plan M-I and 22.95 in optimum plan M-II. The net income received in various alternative plans was Rs.84691, Rs.98193 and Rs.127997, in existing plan, optimum plan M-I and optimum plan M-II respectively.

Table 4.32: Net returns in optimum plans for farming systems followed in study area

(Figures in Rs.)

Clusters	Farming System	Existing plan (Rs.)	M-I		M-II	
			Rs.	Per cent change over existing	Rs.	Per cent change over existing
Cluster I Northern coastal plains	FS-I	57062	87954	54.14	88304	54.75
	FS-II	10272	11726	14.15	18379	78.92
	FS-III	57603	102315	77.62	121515	109.5
	FS-IV	57645	68440	18.73	85053	47.55
	FS-V	227128	285507	25.70	449620	97.96
Cluster II Northern central plains and hills	FS-I	14296	26605	86.10	39432	175.82
	FS-II	7909	12080	52.70	22095	179.36
	FS-III	10701	15088	41.00	22174	107.21
	FS-IV	95168	143955	51.26	177614	86.63
	FS-V	10832	13009	12.10	19829	83.06
Cluster III Southern central plains and hills	FS-I	46201	123258	166.78	142800	209.08
	FS-II	1192	3821	234.59	7080	519.96
	FS-III	11812	18740	58.65	29748	151.84
	FS-IV	191075	205530	7.57	312088	63.33
	FS-V	28038	63085	125.00	87942	213.65
Cluster IV Southern coastal plains	FS-I	24390	33891	38.70	43419	78.02
	FS-II	28773	41669	44.80	52465	82.34
	FS-III	65491	111670	70.51	132855	102.85
	FS-IV	68604	94456	37.68	125321	82.67
	FS-V	21577	23513	8.97	27168	25.91
	FS-VI	84691	98193	15.94	127997	51.13

M-I : Optimum solution at existing resource level.
M-II : Optimum solution at enhanced resource level.

4.7.5 Net Returns in Optimum Plans for Farming Systems followed in Study Area

The optimum plan depicted in Table 4.28 to 4.31 are summarized in order to get a birds eye view for all farming systems in study area and they are presented in table 4.32.

In northern coastal plains region net income was highest in FS-V (Rs.227128) followed by FS-III (Rs.57645). In optimum plan M-I, per cent change in net income over existing plan was maximum in FS-V (86.10%) followed by FS-III (77.62%). In optimum plan M-II per cent change in net income over optimum plan M-I was highest (57.8%) in FS-V.

In northern central plains and hills region net returns in existing plan was highest in FS-IV. As regards to optimum plans it was observed that, per cent increase of net income in optimum plan M-I over existing plan was highest FS-I (86.10%) followed by FS-II (52.70%) and FS-II (51.26%).

As regards southern central plans and hills per farm net returns in existing plan was ranging from Rs.1142 in FS-II to Rs.191075 in FS-IV. The per cent increase in optimum plan M-I over existing plan was highest in FS-II (234.59%). It was more than 50 per cent in all the farming systems except FS-IV. In case of optimum plan M-II per cent increase in net income over optimum plan M-I was highest in FS-II followed by FS-III (58.74%) and FS-IV (51.85%).

The net returns in southern coastal plains region was highest in FS-VI (Rs.84691) followed by FS-IV (Rs.68604) and FS-III) (Rs.65491) and the per cent increase of net income in optimum plan M-I over existing plan was highest in FS-III (70.51%) whereas per cent increase of net income in optimum plan M-II over optimum plan M-I was maximum in FS-IV (32.68%).

4.8 Shadow Prices of Resources

In order to study the resource situation and imputed value of objective function for different resources and to study the possibility of individual resources to be added or to be retained at the existing level the shadow prices for selected resources were calculated. The shadow prices for resources were obtained from two optimum solutions viz. optimum solution at existing resource level (M-I) and optimum solution at enhanced resource level (M-II). The shadow prices of selected resources used in major farming systems followed in different regions are presented in Table 4.33.

4.8.1 Northern Coastal Plains Region

4.8.1.1 Farming System – I

It was observed from the table that the shadow prices for human labour was Rs.50.94 in optimum plan M-I whereas it was zero in optimum plan M-II. The shadow price for bullock labour and land was zero in both optimal solutions. Whereas shadow price for working capital was zero in optimum plan M-I and it was Rs 0.30 in optimum plan M-II.

4.8.1.2 Farming System – II

Shadow prices for human labour was Rs.26.96 in both optimum solutions, whereas it was Rs 0.10 in case of working capital in both optimum solutions. However, the shadow prices for bullock labour and land were observed to be zero in both the optimum solutions (M-I and M-II).

4.8.1.3 Farming System – III

Shadow price for land was zero in optimum solution M-I and it was Rs.61095 in optimum solution M-II. The shadow price for the working capital was Rs.1.13 in optimum plan M-I and zero in optimum plan M-II. The shadow prices for other resources were zero in both optimum solutions.

4.8.1.4 Farming System – IV

The shadow prices for human labour was zero and Rs.124.86 in optimum solution M-I and M-II, respectively. The shadow price for working capital was 0.59 in solution M-I and zero

Table 4.33: Shadow Prices of Resources Used in Major Farming Systems

(Figures in Rs.)

Farming System	Inputs	Northern coastal plains region Cluster I		Central plains and hills (North) region Cluster-II		Central plains and hills (South) region Cluster-III		Southern coastal plains region Cluster-IV	
		M-I	M-II	M-I	M-II	M-I	M-II	M-I	M-II
FS-I	Human labour	50.94	0	5.25	0	0	0	0	0
	Bullock labour	0	0	0	0	405.01	301.52	0	0
	Working capital	0	0.3	1.1	0.29	2.84	0.29	0.49	0.49
	Land	0	0	0	0	0	0	0	0
FS-II	Human labour	26.96	26.96	0	0	10.92	10.92	0	0
	Bullock labour	0	0	0	0	0	0	0	0
	Working capital	0.1	0.1	0.3	0.3	0	0	0.47	0.47
	Land	0	0	0	0	0	0	0	0
FS-III	Human labour	0	0	55.21	0	5.73	5.73	0	0
	Bullock labour	0	0	0	0	0	0	0	0
	Working capital	1.13	0	0	0.28	0.54	0.54	0.59	0.59
	Land	0	61095	0	0	0	0	0	0
FS-IV	Human labour	0	124.86	236.76	0	0	0	0	88.83
	Bullock labour	0	0	113.9	0	0	0	1221.40	1238.07
	Working capital	0.59	0	0	0.18	0.95	0.95	0.69	0
	Land	0	0	0	0	0	0	0	0
FS-V	Human labour	0	0	0	0	102.66	50.03	36.22	0
	Bullock labour	0	0	0	0	0	0	0	0
	Working capital	2.65	2.65	0.31	0.32	0.154	0.27	0	0.23
	Land	0	0	364.5	364.5	0	0	0	0
FS-VI	Human labour							0	0
	Bullock labour							0	0
	Working capital							0.49	0.14
	Land							0	0

M-I : Optimum solution at existing resource level.
M-II : Optimum solution at enhanced resource level.

in M-II. Shadow prices for bullock labour and land were observed to be zero for both optimum solutions.

4.8.1.5 Farming System – V

It was observed from table that, shadow prices for human labour, bullock labour and land were zero and in case of working capital it was Rs.2.65 in both optimum solutions.

4.8.2 Northern Central Plains and Hills Region

4.8.2.1 Farming System – I

It could be observed from the table that, the shadow price for human labour was Rs.5.25 in optimum solution M-I and zero in optimum solution M-II. The shadow prices for working capital was observed to be decreased from Rs.1.10 in optimal solution M-I to Rs.0.29 in optimum plan M-II. The shadow prices for bullock labour and land were zero in both optimal solutions.

4.8.2.2 Farming System – II

The shadow price for working capital was Rs 0.30 in both optimal solutions, while it was zero in case of all other inputs in both optimal solutions.

4.8.2.3 Farming System – III

The shadow price for human labour was Rs.55.21 in optimal solution M-I and zero in optimal solution M-II. The shadow prices for bullock labour and land were zero in both optimal solutions. The shadow price for working capital was zero in optimal solution M-I and it was Rs 0.28 in optimal solution M-II.

4.8.2.4 Farming System – IV

It was observed that in optimal solution M-I the shadow prices for human labour and bullock labour were Rs 236.76 and Rs 113.9, respectively. In case of working capital and land it was zero. In optimal solution M-II shadow prices of working capital was Rs 0.18 while in case of other resources it was zero for other resources.

4.8.2.5 Farming System – V

It was observed from table 4.32 that the shadow price for human labour and bullock labour were zero in both optimal solutions. The shadow price for working capital was Rs 0.31 in optimal solution M-I and Rs.0.32 in optimal solution M-II. In case of land the shadow price was Rs.364.5 in both optimal solutions.

4.8.3 Southern Central Plains and Hills Region

4.8.3.1 Farming System – I

It was observed from the table that, shadow price for human labour and land were zero in both optimal solutions. In case of bullock labour shadow price was observed to be Rs.405.01 and Rs.301.52 in optimal solution M-I and M-II, respectively. In case of shadow prices for working capital, it was Rs.2.84 and Rs.0.29 in optimal solution M-I and M-II, respectively.

4.8.3.2 Farming System – II

The shadow price for human labour was Rs.10.92 in both optimal solutions where as it was zero in case of all other resources in both the optimal solutions.

4.8.3.3 Farming System – III

It is observed that the shadow prices for human labour and working capital was Rs 5.73 and Rs 0.54 respectively in both optimal solutions, whereas it was observed to be zero regarding bullock labour and land.

4.8.3.4 Farming System – IV

The shadow price for working capital was Rs.95 in both optimal solutions (M-I and M-II) whereas it was zero for other resources in all plans.

4.8.3.5 Farming System – V

It could be observed from table that, the shadow price for human labour was Rs.102.66 in optimal solution M-I and Rs 50.03 in optimal solution M-II. In case of working capital shadow price was increased from Rs.0.154 in optimal solution M-I to Rs 0.27 in optimal solution M-II. Whereas the shadow price for bullock labour and land were zero in both optimal solutions.

4.8.4 Southern Coastal Plains

4.8.4.1 Farming System – I

It was observed from table 4.33 that the shadow prices for working capital was Rs 0.49 in both optimal solutions whereas it was zero for all other resources.

4.8.4.2 Farming System – II

The shadow prices for working capital was observed to be Rs 0.47 in optimal solution M-I and M-II. In case of human labour, bullock labour and land shadow price was zero in both the optimal solutions.

4.8.4.3 Farming System – III

The shadow prices for working capital was Rs 0.59 in both optimal solutions whereas it was zero for other resources in both optimal solutions (M-I and M-II).

4.8.4.4 Farming System – IV

In case of human labour it was observed that the shadow price was zero in optimal solution M-I while it was Rs 88.83 in optimal solution M-II. Regarding bullock labour shadow price was Rs 1221.4 and Rs 1238.07 in optimal solution M-I and M-II, respectively. The shadow price for working capital was Rs 0.69 in optimal solutions M-I and it was zero in optimal solution M-II. The shadow price for land in both optimal solutions was observed to be zero.

4.8.4.5 Farming System – V

It was observed from table that the shadow price in optimal solution M-I was Rs 36.22 for human labour while it was zero for all other resources. Regarding optimum solution M-II the shadow price was Rs 0.23 in case of working capital and it was observed to be zero for human labour, bullock labour and land.

4.8.4.6 Farming System – VI

It was observed from table that shadow price for working capital was Rs 0.49 in optimal solution M-I and Rs.0.14 in the optimal solution M-II. The shadow prices for the resources such as human labour, bullock labour and land were observed to be zero in both the optimal solutions.

4.9 Problems and Constraints

Various problems and constraints faced by farmers following different farming systems in delineated areas of different regions are presented in Table 4.34. These problems and constraints are expressed as percentages of opinion of the total number of respondents.

4.9.1 Northern Coastal Plains Region

It was observed from Table 4.34 that, the 68.88 per cent farmers opined that the wage rates were high whereas 75.55 per cent farmers were facing the problem of shortage a labour. The other major constraints faced by the farmers were lack of knowledge of integrated farming (53.33%) and less knowledge of pest control (51.11%).

Table 4.34: Constraints Faced by Farmers in Adoption of Farming Systems in Study Area

(Figures in per cent)

Sl. No	Particulars	Northern coastal plains region (N =90)	Northern central plains and hills region (N = 90)	Southern central plains and hills region (N = 90)	Souther n coastal plains region (N = 90)	North Konkan region (N = 360)
I	Production constraints					
1.	Non availability of inputs in time	40.00	62.22	32.22	37.78	43.47
2.	High wage rates	68.88	15.55	38.89	57.77	45.27
3.	Shortage of labour	75.55	17.77	55.55	24.44	43.23
4.	Non availability of inputs in village itself	44.44	71.11	44.44	42.22	50.55
5.	High cost of fertilizers	25.55	50.00	61.11	27.78	41.11
6	Shortage of water in summer	21.11	38.89	16.67	57.77	33.61
7.	Electricity failure	28.88	44.44	55.55	31.11	27.49
8.	Fragmentation and sub division of land	16.67	34.44	28.89	20.00	25.00
9.	Lack of technical assistance	26.67	20.00	37.78	32.22	29.15
10.	Less knowledge of integrated farming systems	53.33	58.88	20.00	28.89	40.27
11.	Less know how about pest control	51.11	68.89	62.22	34.44	54.16
12.	Water pollution by chemical industries	46.66	22.22	26.68	20.00	28.89
13.	High incidence of pests	41.11	24.44	36.67	28.89	32.77
II	Marketing constraints					
1.	Inadequate demand for output in local market	12.20	10.00	26.68	14.44	15.83
2.	Low price for produce	76.67	18.89	42.22	43.33	45.27
3.	High marketing cost	68.89	26.67	52.22	35.55	45.83
4.	Price fluctuations	80.00	32.22	36.67	52.22	50.27
III	Financial constraints					
1.	Scarcity of own fund	20.00	53.33	37.78	33.33	36.11
2.	Lengthy process of loan sanction in banks	48.89	28.89	57.78	44.44	45.00
3.	Too much documentation	40.00	38.89	23.33	31.11	33.33
4.	No easy access for credit	43.33	47.78	43.33	34.44	41.39
5.	In proper functioning of credit institutions	24.44	13.33	15.55	21.11	18.61
6.	Interest rates are high	20.00	26.67	34.44	48.89	32.50
7.	Irregular subsidy	30.00	23.33	32.22	15.55	25.28

It was observed that, the major marketing constraints of the farmers were low prices for produce (76.67%), high marketing cost (68.89%) and price fluctuation (80.00%).

Regarding financial constraints, it was observed from Table 4.34 that, 43.33 per cent farmers opined that they do not have easy access for credit. The 48.89 per cent farmers were of the opinion that the process of sanctioning of the loan in the banks was very lengthy. The other financial problems were too much documentation (40.00%) and irregular subsidy (30.00%).

4.9.2 Northern Central Plains and Hills Region

It was observed that, the major production constraints faced by the farmers in this region were non availability of inputs in villages, (71.11%), less knowledge about the pest control (68.89%), non availability of inputs in time (62.22%), less knowledge of integrated farming system (58.88%) and high cost of fertilizers (50.00%).

Regarding the marketing problems it was observed that 32.22 per cent farmers were of the opinion that they were facing the problems of price fluctuation and 26.67 per cent farmers had faced the problem of high marketing cost. About 23.33 per cent of the farmers were in the opinion that they were getting subsidy irregularly.

4.9.3 Southern Central Plains and Hills Region

In case of production constraints it was observed from Table 4.34 that, the major constraints in this region were less know how about pest control (62.22%), high cost of fertilizers (61.11%), shortage of labour (55.55%) and electricity failure (55.55%).

The other problems faced by the farmers in this region were high incidence of pests (36.67%), non availability of major inputs in village itself (44.44), lack of technical assistance (37.78%) and high wage rates (38.89%).

As regards marketing problems, 52.22 per cent farmers opined that the marketing cost of agricultural produce was high while 42.22 per cent farmers stated that they were getting low price for their produce. About 36.67 per cent of the farmers mentioned that the price fluctuations in agricultural products should be reduced.

As regards financial constraints it was observed from Table 4.34 that, the constraints opined by most of farmers were lengthy process of loan sanction (57.78%) followed by no easy access to credit (43.33%) interest rates were high (34.44%) and scarcity of owned fund (37.78%).

4.9.4 Costal Plains (South) Region

It was observed from table 4.34 that, the major constraints faced in this region as stated by majority of farmers were shortage of water in summer (57.77%), high wage rates (57.77%), non availability of inputs in village itself (42.22%), non availability of inputs in time (37.78%), lack of knowledge of pest control (34.44%), other constraints were high wage rates, shortage of labour, and high cost of fertilizer.

The major marketing constraint was found to be price fluctuation which was stated by 52.22 per cent farmers. The other problems were low price for produce (43.33%) and high marketing cost (35.55%).

As regards financial problems faced by the farmers, the major problems were high interest rate (48.89%), lengthy process of loan sanction (44.44%) and no easy access for credit (34.44%).

4.9.5 North Konkan Region

At overall level, in north Konkan region, the major production constraints observed were less knowledge about pest control (56.94%), non availability of inputs at village level (50.55%), shortage of labour (43.23%), high wage rates (45.27%), non availability of input in time (43.47%) and less knowledge about integrated farming system (40.27%).

As regards marketing constraints, price fluctuations (50.27%), high marketing cost (45.83%) and low price for produce (45.27%) were the major constraints faced by the farmers.

In case of financial constraints faced by the farmers, the constraints such as lengthy process of loan sanction (45%), no easy access for credit (41.39%), scarcity of own fund (36.11%), too much documentation required for loan proposals (33.33%) and high interest rate (32.50%) were found to be the major problems faced by the farmers.

4.10 Measures to Overcome the Constraints

The measures suggested by the farmers to overcome the constraints faced are presented in Table 4.35.

4.10.1 Northern Coastal Plains Region

It was observed from the table that, the farmers in this region stated their views regarding measures to overcome the constraints faced by them. The maximum number of farmers (75.55%) stated that there was need for demonstration on the control of Eryophite mite, a pest on the coconut palms, followed by regulation of wage rates and technical knowledge regarding control of pest on flowers (50%), demonstration of farming system models (46.67%) and training on processing and preservation of products (44.44%). The other measures suggested were training on integrated farming system (33.33%), distribution of inputs in time (22.22%), use of organic fertilizer and replacement of seed (37.77%), consolidation of land holding (31.11%) and subsidy for fertilizers to farms (27.78%).

In case of marketing measures it was observed that maximum farmers (83.33%) opined that there was need to improve the transport facilities, whereas 51.11 per cent farmers were of the opinion that there was need for reduction in the taxes charged by the commission agents trading agents. Other measures suggested by the farmers were regulation of the fruit prices (46.67%), collective purchase and sale of input and output (44.44%) and providing the warehousing facilities (30.00%).

As regards to measures for the financial problems, 62.22 per cent farmers stated that, the interest rate on agricultural loans should be reduced, while 22.22 per cent of the farmers were of the opinion that procedure for the loan sanction should be made easy.

4.10.2 Northern Central Plains and Hills Region

The measures suggested by the farmers in this region were consolidation of land holding (32.22%), distribution of inputs in time (31.11%), training on processing and preservation of products (24.44%) and training on integrated farming system (20%).

As regards marketing measures it was observed from Table 4.33 that, maximum number of farmers (46.67%) stated that the transport facility should be improved whereas 20 per cent of the farmers expressed their views regarding collective purchase and sale of input and output so that the marketing cost can be reduced.

As regards the financial measures 43.33 per cent farmers opined that the procedure for the agriculture loans should be made easy while 16.70 per cent farmers emphasized that need for reduction in interest rates.

4.10.3 Southern Central Plains and Hills Region

It was observed from Table 4.35 that, major measures suggested by the farmers in this region were replacement of seed (44.44%), demonstration of farming systems, regulation of wage rates (43.33%), training on processing of products (31.34%), training on integrated farming systems and Eryophite mite control (28.78%).

Among marketing measures, maximum number of farmers (50.00%) expressed the need for providing warehousing facility followed by collective purchase and sale of input and output (35.55%) and improvement in transport facilities (22.22%).

The financial measures suggested by the farmers were reduction in the interest rate (35.55%) and easy procedure for loans (25.55%).

4.10.4 Southern Coastal Plains Region

The measures suggested by the farmers of the region regarding production aspect were demonstration on farming systems models (57.78%), Eryophite mite control (55.55%), training on processing and preservation of products (42.22%), demonstration and training on

Table 4.35: Measures Suggested to Over Come the Constraints Faced by the Farmers in Study Area

(Figures in Percent)

Sl. No	Particulars	Northern coastal plains region (N =90)	Northern central plains and hills region (N = 90)	Southern central plains and hills region (N = 90)	Southern coastal plains region (N = 90)	North Konkan region (N = 360)
I	Production					
1.	Training in integrated farming system	33.33	20.00	27.78	40.00	30.27
2.	Distribution of inputs in time	22.22	31.11	15.55	28.89	24.44
3.	Regulation of wage rates	50.00	21.21	43.33	24.44	34.72
4.	Replacement of seed	37.77	17.78	44.44	27.78	33.94
5.	Consolidation of land holding	31.11	13.33	33.33	17.78	23.89
6.	Demonstration of farming system models	46.67	32.22	43.43	57.78	45.00
7.	Subsidy for fertilizers to farmers	27.78	6.67	21.11	20.00	18.89
8.	Demonstration on Eryophite mite control	75.55	14.44	27.78	55.55	43.33
9.	Training on processing and preservation of products	44.44	24.44	34.44	42.22	36.39
10.	Technical knowledge to control pests in flowers	50.00	7.78	2.22	13.33	18.33
II	Marketing					
1.	Collective purchase sell of input and output	44.44	20.00	35.55	31.11	32.78
2.	Regulation on price of fruit crops	46.67	17.87	28.89	43.33	34.17
3.	Warehouse facility	30.00	24.44	50.00	38.89	35.83
4.	Improvement of Transport facilities	83.33	46.67	22.22	31.11	45.83
5.	Reduction in (tax) commission by traders agent	51.11	10.00	17.78	22.22	25.28
III	Financial					
1.	Reduction in interest rates	62.22	16.67	35.55	2.22	41.67
2.	Easy procedures of loan	22.22	43.33	25.55	40.00	32.78

integrated farming system (40%), regulation of wage rates (24.44%) and distribution of inputs in time (28.89%).

As regards marketing measures, it was observed from the table that, maximum number of farmers (43.33%) opined that regulation of fruit prices is necessary followed by the provision of warehousing facilities (38.89%). The other measures suggested by the farmers for improving the marketing of agricultural product were collective purchase and sale of input and output (31.11%), improvement in the transport facilities (31.11%) and reduction in the taxes charged by commission agents /traders (22.22%).

As regards the financial measures the maximum number of farmers (40%) were of the opinion that procedure for the sanction of loans should be made easy.

4.10.5 North Konkan Region

At overall level in North Konkan region, the important measure suggested by the farmers in production front were demonstration of farming system models (45%), demonstration on Eryophite mite control (43.33%), training on processing and preservation of products (36.39%), regulation of wage rates (34.72%), replacement of seed (33.94%) and training on integrated farming system (30.27%).

Among marketing measures, maximum number of farmers (45.83%) were for improvement in the transport facilities followed by providing warehousing facilities (35.83%) regulation of fruit prices (34.17%), collective purchase and sale of input and output (32.78%).

Regarding financial measures, it was observed from the table that maximum number of farmers expressed the need for reduction in the interest rate on the loan (41.67%) and around 32.78 per cent farmers were of the opinion that the procedure for the sanction of loans should be made easy.

5. DISCUSSION

In this chapter findings presented in the preceding chapter are discussed under the following heads.

5.1 Delineation of study area on the basis of agro-climatic parameters

5.2 General characteristics of sample respondents

5.3 Existing farming systems

5.4 Per unit profitability enterprises followed in study area.

5.5 Cost and returns structure of farming systems

5.6 Resource use efficiency of enterprises followed under major farming systems.

5.7 Optimum farming systems

5.8 Constraints faced by farmers and measures to overcome them.

5.1 Delineation of Study Area on the Basis of Agro-Climatic Parameters

It was revealed from Table 4.1, that the result of cluster analysis indicated homogeneity within the cluster formed. In cluster-I, the tahsils namely Talasari, Dahanu, Palghar and Vasai were clubbed together. All these tahsils lie at west cost part of the district. The area under the irrigated plantation crops such as sapota, arecanut, coconut and betelvines in addition to rainfall and other variables etc. may have the greater influence on the clubbing of these tahsils in one cluster. These tahsils have plain land and also less undulating land as compared to other clusters in the district and these tahsils lie to the north side of the study area. This cluster was named as Northern coastal plains region. This region is most developed region as far as agriculture in the study area is concerned. Naik (1998) used the cluster analysis to identify the hoblies with similarity in farming system in Karnataka and area was delineated on forming the clusters of *hoblis* and these clusters were named as coastal region, *malnad* region, and plains region.

It was also observed from table 4.1 that in cluster-II tahsils lying central and north eastern part of the study area have found similarity among the variables considered and included in one cluster. The tahsils such as Vikramgadh, Jawhar, Mokhada, Wada, Bhivandi, Shahapur and Murbad. The variables such as area under other cereals, prosomillet, finger millet, number of goat rearing animals, forest area, area under pulses, area under cashewnut have contributed to larger extent in addition to other variables to combine these tahsils in one cluster. The tahsils in this cluster have a common similarity that most of tahsils have more undulating land, existence of more rainfed crops and tribal population of the tahsils. This cluster is among least developed region of the study area. Eswarappa (1993) found that the clusters brought together the taluks, based on their association among themselves with respect to cropping pattern. This cluster was named as Northern central plains and hills region.

The cluster-III consisted of tahsils namely Panvel, Karjat, Khalapur, Pen, Sudhagadh, Mangaon, Tala, Mahad, Poladpur and Roha. These tahsils lie at central and south east part of study area. In these tahsils the variables namely *Kharif* paddy area, *Rabi* paddy area, area under pulses, number of poultry birds, dairy animals etc. have strongly influenced the bringing together of these tahsils in one cluster. The tahsils in this cluster constitute paddy dominated area in North Konkan region. The cluster was named as per its topography and location as a Southern central plains and hills region.

The cluster-IV is composed of tahsils which lie at west coast part of the study area at southern side. This cluster included tahsils namely Uran, Alibang, Mhasala, Murud and Shrivardhan. The area under plantation crops such as coconut, arecanut, mango and cashew in addition to paddy area and other variables have greatly influenced in clubbing of these tahsils in one cluster. This cluster was named as a Southern coastal plains region.

It was observed from table 4.2, that proximity coefficients in cluster-I ranged between 0.540 to 0.927, indicating high similarity between the tahsils. The proximity value between Dahanu and Talasari, the adjoining tahsils, was maximum (0.927), while it was 0.540 in Vasai and Talasari tahsils, which were comparatively far away from each other.

In case of cluster-II, which consisted of seven tahsils, the proximity value between tahsils namely Bhivandi and Murbad was high (0.958). However, it was low in Vikramgadh and Murbad. Among the various tahsils proximity value was ranging from 0.431 to 0.558. It was revealed from Table 4.2. that the higher proximity value between tahsils indicated much similar agro-climatic situation than with the other tahsils.

cluster-III consisted of 10 tahsils. The proximity value between Poladpur and Panvel tahsils was 0.362, which were located comparatively at long distance. The proximity value between Sudhagad tahsil and Khalapur tahsils was maximum that is 0.962. It indicates that, as the distance of tahsils increases from each other the proximity value decreases which is the result of a little similarity in agro-climatic situation.

It was observed from table 4.2 that, the cluster IV consisted of five tahsils and proximity value between Mhasala and Shrivardhan tahsils were 0.986, followed by value between Shrivardhan and Murud (0.965), Mahad and Alibag 0.964. It was less between Mhasala and Uran (0.620) which were at longer distance from each other. Mangoli (1997) found that the taluks in a clusters could be included on the basis of land use pattern and he also noticed the change in cluster membership of tahsils in two period with respect to land use pattern. It was observed in this cluster, that the majority of the proximity values between tahsils were at higher side showing more similarity in agro-climatic situation.

In the case of cluster-V, the proximity values were ranging from 0.038 to 0.681 indicating less homoginity within the cluster. Though the proximity values between tahsils of this cluster are at lower side, these tahsils did not have strong association with members of other clusters as they may be clubbed in one cluster.

5.1.2 Validation of clusters

It was observed from Table 4.3 that (as indicated in a table) the actual group membership of tahsils in a cluster after testing by the discriminent analysis and the predicted group that is result obtained from cluster analysis (before testing) were same for all the tahsils. It was revealed from discriminent analysis that, the cases or tahsils classified by the cluster analysis were found to be 100 per cent correct, indicating the choice of variables, method adopted for cluster analysis was appropriate.

5.2 General Characteristics of Sample Respondents

5.2.1 Age group

The majority of the farmers in study area were middle aged (Table 4.4). The average age in cluster-I (CPN) was lower than others, indicating young generations involvement in farming particularly in flower, dairy and betelvines production in the cluster.

5.2.2 Education

The literacy percentage of farmers' in study area was high (80.83%). The literacy rate was lower in cluster-II. It may be because in this cluster many tahsils have larger tribal population as compared to other clusters. Usually the tribals in the forest remain separated from main stream of social life. The school facilities in such tribal belts are also very limited. Even the tribal people have not yet recognized the importance of education. This is one of the thrust areas where literacy campaign of the Government can seriously act upon.

5.2.3 Family size

It was observed from the table 4.4 that, family size in study area was higher than national average family size. Joint family system was more common in the study area.

5.2.4 Occupation

The table indicated that, agriculture was dominant occupation of farmers in the study area, while farmers with other occupations such as service were less. The farmers having the

occupation as agriculture and service were more in cluster-I (11.11%) as compared to other clusters. The tahsils falling in this cluster *viz.,* Dahanu, Palghar and Vasai are near to urban areas. Apart from that development of railway line and development of many industries in these tahsils induced many people of the cluster to shed some on agriculture job opportunities. Such developments were less in other clusters. On the other hand, in cluster-II, large population of tribals is existed, hence occupation of farmers as mainly agriculture and service was quite low (3.33%).

5.3 Existing Farming Systems

5.3.1 Farming System in Northern Coastal Plains Region

It was revealed from Table 4.5 that, farmers in this region have followed five major farming systems. The paddy enterprise was observed to be followed in all farming systems except FS-IV. In addition to paddy and irrigated plantations, farmers have followed flowers, betelvines and dairy, indicating awareness among the farmers to implement the market oriented agribusiness practices in this region. The benefit of Mumbai market, rail connectivity was well availed by the farmers following flower cultivation and dairy enterprises in this region.

5.3.2 Northern Central Plains and Hills Region

In this region five major farming systems were followed by the farmers. Paddy was cultivated in all farming systems. The other cereals were grown under FS-I and FS-II, while rainfed plantations in FS-I, indicating the choice of enterprises by the farmers due to shortage of water and suitability of land for these enterprises. The goat rearing was followed mainly by the tribal farmers, while some land was kept idle for grass in which only grass cutting was undertaken. It was due to demand for grass as a cattle feed on one side and on the other side scarcity of certain inputs with the farmers to cultivate the other crop enterprises.

5.3.3 Southern Central Plains and Hills Region

It was observed from Table 4.5 that, five farming systems were identified as major farming systems in this region. Paddy was grown in *Kharif* as well as in *Rabi* season, in all farming systems indicating availability of irrigation facility in the region. The pulses were grown under FS-III, while poultry was undertaken in FS-IV.

The paddy and dairy were major enterprises in this region. However, farmers in this region have also followed vegetable growing and poultry indicating the awareness among the farmers to avail the benefit of the urban market near to this region.

5.3.4 Southern Coastal Plains Region

Six farming systems were identified as major farming systems followed in this region. Irrigated plantations were followed in all farming systems except FS-I. The rainfed plantations were grown under FS-I and FS-VI. The irrigated plantations and rainfed plantations were main enterprises followed in addition to paddy in this region due to a suitable agro-climatic situation for this crop. Paddy was grown in all farming systems except FS-V.

5.3.5 Land holding Under Existing Farming Systems

It was observed from Table 4.6 that, the per farm holding size was ranging from 1.45 to 2.83 among all farming systems in Northern coastal plains region. The farming systems were not classified according to the farm size groups due to inadequate number of farmers in farming systems. In FS-IV of Northern coastal plains region, the irrigated land was maximum (about 95.40 per cent operational holding) indicating dominance of betelvines and irrigated plantation crops such as coconut and arecanut. Regarding Northern central plains and hills region, it could be observed that the operational holding was same as that of the total owned land indicating, farmers in this region are following extensive cultivation. This may be due to more number of tribal farmers in this region and inadequacy of inputs.

In case of the Southern central plains and hills region the irrigated land was maximum in FS-I, while permanent fallow land was maximum in paddy + rainfed plantations + dairy (FS-V), which could be brought under cultivation indicating scope for increasing output mainly through the cultivation of rainfed plantations.

It was observed from Table 4.6 that, per farm land holding in costal plains (South) region was ranging from 1.31 hectare in (FS-V) to 3.28 hectare(FS-III). The irrigated land was maximum in FS-IV due to more emphasis of the farmers of this system towards cultivation of coconut and arecanut.

5.3.6. Cropping Pattern, Followed in Sample Farms

5.3.6.1 Cropping Pattern in Northern Coastal Plains Region

It was observed from Table 4.7 that, paddy, coconut, areanut, banana, betelvines, sapota and flower crops namely balsam (terda), jasmine (mogara), jai, hibiscus, sayali, kagda, yellow champak, sapota, coconut, arecanut, banana and betelvines were grown in this region. Among the perennial crops sapota had a lion's share in FS-I and FS-IV contributing about 41.67 per cent and 77.67 per cent area, respectively, while coconut had a maximum area in FS-V. The paddy was found to be grown in all the farming systems except FS-IV and FS-V. It was observed that area under paddy was substantially reduced in FS-III where, flower crops are introduced as stated by farmers. The flower crops are cultivated in *kharif* season as well as perennial flowers are also grown in this region. The betelvines is another commercially important crop grown in this region which contributes about 26.63 per cent area in FS-V. The cropping intensity was low because the farmers in this region were not interested to undertake any more seasonal crop in *rabi* season, either they have diverted the irrigated land under irrigated plantation crops or perennial flower crops. The cropping intensity was ranging from 78.23 per cent to 300 per cent in various farming systems.

5.3.6.2 Cropping Pattern in Northern Central Plains and Hills Region

The crops grown in the region were observed to be paddy, finger millet (Nagli), prosomillet (Vari), cowpea, grass, blackgram, wal, greengram, brinjal, lady's finger, mango and cashewnut.

It is apparent that, in Northern central plains and hills region (cluster-II), paddy was grown by all the sample farmers (Table 4.8). The area under paddy was substantial, it was minimum in FS-III (47.74%) and maximum in FS-II (85.11%). The net cultivated area was found to be ranging from 0.81 hectare to 2.18 hectare in the different farming systems. However, it was minimum in FS-III, where pulses were grown in *Rabi* season on the paddy follows at *Kharif* season and cropping intensity was found to be maximum in this farming system indicating the tendency of the small farmers towards intensive cultivation. In FS-V, the area under paddy and grass were 50.91 and 49.09 per cent indicating a large area kept idle for larger period of year. It may be due to the scarcity of investible resources with the farmer and in this region tribal farmers are also comparatively larger than that of other regions under study.

5.3.6.3 Cropping Pattern in Southern Central Plains and Hills Region

It was revealed from Table 4.9, that crops grown in this region were paddy, cowpea, wal, gram, green gram, bottle gourd, tomato, brinjal, lady's finger, smooth gourd, chilli, mango and cashewnut. The per farm net cultivated area was maximum in FS-V (2.32 hectare) while it was minimum in FS-I (1.03 hectare). The paddy was grown in *Kharif* as well as *Rabi* season in all the farming systems indicating good irrigation facilities in *Rabi* season. It was found that irrigation has played important role in generating returns in farming systems in the region. It was also observed that out of total cultivable area, some (0.008 hectare) area was not available for *Kharif* season due to excess water in the field in case of FS-I. The per farm *Rabi* paddy area was ranging from 0.13 ha. in FS-IV to 0.85 ha in FS-V. The cropping intensity was high in FS-I, in which along with paddy in *Rabi* season the crops like bottle gourd, tomato, brinjal, lady's finger, smooth gourd and chilli were grown. The contribution of *Rabi* crops in gross cropped area was considerably high (52.14%) in FS-I as compared to other farming systems.

5.3.6.4 Cropping Pattern in Southern Coastal Plains Region

The crops observed to be grown in this region were paddy, brinjal, smooth gourd, bottle gourd, mango, cashewnut, coconut and arecanut. The per farm net cultivated area ranged from 0.85 to 2.66 hectares in different farming systems. The area under paddy in this region was also substantial (29.32% in FS-III to 59.38% in FS-II). The area under perennial

crops was also more in most of the farming systems of the region due to suitable agro-climatic situation for these crops. It can be concluded that the farming systems in this region were strongly influenced by the irrigated plantations and rainfed plantations, as they contributed larger area in almost all the farming systems in this region.

The cropping intensity in this region was high in almost all farming system (145% to 216%) due to dominance of perennial crops.

5.4 Profitability of Different Enterprises

5.4.1 Profitability of Enterprises followed in Northern Coastal Plains Region

a) Paddy : It was observed from Table 4.11, that paddy crop was grown under all the farming systems in the region except FS-IV. The per hectare gross returns were maximum in FS-II (Rs.22321) followed by in FS-III (Rs.22321). The per hectare gross returns were minimum in FS-II (Rs.16097). However, per hectare cost was also less in FS-II (Rs.15339) indicating that as inputs used were less, the gross returns were decreased however, the gross returns were not decreasing in FS-II in proportionate to increase in cost as compared to other farming systems. The per hectare total cost in FS-I, FS-III, FS-V were more due to more utilization of bullock and human labour. Swami (2004) while studying farming systems in Ratnagiri district of Maharashtra found that the per hectare net returns at cost 'C' were Rs.48986 and input-output ratio was Rs.2.78. The returns per rupee invested at total cost were ranging from Rs.0.97 in FS-I to Rs.1.05 in FS-II indicating need to increase adoption of high yielding varieties and also proper utilization of resources

b) Sapota : In case of sapota crop, the total cost as well as gross returns were maximum in FS-IV, Rs.63416 and Rs.109725, respectively. However, total cost and total returns in FS-I were comparatively less than FS-IV, Rs.53369 and Rs.103368 respectively. The total cost in FS-IV was higher due to more use of inputs such as male as well as female labours, plant protection chemicals, fertilizers than their use in FS-I. The returns per rupee invested in FS-I (Rs.1.94) were higher than FS-IV (Rs.1.73). Hence, it can be concluded that more utilization of input may result in increase in gross returns but returns on each rupee investment would decline.

c) Coconut : It was revealed that, the coconut is grown under FS-I, FS-III, FS-IV, and FS-V (Table 4.11). Among the various farming systems the total variable cost worked out to Rs.29495, Rs.25866, Rs.41170 and Rs.16739 in FS-I, FS-III, FS-IV and FS-V, respectively. The variable cost in FS-V was less due to less use of inputs such as human labour and F.Y.M. Betelvines was another higher income earning crop in the system. As it required daily care, more maintenance and continuous attention than coconut, arecanut and paddy, this might have resulted in lesser use of inputs in coconut. The returns per rupee invested and per hectare net returns at total cost were low in FS-IV which was due to the high incidence of Eryophite mite on the coconut farms of sample respondents of this system. Hedge (1990) found that per hectare returns of coconut crop were higher in coconut and banana cropping system than sole coconut crop. Total costs were ranging from Rs.34004 in FS-V to Rs.58143 in FS-IV and gross returns from Rs.51560 in FS-V to Rs.72667 in FS-IV, which underlines economic importance of this crop.

d) Arecanut : Arecanut was found to be grown under FS-I, FS-III, FS-IV and FS-V in the region. The total cost were ranging from Rs.34723 in FS-III to Rs.43820 in case of FS-V. The gross returns were maximum in FS-IV (Rs.84000) and minimum in FS-III (Rs.42000). The returns on per rupee invested was highest in FS-IV (Rs.1.96), indicating high profitability of arecanut. Chipte (1997) also found similar results in case of arecanut in Thane district of Maharashtra.

e) Banana : Banana was found to be grown under FS-I. The per hectare gross returns and total cost were Rs.91255 and Rs.61559, respectively. The per hectare net returns over total cost was Rs.47382 and return per rupee invested at total cost was Rs.1.48, indicating an important supportive role played by the crop in total income earned by farmers following FS-I.

f) Grass : Grass was grown under FS-II. It was observed that the farmers with ample land or land which would have been kept idle because of scarcity of resources were used for grass cultivation where not any cultivation practices were possible by the farmers. Some farmers had spent on fencing and it had resulted in increase in quantity of grass obtained. The net

income earned from grass was very meager (Rs.1582) and return per rupee invested was Rs.1.26.

g) Sayali: In case of sayali flower cultivation in FS-III, the total variable cost worked out to Rs.84193 and total fixed cost Rs.30457. The per hectare gross returns obtained worked out to Rs.156750. The net returns per hectare at total cost was Rs.42099. It was revealed that the sayali was also important crop grown by the farmers following FS-III in addition to other flowers and plantation crops etc.

h) Kagada: The Kagada was another commercially important flower crop from jasmine group in FS-III. The per hectare gross returns was Rs.166215 and total cost Rs.131059. The net return over total cost was Rs.35156 and the return per rupee invested was Rs.1.27.

i) Yellow Champak : It is appearant from Table 4.11 that, per hectare total variable cost and total fixed cost were Rs.65440 and Rs.28067, respectively. The per hectare gross returns amounted to Rs.139008, resulting into returns per rupee invested to the tune of Rs.1.49 and per hectare net return obtained after considering variable and fixed cost together was Rs.45500, indicating the high profitability of the crop.

j) Hibiscus : Hibiscus was also grown under FS-III. Hibiscus is not scented flower, but it has greater demand in Mumbai market for praying purpose and the farmers in this region were cultivating hibiscus. The per hectare total cost and gross returns worked out to Rs.90436 and Rs.113845, respectively. The net returns over variable cost were Rs.46318. The returns per rupee invested at total cost were Rs.1.26. It can be revealed that though hibiscus not considered as important flower crop like rose or jasmine, the farmers in study area had awareness about the market demand and hence they had introduced this flower crop as a commercial crop instead of ornamental or hedge crop as it is generally observed.

k) Balsam (Terada) : It was observed that, balsam flower crop was grown in FS-III in *Kharif* season. The total cost of cultivation worked out to Rs.106904 while gross returns was Rs.149505. The gross returns over total variable cost and total cost were Rs.68807 and Rs.42600, respectively. The returns per rupee invested were to the tune of Rs.1.40. Though the balsam is very perishable flower, as compared to other flowers grown in FS-III, farmers have included the crop in their enterprise mix considering its commercial importance.

l) Jai *(Jasminum auriculatum)* : In FS-III, the jai flower crop was observed to be grown by the farmers. The per hectare total cost and gross returns worked out to Rs.78296 and Rs.119280, respectively. The net return at total cost was Rs.40983 and returns on per rupee invested was Rs.1.52.

m) Velvet *(Cock's comb)* : It was observed from the table, that, velvet or Cock's comb flower crop was included in the enterprise mix under FS-III during *rabi* season. The per hectare gross returns was Rs.104590 and per hectare total cost worked out to Rs.71597. The per hectare net returns over total cost was Rs.32993 and returns per rupee invested at total cost was Rs.1.46 indicating the higher profitability of the crop.

n) Mogara : In case of Mogara, the total variable cost was amounting to Rs.60656, while total fixed cost was Rs.29718. The per hectare total cost and gross returns worked out to Rs.90374 and 151470, respectively. It was observed that among all flower crops grown under FS-III, the mogara crop had highest per hectare net returns (Rs.61095) in FS-III of the region.

o) Dairy : It was observed from Table 4.11 that, the dairy enterprise was undertaken under all farming systems except FS-II. The per animal total cost of maintenance was minimum (Rs.11723) under FS-V. The per animal net returns at total cost was maximum in FS-IV Rs.6730 resulting into net returns per rupee invested at total cost to Rs.1.42. However, the net returns per rupee among all farming systems of the region, was highest in FS-V (1.53) because of lower cost of maintenance.

p) Betelvines : As indicated in results the betelvines was grown under FS-V (Table 4.11)). The per hectare total cost of maintenance was to Rs.272259. The per hectare gross returns worked out to Rs.641866, resulting into net returns at total cost to the tune of Rs.369607 which was highest among all enterprises in the study area. The returns per rupee invested was Rs.2.36, indicating high profitability of crop. Nikam (2003) in his study found that that cost benefit ratio in betelvines in Thane district was 1.31 and per hectare profit at cost 'C' was Rs.114132. It was observed that the farmers growing this crop have tradition of more than 40

years and it is grown in specific villages along sea coast. The farmers themselves have created a marketing system in village itself and further these betelvines were transported to Northern India and some part of Pakistan etc. However, cultivation of this particular species of crop requires a typical agro-climatic situation and due to that this crop has not crossed even boundaries of tahsil even after efforts of farmers in other region for its cultivation.

5.4.2 Profitability of Enterprise Followed in Northern Central Plains and Hills Region

a) Paddy : In case of paddy, farmers in FS-V incurred higher cost than the farmers of FS-I, FS-II, FS-III and FS-IV. The higher cost was due to use of higher level of human labour, and F.Y. M. The gross returns was also higher in FS-V (Rs.15735) as compared to other farming systems. The per hectare net returns in FS-I and FS-IV were negative incurring loss to farmers. Due to low productivity of the crop in the region farmers did not give much attention to control pests and diseases. However, the returns on per rupee invested in other farming systems were not too high; they were ranging from Rs.1.00 to 1.05. It was observed in this region that as per opinion recorded from farmers those farmers, who replaced the seeds could obtain higher yields than the average yield in particular farming system.

b) Finger millet (Nagli, Ragi) : The per hectare cost and returns structure of finger millet depicted in Table 4.12 showed that, the total variable cost was higher in FS-II, than in FS-I, due to more use of human labour, and F.Y.M. The gross returns in FS-I was greater than in FS-II. Returns on each rupee invested at total cost were either less than one (0.75 in FS-II) or very marginal (1.08 in FS-I) in both the farming systems where the crop was included, indicating the low productive efficiency of the crop. Swami (2004) in his study in Ratnagiri district also found that the input output ratio in nagli was 0.77. The results indicated the need for proper farm management practices in nagli crop as the crop is being grown in less fertile and eroded lands.

c) Mango : As indicated in results (Table 4.12) mango was grown only under FS-I. The total variable cost and total fixed cost were amounted to Rs.23275 and Rs.11741, respectively. The per hectare gross returns worked out to Rs.60806, resulting into per hectare net returns at total cost Rs.25789. The returns per rupee invested were found to be on higher side (Rs.1.74) which indicated the suitability and economic importance of this crop in the region.

d) Cashewnut : Cashewnut was observed to be grown only under FS-I, (Table 4.12) as an important enterprise in rainfed condition along with mango. The per hectare total variable cost was Rs.16750 and total fixed cost was Rs.8762 indicating comparatively less input requirement than the mango crop. The per hectare gross returns amounted to Rs.44460 and per hectare net returns over total cost were Rs.18947 and return per rupee invested was Rs.1.73. Similar observations were also recorded by Swami (2004) while studying farming systems in Ratnagiri district of Maharashtra. It can be concluded that cashew is comparatively high income earning crop and requires less care and inputs and thus can be included in the farming system under rainfed conditions.

e) Prosomillet (Vari) : It was observed from Table 4.12 that, prosomillet was grown under FS-I and FS-II. The total cost per hectare in FS-I and FS-II were Rs.7857 and Rs.7594, respectively. The per hectare gross returns in FS-I and FS-II were Rs.6476 and Rs.8147, respectively. Inspite of less cost incurred in FS-II, the net return was higher than FS-I. This was due to higher productivity of prosomillet in FS-II, which resulted in higher gross returns. The net returns per rupee invested at total cost in FS-I and FS-II were 0.82 and Rs.1.07, respectively indicating marginal profitability of the crop.

f) Blackgram : The blackgram grown during *rabi* season under FS-III had per hectare total cost of Rs.11289 and gross returns amounted to Rs.16043, resulting into net returns over total cost at Rs.4753. The benefit cost ratio or returns per rupee invested was Rs.1.42 indicating the profitability of the crop. The black gram had played a complementary role in increasing the earning of farmers who followed FS-III by giving good returns.

g) Cowpea : As indicated in results (Table 4.12), the farmers following FS-III, have preferred to grow cowpea in both *kharif* and *rabi* seasons. The total variable cost in *rabi* season was less than that of *kharif* season. Use of fertilizer and seed in *kharif* season was more as compared to *rabi* season. However, it has not replicated in similar way in gross returns. The per hectare gross returns, despite more use of fertilizer and seed in *kharif* season, was on par

with that of *rabi* season. The per hectare net returns at total cost were Rs.7171 and Rs.9746 in *kharif* and *rabi* seasons, respectively. The net returns per rupee invested in both the seasons were positive it was higher in *rabi* (Rs.1.45).

h) Wal : Per hectare total cost and total returns in cultivation of wal in FS-III were Rs.22384 and Rs.31547, resulting into net returns over total cost to the tune of Rs.9162.

i) Green gram : In case of green gram grown along with the other pulse crop in *Rabi* season by the farmers following FS-III, the per hectare gross returns was Rs.26235 and per hectare total cost amounted to Rs.18522, resulting into net returns of Rs.7712. The returns per rupee invested at total cost was Rs.1.42. It was concluded that, greengram has also contributed in total farm earning like other pulse crops in farming system III of the region.

j) Brinjal : In brinjal, which was cultivated by the farmers in FS-IV, the per hectare total cost of cultivation was Rs.77198 and gross returns worked out to Rs.190325. The net return per hectare was found to be Rs.113126 which was highest among all crops grown in this region. The returns on per rupee invested at total cost was also on higher side (Rs.2.47) indicating the economic importance of crop.

k) Lady's finger : As indicated in results (Table 4.12) the per hectare total variable cost amounted to Rs.27981 and total fixed cost worked out to Rs.27537. The per hectare gross returns was Rs.158666 and net returns per hectare at total cost was Rs.103684. The returns per rupee invested were the highest among all crops and non crop farm enterprises highlighting the role of this enterprise in the economic life of people following the farming system-IV in the region.

l) Grass : The grass was one of the enterprises followed in FS-V though the contribution of earning from grass were less; moreover these returns were from waste land or idle land. The present practice may not be the good solution for the farmers in the region as its per hectare gross return was meager.

m) Dairy : The dairy enterprise was followed by the farmers following FS-I, FS-II, FS-III and FS-V. The gross returns was highest in FS-II than other farming systems. The per animal total cost had the same trend as that of gross returns. Similarly the per animal net returns at total cost was maximum in FS-II and FS-I, respectively. More number of supplementary enterprises in the form of paddy, finger millet and proso-millet which supplied fodder to dairy enterprise resulted into increase in milk production and ultimately increased gross returns in these farming systems.

n) Goat rearing : In case of goat rearing it was observed that this enterprise was followed in FS-II where there is comparatively more tribal population. The per animal total annual maintenance cost was Rs.1154 and gross returns worked out Rs.1283. The per animal per year net returns at total cost was Rs.128, but, net returns at variable cost was Rs.440. Though, the returns per rupee invested at total cost were very less, (Rs.1.11) the goat rearing is profitable because net returns per animal at variable costs was considerably good, because the tribal farmers in this region had very less assets and small increase in their income through those enterprise with less maintenance and care resulted into reasonably good returns.

o) Poultry : In case of poultry it was observed that, poultry enterprise was followed by the farmers, those who were following FS-IV. The per unit (1000 birds) total variable cost worked out to Rs.28300 and total cost per unit was Rs.31426. It was observed that the farmers were taking the poultry production for 6 to 8 batches in a year. The net returns per unit was Rs.4642 and returns on per rupee invested was Rs.1.14. It was stated by the farmers that presently returns from poultry was lesser as compared to the past due to increase in the cost of inputs. However, it can be concluded that the poultry enterprise gives a substantial boost to economy of farmers as the most profitable supplementary enterprise.

5.4.3 Profitability of Enterprises Followed in Southern Central Plains and Hills Region

a) Paddy: As indicated in results paddy was grown in all farming systems in this region (Table 4.13). The tahsils in this region lie in Raigad district and Raigad district is known in Konkan region as paddy bowl. The tahsils consisting in cluster-III (central plains and hills South region) had comparatively more paddy area than the remaining tahsils in the district. Good

rainfall during *kharif* season coupled with ample irrigation facilities during *rabi* season made the belt highly conducive to grow paddy. It was observed in *kharif* season, the maximum gross return was obtained in FS-V (Rs.21042) followed by FS-II (Rs.14137). There was not much difference in gross returns under FS-III, FS-V and FS-II. The total cost in *kharif* season under FS-V was higher than that of other systems due to more use of seed and labour under this farming system. Among the various systems, per rupee net returns at total cost were ranging from 0.81 to 1.00 indicating low profitability in *kharif* season. In case of paddy grown in *rabi* season the gross returns was maximum in FS-IV, followed by FS-I (Rs.18095 and Rs.8089). It was observed that the net return per hectare at total cost in *rabi* season was more than *kharif* season. The returns per rupee invested in paddy cultivation during *rabi* season was maximum in FS-IV among all the farming systems and in both seasons indicating profitability of paddy in *rabi* season.

b) Bottle gourd : It was found that the bottle gourd was grown by the farmers following FS-I. The gross return per hectare was Rs.78333, whereas, per hectare total cost of cultivation was Rs.42446. The net return per hectare over total cost was Rs.35886 resulting into cost benefit ratio at total cost to the tune of Rs.1.8 indicating the high profitability of this crop.

c) Tomato : In case of tomato in FS-I, per hectare gross returns amounted to Rs.102500 resulting into net returns at total cost to Rs.57849, indicating high profitability and commercial importance of this crop. However, it was also revealed from study that, the price fluctuation in vegetable crops influences on the profitability as stated by the sample respondents indicating need for importance of risk management. The fruit processing is one of the alternatives in the case of low prices prevailing in markets.

d) Brinjal : For brinjal grown in *rabi* season under FS-I, the per hectare total cost was Rs.42993 and gross return was Rs.113603. Per hectare net returns over variable cost and total cost were Rs.90114 and Rs.70609, respectively. The returns per rupee invested was high (Rs.2.6) indicating the commercial importance of the crop due to greater demand in the markets.

e) Lady's finger : It was observed from Table 4.13, that the lady's finger was another important vegetable crop grown under FS-I. The per hectare gross returns was higher Rs.141500 than all other crops included in the system. The per hectare total cost was also higher (Rs.48407). The per hectare net returns and returns per rupee invested were highest in the case of this crop as compared to other crop as well as these from non crop farm enterprises.

f) Smooth gourd : The per hectare cost and returns depicted in Table 4.13 indicated that the smooth gourd was found to be one of the remunerative crops grown in this region under FS-I. The per hectare gross returns and total cost were Rs.69645 and 33200, respectively, resulting into returns on per rupee invested at total cost to Rs.2.1.

g) Chilli : It was observed from Table 4.13 that, chilli grown under FS-I have also important role in addition to other vegetable crop as it had contributed to farm earning of the farmer following FS-I. The per hectare net returns was more Rs.78070 and return on each rupee invested was Rs.2.6, indicating high profitability of the crop.

h) Cowpea : It was observed from Table 4.13, that the cowpea was grown under FS-IV. The per hectare total cost and gross returns amounted to Rs.26597 and 33750, respectively. In cowpea the returns on per rupee invested was also good (Rs.1.27).

i) Wal : In the case of wal, the per hectare gross returns and total cost had less difference leaving low margin of Rs.3125, which results into returns per rupee invested at total cost at low level (Rs.1.1). This was due to low productivity and high cost incurred on plant protection chemicals and human labour.

j) Gram : It was observed that gram was grown in *kharif* season on residual moisture under FS-IV. The results depicted in Table 4.1 showed that the per hectare gross returns and total cost in the crop worked out to Rs.31140 and Rs.24490, respectively, which resulted into returns per rupee invested at total cost to Rs.1.30. The B:C ratio was the highest among the other pulse crop grown under the region next to greengram.

k) Green gram : As indicated in results (Table 4.13), the total variable cost and total fixed cost for greengram grown under FS-IV were higher compared to other pulse crops. However, total

gross returns also had the same trend. It was revealed that the green gram was most remunerative crop among all the pulse crops as it gave greater per hectare net returns.

l) Mango : In Southern central plains and hills region mango was found to be grown under FS-V (Table 4.13). It was revealed from table that, the per hectare profitability of mango was high as indicated by per hectare net returns at total cost (Rs.23979) and returns per rupee invested (Rs.1.61).

m) Cashewnut : As indicated in results (Table 4.13) the cashewnut was grown under FS-V. The per hectare profitability of cashew was higher than mango as returns on per rupee invested at total cost was higher (Rs.1.82). It can be concluded that, the cashewnut gives comparatively higher income than mango, even the initial capital investment in the crop was low.

n) Dairy : It was observed from Table 4.13 that, among the non crop farm enterprises followed by the farmers in the region, the dairy enterprise was undertaken by majority of the farmers. The per animal total annual cost of maintenance was minimum under FS-V. However, per animal gross return was maximum in FS-III (Rs.19636) due to the adoption of more number of Mhaisana buffaloes. The returns on per rupee invested at total cost were ranging from Rs.1.13 in FS-II to Rs.1.49 in FS-V indicating the profitability of enterprise and also supported the farm earnings substantially and supplied F.Y.M. to other crops, leading to indirect saving to the farmers.

o) Goat rearing : It was observed from Table 4.13 that goat rearing was undertaken only by farmers operating under FS-III. The per animal gross returns and total cost worked out to Rs.1396, and Rs.975, respectively. The net returns over variable cost was considerably high (Rs.741). The net returns at total cost were also comparable to other enterprises indicating its suitability and economic importance in the region.

p) Poultry : The per unit (1000 birds) total cost and gross returns under FS-IV were Rs.16894 and Rs.30244, respectively, resulting into net returns of Rs. 13350 per unit. The returns on per rupee invested was high (Rs.1.70) indicating the high profitability and the proper management of the units by the farmers in this region. In this farming system it was observed that, the returns were highest for the enterprise next to FS-VI in Southern coastal plains region. However, the total cost of the enterprise in this farming system (FS-IV) was minimum than that of all other regions. Minimization of cost of labour, feed and management practices were the major reasons for such a difference.

5.4.4 Profitability of Enterprises Followed in Southern Coastal Plains Region

a) Paddy : It was observed from Table 4.14, that paddy was grown only in *kharif* season under FS-I, FS-II, FS-III, FS-IV and FS-VI. The per hectare gross returns was found to be higher in FS-VI (Rs.19003). However, per hectare total cost was minimum under FS-I (Rs.17364). The per hectare total cost in FS-I was less due to minimum use of female labour, bullock labour and seed as compared to other systems. However, among all systems the returns per rupee invested were less than one indicating the need for increasing the efficiency in production of paddy and proper regulatory measures for price fixation of the crop.

b) Mango : As indicated in the results (Table 4.14) the mango was grown in this region under FS-I, FS-III and FS-VI. It was revealed that, despite the total cost in FS-I being less than FS-III, the return in FS-I was more. The per hectare total cost and gross returns in FS-I worked out to Rs.26719 and Rs.49758, respectively, which may be attributed to proper use of the resources. The gross returns in FS-I and in FS-VI were more or less same. The returns per rupee invested in FS-I were higher than FS-VI (Rs.1.86) indicating high profitability of crop under the farming system.

c) Cashewnut : In case of cashewnut, it was observed that in Southern coastal plains region (Table 4.14), cashewnut was grown under FS-I, FS-III and FS-VI. The total cost was minimum in FS-III (Rs.17589) than FS-I and FS-VI. It was also observed that there was very less difference in cost as well as gross returns in FS-I and FS-III. However, despite higher cost in FS-VI, it had comparatively lower returns. The gross returns was maximum in FS-I followed by FS-III. The lower level of gross returns in FS-I was due to lower productivity. The returns on per rupee invested was ranging from Rs.1.28 in FS-VI to Rs.1.49 in FS-III, indicating cashewnut profitable enterprise in the region.

d) Coconut : As indicated in results (Table 4.14) coconut was grown by majority of the farmers in Southern coastal plains region. It was also observed that coconut was grown under all farming systems except FS-I. The total cost was minimum in FS-VI (Rs.30797). The per hectare gross returns was higher in FS-III (Rs.77184) followed by in FS-II (Rs.61980). The per hectare net returns was ranging from Rs.27981 to Rs.41622. The higher gross return in FS-III was not mainly due to the productivity but due to the selling method adopted by the farmers in FS-III which differed from that of other farming systems. It was revealed that the majority of the farmers following FS-III have sold the coconut on nut basis whereas in other farming systems the coconut is sold on tree basis, in which production from whole tree was sold at a particular price for a year. It was also revealed during the investigation that there was negligence on the part of some farmers with regard to the care and maintenance of the trees, once the price of the tree was negotiated. This inturn had long term impact on the bearing ability of the trees, where the yield had been reduced considerably. Krishnaraja (1982) worked out the annual net returns per hectare to the tune of Rs.16437 in Dakshina Kannada district of Karnataka. The return on per rupee invested by the farmers was ranging from Rs.1.37 in FS-IV to Rs.2.17 in FS-III indicating suitability of crop to agro-climatic situation and its high profitability.

e) Arecanut : In case of arecanut the per hectare total cost in FS-V was less than that in other systems, because of lesser use of human labour. The per hectare gross returns in FS-III was higher than FS-II, whereas returns on per rupee invested was higher in FS-II due to less cost incurred on inputs used. Chipte (1997) in his study on farming systems found that the returns on per rupee invested was Rs.1.93 and per hectare net returns was Rs.27475. The net returns per hectare were ranging from Rs.12139 to Rs.17782 among the different farming systems. Per hectare net returns and returns per rupee invested in various farming system have indicated that arecanut is profitable in this region.

f) Brinjal : As indicated in results (Table 4.14) the per hectare total cost and gross returns for brinjal crop grown under FS-IV were Rs.66938 and Rs.116299, respectively, which lead to net returns per hectare at Rs.49360. The returns per rupee invested were high (Rs.1.74) indicating high profitability of the crop in the region.

g) Smooth gourd : It was observed from Table 4.14 that the per hectare gross returns and total cost of smooth gourd cultivation in FS-IV were Rs.145903 and Rs.59734, respectively. The per hectare net returns and returns per rupee invested where higher than all crops in all farming systems in the region which indicated that the smooth gourd is highly profitable crop in the region.

h) Bottle gourd : In case of bottle gourd it was observed that, the per hectare gross returns was amounted to Rs.90366 and total cost worked out to Rs.56198. The returns on per rupee invested was Rs.1.61, which indicated the profitability of the crop.

i) Poultry : It was observed that, (Table 4.14) the poultry was one of the important non crop farm enterprise followed in this region under FS-VI. The per unit total variable cost was Rs.27989 and total cost worked out to Rs.29279. The per unit gross returns worked out to Rs.32976 which indicated that, the poultry enterprise was remunerative in the region.

j) Dairy : It was revealed from Table 4.14 that, the dairy enterprise was the main non crop farm enterprise followed in the region. The dairy was found to be undertaken under all farming system except FS-VI. It was observed that per animal total cost of maintenance was minimum in FS-I (Rs.12962) than the other farming systems. The per animal gross return was maximum in FS-III. The return per rupee invested was ranging from Rs.1.18 in FS-V to Rs.1.47 in FS-III, It can be concluded that the dairy enterprise was found to be remunerative under all the farming systems.

5.5 Cost and Returns Structure of Farming Systems

The per farm cost and returns of existing farming systems are presented in Table 4.15 to 4.18.

5.5.1 Cost and Returns Structure of Farming Systems in Northern Coastal Plains Region

It was observed from Table 4.15, that five major farming systems were adopted by the farmers in the study area. The labour required or employment generated was higher in FS-III (1197 man days) among the various farming systems studied. The labour used in FS-III was maximum because FS-III, included enterprises such as paddy, coconut, arecanut and eight different types of flower crops. The operations in flower crops were more labour intensive and hence labour employed were maximum in this system. In case of FS-V, it was also found to be labour intensive in which paddy, coconut, betalwines and arecanut were grown. More prominently betalwines shared larger proportion. In maintenance of betalwines, operations such as giving support to the betalwines, application of fertilizers, care from pests and picking of leaves, etc. required more labour per unit area than other crops. The labour use was minimum in FS-II (355 man days) in which paddy, grass, dairy and goat rearing enterprises were followed.

The use of fertilizers was maximum in FS-V than all other farming systems. The expenditure on fertilizer in FS-V was increased at large extent than other farming systems due to more use of organic fertilizers for cultivation of betalwines. It was observed from Table 4.15 that, the expenditure on plant protection chemicals was higher in FS-III (Rs.13032) followed by FS-V (Rs.1238) and FS-I (Rs.358). It was revealed that in FS-III the plant protection chemicals were used at more extent mainly for flowers. Regarding total variable cost incurred in various farming systems it was observed that the total variable cost (TVC) was maximum in FS-V (Rs.122004) indicating high capital requirement.

The total variable cost was ranging from Rs.38440 to Rs.89183 among FS-I to FS-IV. It was also observed that, total cost was maximum in FS-V (Rs.212360) while it was minimum in FS-II (Rs.58176). The per farm gross returns were maximum in FS-V Rs, 430375 followed by FS-III (Rs.177077), FS-I (Rs.167117), FS-IV (Rs.158727) and FS-II (Rs.59374), which indicated higher returns in farming systems in which betelvines, flowers and irrigated plantations were undertaken.

The per farm net returns were maximum in FS-V (Rs.218016) followed by FS-IV (Rs.57618) F-I (Rs.57063), FS-III (Rs.52635) and FS-II (Rs.1198). It was revealed from the table that, though the gross returns in FS-III were higher than that of FS-I and FS-IV, the net returns were less than these two systems. This indicated that the irrigated plantations gave more returns per rupee invested than flower crops, as there was little difference in other components of these three farming systems. The net returns per rupee invested was higher in FS-V (Rs.2.02) indicating high profitability of the system. It can be concluded that the farmers in coastal plain (North) region, following paddy + irrigated plantations + betalwines farming system (FS-V) were earning more profit than other farming systems. However, it was observed that there were spatial limitations for this system, because this system can not be followed in whole of region due to requirement of peculiar climatic situation. This farming system (FS-V), due to its specific requirement, has not spread over not only in region but also within the tahsils. In the coastal plains (North region) the FS-I, FS-III and FS-IV have also shown high profitability. Similar results were obtained by Chipte (1997). The FS-I, FS-III and FS-IV have wider applicability within the region than FS-V.

It was observed that the farmers have a tendency to grow more number of flower crops on smaller area for each flower, which indicated the crop diversification followed by farmers for commercial advantage.

It can also be concluded that though the per hectare gross returns and net returns in crops such as betelvines, coconut, arecanut, flowers and vegetables such as smooth gourd, bottle gourd, brinjal were higher, the per farm actual income earned by farmer was less because of the enterprise mix followed in particular farming system consisting of a vary less area or farm size for each of these enterprise.

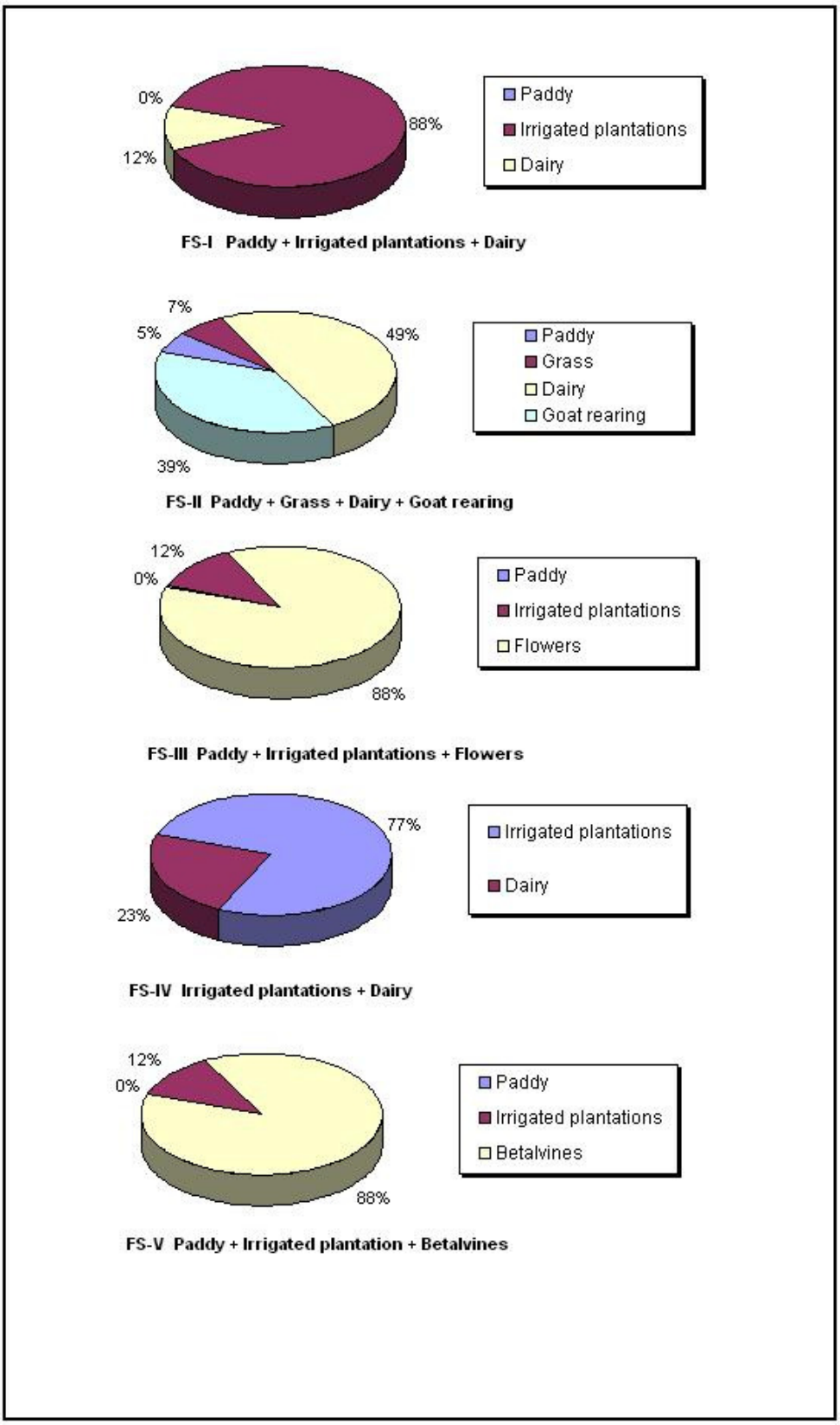


Fig. 12. Net Income in Major Farming Systems Followed in Northern Coastal Plains Region

5.5.2 Cost and Returns Structure of Farming Systems in Northern Central Plains and Hills Region

It was seen from Table 4.16 that, the five major farming systems were followed by the sample farmers in this region.

Among the different farming systems the labour requirement was found to be maximum in FS-IV (471 man days) than other farming systems, which was ranging from 302 to 350 man days in various farming systems. In case of the variable cost items across the various farming systems, the per farm expenditure on chicks and poultry feed in FS-IV was higher than all other items of variable cost in all the farming systems. The total variable cost was maximum (Rs.301231) in FS-IV, followed by FS-II (Rs.48427), FS-V (Rs.47163) FS-I (Rs.40814) and FS-III (Rs.35323) which indicated that the working capital requirement in the farming system IV was at larger extent, than other farming system due to inclusion of poultry enterprise in the farming system. However, the recovery period of the working capital invested in poultry was low.

The total cost on fixed assets was ranging from Rs.8786 in FS-II to Rs.47819 in FS-IV indicating large variation in fixed asset requirements among the various farming systems. In case of total cost incurred in different farming systems, it was maximum in FS-IV (Rs.349050) than other farming systems. The gross returns obtained were also maximum in FS-IV than in other farming systems. The per farm net returns in different farming systems were ranging from Rs.8683 in FS-II to Rs.95111 FS-IV, which indicated that the farmers who have followed FS-IV were earning more income from farming. It was also revealed that in FS-II and FS-V more number of tribal farmers were involved. The subsidiary enterprises like dairy and goat rearing were playing important role in improving economic condition of these farmers because even if the net amount realized by the farmers were less, considering their asset position and paid out costs incurred, the income earned under these farming system were very helpful to the farmers. Kandasamy (1998) noticed that dairy based farming system was found to be more profitable than others.

The returns per rupee invested at total cost were maximum I FS-I (Rs.1.29) followed by FS-IV (Rs.1.27). In remaining farming systems it was ranging from Rs.1.15 to Rs.1.24. It can be concluded that, the area under rainfed plantations, number of dairy animals, number of poultry birds need to be increased to improve the per farm net returns on different farming systems in this region.

5.5.3 Cost and Return Structure of Farming Systems in Southern Central Plains and Hills Region

As indicated in results it was observed that in this region five major farming systems were followed by the sample farmers (Table 4.17).

It was observed that, labour required was high in FS-IV followed by FS-V, FS-III, FS-II and FS-I. It was revealed that the labour employed were more in farming system in which poultry and vegetables were undertaken. In case of FS-I the labour used was comparatively less despite more number of enterprises undertaken due to less area allocation on each crop enterprise which indicated the awareness of farmers towards crop diversification and skill of labour management. It was observed that among variable cost items, money spent by farmers was maximum in case of poultry than all other inputs used in all farming systems. The total variable cost was maximum in FS-IV (Rs.242220) followed by FS-V, FS-I, FS-III and FS-II (Rs.71413, Rs.54608, Rs.38627 and Rs.35492, respectively). Regarding total cost incurred by the farmers, it has a same trend as in case of variable cost. The total cost was maximum in FS-IV (Rs.266949) and minimum in FS-II (Rs.42966).

The per farm gross returns were maximum in FS-IV (Rs.465063) followed by FS-I (Rs.120722), FS-V (Rs.117204), FS-III (Rs.59009) and FS-II (Rs.44101). It was revealed from Table 4.17 that inclusion of poultry enterprise and vegetable crops in the farming system increased cost as well as net returns as compared to other enterprises. It was revealed that FS-I, FS-III and FS-V were also found to be the more profitable farming systems in which per farm net returns obtained were Rs.46202, Rs.11813 and Rs.27760, respectively. Similar observations were made by Swami (2004) while studying farming systems in Ratnagiri district of Maharashtra.

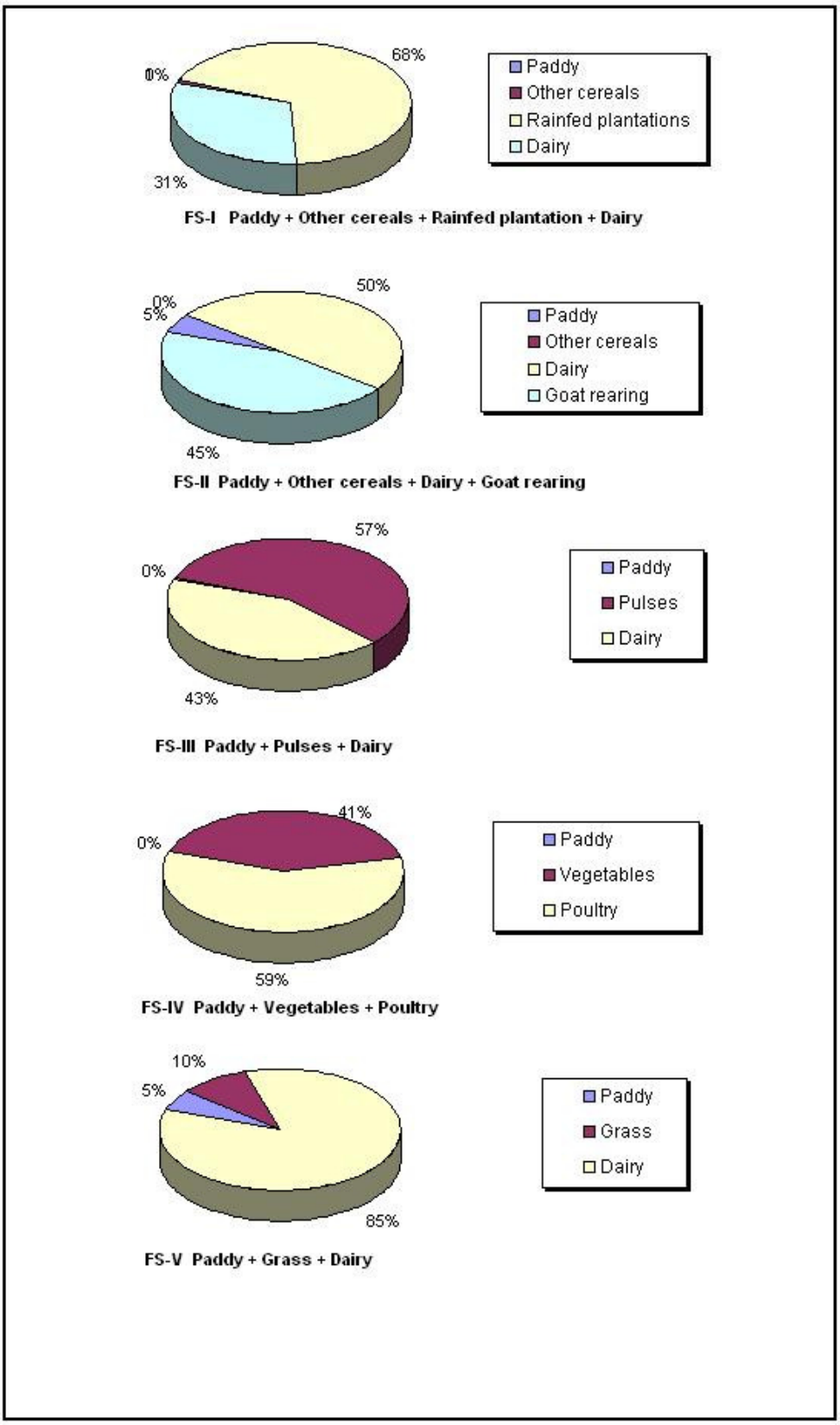


Fig. 13. Net Income in Major Farming Systems Followed in Northern Central Plains and Hills Region

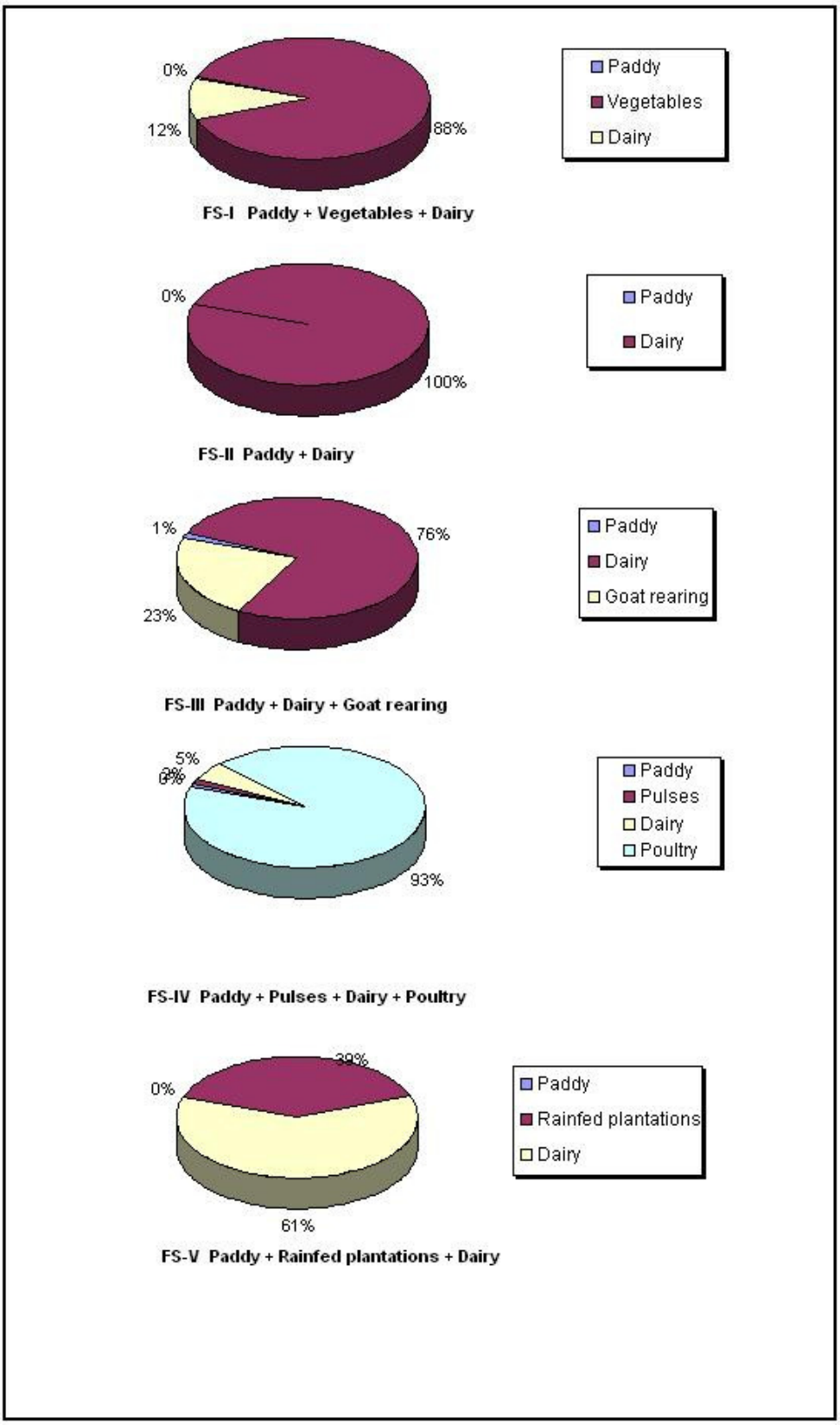


Fig. 14. Net Income in Major Farming System Followed in Southern Central Plains and Hills Region

Return on per rupee invested was very low (Rs.1.03) in FS-II where only paddy and dairy enterprise were followed indicating need of crop diversification to increase farm income. The returns on per rupee invested in farming systems other than FS-II were ranging from 1.25 in FS-III to Rs.1.74 in FS-IV. It was further concluded that the FS-IV and FS-I, were highly profitable farming systems in this region.

5.5.4 Cost and Returns Structure of Farming Systems in Southern Coastal Plains Region

It was observed from Table 4.18 that, the farmers in Southern coastal plains region have followed six major farming systems. It was revealed that among the different farming systems, employment generated was found to be maximum in FS-IV (705 man days) followed by FS-VI (614 man days). It indicated that the farmers following FS-IV in which paddy, vegetables and irrigated plantations were grown along with dairy were labour requirement was more due to larger average area under cultivation (2.12 ha.). In FS-VI the labour requirement was higher not only due to the larger farm size (2.19 ha.), but also due to inclusion of poultry in this system. In farming systems other than FS-IV and FS-VI, the labour used were ranging from 244 to 554 man days.

The total variable cost was observed to be maximum in FS-VI (Rs.449977) followed by FS-IV (Rs.92434), FS-III (Rs.80227), FS-II (Rs.50068), FS-I (Rs.42884) and FS-V (Rs.38432), indicating higher input requirement for FS-VI, FS-IV and FS-III. The variable cost in FS-VI was more mainly due to labour wages, poultry feed and cost of chicks. The variable cost in FS-IV and FS-III was also on higher side due to cost of labour, F.Y.M., fertilizers and concentrate for dairy animals.

The total cost incurred by the farmers was highest in FS-VI (487771) than in other farming systems. The gross return had also shown the same trend and was also higher in FS-VI (Rs.571233) compared to other farming systems. The gross returns in FS-I, FS-II, FS-III, FS-IV, FS-V were Rs.78944, Rs.88935, Rs.176208, Rs.185659 and Rs.68488, respectively indicating the average annual farm receipts of the farmers following these systems. It can be concluded that the annual gross income from farm in FS-VI was more in the region.

The returns on per rupee invested at total cost were ranging from Rs.1.17 (FS-VI) for Rs.1.57 (FS-III). It was revealed that though the gross income and per farm net returns in FS-VI were higher than all farming systems, the returns on per rupee invested were less indicating operation of economies of scale. It can also be concluded that at overall level the profitability of these farming systems in this region was very high.

In North Konkan region, 18 major farming systems were identified which were being followed by the farmers. The per farm total human labour required were maximum (1197 man days) in Paddy + Irrigated plantations + Flowers farming system.

The per farm total variable cost (Rs.449976), total cost (Rs.487771) and gross returns (Rs.571232) were maximum in Paddy + Irrigated plantations + Rainfed plantations + Poultry farming system (cluster-IV). However, the returns on per rupee invested were very low (Rs.1.17). In Paddy + Irrigated plantations + Betelvines the per farm total variable cost, total cost and gross returns were Rs.12200, Rs.212359 and Rs.430375, respectively.

The returns per rupee invested were maximum (Rs.2.02) in this system as compared to all farming systems in different regions. Hence, it can be concluded that the Paddy + Irrigated plantation + Betelvines was the most remunerative system in the study area.

It was also observed that, the Paddy + Irrigated plantations + Dairy farming system was more remunerative in Northern coastal plains region than the Southern coastal plains region. Return on per rupee invested in coastal plains region was Rs.1.52 (FS-I), whereas it was 1.38 in Southern coastal plains region. It was observed that, the total variable cost (Rs.77062) and total cost (Rs.110053) incurred were maximum in Northern coastal plains region. The gross returns in Northern coastal plains region were Rs.167116 as compared to Rs.88935 in Southern coastal plains region. Hence, the hypotheses was proved that economic advantages for specific farming system in specific region are more as compared to other region.

In case of farming system with Irrigated plantation + Dairy, it was revealed that the system was more profitable in Northern coastal plains region as gross returns (Rs.45132), net

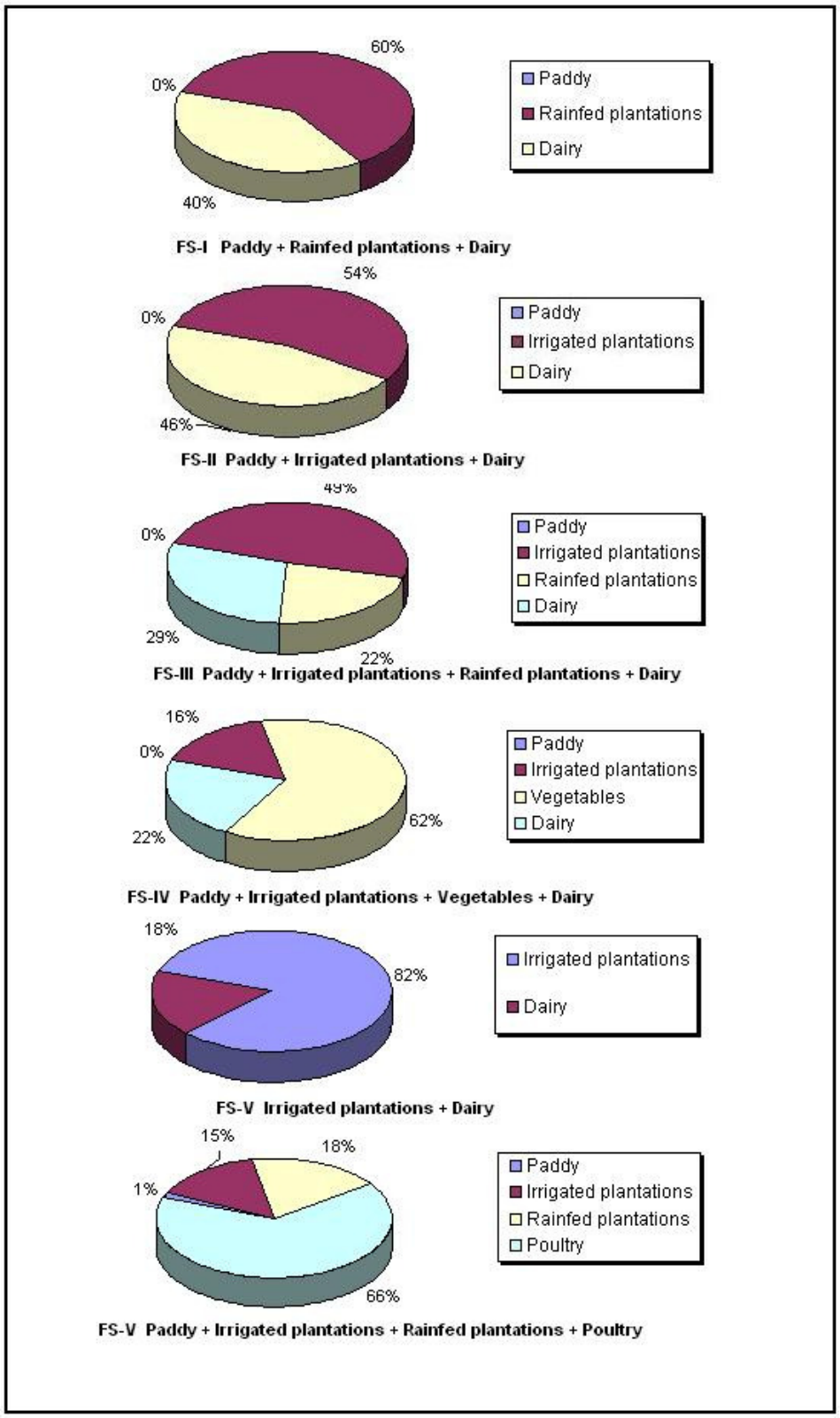


Fig. 15. Net Income in Major Farming Systems Followed in Southern Coastal Plains Region

returns over total cost (Rs.57617) and returns per rupee invested were maximum (Rs.1.56) as compared to Southern coastal plains region.

As regards Paddy + Rainfed plantations + Dairy farming system, it was revealed that the profitability of this system was higher in Southern coastal plains region. The per farm gross returns (Rs.1172004), total cost (Rs.89443) per farm net returns over total cost (Rs.27780) were maximum in the Southern central plains and hills region than in Southern coastal plains region. However, there was very less difference in the net returns over total cost in both the regions. The returns on per rupee invested at total cost was maximum (Rs.1.43) in Southern coastal plains region.

Among all clusters in North Konkan region, the farming systems namely 1) Paddy + Irrigated plantations + Betelvines, 2) Irrigated plantations + Dairy, 3) Paddy + Pulses + Dairy + Poultry, 4) Paddy + Vegetables + Dairy, and 5) Paddy + Irrigated plantations + Rainfed Plantations + Dairy were found to be highly profitable farming systems among the major farming systems (18) identified in the study area.

5.6 Resource Use Efficiency in Major Farming Systems

Resource use efficiency of various crop as well as other (non crop farm enterprises) was studied in different farming systems in all the regions.

5.6.1 Resource Use Efficiency in Northern Coastal Plains Region

5.6.1.1 Crop Production Enterprises

The Cobb-douglas production function was found to be 'good fit' to data as it was revealed from the 'F' value which was significant in all the set functions for crop enterprises. The coefficient of multiple determination (R^2) was ranging from 0.802 to 0.894 indicating 80 to 89 per cent of variation in dependent variables was explained by independent variables included in the function. The seed was found to be most influencing input on paddy production with regression coefficient of 0.524 which indicated that, one per cent increase in the seed will result in to 0.5 per cent increase in the output while other inputs are held constant at their geometric mean level. Results are in conformity with Wadear (2003) who studied on animal based farming systems for long term sustainability in North Karnataka. The constant returns to scale was observed in paddy from sum of output elasticities as indicated in results (Table 4.19). It was observed that, the majority of the inputs were excessively used in paddy as MVP to MFC ratio were less than one.

As regards coconut production, F.Y.M., nitrogen and human labour had positive and significant influence on production. The ratio of marginal value of product and marginal factor cost indicated that F.Y.M., Nitrogen and human labour were less utilized than optimum level. It can be concluded that, the coconut production can be increased by using more quantity of these resources. Similar observations were recorded by Rajeshwari (2004), while studying economic analysis of coconut based farming systems in Tumkur district of Karnataka. The returns to scale was found to be constant in FS-I while it was increasing returns scale in FS-V.

In case of mogra (Jasmine) cultivation, it could be observed from results that, F.Y.M., phosphorus and human labour had positive and significant influence on production; however it was revealed that farmers were using more quantity of majority of these resources as it was indicated from MVP to MFC ratio for respective resources. In order to increase production to get more returns, farmer resorted to intensive cultivation, which results into use of more quantity of these resources.

In sapota crop, F.Y.M., potash and human labour were mainly contributing to the production. The increasing returns to scale were observed from sum of output elasticities. In case of allocative efficiency in sapota production, F.Y.M. potash and human labour were utilized at higher extent than desired level as revealed from MVP to MFC ratio.

As regards betelvines, the coefficient of multiple determination was 0.80, which indicated that the 80 per cent variation in dependent variable was explained by independent variables included in the function. The F.Y.M, plant protection chemicals and organic fertilizers were found to be influencing the betelvines production positively and significantly. The MVP to MFC ratios indicated that the organic fertilizers were less utilized than the desired

level. However, F.Y.M., PPC and human labour were excessively used. It can be concluded that by keeping other inputs constant at their geometric mean levels applying more quantity of the organic fertilizers would result in increase in the betelvines production.

5.6.1.2 Other Enterprises

In order to study the resource use efficiency in dairy enterprises in the region, the Cobb-douglas production function fitted to data was found to be 'good fit' as it was revealed from the significant 'F' value in all the set functions. The 'F' value was ranging from 11.53 to 65.74 across different enterprises followed under various farming systems. The coefficient of multiple determination (R^2) was ranging from 0.80 to 0.919 which indicated that, the 80 to 92 per cent of variation in dependent variable was explained by the independent variables included in the function. As regards resource use efficiency in dairy, dry fodder, green fodder and concentrates were influencing the gross returns positively and significantly. The results are in conformity the findings of Sharma and Singh (1993). It was concluded from the MVP and MFC ratio for the resources in different farming systems that, the green fodder and concentrates were less utilized than the desired levels, as the MVP/ MFC ratio was more than unity. It was also concluded that the dry fodder was used more than the desired level. The constant returns to scale and increasing returns to sale was observed in FS-I and the FS-II, respectively, which was revealed from sum of output elasticities. The analysis prompts that there is need to have proper mix of these inputs for better milk production.

In case of goat rearing, the green fodder was highly contributing (positively and significantly) to the gross returns. The elasticity coefficient was 0.502 which indicated that one per cent increase in the green fodder will result into 0.5 per cent increase in gross returns, while other resources were held constant at their geometric mean levels. The constant returns to scale was observed as sum of output elasticities was nearer to one.

5.6.2 Resource Use Efficiency in Northern Central Plains and Hills Region

5.6.2.1 Crop Production Enterprises

The Cobb-douglas type of production function was found to be a good fit to data as it was revealed from the 'F' value which was significant in all the set functions for crop enterprises. The coefficient of multiple determination (R^2) was ranging from 0.71 to 0.96 indicating, 71 to 96 per cent of variation in dependent variables was explained by the independent variables included in the function.

As regards paddy production, the seed was observed to be most production positively influencing variable on paddy and significantly in different farming systems. The similar observations were made by Wader (2003). The other inputs influencing production were phosphorous, plant protection chemicals in FS-I and human labour in FS-II. Whereas, nitrogen had negative coefficient in FS-V and it was statistically significant. The seed was excessively used in FS-II while it was less used in FS-V which was revealed from MVP to MFC ratio. Phosphorous and plant protection chemicals were utilized more in FS-I, whereas, use of human labour was at higher side than the desired level in FS-II. The returns to scale was observed to be increasing in FS-I whereas it was decreaisng in FS-II as revealed from sum of output elasticities.

As regards mango crop, F.Y.M., phosphorus, potash and human labour were contributing positively and significantly in its production. The influence of phosphorus was observed to be higher with the regression coefficient of 0.558 which indicated that, 1 per cent change in mango in the use of phosphorus would result into 0.5 per cent change in the production while other inputs are held constant at their geometric mean levels. The MVP to MFC ratio indicated that potash and human labour were less used whereas phosphorus was more utilized than the desired level. Similar observations were made by Sunanda and Narendra (2003). The sum of output elasticities was higher than one which indicated an increasing returns to scale.

In case of cashewnut, the resources such as F.Y.M., human labour and phosphorous were contributing positively and significantly in the production. It was revealed that extent of use of phosphorous and human labour was less than the desired level whereas, F.Y.M. was utilized more as it was indicated by the MVP to MFC ratio. The sum of output elasticities was higher than one which indicated a increasing returns to scale.

As regards brinjal production it was revealed that, seed was the most significantly contributing input in its production with higher (0.602) output elasticity and it was significant at 5 per cent. The potash and human labour have also exerted positive and significant influence on the brinjal production. It was observed from MVP to MFC ratio that, seed was less used than optimum level, while phosphorus and human labour were more than the desired level. The sum of output elasticities (1.36) indicated increasing returns to scale. Results are contradictory with Singh (2004) as sum of output elasticities indicated constant returns to scale.

5.6.2.2 Other Enterprises

In order to study the resource use efficiency in other enterprises, the Cobb-douglas production function fitted to data was found to be good fit as it was revealed from the significant 'F' value in all the set functions. The 'F' value ranging from 5.51 to 29.34 across different enterprises followed under various farming systems. The coefficient of multiple determination (R^2) was ranging from 0.72 to 0.9 which indicated that the 72 to 91 per cent of variation in dependent variable was explained by the independent variables included in the function.

In case of dairy enterprise, followed under various farming systems, dry fodder, green fodder and concentrates were found to be positively and significantly influencing on income from dairy. The coefficient of human labour was negative in FS-I while it was positive and significant in FS-III.

The MVP to MFC ratio indicated that the dry fodder was more utilized as the ratio was less than one while, green fodder and concentrates were less used as the MVP to MFC ratio were higher than one. The sum of output elasticities indicated a constant returns to scale in FS-I while it was increasing returns to scale in FS-III.

As regards goat rearing production, the green fodder and concentrate had positive and significant influence on the income from goat rearing. The contribution of green fodder was higher than the concentrates. With respect to extent of use of the resources, it was revealed from MVP to MFC ratio that, the green fodder was more used, while the use of concentrate was less than the desired level. The returns to scale was observed to be constant as indicated from sum of output elasticities.

In case of poultry enterprise it was revealed that, the feed was most positively and significantly contributing input on poultry income. The elasticity coefficient was as high as 0.81 indicating one per cent increase in feed would result into 0.81 per cent increase in the income, while other resources being kept constant at their geometric mean level. The MVP to MFC ratio indicated that, the feed was less used than optimum level. The returns to scale was decreasing as other inputs failed to influence strongly the gross income. This showed that, there is scope for reorganization of the inputs. So that the gross returns from poultry could be increased.

5.6.3 Resource Use Efficiency in Southern Central Plains and Hills Region

5.6.3.1 Crop Production Enterprises

To study the resource use efficiency in various crop enterprises, the Cobb-douglas production function was found to be 'good fit' to data as it was revealed from the significant 'F' value in all the set functions. The 'F' value was ranged from 8.42 to 663 across various crop enterprise in the region. The coefficient of multiple determination (R^2) was ranging from 0.81 to 0.99 indicating about 81 per cent to 99 per cent variation in dependent variable was explained by independent variables included in the function. Results are in conformity with Ganesh (2000).

As indicated in the results (Table 4.23), in case of paddy grown in *Kharif* season the output elasticities for the resources like seed and human labour were found to be positive and significant in most of the farming systems. The nitrogen and bullock labour had exerted their influence on paddy production in FS-IV and FS-I, respectively; while F.Y.M. was observed to be positive and significant in FS-II and FS-III. Regarding the extent of use of resources, the seed and human labour were more utilized than their desired level in majority of the farming systems, while nitrogen and potash fertilizers found to be excessively used than the required

level in FS-IV and FS-II, respectively. The MVP to MFC ratio also indicated that the bullock labour, human labour and F.Y.M. were less utilized than the desired level in FS-IV, FS-II and FS-III, respectively. The sum of output elasticities indicated increasing returns to scale in all the farming systems except FS-III in which, the constant returns to scale was observed.

As regards paddy grown in the *rabi* season the inputs such as F.Y.M., seed, nitrogen and potash have shown positive and significant influence on paddy production. The allocative efficiency studied with the help of MVP to MFC ratio indicated that, the nitrogen and seed were used less than the optimum level where as potash and F.Y.M. were excessively used. The sum of output elasticities indicated increasing returns to scale.

5.6.3.2 Other Enterprises

In the study of resource use efficiency of various other enterprises, the Cobb-douglas production function was found to be good fit to data, which was revealed from significant 'F' value in all the set functions. The 'F' value was ranging from 9.2 to 666.54 across the various other enterprises, followed under different farming systems in the region.

As regards dairy enterprises, it was found that dry fodder and concentrate had positive and significant influence on gross returns in all farming systems under the study. Similar observations were made by Sharma and Singh (1993). The green fodder had positive and significant influence in FS-I, but incases of FS-II and FS-III it failed to exert any influence on the gross returns. Though the coefficient was positive, it was not significant in FS-II and FS-III. The human labour had shown a positive and significant influence on the gross returns in FS-II and FS-III. Regarding the allocative efficiency of use of the resources it was found that, the dry fodder and concentrates were excessively used in all farming systems, as it was revealed from the MVP to MFC ratio.

As regards goat rearing, green fodder, concentrates and human labour were found to have a positive and significant influence on the gross returns. The MVP to MFC ratio indicated that, the green fodder, concentrates and human labour were used at more than the desired level as the ratios were less than one. The returns to scale was observed to be constant as the sum of output elasticities was nearer to one.

In case of poultry enterprise, expenditure on chicks, feed and paddy straw husk were found to influencing on the gross returns as they were statistically significant. However, the chicks and feed have positive coefficient whereas paddy straw husk had a negative coefficient.

The MVP to MFC ratio indicated that expenditure on chicks was less than optimum level, however, the feed and paddy straw husk were excessively used than the desired level. The sum of output elasticities revealed increasing returns to scale.

5.6.4 Resource Use Efficiency in Southern Coastal Plains Region

5.6.4.1 Crop Production Enterprises

In order to study resource use efficiency of crop enterprises in Southern coastal plains region the Cobb-douglas production function was used. It was found that the function was 'good fit' to data as it was revealed from the significant 'F' value in all the set functions. The coefficient of multiple determination (R^2) was ranging from 0.77 to 0.98 indicating 77 to 98 per cent variation in dependent variable were explained by independent variables included in the function. The 'F' value was ranging from 4.5 to 50.31 in various crop enterprises across different farming systems. In case of paddy as indicated in results, F.Y.M. and nitrogen were found to be positively and significantly influencing inputs in both farming systems (FS-II and FS-III). In case of FS-III, the phosphorous and potash had also shown positive and significant influence on the production. Among the various inputs seed was found to be more influencing with high elasticity coefficient (0.614) which indicated that one per cent increase in the seed would result into 0.61 per cent increase in the production when other inputs were held constant at their geometric mean levels. The MVP to MFC ratio indicated that, nitrogen was more utilized in both the farming system while phosphorous and potash were less utilized than the desired level in FS-III. The sum of output elasticities indicated the constant returns to scale in both the farming systems.

As indicated in results (Table 4.26), the resource use efficiency in mango cultivation was influenced by F.Y.M. and plant protection chemicals positively and significantly in both farming systems (FS-I and FS-III). In FS-III in addition to the F.Y.M., the inputs such as nitrogen, phosphorus and potash had a positive and significant elasticity coefficient. Among the various inputs used in FS-III nitrogen was found to be most important input conditioning mango production as indicated by its regression coefficient 0.85 which revealed that one per cent change in nitrogen would result in to 0.85 per cent change in production while other inputs were held constant at their geometric mean levels. The MVP to MFC ratio indicated that, F.Y.M. was used more than the optimum level. The plant protection chemicals and human labour were used at more extent than required as it is revealed from their respective MVP to MFC ratios. In case of FS-III, the MVP to MFC ratio for phosphorus and potash was less than one indicating their less use while in case of nitrogen the ratio was more than one which indicated that the nitrogen was less utilized than the desired level. The returns to scale was increasing in case of FS-I where as the constant return to scale was observed in FS-III.

In case of coconut production the resource use efficiency was influenced by F.Y.M., nitrogen and potash in both farming systems (FS-II and FS-III). The nitrogen was found to be most important input in FS-II which was contributing at maximum extent to the production. Regarding extent of use of inputs, nitrogen and potash were found to be less utilized than the desired level as the MVP to MFC ratio was more than one. While in case of F.Y.M., MVP to MFC ratio was less than one in FS-II, while in FS-III it was more than one. The sum of output elasticities revealed that, in both the farming systems the value was more than one which indicated an increasing returns to scale. Similar observations were made by Rajeshwari (2004) while studying coconut based farming systems in Tumkur district of Karnataka.

As regards arecanut production it was revealed that, F.Y.M. and plant protection chemicals were contributing positively and significantly in both farming systems, FS-II and FS-IV, whereas potash had positive coefficient. The MVP to MFC ratio indicated that, the use of inputs such as F.Y.M. and plant protection chemicals was less than the optimum level in both farming systems. Whereas human labour was excessively used than desired level in FS-II. The sum of output elasticities indicated an increasing returns to scale in arecanut production in both farming system in the region.

5.6.4.2 Other Enterprises

To study the resource use efficiency in other enterprises (Non crop farm enterprises), the Cobb-douglas production function was fitted to data. The function was found to be good fit to data as it was revealed from the significant 'F' value in all the set functions. The 'F' value was ranging from 6.64 to 184.8 across different enterprises followed under various farming systems. The coefficient of multiple determination (R^2) was ranging from 0.74 to 0.98 which indicated that, the 74 to 98 per cent of variation in dependent variable was explained by the independent variables included in the function.

In case of dairy enterprise followed in Southern coastal plains region under various farming systems it was found that dry fodder, green fodder and human labour had contributed positively and significantly to gross returns in majority of farming systems. The concentrates also had a positive and significant coefficient in FS-I. Regarding allocative efficiency, it was revealed from MVP to MFC ratio that, the human labour were used optimally in FS-II, as the MVP to MFC ratio was exactly one. However, green fodder was less utilized than the desired level in FS-I, FS-II and dry fodder were more used than the desired level in FS-I, FS-II and FS-IV. The green fodder and human labour were also found to be excessively used in FS-IV. The sum of output elasticities indicated an increasing returns to scale in FS-I and FS-II, while constant returns to scale was observed in FS-IV.

As regard poultry enterprise followed under FS-VI, it was found that, the expenditure on chicks, feed and human labour were influencing positively and significantly on gross income. Among the various inputs used, expenditure on chicks had an important role in contributing to gross returns at high rate with elasticity coefficient of 0.93. The MVP to MFC ratio for the various inputs revealed that, the expenditure on chicks, feed and human labour were to be higher extent than the desired level. The sum of output elasticities was nearer to one which indicated a constant returns to scale.

5.7 Optimum Farming Systems

5.7.1 Northern Coastal Plains Region

Farming System I

As indicated in results, the area under *Kharif* paddy was substantially decreased in optimum plans due to low productivity of paddy and the more area was allotted to sapota crop. The area under sapota was increased substantially from 41.67 per cent in existing model to 83.42 per cent in both optimum plans (M-I and M-II). It indicated the high profitability and competitiveness of sapota crop which is one of the commercially important fruit crops of this region. The area under coconut and arecanut was eliminated in optimum plains which may be due to high requirement of labour. The number of dairy animals were found to be reduced in optimum plans. However the dairy enterprise was not eliminated from the farming system in optimum plans which indicated that the dairy animal in this farming system can be reduced but it should not be eliminated as this enterprise plays important supportive role to the system. The net income was substantially increased by 54.14 per cent in optimum plan M-I over existing model which underlines importance of reallocating the resources to increase the profit. However, in optimum plan M-II, inspite of increase in the resources by 50 per cent, the increase in the profit was very meager (0.40) which indicated that without much increase in capital and other resources, income can be increased to a greater extent by reallocating the resources.

Farming System – II

It was observed that inspite of decrease in paddy area the income was increased due to increase in number of dairy animals and goat. In optimum plan M-I, paddy area was decreased to 0.42 hectares from 0.72 ha in the existing model. It indicated that the area under paddy can be saved and these resources could be diverted to dairy and goat rearing to increase the profit.

The optimum plan M-II suggested that the additional resources further can be used with goat rearing and dairy enterprises. In optimum plan M-II indicated that, if the resources are increased by 50 per cent and if they allocated properly the net income could be increased by 56.73 per cent over the net income in optimum plan M-I.

Farming System – III

The area under jasmine flower cultivation was increased substantially due to its high profitability under optimum plan M-I. The other flower crops, though they were profitable, area under these flower crops were diverted to jasmine crop in optimum plans and other flower crops were completely eliminated in optimum plans. The paddy area was found to be decreased in optimum plans which may be due to low profitability as compared to other crops.

Faming System – IV

It was indicated in results (Table 4.28), that, all the area was found to be diverted to arecanut crop which were earlier under sapota and coconut crop with optimization. High requirement of labour and working capital under coconut and sapota might have eliminated these crops optimum plans. In addition to arecanut, dairy was found to be competitive enterprise because number of dairy animals was increased in both the optimum plans (M-I and M-II). The net income was found to be increased by 18.73 per cent due to reallocating the present resources in optimum plan – M-I. The per cent increase in net income in optimum plan M-II over M-I was also found to be higher (24.27%).

Farming System – V

It was observed from results that, paddy area was decreased in optimum plans to larger extent. The area under coconut was also found to be decreased in optimum plan and the arecanut crop was found to be eliminated in optimum plans. This may be due to the larger requirement of resources for paddy, coconut and arecanut crop and also due to higher profitability of betelvines. The area under betelvines was increased at very large extent in optimum plans.. The resources used in existing model for paddy, coconut and arecanut could be used for betelvines as suggested by the optimum plans. The net income over existing

model was increased by 25.70 per cent in optimum plan M-I and 97.96 per cent in optimum plan M-II.

5.7.2 Northern central plains and hills region

Farming System - I

It was revealed that, proper rearrangement of existing resource has a great scope for increasing income (86.10%) as indicated by the optimum plan M-I. The optimum plans M-I suggested decrease in paddy area, elimination of nagli and vari crops. The saved area from paddy, nagli and vari could be brought under mango and cashewnut. The paddy area might be reduced due to high requirement of labour and low productivity. The increase in net income was observed to be more in both optimum plans (M-I and M-II). In optimum plan M-II, the income was increased by 48.20 per cent than optimum plan M-I, indicating a possibility of increasing the income by reallocation of the existing resources as well as by increasing the resource levels.

Farming System – II

As indicated in results, (Table 4.29) it was revealed that the reallocation of the existing resources would increase the net income to a large extent. The optimum plan M-I suggested that the net income could be increased by 52.70 per cent by reallocation of existing resources. The optimum plan M-II indicated that, net income can be increased by 82.91 per cent by increasing the resources by 50 per cent over optimum plans M-I and 179.36 per cent over existing model. The optimum plan indicated the possibility of increasing income with proper utilization of resources. In optimum plans paddy area was decreased from 1.2 ha in existing model to 0.47 ha. in model M-I. The crops such as nagli and vari were eliminated in optimum plans. The number of goat rearing and dairy animals were found to be decreased in optimum plans but still they have a supporting role in the system.

Farming System – III

As indicated in results, (Table 4.29) the area under *rabi* cowpea was observed to be increased, from 2.58 per cent in existing model to 68.39 per cent in optimum model plan M-I and M-II. The optimum plan M-I suggested the reduction in area under paddy. The crops such as *kharif* cowpea, *rabi* blackgram, *rabi* wal, *rabi* green gram were eliminated. In dairy enterprise number of animals was also found to be increased from 1.14 in existing plan to 1.53 in optimum plan M-I and 3.82 in optimum plan M-II. The optimum plan indicated that the reallocation of existing level of resources would result in increase in net income by 41 per cent (plan M-I). The optimum plan M-II also indicated substantial increase in net income. The increase in income in optimum plan M-II over optimum plan M-I was 47 per cent, which indicated possibilities to increase the income by reallocating the resources.

Farming System – IV

In case of faming system IV, brinjal and lady's finger were influencing in reallocation of the resources. The paddy area was decreased from 68.67 per cent in existing model to 34 per cent in optimum plan M-I and optimum plan M-II. It was revealed that, the paddy area was retained in optimum plans and restricted to 34 per cent as per minimum restriction imposed. The area under brinjal was found to decrease from 0.31 ha (20.67%) in existing model to 0.24 ha (16.00%) which may be due to higher labour and working capital requirement in brinjal. The area under lady's finger was found to increase from 0.16 ha (10.67%) to 0.75 ha (50%) in optimum plan model-I. However, it was also seen that the area under lady's finger was eliminated and whole area was diverted to the brinjal crop in optimum plan M-II which may be because of the higher profitability of the crop when additional resources are available. The poultry units were also found to be decreased in optimum plan M-I but increased substantially in optimum plan M-II. The net income was found to increase by reallocation of existing resources (optimum plan M-I) by 51.26 per cent and 23.38 per cent increase in optimum plan M-II over plan M-I.

Farming System – V

As indicated in results (Table 4.29) the optimum plan designed at existing resource level suggested the shift of area from paddy to grass which may be because of low cost, low human labour and less working capital requirement in grass as compared to paddy which

resulted also in to saving in area. Goat rearing animals were found to increase in optimum plans (M-I and M-II), which indicated the importance of supportive role of non crop farm enterprises in farming systems.

5.7.3 Southern Central Plains and Hills Region

Faming System – I

As indicated in results (Table 4.30) it was revealed that the optimum plan M-I indicated the increase in the income by 166.78 per cent due to recognized allocation of existing resources in optimum plan M-I and 209.08 per cent in optimum plan M-II. The net income in existing model was Rs.46201 which increased to Rs.1,23,258 in optimum plan M-I and Rs.1,42,800 in optimum plans M-II. The area under paddy was retained in optimum plans but it was reduced to 21.62 per cent in plan M-I as compared to 47.86 per cent in existing model.

Farming System – II

It was seen from results that, the same paddy area in optimum plans retained in *kharif* season was due to the minimum area restriction imposed in the model. However, the area under paddy in *rabi* season was eliminated and this system was dominated by the dairy animals in optimum plans as the number of dairy animals were increased in optimum plan M-I and also M-II as compared to existing model. It may be due to the less requirements of working capital and high income from dairy enterprise.

Farming System – III

The results of optimum models indicated that (Table 4.30), the area under paddy should be decreased from 1.07 ha in existing model to 0.39 ha in optimum plans (M-I and M-II). The number of dairy animals and goat rearing were found to increase in both the optimum plans which might be due to higher requirement of resources such as human labour, working capital in paddy while higher net returns and less requirement of resources in dairy and goat rearing enterprises. The net income was also found to increase substantially in optimum plans. The optimum plan M-I over existing resource level recorded 58.65 per cent increase in the income, while plan M-II, that is optimum plan at enhanced resource level, also indicated a 58.74 per cent increase in net income over optimum plan M-I. The entire exercise has clearly show greater possibility of increase in income by reallocation of the resources and increase in the resource levels.

Farming System – IV

The optimum plan at existing resource level and also optimum plan at enhanced resource levels suggested to retain 0.42 ha of *kharif* paddy area which was 0.96 ha. in existing model. The area under all other crops were eliminated in optimum plans while the available resources were diverted to poultry enterprise and the net earnings could be increased. The dairy enterprise was retained in optimum plan M-I but it was eliminated in optimum plan M-II. The net earning were found to increase by 7.57 per cent in optimum plan M-I, while they were substantially increased (51.85%) in optimum plan M-II over optimum plan M-I. It was concluded that, the net income in this system could be increased by more emphasis on poultry enterprise by keeping some area under paddy at enhanced resource levels.

Farming System - V

In this farming system, crops retained in the optimum plans were paddy, mango and Cashewnut. The area under paddy was decreased from 57.41 per cent in existing model to 16.56 per cent and 16.14 per cent of gross cropped area in optimum plans M-I and M-II, respectively. It was due to minimum area constraint imposed for paddy, other wise entire paddy would have been eliminated in optimum plants. The area under mango was increased from 0.37 ha to 1.49 ha in optimum plan M-I and it was found to decrease to 0.52 ha in optimum plan M-II. The optimum plans suggested to increase area under cashewnut from 0.13 ha in existing to 1.08 ha in optimum plan M-I and 2.13 ha in optimum plan M-II which might be because of less capital and labour requirement as compared to mango

The increase in optimum plan M-I and M-II over existing plan was 125 per cent and 213.65 per cent respectively, which indicated the scope for the reallocation of resources.

5.7.4 Southern Coastal Plains Region

Farming System – I

As indicated in results (Table 4.31), the optimum plan M-I and M-II suggested to increase the area under mango. The area was found to increase from 39.58 per cent in existing model to 72.22 per cent in optimum plans M-I and M-II. The area under paddy was retained to 0.40 ha. in optimum plan M-I and M-II, which was 0.71 ha. in existing model. The number of dairy animals was decreased (from 1.89 in existing model) in optimum plan M-I. to 1.81 and it was increased to 3.69 in optimum plan M-II, which indicated the higher profitability of the enterprises with the added resources. The net income was found to increase in both optimum plans M-I and M-II. The paddy area was decreased in optimum plans which may be due to less net returns due to lower productivity levels.

Farming System – II

It could be seen from the results (Table 4.31) that in this farming system the optimum plans, indicated that the net income could be increased by bringing more area under coconut in this farming system. The coconut area was increased from 0.39 ha. in existing model to 0.94 ha in optimum plans. However, the *kharif* paddy area was decreased from 59.38 per cent to 26.56 per cent, which may be due to high labour requirement in paddy. The dairy enterprise was observed to be important supporting enterprise, which was found to increase in optimum plans. The number of dairy animals in optimum plan M-I were 1.78 and in optimum plan M-II it was 3.46.

Farming System – III

As indicated in results (Table 4.31), among the crops in the existing model such as paddy, mango, cashewnut, coconut and arecanut, paddy and coconut were retained in the optimum models. The area under paddy both in optimum plans (M-I and plan M-II) was 15.41 per cent. While in existing models it was 29.32 per cent. The area retention under paddy was observed to be the effect of minimum area restriction imposed for paddy crop. The area under coconut was substantially increased from 23.68 per cent in existing plan to 84.59 per cent in both optimum plans which may be due to higher per hectare net returns as compared to all other crops and less requirement of labour as compared to arecanut and paddy. The net income was found to be increased in optimum plan M-I by 70.51 per cent over existing plan and by 18.97 per cent in optimum plan M-II over optimum plan M-I. The number of dairy animals were slightly decreased in optimum plan M-I but it was substantially increased in optimum plan M-II which indicated greater scope for making higher investment in the dairy enterprise.

Farming System – IV

It could be observed from the results that, the optimum plan M-I and M-II suggested to increase the area under smoothgourd. It may be because of higher net return at comparatively lower working capital and less human labour requirement. The paddy area was reduced from 0.67 ha in existing model to 0.27 ha. in optimum plans. It was due to less per hectare net returns and high requirement of labour etc. The net income was found to increase by 82.67 per cent in optimum plan M-II, over existing model which indicated that the use of more resources with proper allocation can increase income to a larger extent.

Farming System – V

As indicated in results, the area under coconut was increased from 76.47 per cent in existing plan to 100 per cent in optimum plans. It indicated that the optimum plans suggested to divert all area under coconut in this farming system to increase the net income which was mainly due to higher net returns and lower labour requirement in coconut. This was also observed that the coconut was well supported by dairy enterprise which resulted in to increase in the net income over existing model by 8.97 per cent in optimum plan M-I and by 25.91 per cent in optimum plan M-II.

Farming System – VI

It could be observed from the results that, paddy and mango crop were retained in the optimum plans. However, the paddy area was decreased from 32.42 per cent in existing plan to 16.89 per cent in optimum plans (M-I and M-II); which might be because of less net

returns per hectare in paddy. Mango area was substantially increased from 28.77 per cent in existing plan to 83.11 per cent in optimum plans. It was due to per hectare higher net returns and also comparatively lower labour requirement than the other crops in the system. The number of poultry birds were also found to increase in optimum plans, because of the higher per unit productivity. The net returns were increased by 15.94 per cent in optimum plan M-I and 51.13 per cent in optimum plan M-II over existing plan. It indicated the scope for increasing the income by proper allocation and use of additional resources in the system.

It was concluded that in all the farming systems reallocation of existing resource level have shown higher returns than the existing plans. This indicated greater need to reallocate, rearrange, the resource in all farming system and in all regions. The optimum plan M-II that is optimum plan of enhanced resource level also suggested to increase the capital because it indicated higher returns more than these of optimum plan M-I. In majority of the farming systems the increase in net returns was higher than the 50 per cent over existing model and in some farming system the increase in the net returns was more than 50 per cent over optimum plan M-I. In case of paddy it was observed that the paddy area retained in the optimum plan has a strong relation with the minimum restriction imposed in the model. If this restriction would not have been kept in the analysis, the paddy crop might have been eliminated from the optimum plans which do not suit to the practical situation of the study area as paddy was a staple food crop and despite less returns it is grown over years.

In optimum plan it was observed that the crop enterprises such as coconut, mango, paddy, smooth gourd, betelvines, sapota, jasmine, arecanut, cashewnut and other enterprises such as dairy, poultry and goat rearing had shown their influence and competitiveness in the optimum plans. It can be inferred from the optimization exercise attempted in the study that there is great scope for reallocation or rearrangement of the existing resources and also it is possible to increase the net income supported by proper allocation at increased resource level.

5.7.5 Net Returns under Optimum Plans for Farming Systems in Study Area

As presented in results (Table 4.32), it was revealed that, the allocation of resources and rearrangement of enterprises has greater scope in majority of the farming systems. The rearrangement in existing perennial crops is difficult but in case of establishment of new plantations it can be easily implemented.

In case of northern coastal plains FS-III and FS-V, in northern central plains and hills region FS-II, FS-III, in southern central plains and hills FS-I, FS-II, FS-III, FS-V and in southern coastal plains FS-III had a higher advantage for resource allocation than the remaining other farming systems. Finance should be easily available to the farmers because the rearrangement of enterprise combination as per optimum plan M-I (at existing resource level) in majority of farming systems net income can be increased by more than 25 per cent. It was also observed that in majority of the farming systems at enhanced resource level (optimum plan M-II) the net income can be increased by more than 75 per cent than the existing plan and more than 30 per cent than income at optimum plan M-I.

5.8 Shadow Prices of Resources

5.8.1 Northern Coastal Plains Region

As indicated in the results the shadow prices for majority of the resources in this region were zero indicating no scope for increasing the additional resources. However, the resource position was found to be different in different farming systems which can guide the farmers following a particular farming system that, which resources should be increased and how these increased resources can be used optimally within the farming system with allocative advantage.

Farming System – I

It could be seen from results (Table 4.33) that the shadow prices for human labour was less than average wage rates (Rs.50.94) at optimum plan (M-I), which indicated less scope for increasing the labour. However, in solution M-II, the human labour was found to be not completely utilized as the shadow price was zero. Which indicated that the there was no necessity to use additional labour resource at enhanced resource level. The shadow price for

working capital at optimum solution that is at existing resource level (M-I) was zero indicating sufficient working capital available with the farmer and at optimum solution M-II the shadow price for working capital was Rs.0.30 which indicated the farmer should not put more working capital as the shadow price for working capital was less than one. The shadow prices for other resources were zero indicating incomplete use of these resources.

Farming System – II

As indicated in results, the shadow price for human labour was Rs 26.96 in both the optimal solutions (M-I and M-II) which indicated the imputed value of the human labour was Rs 26.96. That means, if one labour day was increased in present situation, the additional labour would add Rs.26.96 in the income or objective function, which revealed less returns from the use of additional unit of human labour as the average wage rate was higher than Rs.26.96. Similarly, the shadow price for working capital was also less (Rs 0.10) and the shadow prices for other resources such as bullock labour and land were zero. It can be concluded that in this farming system instead of increasing the resource level, proper allocation could increase the net income.

Farming System – III

It was observed from results that the shadow price of the land was Rs. 61095 which indicated greater scope in increasing the farm size at enhanced resource level (M-II). It was also observed that the shadow price of working capital was Rs 1.13 in optimum solution M-I which revealed need of additional working capital to increase the net income. The shadow prices for human labour, bullock labour in both plans were zero which show that if the farmers following this farming system increase more quantity of these resources their net income would get reduced.

Farming System – IV

As indicated in results, the shadow price for human labour was zero at existing level (M-I) and it was Rs 124.96 at optimum solution M-II which indicated scope for increasing the human labour because the imputed value of the human labour day was Rs.124.96. The shadow prices for other resources were zero, which indicated that these resources were not completely utilized.

Farming System – V

The shadow price for working capital was Rs.2.65 in this farming system in both optimum solutions (M-I and M-II) which revealed that, increasing one unit (Rs 1) of working capital would result in to increase of Rs.2.65 in the objective function (net returns). The shadow prices for other resources such as human labour, bullock labour and land were zero which showed that these resources were not fully utilized and they were available at higher extent with the farmer. It can be concluded that the net income in this farming system can be increased by increasing level of resources such as seed, fertilizers, manures, insecticides etc.

5.8.2 Northern Central Plains and Hills Region

Farming System – I

As indicated in results (Table 4.33), the shadow price for human labour was Rs 5.25 in optimum solution M-I which indicated that, if one unit of human labour added in the present resource level would only add Rs.5.25 in the net income which was below the average wage rate. It could be revealed that the farmer should not go for increasing the unit of human labour. The shadow prices for bullock labour and land were zero in both optimum solutions indicated that, these resources were not completely utilized. The shadow price for working capital was Rs 1.10 which revealed that the scope for increasing the working capital at existing resource level. However, the shadow price of working capital was Rs 0.29 in optimum solution M-II, which was less than one. It can be concluded that the income in this system can be increased by increasing working capital at existing resource level and by proper allocation of the resources without increasing the resource levels.

Farming System – II

It was observed that shadow prices for the human labour, bullock labour and land were zero indicating these resources were not fully utilized in both optimal solutions (M-I and

M-II). The shadow price of working capital in both the optimal solutions was Rs. 0.30 which revealed that addition of working capital would add very less (Rs.0.30) in the net return. It can be concluded that, the proper allocation of resources would help the farmers in increasing the net income rather than increasing the level of resources.

Farming System – III

It was observed that, the shadow price of human labour at optimum solution M-I was Rs.55.21 which indicated very less scope for increasing the human labour as the imputed value of the human labour was not higher than the average wage rate. The shadow price for working capital at optimum solution M-I was zero indicating working capital was not completely utilized. However, it was Rs.0.28 in optimum solution M-II which revealed that the net income would be increased by Rs.0.28 by adding one rupee. So it can be concluded that, the net income in this system could be increased by increasing more of human labour and proper allocation of other resources.

Farming System – IV

As indicated in the results Table 4.33, the shadow price for the human labour in optimum solution M-I was much higher (Rs.236.76) than the prevailing wage rate indicating need to increase the quantity of human labour used in this system. However, the shadow price in optimum solution M-II was zero which revealed that human labour was not fully utilized at enhanced resource level. The shadow price for the bullock labour was Rs,113.90 in optimum solution M-I and zero in optimum solution M-II. The shadow price for the working capital in optimum solution M-I was zero and in M-II it was Rs.0.18.The shadow price in case of land was zero in both optimum plans M- I and M-II. It can be concluded that the land was not fully utilized in this system. The increase in the bullock labour, human labour and working capital would not add much in the net returns. So income can be increased with increase in the human labour at existing resource level.

Farming System – V

It is observed than, human labour and bullock labour were not completely utilized as their shadow prices were zero in both optimum plans and the shadow prices for working capital and land were also less indicating very less scope to increase these resources.

5.8.3 Southern Central Plains and Hills Region

Farming System – I

As indicated in the results (Table 4.33) the shadow prices for the human labour and land were zero which revealed that these resources were not completely utilized. The shadow prices for the bullock labour were Rs.405.01 and Rs.301.52 in optimum plan M-I and M-II, respectively. Which indicated that the bullock labour should be increased as one unit of bullock labour would add Rs.405.01 and Rs.301.52 in the net returns in optimum plan M-I and M-II, respectively which were much higher than the prevailing wage rate. The shadow price for working capital was also as high as Rs.2.84 in optimum plan M-I, which showed that the addition of working capital will add at higher rate in net returns. It can be concluded that the net returns in this system can be increased with addition of more resources; such as bullock labour, seed, fertilizer, manures etc.

Farming System – II

It was observed from the results Table 4.32 that the shadow prices for bullock labour, working capital and land were zero and in case of human labour it was Rs.10.92, which indicated that if the farmer could increase extent of resource use of inputs such as bullock labour, working capital and land he would not increase the returns. It can be concluded that there in no need to increase the resource level. However, income could be increased only proper allocation of resources.

Farming System – III

It was revealed from the results that, the shadow price for bullock labour and land were zero. The shadow price for human labour and working capital were also very less (Rs.5.73 and Rs.0.54, respectively), which indicated that, these resources were not completely utilized so their level should not be increased.

Farming System – IV

It was observed from table than the shadow prices for human labour, bullock labour and land were zero as these resources were not completely utilized. Shadow prices for working capital was less than Rs.1 (0.95) which indicated that the income can be increased with proper allocation of resources at existing level, without increase in the level of resources.

Farming System – V

It was observed that the shadow price for the human labour was Rs.102.66 which was much higher than the prevailing average wage rate so income could increase by increasing more quantity of human labour. The shadow prices for bullock labour and land were zero and in case of working capital it was less than one which indicated that increase in these resources would not result in proportionate increase in the net returns.

5.8.4 Southern Coastal Plains Region

Farming System – I

It was observed from results (Table 4.33), the shadow prices for human labour, bullock labour and land was zero which indicated that these resources were not fully utilized in optimum solution M-I and M-II. In case of working capital the shadow price was Rs.0.49 which revealed that the addition of the resource would add proportionately less to the net returns.

Farming System – II

In this farming system shadow prices for bullock labour, human labour and land were zero which indicated that these resources were not completely utilized in both optimum plans (M-I and M-II). The shadow price for working capital was less than one (0.47) which revealed that there was no need of increase the working capital.

Farming System – III

As indicated in the results, the shadow prices for human labour, bullock labour and land were zero and shadow price for working capital was Rs.0.59 indicating human labour, bullock labour and land were not fully utilized and addition in the working capital would not increase the net returns. It can be concluded that without increase in the level of resources, proper allocation of existing resources would help to increase the net returns.

Farming System – IV

As indicated in the results (Table 4.33), the shadow price for the human labour was Rs.88.83 in optimum plan M-II, which revealed that net income could be increased by increasing the human labour at enhanced resource level. It was observed that the shadow price for the bullock labour was much higher (Rs.1221.4) in optimum plan M-I and (Rs.1238.07) in optimum plan M-II indicating increase in bullock labour would result in increase in net returns at very high rate. However, the shadow price for working capital was Rs.0.69 in optimum solution M-I which revealed that there is no need to increase the working capital at existing resource level. The shadow price for land was zero in both optimum solutions (M-I and M-II) indicating land was not fully utilized in this farming system.

Farming System – V

It was observed from the results that, in optimum solution M-I the human labour has shadow price of Rs.36.22 which was less than the prevailing wage rate, which revealed that, there was no need to increase the extent of human labour. The shadow prices for other resources in optimum solution M-I were zero, indicating these resources were not utilized completely. In optimum solution M-II the shadow prices for working capital was less than one (Rs.0.23) and for other resources it was zero. It can be concluded that the proper allocation of resources at existing resource level could increase the net income.

Farming System – VI

It was observed from the results that, the shadow prices for human labour, bullock labour and land were zero in both optimum plans which revealed that, if the farmers would increase the level of these resources, it would not add in the net returns. The shadow price for

the working capital was Rs.0.49 and Rs.0.14 which indicated that increase in the working capital would also result in less proportionate increase in the net returns.

It can be concluded that, in coastal plain (south) region, in majority of the farming systems, most of the resources were not fully utilized which indicated greater need for the proper rearrangement of the resources rather than increase in the level of resources.

5.9 Problems and Constraints

5.9.1 Northern Coastal Plains Region

It was observed from the results (Table 4.34) that, farmers expressed constraints regarding high wage rates and shortage of labour. It might be due to farm practices were conducted more intensively in this region. As the farmers were engaged in managing the other activities of farm they had to depend heavily on hired labour and due to nearness of urban area to this region, the farmers had faced the problem of shortage of labour which has resulted in to increasing of wage rate. The other constraints the farmers had opined were less knowledge of integrated farming system. In this region farmers had tendency to increase the income from highly commercial crops such as flowers, betelvines, sapota, coconut, dairy etc due to market demand. The focus of farmers from other enterprises and internal linkage between the enterprises have moved some farmers to adopt specialized farming which resulted in to less observations on the farm enterprise linkages and ultimately the integrated farming systems. The farmers also faced production constraints such as less knowledge about pest control, non availability of inputs in time, high incidence of pests etc. The farmers were facing the problems in protecting the crop such as flowers in general and particularly jasmine (Mogara) from insect attack, coconut from Eryophite mite attack, sapota and other vegetable crops from snails.

In case of marketing constraints the farmers had expressed their views regarding the low prices for produce and high cost of marketing. The farmers observed that in crop like sapota, farmers were getting price less than Rs.6 /kg. Whereas, in market the price paid by consumer was very high which may go up to Rs.40/kg. So they opined that they should get more than what they are getting today. The observations in other crops were also similar. The other important constraint faced by the farmers was price fluctuation. The farmers growing flower crop mentioned that the prices in Mumbai market were so volatile that some times they would change at higher rate than stock market prices. The flower prices change on hour basis and small change in the per kg or per bundle price affected entire calculation of farm business.

In case of financial constraints, the major constraints were lengthy process of loan sanction, no easy access for credit etc. These were due to the procedure adopted by the credit institutions and the illiteracy and less knowledge about the documentation on part of the farmers.

5.9.2 Northern Central Plains and Hills Region

As indicated in the results, (Table 4.34) the farmers in this region have faced the constraints such as non availability of inputs in village itself, non availability of inputs in time and high cost of fertilizers. Majority of the farmers in this region were tribals and their purchasing capacity was less, hence the farmers might have this kind of difficulties. Other constraints faced by the farmers were less knowledge about the integrated farming system and pest control, which might be due to higher illiteracy rate.

As regards marketing constraints, it was observed that, very few farmers had expressed the marketing constraints such as high marketing cost and price fluctuations. It might be due to less marketable surplus with the farmers.

It was observed that the farmers in this area were facing greater financial constraints, majority of the farmers had expressed scarcity of own fund. The economic backwardness of the farmers as most of the farmers were tribals prompted them to have less owned funds. The other constraints expressed were no easy access for credit, too much documentation and lengthy process in sanction of loans which may be due to less credit worthiness, illiteracy etc. on part of the farmers.

5.9.3 Southern Central Plains and Hills Region

As indicated in the results, (Table 4.34) the major constraints faced by the farmers in this region were non availability of inputs in time and non availability of inputs in village itself, which may be due to lacunas in the distribution of inputs and the less retail outlets in rural areas. The other problems faced by the farmers in this region were shortage of labour, high cost of fertilizer, electricity failure and less knowledge about pest control.

Among the marketing constraints, low prices for produce and high marketing cost were the major problems faced by the farmers. This area was mainly dominated by the paddy crop and as the cost of cultivation of paddy was high and per quintal price received by the farmers was comparatively low, ultimately lower returns as compared to other crops.

Farmers in this region opined that lengthy process in sanction of loan, no easy access for credit and high interest rates were the major financial problems. These were mainly due to procedure followed by the financial institutions. They consumed more time in formalities in sanction of loan, the documents required for clarifications may not be submitted by the applicants at once and power of sanction to district or regional level office delaying loan sanction.

5.9.4 Southern Coastal Plain Region

It was observed from results (Table 4.34) that, constraints faced by the farmers in production were shortage of water in summer, high wage rates, failure of electricity, non availability of inputs in village etc. These constraints may be due to less supply of electricity than the requirement, high requirement of the labour at the time of sowing and harvesting of paddy, less irrigation facilities etc. In case of marketing the major constraints were price fluctuation, low price for the produce and high marketing cost. As indicated in the results the financial constraints faced by the farmers were high interest rates and lengthy process of sanction of loan.

5.9.5 North Konkan Region

The production constraints at overall level in North Konkan region were non availability of inputs in time and in village, shortage of labour, less know-how about pest control, high cost of fertilizers, shortage of water in summer, less knowledge of integrated farming system, fragmentation of holding, high incidence of pests, high wage rates, electricity failure or irregular supply, lack of technical assistance and water pollution by chemical industries.

The problems faced by the farmers in North Konkan region differ between sub regions. However, the above mentioned problems indicate in general the situation that farmers were facing. In North Konkan region, there were some villages near urban areas facing the problems due to chemical industries. The problems in some tahsils such as Jawhar, Mokhada, Talasari, Vikramgadh, Shahapur and some part of Murbad, Karjat, and Khalapur were varied in nature. It can be concluded that, the major problems in study area in production aspects were high cost of fertilizers, non availability of inputs, less knowledge about pest control, integrated farming system, high wage rates, shortage of water in summer, fragmentation of holding etc.

As regards marketing problems the major problems observed in North Konkan region were price fluctuation, transport, storage and warehousing facilities. In case of financial problems too much documentation and no easy access for credit and high interest rates were found to be the major problems and hence hypotheses no. 4 is proved.

5.10 Measures Suggested to Overcome the Constraints

5.10.1 Northern Coastal Plains Region

It was revealed from results (Table 4.35), the measures suggested by the farmers to overcome the constraints were demonstrations on Eryophite mite control, regulation of wage rates, demonstrations regarding farming system models and technical know how regarding pest in flowers etc.

In this region the coconut was one of the important crops along with paddy, betelvines, sapota, flower etc. The production of coconut was considerably affected by the Eryophite mite attack and farmers were not getting satisfactory results. So, they felt the need to have demonstrations for control of this pest. Another important crop of this region was flowers and hence pest control was very important aspect in flowers. About 50 per cent farmers opined that there is need for pest control. The farmers were following various farming systems but they did not focus these systems in totality or as a farming system approach. Enterprise mix, interlinking, their relations the complimentary relations between various enterprises within the farming system are required to be focused. It was observed that there is large variation in wage rate in various operations in different crops. Some times farmers had to pay very high wage rates. In this regard farmers stated that there is need for regulations of wage rates.

As regards the measures for improving the marketing operations the farmers emphasized the need of transport facilities. The farmers also stated to have regulation on prices of fruits. They should get some assured price for fruits in the market so that they can manage the other operations in the farm efficiently. The farmers also opined that they have to pay a high amount of commission (about 15%) to agents which should be reduced. It can be done either by negotiation with traders by farmers society or by some Govt. efforts.

As regards measures regarding financial constraints, majority (62.22%) of the farmers opined that they should get the loan at lower rate.

5.10.2 Northern Central Plains and Hills Region

On of the important measures regarding production constraints suggested by the farmers in this region was the distribution of the inputs in time. More number of retail outlets may be opened to meet the farmers need in remote areas. In addition to this the facilities such as good road, transport vehicles are also required as was felt by 46.67 per cent farmers.

Regarding financial facility, the farmers were facing problems due to procedural requirement of loan. The most of the farmers were illiterate, so the official formalities, documents required etc. were difficult from the view point of farmers.

5.10.3 Southern central plains and hills region

As indicated in the results (Table 4.35), the farmers in this region have suggested for replacement of seed every year which help to improve the productivity. The farmers also emphasized the regulation of wage rates to reduce the large variation in wage rate and unnecessary competition. Some farmers also felt the necessity of the farming system models and training on processing and preservation of fruit products, so that they can get higher income by value addition and also avoid loss due to damage caused due to over ripening in mango and other fruits.

It was observed from results that, the farmers had suggested that if warehousing facility was provided at large extent they could store their products in the warehouses and avoid forced sale. Other important measures suggested by the farmers were the collective purchase and sell of input and output, respectively. If the inputs are directly purchased by the farmers or output is directly sold in the market they can reduce the market cost and marketing margins as well as availability of input can be as per the convenience of farmer and at right time. In case of financial problems more number of farmers expressed need of the reduction in interest rates.

5.10.4 Southern Coastal Plains Region

The farmers in this region had suggested for demonstrations for Eryophite mite control, training for processing and preservation of fruit crops, training on various farming systems models, distribution of inputs in time and replacement of seed to improve the yield.

In case of marketing the farmer felt the need for regulation of fruit prices, so that they can get some assured price. In addition to this they also suggested to provide large number of warehouse facilities. In financial aspects farmers in this region emphasized on making the loan procedure easy.

5.10.5 North Konkan Region

It was revealed from the results that, the suggestions from the farmers from various sub-regions were different. But in general in North Konkan region the measures to facilitate the farmers in adoption of the farming systems were demonstrations on control of Eryophite mite, farming system models. The training on processing of fruit products and supply of good quality seed, so that the farmers would replace seeds to improve the productivity.

On marketing front, improvement in transport, warehousing facility, regulation of prices in general for agricultural products and particularly for fruits were measures suggested by the farmers in the study area.

On financial aspects, the reduction in the interest rates and the making an easy loan procedure were the two measures suggested by the farmers. Recently, the Government of Maharashtra had taken a decision to give loan to women self help groups at the rate of four per cent. This decision may help the farmers in study area to avail credit at cheaper rate and to invest it in agriculture.

6. SUMMARY AND POLICY IMPLICATIONS

In farming system approach, the farm is viewed in holistic manner. The farmers are confronted with many socio-economic, biological, institutional, administrative and technological constraints. The farming system conceptually is a set of elements or components, which are interrelated and interact among themselves. At the centre of interaction is the farmer himself, exercising control and choice regarding the type and results of interaction.

Recently research on farming system has been gaining momentum and the scientists and research scholars are developing tools and techniques to discover the more practicable methods to improve the farming. This study is an attempt in this direction covering different aspects of farming system with respect to agricultural development in North Konkan region of Maharashtra State.

Farming is a complex human activity consisting of farm enterprises which are interrelated and interact for the available resources and environment. It also involves application of highly sophisticated technology on one side and the physical, social and economic factor on other. Hence, successful attainment of total agricultural development depends on the farming system approach to a large extent. Many experts have also opined that there is need to understand and analyse the existing farming systems in order to quicken the pace of agricultural development. Failure to understand the existing farming systems and the proposed improved technology might often lead to failure of the new technology. It was therefore, felt necessary that study on farming systems be taken up. Present study was undertaken to examine the farming systems in North Konkan region.

The multistage sampling procedure was followed in the present study. The North Konkan region has varied agroclimatic conditions. Hence, it was felt necessary to delineate the region in to sub regions. The secondary data on various aspects were collected from the district statistical abstracts and Joint Director of Agriculture, Thane for both districts *viz.,* Thane and Raigad.

Primary data on various aspects of farming were collected from head of each household with the help of a set of pre-tested comprehensive questionnaire designed for the study. Primary data so collected pertained to 30 samples from each small, medium and large group in each region. In all, 360 farmers were selected to elicit information for study.

The present study made use of different statistical techniques such as percentages, ratios, correlations, different cost concepts and higher analytical techniques, such as cluster analysis, discriminent analysis, production function analysis and linear programming etc, The cluster analysis was carried out by using hierarchical agglomerative method. The Pearson's correlation coefficient was used to form a proximity matrix, while complete linkage method was used for cluster formation. The discriminent analysis was carried out by using a cluster membership as a grouping variable for validation of formed clusters. Cobb-douglas type of production functions were formed separately for crop and other enterprises to study the resource use efficiency. The deterministic linear programming model was used for studying the optimum farming systems. The two types of optimum solutions simulated were : a) optimum farming system at existing resource level (optimum plan M-I) and b) optimum farming system at enhanced resource level (optimum plan M-II).

The important outcomes with reference to objectives referred for the study are presented in following paragraphs.

6.1 Delineation of Study Area

The cluster analysis delineated the study area in to five distinct clusters. The first cluster included 4 tahsils namely Dahanu, Palghar, Vasai and Talasari which are lying on the bank of west coast. This cluster was regarded as Northern coastal plains region. The second cluster consisted 7 tahsils namely Vikramgadh, Jawhar, Mokhada, Wada, Bhivandi, Shahapur and Murbad, lying at eastern and northern central area nearer to Sahyadri hills. This cluster was named as Northern central plains and hills region.

The third cluster consisted of ten tahsils, namely Poladpur, Panvel, Karjat, Khalapur, Pen, Mahad, Roha, Sudhagadh, Mangaon and Tala. These tahsils lie at southern central part

of North Konkan region and some tahsils are in the pockets of Sahyadri hills. This cluster was regarded as Southern central plains and hills region.

The fourth cluster comprised 5 tahsils namely Alibaug, Mhasala, Murud, Shrivardhan and Uran. The tahsils in this cluster lie at the bank of west coast of southern part of study area and this cluster was regarded as Southern coastal plains region. The fifth cluster consisted of 4 tahsils namely Thane, Kalyan, Ulhasnagar and Ambaranath and this cluster was named as central region. However, due to less agricultural land, this cluster was not considered for study. The clusters formed were tested by the discriminant analysis and it was found that cent per cent of cases were correctly classified.

6.2 General Characteristics of Sample Respondents

The average age of the farmers was 43.71 years with 80.63 per cent literacy. The average family size was 6.91. As regards to occupation at overall level, the majority of the farmers (78.08 %) have their main occupation as agriculture.

6.3 Existing Farming Systems

In study area 18 existing major farming systems were identified. In Northern coastal plains region 5 major farming systems were identified namely 1) Paddy + Irrigated plantations + Dairy, 2) Paddy + Grass + Dairy + Goat rearing, 3) Paddy + Irrigated plantations + Flowers, 4) Irrigated plantations + Dairy and 5) Paddy + Irrigated plantations + Betelvines.

In Northern central plains and hills region, 5 major farming systems are adopted by the farmers such as 1) Paddy + Other cereals + Rainfed plantations + Dairy, 2) Paddy + Other cereals + Dairy + Goat rearing 3) Paddy + Pulses + Dairy, 4) Paddy + Vegetables + Poultry and 5) Paddy + Grass + Dairy.

The major farming systems in Southern central plains and hills region were 1) Paddy + Vegetables + Dairy, 2) Paddy + Dairy, 3) Paddy + Dairy + Goat rearing 4) Paddy + Pulses + Dairy + Poultry and 5) Paddy + Rainfed plantations + Dairy.

In Southern coastal plains region six major existing farming systems were identified such as 1) Paddy + Rainfed plantations + Dairy, 2) Paddy + Irrigated plantations + dairy, 3) Paddy + Irrigated plantations + Rainfed plantations + Dairy, 4) Paddy + Irrigated plantations + Vegetables + Dairy, 5) Irrigated plantations + Dairy, 6) Paddy + Irrigated plantations + Rainfed Plantations + Poultry.

6.4 Land Holding

The land holding pattern across all the farming systems adopted in different regions indicated that per farm land holding was ranging from 1.31 hectare (FS-V) in the Southern coastal plains region to 3.28 hectare (FS-III) in same region .

6.5 Cropping Pattern

In the study area the crops grown and enterprises followed had a large variation not only between farming systems and also in different regions. The important crops grown in the study area were Paddy, Finger millet (Nagli), Coconut, Arecanut, Cashewnut, Banana, Sapota, Betelvines and Mango. The flower crops grown in study area were Mogra (Jasmine), Jai, Hibiscus, Sayali, Kagda and Yellow champak. The pulses and vegetables crops included Lady's finger, Brinjal, Cowpea, Green gram, Smooth gourd, Chilli, Bottle gourd etc. The gross cultivated per holding area in coastal plains was ranging from 1.12 ha. to 1.99 ha among the various farming systems. However, cropping intensity was very less at 89.80 to 186.18 per cent in various farming systems. In Northern central plains and hills region, the gross cropped area was ranging from 0.81 ha to 2.18 ha. The cropping intensity was highest (300%) in FS-V in northern coastal plains region.

As regards cropping pattern followed in Southern coastal plains region, the per farm gross cropped area was ranging from 0.85 ha to 2.66 ha. The cropping intensity was on higher side in all the farming systems.

6.6 Per Unit Profitability

In North Konkan region it was observed that, in case of paddy the per hectare cost of cultivation and gross returns were maximum at Rs.22970 and Rs.22321 in FS-I and FS-III, respectively in Northern coastal plains region.

In case of sapota per hectare gross returns and total cost were Rs.109725 and Rs.63416 (FS-IV). The returns per rupee invested was Rs.1.73 to Rs.1.94. The per hectare total cost was ranging from Rs. 53369 (FS-I) to Rs. 63416(FS-IV

In case of banana the total cost and total returns were Rs. 61557 and Rs. 91225 in FS-I (cluster-I). Among the various flower crops per hectare gross returns (Rs.90374) and net returns over total cost (Rs.61095) were maximum in Jasmine flower. The per hectare total cost and total returns in betelvines were Rs.369607 and Rs.641866 which revealed that betelvines was most remunerative crop of the region.

In case of mango production per hectare net return over total annual cost was minimum Rs.25789 in FS-I (cluster-II). The per hectare gross returns were maximum (Rs.63451) in FS-V (cluster-III). The per hectare net returns were maximum (Rs.44460) in cluster-II, where as returns per rupee invested were Rs.1.82.

The per hectare gross returns in Lady's finger, brinjal and smooth gourd were Rs.93042, Rs.113603 and Rs.696445, respectively. The per animal total maintenance cost in dairy enterprise was minimum (Rs.11428) in FS-V whereas the maximum gross returns were obtained in FS-IV in Northern central plains and hills region. The net returns per rupee invested at total cost were maximum Rs.1.53 (FS-V) in Northern central plains and hills region.

The per animal total cost of goat rearing was minimum Rs.975 (FS-III) in cluster-III and maximum gross returns (Rs.1431) and maximum net returns per rupee invested (Rs.1.45) were observed in cluster-I.

As regards poultry enterprise the per unit total cost of maintenance and gross returns were maximum in FS-IV in Northern central plains and hills region. However, returns per rupee invested were maximum (Rs.1.70) in FS-IV in Southern central plains and hills region.

6.7 Cost and Returns in Major Farming Systems

In case of Northern coastal plains region, among the farming systems followed in the region, maximum per farm labour used was in FS - III (1197 man days). The per farm net returns over total cost was maximum in FS-V which amounted to Rs.218016 followed by FS - IV (Rs.57618). The maximum returns on per rupee invested at total cost worked out to Rs.2.02 in FS – V.

As regards Northern central plains and hills region, among all farming systems followed, FS-IV required maximum labour (471 man days). The per farm gross returns were maximum in FS-IV (Rs.4,44,161) followed by FS-V (Rs.68,197). The net returns over total cost were maximum in FS–IV (Rs.95,111).

In case of Southern central plains and hills region, among different farming systems in the region, it was found that per farm gross returns (Rs.4,65,062) net returns over total cost (Rs.198113) and returns on per rupee invested at total cost (Rs.1.72) were maximum in FS - IV.

Regarding the cost and returns in Southern coastal plains region it was found that, among the different farming systems per farm maximum employment was created in FS - IV (705 man days), followed by FS- VI (614 man days). The per farm gross return was maximum in FS - VI (Rs.571232), followed by FS - IV (Rs.185659). The returns on per rupee invested was maximum in FS - III (Rs.1.57).

In North Konkan region the 18 farming systems were found to be major farming systems followed by the farmers. The per farm total human labour required was maximum (1197 man days) in Paddy + Irrigated plantations + Flowers farming system.

The per farm total variable cost (Rs.4,49,976), total cost (Rs.4,87,771) and gross returns (Rs.5,71,232) were maximum in Paddy + Irrigated plantations + Rainfed plantations + Poultry farming system in Southern coastal plains region. However, in this system the returns

on per rupee invested was very low (Rs.1.17). In Paddy + Irrigated plantations + Betelvines farming system followed in northern costal plains region, the per farm total variable cost, total cost and gross returns were Rs.1,22,005, Rs.2,12,359, Rs.4,30,375, respectively. The returns per rupee invested were maximum (Rs.2.02) in this system as compared to all farming systems in different regions. Hence, it can be concluded that the Paddy + Irrigated plantation + Betelvines was most remunerative system in the study area.

6.8 Resource Use Efficiency in Major Farming Systems

6.8.1 Northern coastal plains region

The results of resource use efficiency in paddy indicated that, seed, nitrogen and phosphorous were positive and influencing factors on production. The sum of regression coefficients indicated constant returns to scale.

As regards jasmine cultivation, F.Y.M., phosphorus, human labour were positive and significant inputs. In sapota production, the increasing returns to scale was observed whereas, F.Y.M., potash and human labour were significantly contributing to the production and their use was more than the desired level.

In case of betelvines, F.Y.M., plant protection chemicals and organic fertilizers were contributing to the production positively and significantly. The F.Y.M., P.P.C. and human labour were excessively used than the desired level.

As regards dairy enterprise, dry fodder, green fodder and concentrates were positive and significant, while the green fodder and concentrate were utilized at more extent than the required quantity. It was concluded that there is need to have proper mix of these inputs in milk production.

In goat rearing, green fodder was highly contributing input. The constant returns to scale was observed from sum of output elasticities.

6.8.2 Northern Central Plains and Hills Region

As regards paddy production, seed was most influencing variable along with phosphorus and plant protection chemicals in FS-I, whereas nitrogen had shown negative influence in FS-V.

In mango production, F.Y.M., phosphorous, potash and human labour were contributing positively and significantly. Potash and human labour were less utilized than desired level whereas, use of phosphorus was more than the desired level. The increasing returns to scale was observed in mango production.

As regards cashewnut, the inputs such as F.Y.M., human labour and phosphorous were contributing positively. The extent of use of phosphorus and human labour was less than the desired level where as F.Y.M. was utilized more than the desired level. The increasing returns to scale was observed in cashewnut production. In brinjal cultivation, seed was most influencing input positively on the production along with potash and plant protection chemicals. Seed was utilized less than the optimum level whereas, phosphorus and plant protection chemicals were utilized more than the desired level. The increasing returns to scale was observed in brinjal production.

Dairy enterprise was found to be influenced positively and significantly by green fodder, dry fodder and concentrates out of which dry fodder was utilized more than optimum level and green fodder and concentrates were utilized less than the desired level.

In case of goat rearing enterprise, green fodder and concentrate had positive influence on the income. It was revealed that the green fodder was more utilized. The constant returns to scale was observed in goat rearing enterprise.

As regards poultry production, feed was most contributing input. It was observed that feed was utilized less than the desired level. However, in poultry enterprise, decreasing returns to scale was observed.

6.8.3 Southern Central Plains and Hills Region

In *kharif* paddy production, nitrogen and bullock labour exerted their influence (FS-IV and FS-I) positively and significantly. Seed and human labour were utilized at more extent than the desired level in majority of the farming systems. The returns to scale was found to be increasing in all farming systems except FS-III.

In case of paddy grown in *rabi* season, inputs such as F.Y.M., seed, nitrogen and potash had shown positive and significant influence on its production. It was also observed that nitrogen and seed were used less than the optimum level where as potash was excessively used. The returns to scale was found to be increasing.

As regards dairy enterprise, it was found that dry fodder and concentrate had positive and significant influence on gross returns in all farming systems in the region. Regarding allocative efficiency, dry fodder and concentrate were found to be excessively used in all the farming systems.

In case of goat rearing, green fodder, concentrates and human labour were more influencing factors. Green fodder, concentrates and human labour were used more than the desired level. The returns to scale was found to be constant.

In poultry enterprise, the expenditure on chicks, feed and paddy straw husk was found to be influencing positively and significantly. The sum of output elasticities indicated increasing returns to scale.

6.8.4 Southern Coastal Plains Region

In *kharif* paddy production, the inputs such as F.Y.M. and nitrogen were positively and significantly influencing on the production (FS-II and FS-III). Nitrogen was more utilized in both the farming systems (FS-II and FS-III), while phosphorus was less utilized in FS-III. The sum of output elasticities indicated constant returns to scale.

In FS-III, nitrogen was most influencing input in mango production with output elasticity of 0.85. F.Y.M. was used more than optimum level in FS-I. In FS-III, phosphorus and potash were utilized less than the optimum level where as nitrogen was excessively used. The returns to scale was increasing in FS-I, while there was constant returns to scale in FS-III.

In case of coconut, it was revealed that F.Y.M., nitrogen and potash had exerted positive significant influence on production. Regarding the extent of use of inputs, the nitrogen and potash were found to be less utilized than the desired level. The returns to scale was found to be increasing in coconut production.

As regards arecanut production, it was revealed that F.Y.M. and plant protection chemicals were contributing positively and significantly and they were utilized less than optimum level. The increasing returns to scale was observed in arecanut production.

In case of dairy enterprise, inputs such as dry fodder, green fodder and human labour have contributed positively and significantly in majority of farming systems. The sum of output elasticities indicated increasing returns to scale in FS-I and FS-II while constant returns to scale was observed in FS-IV.

In case of poultry, the expenditure on chicks, feed and human labour had shown positive and significant influence on gross income. The chicks, feed and human labour were found to be used to more extent than desired level. The returns to scale in poultry enterprise was observed to be constant.

6.9 Optimum Farming Systems

6.9.1 Northern Coastal Plains Region

The optimum plan M-I suggested increase in area under sapota whereas paddy area was decreased. The income was increased by 54 per cent in optimum plan M-I and 0.4 per cent in optimum plan M-II over optimum plan M-I. In case of FS-II, in optimum plan M-I, area under paddy was decreased and the number of dairy animals was increased. The net income over existing model was increased by 14 per cent in optimum plan M-I and 78.92 per cent in optimum plan M-II. It was observed that in FS-III, the paddy area was slightly reduced while

area under other flower crops were eliminated and it was diverted to mogra in optimum plan M-I. In optimum plan M-II the area under crops was unchanged and additional resources were utilized for dairy enterprise. The net income was increased by 77.16 per cent in optimum plan M-I over existing plan and 18.77 per cent in optimum plan M-II over optimum plan M-I. In case of FS-IV, whole area was diverted to arecanut in optimum plan M-I. The number of dairy animals was also increased in both the optimum plans. The net returns were increased by 47.54 and 24.27 per cent in optimum plan M-II over existing plan and optimum plan M-I, respectively. In FS-V the paddy area was decreased while area under betelvines was increased by 60.34 per cent. The net income was found to be increased by 25.70 per cent in optimum plan M-I and 57.48 per cent in optimum plan M-II over existing model.

6.9.2 Northern Central Plains and Hills Region

In farming system-I, the area under paddy was decreased in both optimum plans. However, the area under mango was increased from 16.29 per cent to 71.34 per cent. The number of dairy animals were also found to be increased in both the optimum plans. The net income (Rs.39432) had indicated 75.82 per cent and 48.21 per cent increase over existing model and plan M-I, respectively.

As regards FS-II, it was revealed that optimum plans suggested to increase the number of goats rearing by diverting the resources used under paddy. The net income was increased from Rs.7,909 in existing plan to Rs.12,080 in optimum plan M-I and Rs.22,095 in optimum plan M-II.

In FS-III it was observed that area under *kharif* cowpea and number of dairy animals were substantially increased in both the optimum plans. The net income was increased by 41 per cent in optimum plan M-I and 107.21 per cent in optimum plan M-II over existing model.

In FS-IV, paddy area was reduced and it was suggested to be diverted for brinjal crop. The number of poultry units were found to be decreased in optimum plan M-I and it was increased in optimum plan M-II. The net income was increased from Rs.95,168 in existing model to Rs.1,43,955 in optimum plan M-I and Rs.1,77,614 in optimum plan M-II.

As regards FS-V, the area under paddy was decreased and the number of goats rearing animals were increased which resulted in increase in the net income by 20 per cent in optimum plan M-I and 83.06 per cent in optimum plan M-II over existing model.

6.9.3 Southern Central Plains and Hills Region

In case of FS-I, it was revealed that, the paddy area was reduced and it was diverted to lady's finger. The area under chilli was also increased by 49 per cent. The net returns were increased over existing model by 160.79 per cent and 209.08 per cent in optimum plan M-I and M-II, respectively.

In case of FS-II, it was observed that, paddy area was decreased and the saved resources were utilized for dairy enterprise in the optimum plan. The net returns were Rs.1,142, Rs.3,821 and Rs.7,080 in existing, optimum plan M-I and optimum plan M-II, respectively.

As regarded FS-III, the number of goat rearing animals and dairy animals were found to be increased substantially which resulted in increase of net returns over existing model by 58.65 per cent and 151.84 per cent in optimum plan M-I and M-II, respectively.

Regarding FS-IV, it was found that, the optimum plan M-II, suggested to utilize the resources mainly for poultry. In optimum plan M-II, net returns were 63.33 per cent higher than existing model.

In FS-V, the area under mango and cashewnut were increased and area under *kharif* as well as *rabi* paddy was decreased. The number of dairy animals, however, found to be decreased in optimum plan M-I, and it was substantially increased in optimum plan M-II. The net returns over existing model were increased by 125.00 per cent in optimum plan M-I and 213.65 per cent in optimum plan M-II.

6.9.4 Southern Coastal Plains Region

In FS-I, the area under mango was increased by 72.22 per cent. Number of dairy animals was increased from 1.89 in existing model to 3.69 in optimum plans. The net income over existing model was increased by 38.70 per cent and 78.02 per cent in optimum plan M-I and M-II, respectively.

In FS-II, area under coconut was increased from 30.47 per cent in existing model to 73.44 per cent in both the optimum plans. Number of dairy animals were also increased in optimum plans. The net income was increased by 44.82 per cent in optimum plan M-I and 82.34 per cent in plan M-II over existing model.

As regards FS-III, the area under coconut was increased to a larger extent (84.59 %) in optimum plans. The net income was Rs.63,491, Rs.1,11,670 and Rs.1,32,855 in existing model, optimum plan M-I and optimum plan M-II, respectively.

As regards FS-IV, the area under smooth gourd was increased from 11.79 per cent in existing model to 70.96 per cent and 79.39 per cent in optimum plans M-I and M-II, respectively. The number of dairy animals in optimum plans were also found to be increased over existing model. The net income was also increased by 37.68 per cent and 82.67 per cent in optimum plan M-I and M-II, respectively over existing model.

In case of FS-V, it was revealed that in both the optimum plans whole cultivable area was allotted to coconut. The number of dairy animals were also increased. The net income over existing model was increased by 8.97 per cent and 25.91 per cent in optimum plan M-I and M-II, respectively.

As regards FS-VI, it was observed that the area under mango was increased from 28.77 per cent in existing model to 83.11 per cent in optimum plans. The number of poultry units were increased at lower extent that is from 14.75 in existing model to 14.88 in optimum plans M-I and 22.95 in optimum plan M-II. The net income had shown increase over existing model by 15.94 per cent in optimum plan M-I, and 51.13 per cent in optimum plan M-II.

It was concluded that in all the farming systems reallocation of existing resources had shown a higher returns than those from the existing plans. It indicated a greater need to reallocate, rearrange the resource in all farming system and in all regions. The optimum plan M-II that is optimum plan with enhanced resource level also suggested to increase the capital because it indicated higher returns than the optimum plan M-I. In majority of the farming systems the increase in net returns was higher than 50 per cent over existing model and in some farming system the increase in the net returns was more than 50 per cent over optimum plan M-I. In case of paddy it was observed that the paddy area retained in the optimum plan has a strong relation with the minimum restriction imposed in the model. If this restriction would not have been kept in analysis the paddy crop might have been eliminated from the optimum plans which do not suit the practical situation of the study area as paddy is a staple food crop and despite less returns is being grown over years.

In optimum plan it was observed that the crop enterprises such as coconut, mango, paddy, smooth gourd, betelvines, sapota, jasmine, arecanut, cashewnut and other enterprises such as dairy, poultry and goat rearing had shown their influence and competitiveness in the optimum plans. In conclusion it can be inferred from the optimization exercise attempted in the study that there is great scope for reallocation or rearrangement of the existing resources and also it is possible to increase the income supported by proper allocation at increased resource levels.

6.10 Shadow Prices

6.10.1 Northern Coastal Plains Region

It was revealed that in FS-I, bullock labour and land were not completely utilized in optimum plan M-I and working capital in optimum plan M-II. As their prices were less, it is uneconomical to increase these resources. In case of FS-II and FS-III also similar trend was observed as in FS-I. It is concluded that, proper reallocation is necessary than increase in the resource. In case of FS-IV, the shadow price for human labour at optimum solution M-II was very high (Rs.124.86) which indicated the need for increase in the extent of labour use.

Shadow price for other resources except working capital were zero indicating they were not completely utilized.

In FS-V, the shadow price for working capital was high in both the optimum plans. This indicated the use of working capital at higher extent.

6.10.2 Northern Central Plains and Hills Region

The shadow prices in FS-I, FS-II, FS-III and FS-V for majority of the resources were either zero or less than their unit prices. It indicated that these inputs should not be increased as some of them were not completely utilized and their excess use will not increase the income. However, in case of FS-IV, the shadow price for human labour and bullock labour in optimum solution M-I was on higher side (Rs.236.7 and Rs.113.9, respectively). This indicated that these resources need to be increased.

6.10.3 Southern Central Plains and Hills Region

In FS-I, the shadow price for bullock labour and working capital were 405 and Rs.2.84 in optimum solution M-I, respectively, which indicated that the extent of use of these resource should be increased. In FS-II, FS-III and FS-IV the shadow prices for majority of the resources were either zero or less than their unit prices which suggested that these resource should not be used more than the present level. In case of FS-V, the shadow price for human labour was Rs.102.66 which revealed that the more quantity of the resource would result in increase in net farm income.

6.10.4 Southern Coastal Plains Region

The shadow prices in FS-I, FS-II, FS-III, FS-V and FS-VI for majority of resources were zero or less than their respective unit prices. However, in FS-IV, the shadow price for bullock labour was very high (Rs.1221 and Rs.1238) respectively in optimum solution M-I and M-II. The shadow price for human labour was Rs.88.83 in optimum solution M-II, which was higher than the average wage rate indicating scope for increasing these resource.

The shadow prices for majority of the resources in study area were zero indicating no scope for increasing the additional resources, however the resource position was found to be different in various farming systems. It may guide the farmers following a particular farming system that which resources should be increased and optimum solution could give the information as how these increased resources could be allocated.

6.11 Problems and Constraints

The study of production constraints at overall level in North Konkan region, revealed that, the constraints faced by the farmers were non availability of inputs in time and in village, shortage of labour, inadequate know how about pest control, high cost of fertilizers, shortage of water in summer, less knowledge of integrated farming system, fragmentation of holding, high incidence of pests, high wage rates, electricity failure or irregular supply, lack of technical assistance and water pollution by chemical industries.

The problems faced by the farmers in North Konkan region indicate difference between sub regions. However, the above mentioned problems indicate in general the situation that farmers were facing. Some tahsils like Jawhar, Mokhada, Talasari, Vikramgadh, Shahapur and some part of Murbad, Karjat, Khalapur had problems and these problems were of varied nature. It can be concluded that the major problems of study area in production aspects were high cost of fertilizers, non availability of inputs, inadequate knowledge about pest control, integrated farming system, high wage rates, shortage of water in summer and fragmentation of holding etc.

As regards marketing problems the major problems observed in North Konkan region were price fluctuation and inadequate transport, storage and warehousing facilities. In case of financial problems too much documentation and no easy access to credit and high interest rates were found to be the major problems.

6.12 Measures to Overcome the Constraints

It was revealed from the results that, the suggestions from the farmers from various sub-regions were different. But in general in North Konkan region, the measures to facilitate the farmers in adoption of the farming systems were demonstrations on control of Eryophite mite, demonstrations on farming system models, the training on processing of fruit products and supply of the good quality seed. So that the farmers will replace seed regularly and productivity can be improved. These were found to be major measures in North Konkan region.

In case of marketing, improvement in transport, warehousing facility, regulation of prices in general of agricultural products, particularly fruits were marketing measures suggested by the farmers in the study area.

In case of financial aspects the reduction in the interest rates and the easy procedure for loan were the two measures suggested by the farmers. Recently, Government of Maharashtra had taken a decision to give loans to women self help groups at the rate of four per cent. This decision may help the farmers in study area to avail credit at cheaper rate and to invest in agriculture.

Policy Implications

On the basis of the study on farming systems the following suggestions and policy implications are made.

1. The region wise specific farming systems needs to be focused/promoted such as
    a. In Northern coastal plains region 1) Paddy + Irrigated plantations + Dairy, 2) Paddy + Irrigated plantations + Flowers and 3) Irrigated plantations + Dairy are suggested for implementation on larger area.
    b. In Northern central plains and hills region farming systems such as 1)Paddy + Other cereals + Rainfed plantation + Dairy and 2) Paddy + Vegetables + Poultry need to be promoted and implemented on large scale.
    c. In southern central plains and hills region farming systems such as 1) Paddy + Vegetables + Dairy 2) Paddy + Pulses + Dairy + Poultry and 3) Paddy + Rainfed plantations + Dairy, these farming systems need to be promoted and implemented on large scale.
    d. In Southern coastal plains region 1) Paddy + Rainfed plantation + Dairy 2) Paddy + Irrigated plantations + Rainfed plantation + Dairy, 3) Paddy + Irrigated plantations + Vegetables + Dairy and 4) Paddy + Irrigated plantations + Rainfed plantations + Poultry are suggested for implementation on extended area.
2. In North Konkan region it is found that the farming systems followed by the farmers are of varied nature, however there is need for training on integrated farming systems. Therefore, it is suggested that special training along with demonstrations should be organized for the benefit of farmers in different regions.
3. The awareness among the farmers is needed to follow package of practices for various crops. The balanced use of fertilizers is required because nitrogen application was found to be excessive in many crops. The human labour should be used judiciously so that it would be cost effective. The use of FYM and organic fertilizers should be increased. The more extent of green fodder in dairy and concentrates in goat rearing are required.
4. The extension efforts have to be made in reorganization of enterprise mix in the farming systems. The allocation of resources and rearrangement of enterprises has greater scope in majority of the farming systems. The rearrangement in existing perennial crops is difficult but in case of establishment of new plantations it can be easily implemented. At existing resource level (optimum plan M-I) in majority of farming systems net income can be increased by more than 25 per cent. Finance should be easily available to the farmers because the rearrangement of enterprise at enhanced resource level (optimum plan M-II) the net income can be increased by more than 75

per cent than the existing plan and more than 30 per cent than income at optimum plan M-I.

5. The study revealed that classification of the geographical areas into different regions based on geographical, climatic and crop and livestock characteristics has much advantages compared to conventional agro-climatic regional classification. Research in agriculture could be appropriate and extension recommendations would be much successful as one moves to much micro level approaches for classification, as was found out in the study. Hence, relying upon micro level classification of area based on village or revenue circle for recommendation of technologies, extension activities and advisory services would lead to more success in farming business.

6. In Northern coastal plains region, the study suggested that there is ample scope for developing flower cultivation, particularly jasmine (mogra) and also crops such as sapota and betelvines. In Northern central plains and hills region mango, brinjal cultivation and goat farming were found remunerative. In the Southern central plains and hills region, dairy farming, poultry, goat rearing, mango and cashewnut cultivation were suggested to be more profitable. Similarly, in Southern coastal plains region, mango, coconut and poultry farming were found to be highly profitable. Hence, research efforts may be strengthened to provide quality and high yielding varieties of these crops and livestock. Along with this establishment of crop specific cooperative marketing arrangements, network of refrigerated warehouse facilities and regulation of market practices would go a long way in protecting the interests of the farmers.

7. In Southern central plains and hills region, special economic zones (SEZ) projects are being established. After implementation of SEZ projects, the area at present under the vegetables, flowers and other agricultural crops will be seized. On the contrary, due to development of SEZs, the area in adjoining tahsils may come under the above mentioned crops on large scale. This calls for forward and backward linkages to enhance productivity of crops and livestock enterprises in the region.

8. The farming system on long term basis can be sustainable when the reasonable balance between crops and livestock enterprises would be maintained. In view of this it is necessary to motivate farmers to adopt livestock based farming systems suitable to the specific regions for efficient allocation and proper utilization of the resources.

9. The study area has adjoining Mumbai market which has created the ever expanding potential for market oriented agribusiness activities such as flowers, dairy, poultry, fruits, and vegetables. It is therefore needed to harness this market as far as possible by developing infrastructure facilities and implementing market oriented agricultural activities.

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Appendix I. Per hectare cost and returns of crop grown in farming systems in northern coastal plains

FS-1												
Sr. No	Particulars		PADDY		SAPOTA		COCONUT		ARECANUT		BANANA	
			AV.Size	0.77	AV.Size	0.83	AV.Size	0.33	AV.Size	0.04	AV.Size	0.022
I	Variable cost	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	Human labour											
a	Male	MD	129	7890	158	10270	225	15654	145	9425	200	13383
b	Female	FD	86	3413	145	7250	43	1906	81	3645	98	4083
2	Bullock labour	BD	24	888	0	0		0		0	0	0
3	Machine labour	HR	0	58	0	0		0		0	0	0
4	Seed	KG	83	1194	0	0	0	0		0	508	2692
5	FYM	CL	8	1649	17	4873	12	4080	15	6750	43	10133
6	Fertilizer	KG	232	1388	387	2367	491	2766	350	2199	750	4770
7	PPC	KG	0	42	1	231	1	222	1	290	5	2256
8	Irrigation Charges		0	0		573		577		670	0	667
9	Rabbing Material	KG	1190	640		0		0		0	0	0
10	Vermicompost	KG	19	96		0		0		0	167	833
11	Miscellaneous charges		0	0		1702		1131		350		328
12	Interst on working capital			1035		3272		3160		2799		4697
	Total Variable Cost (TVC)			18293		30538		29496		26128		43842
II	Fixed cost (FC)			0								
1	Land revenue and taxes			11		11		13		12		11
2	Depreciation charges			394		788		788		788		788
3	Rental value			3705		17228		11466		10042		15204
4	Interest on fixed capital			571		2403		1714		1714		1714
5	Amartization cost			0		2402		1544		2393		0
	Total fixed cost (TFC)			4681		22832		15525		14949		17717
III	Total cost			22974		53369		45021		41077		61560
IV	Output/ Returns											
1	Main product	QT	25	20521	202	103368	11978	68798	11	60250	755	86825
2	Byproduct	QT	26	1709							1008	4400
	Gross returns			22230		103368		68798		60250		91225
V	Net returns at TVC			3937		72830		39302		34122		47383
VI	Net returns at TC			-744		49999		23777		19173		29665
VII	Returns per rupee invested at TVC			1.22		3.38		2.33		2.31		2.08
VIII	Returns per rupee invested at TC			0.97		1.94		1.53		1.47		1.48

Appendix I. Contd…..

			FS-2				FS-3					
Sr. No	Particulars		Paddy		Grass		Paddy		Coconut		Arecanut	
			AV.Size	0.73	AV.Size	0.43	AV.Size	0.415	AV.Size	0.41	AV.Size	0.01
I	Variable cost	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	Human labour											
a	Male	MD	70	4550	29	1570	102	6579	177	12393	150	8750
b	Female	FD	76	3023	39	1549	97	3632	39	1804	40	2000
2	Bullock labour	BD	24	802	6	706	35	1400		0	0	0
3	Machine labour	HR	0	0		0	0	0		0	0	0
4	Seed	KG	76	1075		0	90	1251		0	0	0
5	FYM	CL	8	1579		0	8	1671	11	4212	10	2000
6	Fertilizer	KG	50	310		0	170	1026	660	3165	841	4605
7	PPC	KG	0	0		0	0	0	1	150	3	625
8	Irrigation Charges		0	0		0	0	0		766	0	1500
9	Rabbing Material	KG	749	485		0	1804	442		0	0	0
10	Vermicompost	KG	0	0		0	0	0		0	0	0
11	Miscellaneous charges			0		0	0			605		1620
12	Interst on working capital			138		230		960		2771		2532
	Total Variable Cost (TVC)			11962		4055		16961		25866		23632
II	Fixed cost (FC)											
1	Land revenue and taxes			11		6		11		13		19
2	Depreciation charges			388		388		368		735		735
3	Rental value			2683		1265		3720		8664		7000
4	Interest on fixed capital			296		296		912		1824		1824
5	Amartization cost			0				0				1514
	Total fixed cost (TFC)			3377		1955		5012		11236		11092
III	Total cost			15339		6009		21973		37102		34724
IV	Output/ Returns											
1	Main product	QT	25	14700	54	7592	28	20885	8861	51984	7	42000
2	Byproduct	QT	21	1397			27	1436				
	Gross returns			16097		7592		22321		51984		42000
V	Net returns at TVC			4135		3538		5360		26118		18368
VI	Net returns at TC			758		1583		348		14882		7277
VII	Returns per rupee invested at TVC			1.35		1.87		1		2		2
VIII	Returns per rupee invested at TC			1.05		1.26		1		1		1

Appendix I. Contd…..

			FS-3									
Sr. No	Particulars		Sayali		Kagda		Yellow Champak		Hibiscus		Terada	
			AV.Size	0.114	AV.Size	0.04	AV.Size	0.19	AV.Size	0.23	AV.Size	0.11
I	Variable cost	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	Human labour											
a	Male	MD	330	19575	400	26075	318	20690	259	16859	88	5697
b	Female	FD	515	19505	308	13417	100	8446	270	12192	522	24135
2	Bullock labour	BD		0		0		0		0		0
3	Machine labour	HR		0		0		0		0		0
4	Seed	KG		0		0		0		0	10	18395
5	FYM	CL	51	12337	88	18667	31	12538	25	10245	27	8339
6	Fertilizer	KG	921	7884	666	3893	855	5446	923	5497	814	6425
7	PPC	KG	35	13960	63	23767	9	9011	22	14053	11	6558
8	Irrigation Charges			812		708		838		650		833
9	Rabbing Material	KG		0		0		0		0		0
10	Vermicompost	KG		0		0		0		0		0
11	Miscellaneous charges			1100		1236		1460		796		1669
12	Interst on working capital			9021		10532		7011		7235		8646
	Total Variable Cost (TVC)			84194		98295		65440		67527		80697
II	Fixed cost (FC)											
1	Land revenue and taxes			11		21		10		12		11
2	Depreciation charges			735		735		735		735		368
3	Rental value			26125		27703		23168		18974		24918
4	Interest on fixed capital			1824		1824		1824		1824		911
5	Amartization cost			1762		2482		2330		1365		
	Total fixed cost (TFC)			30457		32765		28067		22910		26208
III	Total cost			114651		131059		93508		90437		106905
IV	Output/ Returns											
1	Main product	QT	55	156750	14	166216	79	139008	1474	113846	82	149505
2	Byproduct	QT										
	Gross returns			156750		166216		139008		113846		149505
V	Net returns at TVC			72556		67921		73568		46319		68808
VI	Net returns at TC			42099		35156		45501		23409		42600
VII	Returns per rupee invested at TVC			2		2		2		2		2
VIII	Returns per rupee invested at TC			1		1		1		1		1

Appendix I. Contd…..

			FS-3						FS-4			
Sr. No	Particulars		Jui		Velvet		Jasmine		Sapota		Coconut	
			AV.Size	0.04	AV.Size	0.08	AV.Size	0.26	AV.Size	0.87	AV.Size	0.238
I	Variable cost	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	Human labour											
a	Male	MD	146	9620	88	5731	102	6605	256	17084	245	16427
b	Female	FD	296	8300	269	10763	315	14168	183	7656	88	4296
2	Bullock labour	BD		0	18	1090	4	162		0		0
3	Machine labour	HR		0	3	327		0		0		0
4	Seed	KG		0	18	8636		0		0		0
5	FYM	CL	24	7700	27	5863	49	10027	15	5023	25	8661
6	Fertilizer	KG	980	7781	727	4756	968	5752	646	3938	960	5282
7	PPC	KG	19	13360	11	8909	14	13500	1	374	0	47
8	Irrigation Charges			1500		1136		972		568		1054
9	Rabbing Material	KG		0		0		0		0		0
10	Vermicompost	KG		0		0		0		0		0
11	Miscellaneous charges			0		0		2972		1307		993
12	Interst on working capital			5791		5665		6499		4314		4411
	Total Variable Cost (TVC)			54052		52876		60656		40264		41171
II	Fixed cost (FC)											
1	Land revenue and taxes			11		10		22		10		10
2	Depreciation charges			735		367		735		624		624
3	Rental value			19880		17432		25245		18288		12111
4	Interest on fixed capital			1823		912		1824		1829		1829
5	Amartization cost			1795				1893		2402		2398
	Total fixed cost (TFC)			24244		18721		29719		23153		16972
III	Total cost			78297		71597		90375		63417		58143
IV	Output/ Returns											
1	Main product	QT	17	119280	37	104591	18	151470	192	109725	12070	72667
2	Byproduct	QT										
	Gross returns			119280		104591		151470		109725		72667
V	Net returns at TVC			65228		51714		90814		69461		31496
VI	Net returns at TC			40983		32993		61095		46308		14524
VII	Returns per rupee invested at TVC			2		2		2		2.73		1.77
VIII	Returns per rupee invested at TC			2		1		2		1.73		1.25

Appendix I. Contd…..

			FS-4		FS-5							
Sr. No	Particulars		Arecanut		Paddy		coconut		Betal leaves		Arecanut	
			AV.Size	0.01	AV.Size	0.78	AV.Size	1.38	AV.Size	0.53	AV.Size	0.08
I	Variable cost	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	Human labour											
a	Male	MD	120	6300	127	7663	112	7196	899	54737	232	10927
b	Female	FD	90	4800	96	3880	22	998	576	26123	64	3494
2	Bullock labour	BD		0	38	1244		0				
3	Machine labour	HR		0	1	189		0	12	2889		
4	Seed	KG		0	90	1260		0	175	2119		
5	FYM	CL	20	4000	10	1871	7	2556	48	10427	11	3055
6	Fertilizer	KG	750	5560	64	395	536	2871	7723	39159	683	4052
7	PPC	KG	2	300		0		254	5	1553	4	811
8	Irrigation Charges			1500		0		274		1491		1115
9	Rabbing Material	KG		0	1341	548		0		0		
10	Vermicompost	KG		0		0	59	267		0		
11	Miscellaneous charges			0		52		530		759		
12	Interst on working capital			2695		1026		1794		16711		2814
	Total Variable Cost (TVC)			25155		18128		16740		155968		26268
II	Fixed cost (FC)											
1	Land revenue and taxes			10		12		13				
2	Depreciation charges			624		240		2179		2179		2179
3	Rental value			14000		3037		8593		106978		10042
4	Interest on fixed capital			1829		238		4087		4087		4087
5	Amartization cost			1244		0		2393		3048		1244
	Total fixed cost (TFC)			17707		3527		17265		116292		17552
III	Total cost			42862		21655		34004		272260		43820
IV	Output/ Returns											
1	Main product	QT	12	84000	23	16078	7889	51560	4952	641867	11	60250
2	Byproduct	QT			25	2144		0				
	Gross returns			84000		18222		51560		641867		60250
V	Net returns at TVC			58845		94		34820		485899		33982
VI	Net returns at TC			41138		-3433		17556		369607		16430
VII	Returns per rupee invested at TVC			3.34		1.01		3.08		4.12		2.29
VIII	Returns per rupee invested at TC			1.96		0.84		1.52		2.36		1.37

Appendix II. Per unit cost and returns from other enterprises followed in Northern coastal plains

			FS-1		FS-2		FS-2		FS-4	
			Dairy		Dairy		Goat		Dairy	
			AV.Size	1.45	AV.Size	1.93	AV.Size	8.84	AV.Size	2
Sr. No	Particulars	unit	Quantity	Value	Per unit	Value	Quantity	Value	Quantity	Value
I	Variable cost									
1	Humal labour									
a	Male	MD	69.36	3083	45	2025	13.98	185.65	35	1831
b	Female	FD	34.35	1073	14.13	442	1.88	20.73	27	876
2	Feed (poultry)	KG	0	0	0	0				0
3	Dry fodder	KG	28.12	3029	19.69	1977			19.19	2433
4	Green fodder	N0	4.42	3648	1.9	2129	34.34	279	3.61	3945
5	Medicine / Vetarnery exp		0	284		162		19.6		330
6	chicks (poultry)		0	0		0				0
7	Paddy straw (husk)		0	0		0				0
8	Concentrates	kg	645	4823	477	3546	13.15	74.84	276	2045
9	Electricity charges		0	0		0				0
10	Miscellaneous charges			0		0				0
11	Interst on working capital			1912.8		1233.7		69.578		1375.21
12	Total Variable Cost (TVC)			17853		11515		649.4		12835.3
II	Fixed cost (FC)									
1	Depreciation charges			560		420		32.15		481
2	Interest on fixed capital			881		559		24.78		603
3	Imputed value of animal			1543		1310		278.48		1916
4	Total fixed cost (TFC)			2984		2289		335.41		3000
III	Total cost			20837		13804		984.81		15835.3
IV	Output/ Returns									
1	Milk		1272	24496	1532	14688	40.59	626.1	1165	21544
2	FYM /poultry sheet		2.85	669	2.05	1259	0.3	127	2.68	638
	Sale of animal /bird		0.2	410	0.17	482	0.28	678	0.23	384
	Gross returns			25575		16429		1431.1		22566
V	Net returns at TVC			7722.2		4914.3		781.7		9730.7
VI	Net returns at TC			4738.2		2625.3		446.29		6730.7
VII	Returns per rupee at TVC			1.4325		1.4268		2.2037		1.75812
VIII	Returns per rupee at TC			1.2274		1.1902		1.4532		1.42504

Appendix III. Per hectare cost and returns of crop grown in farming systems in northern central plains and hills

			FS-1									
Sr. No	Particulars		Paddy		Nagli		Mango		Cashewnut		Vari	
			AV.Size	1.048	AV.Size	0.22	AV.Size	0.29	AV.Size	0.14	AV.Size	0.08
I	Variable cost	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	Human labour											
a	Male	MD	88.6	3480.0	74.2	4166.7	148.7	8978.0	182.4	10074.0	83.0	3100.0
b	Female	FD	63.3	2113.0	49.7	3392.5	63.0	2665.0	42.4	1917.0	63.6	2018.0
2	Bullock labour	BD	16.1	940.0	2.6	96.3	0.0	0.0	0.0	0.0	0.0	0.0
3	Machine labour	HR	0.6	212.0	0.2	32.5	0.0	0.0	0.0	0.0	0.6	90.0
4	Seed	KG	69.8	887.0	8.3	90.0	0.0	0.0	0.0	0.0	6.8	81.0
5	FYM	CL	8.2	1939.0	7.7	1472.0	22.8	4685.0	4.5	903.0	5.2	942.0
6	Fertilizer	KG	110.1	575.0	67.7	456.0	457.7	3339.0	319.0	2316.0		0.0
7	PPC	KG	0.0	0.0		0.0	1.5	749.0	1.4	896.0		0.0
8	Irrigation Charges		0.0	0.0		0.0		0.0		0.0		0.0
9	Rabbing Material	KG	8.9	172.0		0.0		0.0		0.0		0.0
10	Vermicompost	KG	4.5	22.0		0.0		0.0		0.0		0.0
11	Miscellaneous charges			153.0		0.0		1964.0		0.0		0.0
12	Interst on working capital			419.7		388.2		895.2		644.2		249.2
	Total Variable Cost (TVC)			10912.7		10094.2		23275.2		16750.2		6480.2
II	Fixed cost (FC)											
1	Land revenue and taxes			11.3		6.8		10.5		6.5		6.9
2	Depreciation charges			146.0		146.0		440.0		440.0		146.0
3	Rental value			2122.3		2268.7		10134.3		7410.0		1079.3
4	Interest on fixed capital			145.0		145.0		435.0		435.0		145.0
5	Amartization cost			0.0		0.0		721.5		471.0		0.0
	Total fixed cost (TFC)			2424.6		2566.5		11741.3		8762.5		1377.2
III	Total cost			13337.3		12660.7		35016.5		25512.8		7857.4
IV	Output/ Returns											
1	Main product	QT	17.4	11353.0	13.7	13034.0	974.8	60806.0	14.1	44460.0	9.8	6061.0
2	Byproduct	QT	17.3	1381.0	10.5	578.4					8.3	415.0
	Gross returns			12734.0		13612.4		60806.0		44460.0		6476.0
V	Net returns at TVC			1821.3		3518.2		37530.8		27709.8		-4.2
VI	Net returns at TC			-603.3		951.7		25789.5		18947.2		-1381.4
VII	Returns per rupee invested at TVC			1.17		1.35		2.61		2.65		1.00
VIII	Returns per rupee invested at TC			0.95		1.08		1.74		1.74		0.82

Appendix III. Contd…..

			FS-2						FS-3	
Sr. No	Particulars		Paddy		Nagli		Vari		Paddy	
			AV.Size	1.2	AV.Size	0.16	AV.Size	0.05	AV.Size	0.74
I	Variable cost	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	Human labour									
a	Male	MD	87.5	3556.0	90.4	4972.0	63.5	2600.0	97.8	3961.0
b	Female	FD	65.6	2091.0	47.5	3444.0	44.3	1578.0	71.9	2322.0
2	Bullock labour	BD	14.9	903.0	1.4	92.0	0.0	0.0	17.9	943.0
3	Machine labour	HR	1.2	224.0	2.0	739.0	0.9	130.0	0.8	64.0
4	Seed	KG	77.7	824.0	6.0	68.0	7.4	88.0	70.8	991.0
5	FYM	CL	6.9	1652.0	9.9	1860.0	7.0	1295.0	6.0	1196.0
6	Fertilizer	KG	103.7	499.0	60.9	391.0		0.0	110.6	569.0
7	PPC	KG	0.0	0.0		0.0		0.0	0.0	0.0
8	Irrigation Charges		0.0	0.0		0.0		0.0	0.0	0.0
9	Rabbing Material	KG	6.4	125.0		0.0		0.0	13.9	269.0
10	Vermicompost	KG		0.0		0.0		0.0	18.1	90.0
11	Miscellaneous charges			0.0		0.0		0.0		0.0
12	Interst on working capital			395.0		462.6		227.6		416.2
	Total Variable Cost (TVC)			10269.0		12028.6		5918.6		10821.2
II	Fixed cost (FC)									
1	Land revenue and taxes			11.3		6.5		6.5		11.5
2	Depreciation charges			154.0		154.0		154.0		106.0
3	Rental value			2213.8		1753.0		1357.8		2264.2
4	Interest on fixed capital			158.0		158.0		158.0		338.0
5	Amartization cost			0.0				0.0		
	Total fixed cost (TFC)			2537.1		2071.5		1676.3		2719.7
III	Total cost			12806.0		14100.1		7595.0		13540.9
IV	Output/ Returns									
1	Main product	QT	18.9	11738.0	12.8	9865.0	10.0	7680.0	18.2	11794.0
2	Byproduct	QT	19.7	1545.0	11.9	653.0	9.3	467.0	17.7	1791.0
	Gross returns			13283.0		10518.0		8147.0		13585.0
V	Net returns at TVC			3014.0		-1510.6		2228.4		2763.8
VI	Net returns at TC			477.0		-3582.1		552.0		44.1
VII	Returns per rupee invested at TVC			1.3		0.9		1.4		1.3
VIII	Returns per rupee invested at TC			1.0		0.7		1.1		1.0

Appendix III. Contd…..

			FS-3									
Sr. No	Particulars		Blackgram		Cow pea(K)		Cow pea (R)		Wal		Green Gram	
			AV.Size	0.02	AV.Size	0.07	AV.Size	0.04	AV.Size	0.63	AV.Size	0.05
I	Variable cost	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	Human labour											
a	Male	MD	103.5	3147.0	83.8	3809.0	116.6	4791.0	126.3	5263.0	101.2	3447.0
b	Female	FD	23.5	678.0	125.7	4471.0	53.0	2120.0	89.5	3405.0	90.6	2705.0
2	Bullock labour	BD	3.5	222.0	6.7	213.0	6.7	213.0	6.3	202.0	5.9	188.0
3	Machine labour	HR	4.3	739.0	6.7	1171.0	8.3	1450.0	4.2	894.0	4.7	1152.0
4	Seed	KG	18.3	517.0	38.6	1157.0	32.5	975.0	48.4	968.0	55.3	1342.0
5	FYM	CL	5.2	1043.0	12.4	2666.0	11.7	2466.0	8.4	2694.0	8.2	2705.0
6	Fertilizer	KG	282.6	1500.0	500.0	3406.0	241.7	1516.0	184.2	1230.0	117.6	827.0
7	PPC	KG		0.0	32.3	1244.0	3.8	1386.0	4.1	1375.0	2.5	802.0
8	Irrigation Charges			0.0		0.0		500.0		0.0		0.0
9	Rabbing Material	KG		0.0		0.0		0.0		0.0		0.0
10	Vermicompost	KG		0.0		0.0		0.0		0.0		0.0
11	Miscellaneous charges			0.0		0.0		0.0		0.0		0.0
12	Interst on working capital			313.8		725.5		596.7		641.2		526.7
	Total Variable Cost (TVC)			8159.8		18862.5		16013.7		16672.2		13694.7
II	Fixed cost (FC)											
1	Land revenue and taxes			11.5		9.9		11.3		10.5		11.5
2	Depreciation charges			106.0		106.0		106.0		106.0		106.0
3	Rental value			2673.8		5297.5		5243.0		5257.8		4372.5
4	Interest on fixed capital			338.0		338.0		338.0		338.0		338.0
5	Amartization cost			0.0				0.0				0.0
	Total fixed cost (TFC)			3129.3		5751.4		5698.3		5712.3		4828.0
III	Total cost			11289.2		24613.8		21711.9		22384.6		18522.7
IV	Output/ Returns											
1	Main product	QT	5.3	16043.0	12.7	31785.0	12.6	31458.0	9.1	31547.0	10.5	26235.0
2	Byproduct	QT										
	Gross returns			16043.0		31785.0		31458.0		31547.0		26235.0
V	Net returns at TVC			7883.2		12922.5		15444.3		14874.8		12540.3
VI	Net returns at TC			4753.8		7171.2		9746.1		9162.4		7712.3
VII	Returns per rupee invested at TVC			2.0		1.7		2.0		1.9		1.9
VIII	Returns per rupee invested at TC			1.4		1.3		1.4		1.4		1.4

Appendix III. Contd…..

			FS-4					
Sr. No	Particulars		Paddy		Brinjal		Lady's Finger	
			AV.Size	1.03	AV.Size	0.31	AV.Size	0.16
I	Variable cost	unit	Quantity	Value	Quantity	Value	Quantity	Value
1	Human labour							
a	Male	MD	99.0	3291.0	214.8	11177.0	123.3	7071.0
b	Female	FD	64.6	1795.0	156.8	6270.0	110.5	4419.0
2	Bullock labour	BD	19.3	1209.0	0.0	0.0	17.1	3152.0
3	Machine labour	HR		0.0	37.0	6675.0	0.0	0.0
4	Seed	KG	77.0	915.0	0.7	5262.0	13.3	1600.0
5	FYM	CL	7.7	1594.0	21.3	6087.0	17.1	3247.0
6	Fertilizer	KG	94.8	552.0	762.5	4445.0	440.5	3219.0
7	PPC	KG		0.0	0.7	357.0	3.9	1339.0
8	Irrigation Charges			0.0		131.0		309.0
9	Rabbing Material	KG	10.1	149.0		0.0		0.0
10	Vermicompost	KG		0.0		0.0		0.0
11	Miscellaneous charges			0.0		2278.0		2561.0
12	Interst on working capital			380.2		1702.0		1064.3
	Total Variable Cost (TVC)			9885.2		44384.0		27981.3
II	Fixed cost (FC)							
1	Land revenue and taxes			11.5		11.3		11.5
2	Depreciation charges			313.0		313.0		313.0
3	Rental value			1921.7		31720.8		26444.3
4	Interest on fixed capital			769.0		769.0		769.0
5	Amartization cost							
	Total fixed cost (TFC)			3015.2		32814.1		27537.8
III	Total cost			12900.4		77198.1		55519.2
IV	Output/ Returns							
1	Main product	QT	16.1	10117.0	40.6	190325.0	124.8	158666.0
2	Byproduct	QT	16.0	1413.0				
	Gross returns			11530.0		190325.0		158666.0
V	Net returns at TVC			1644.8		145941.0		130684.7
VI	Net returns at TC			-1370.4		113126.9		103146.8
VII	Returns per rupee invested at TVC			1.2		4.3		5.7
VIII	Returns per rupee invested at TC			0.9		2.5		2.9

Appendix III. Contd…..

			FS-5			
Sr. No	Particulars		Paddy		Grass	
			AV.Size	1.11	AV.Size	1.07
I	Variable cost	unit	Quantity	Value	Quantity	Value
1	Human labour					
a	Male	MD	108.5	4651.0	29.7	1251.0
b	Female	FD	67.8	2337.0	39.2	1260.0
2	Bullock labour	BD	12.7	512.0	9.5	768.0
3	Machine labour	HR	0.0	0.0		
4	Seed	KG	75.1	1002.0		
5	FYM	CL	7.6	1987.0		
6	Fertilizer	KG	168.3	733.0		
7	PPC	KG	0.0	0.0		
8	Irrigation Charges		0.0	0.0		
9	Rabbing Material	KG	11.0	218.0		
10	Vermicompost	KG		0.0		
11	Miscellaneous charges			0.0		
12	Interst on working capital			457.6		131.2
	Total Variable Cost (TVC)			11897.6		3410.2
II	Fixed cost (FC)					
1	Land revenue and taxes			11.5		5.5
2	Depreciation charges			177.0		177.0
3	Rental value			2622.5		1061.0
4	Interest on fixed capital			274.0		274.0
5	Amartization cost					0.0
	Total fixed cost (TFC)			3085.0		1517.5
III	Total cost			14982.6		4927.7
IV	Output/ Returns					
1	Main product	QT	21.2	13979.0	80.7	6366.0
2	Byproduct	QT	20.2	1756.0		
	Gross returns			15735.0		6366.0
V	Net returns at TVC			3837.4		2955.8
VI	Net returns at TC			752.4		1438.3
VII	Returns per rupee invested at TVC			1.3		1.9
VIII	Returns per rupee invested at TC			1.1		1.3

Appendix IV. Per hectare cost and returns of other enterprises in farming systems in northern central plains and hills

			FS-1		FS_2		FS_2		FS-3		FS-4		FS-5	
			Dairy		Dairy		Goat		Dairy		Poultry		Dairy	
			AV.Size	1.22	AV.Size	1.34	AV.Size	12.76	AV.Size	1.14	AV.Size	9.64	AV.Size	2.27
Sr. No	Particulars	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
I	Variable cost													
1	Humal labour													
a	Male	MD	48.2	2379.0	49.3	3233.0	6.0	222.0	45.9	2660.0	13.8	692.0	29.7	2451.0
b	Female	FD	10.7	389.0	16.4	861.0	0.9	14.0	14.5	385.0	8.4	330.0	0.8	268.0
2	Feed (poultry)	KG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1121.0	12229.0	0.0	0.0
3	Dry fodder	KG	23.8	2757.0	35.4	3922.0	0.0	0.0	20.7	2226.0	0.0	0.0	32.8	3301.0
4	Green fodder	N0	4.6	4069.0	75.3	3487.0	4.1	379.0	27.9	2638.0	0.0	0.0	29.1	2625.0
5	Medicine / Vetarnery exp			157.0		392.0		14.0	0.0	200.0		172.0	0.0	242.0
6	chicks (poultry)			0.0					0.0	0.0	1023.0	11263.0	0.0	0.0
7	Paddy straw (husk)			0.0					0.0	0.0	219.5	582.0	0.0	0.0
8	Concentrates	kg	503.4	3073.0	579.0	3521.0	22.9	123.0	465.7	2858.0			438.5	3034.0
9	Electricity charges		0.0				0.0		0.0		0.0		0.0	
10	Miscellaneous charges			145.0					0.0					
11	Interst on working capital			1556.3		1849.9		90.2	0.0	1316.0		3032.2		1430.5
12	Total Variable Cost (TVC)			14525.3		17265.9		842.2		12283.0		28300.2		13351.5
II	Fixed cost (FC)													
1	Depreciation charges			255.0		216.0		33.5		449.0		1203.0		360.0
2	Interest on fixed capital			337.0		337.0		25.6		199.0		1923.0		467.0
3	Imputed value of animal			868.0		1030.0		253.0		1014.0		0.0		1359.0
4	Total fixed cost (TFC)			1460.0		1583.0		312.1		1662.0		3126.0		2186.0
III	Total cost			15985.3		18848.9		1154.4		13945.0		31426.2		15537.5
IV	Output/ Returns													
1	Milk		926.0	19211.0	1129.0	22462.0	69.0	723.0	734.6	16315.0		0.0	963.0	18400.0
2	FYM /poultry sheet		2.6	543.0	2.8	704.0	0.3	100.0	2.6	577.0	10.9	774.0	1.8	763.0
	Sale of animal /bird		0.0	77.8	0.1	337.0	0.3	460.0	0.1	145.0	1017.0	35315.0	0.0	185.0
	Gross returns			19831.8		23503.0		1283.0		17037.0		36089.0		19348.0
V	Net returns at TVC			5306.5		6237.1		440.8		4754.0		7788.8		5996.5
VI	Net returns at TC			3846.5		4654.1		128.7		3092.0		4662.8		3810.5
VII	Returns per rupee at TVC			1.4		1.4		1.5		1.4		1.3		1.4
VIII	Returns per rupee at TC			1.2		1.2		1.1		1.2		1.1		1.2

Appendix V. Per hectare cost and returns of crops grown under farming systems in southern central plains and hills

Sr. No	Particulars		FS-1									
			Paddy (Kharif)		Paddy (Rabi)		Bottlegourd (Rabi)		Tomato		Brinjal	
I	Variable cost	unit	AV.Size	0.95	AV.Size	0.37	AV.Size	0.14	AV.Size	0.045	AV.Size	0.24
1	Human labour		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
a	Male	MD	84.0	4453.0	82.0	3690.0	172.4	10342.0	165.0	9900.0	73.5	4407.0
b	Female	FD	88.8	2711.0	98.0	3430.0	100.3	4514.0	131.0	5240.0	188.2	7528.0
2	Bullock labour	BD	16.7	656.0	20.2	820.0					0.0	0.0
3	Machine labour	HR	1.6	237.0	1.0	150.0	8.9	1392.0	5.0	850.0	11.2	1740.0
4	Seed	KG	84.7	1156.0	89.9	1188.0	0.8	1778.0	0.5	450.0	0.5	3658.0
5	FYM	CL	7.1	1477.0	13.4	3290.0	155.5	6285.0	14.0	5900.0	12.0	2990.0
6	Fertilizer	KG	116.0	635.0	148.0	514.0	206.3	2107.0	275.0	2096.0	320.0	1745.0
7	PPC	KG					3.2	978.0	4.3	1521.0	2.5	295.0
8	Irrigation Charges					291.0		328.0				231.0
9	Rabbing Material	KG										
10	Vermicompost	KG			12.0	60.0						
11	Miscellaneous charges											
12	Interst on working capital			453.0		525.7		1095.8		1038.3		894.5
	Total Variable Cost (TVC)			11778.0		13958.7		28819.8		26995.3		23488.5
II	Fixed cost (FC)											
1	Land revenue and taxes			11.5		11.5		11.5		11.5		11.5
2	Depreciation charges			118.0		118.0		118.0		118.0		118.0
3	Rental value			1927.7		3014.8		13055.5		17083.3		18933.8
4	Interest on fixed capital			442.0		442.0		442.0		442.0		442.0
5	Amartization cost			0.0		0.0		0.0		0.0		0.0
	Total fixed cost (TFC)			2499.2		3586.3		13627.0		17654.8		19505.3
III	Total cost			14277.2		17545.0		42446.8		44650.1		42993.9
IV	Output/ Returns											
1	Main product	QT	17.1	10185.0	24.1	16192.0	164.0	78333.0	165.0	102500.0	226.0	113603.0
2	Byproduct	QT	12.2	1381.0	23.1	1897.0						
	Gross returns			11566.0		18089.0		78333.0		102500.0		113603.0
V	Net returns at TVC			-212.0		4130.3		49513.2		75504.7		90114.5
VI	Net returns at TC			-2711.2		544.0		35886.2		57849.9		70609.1
VII	Returns per rupee invested at TVC			1.0		1.3		2.7		3.8		4.8
VIII	Returns per rupee invested at TC			0.8		1.0		1.8		2.3		2.6

Appendix V. Contd…..

			FS-1						FS-2	
Sr. No	Particulars		Lady's Finger		Smoothgourd		Chilli(Rabi)		Paddy(Kharif)	
I	Variable cost		AV.Size	0.06	AV.Size	0.03	AV.Size	0.15	AV.Size	1.06
1	Human labour	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
a	Male		100.7	6400.0	73.8	4800.0	125.8	7547.0	87.7	4315.0
b	Female		91.3	4693.0	92.3	4376.0	150.7	6028.0	69.2	2547.0
2	Bullock labour	MD			0.0	0.0	14.1	2133.0	11.5	589.0
3	Machine labour	FD	11.3	2453.0	12.3	2000.0	0.0		3.9	637.0
4	Seed	KG	8.0	960.0	1.2	2200.0	1.4	1122.0	76.0	1009.0
5	FYM	KG	16.0	3520.0	16.9	3384.0	18.6	3246.0	8.3	2265.0
6	Fertilizer	N0	270.0	1863.0	269.3	1461.0	156.5	1039.0	156.8	683.0
7	PPC		3.8	1395.0	5.8	1776.0	2.3	2205.0		
8	Irrigation Charges			266.0		230.0		275.0		
9	Rabbing Material									
10	Vermicompost	kg								
11	Miscellaneous charges			1770.0				1830.0		
12	Interst on working capital			932.8		799.9		1006.0		481.8
	Total Variable Cost (TVC)			24252.8		21026.9		26431.0		12526.8
II	Fixed cost (FC)									
1	Land revenue and taxes			11.5		11.5		11.5		11.5
2	Depreciation charges			118.0		118.0		118.0		113.0
3	Rental value			23583.3		11602.5		21014.5		2356.2
4	Interest on fixed capital			442.0		442.0		442.0		354.0
5	Amartization cost			0.0		0.0		0.0		0.0
	Total fixed cost (TFC)			24154.8		12174.0		21586.0		2834.7
III	Total cost			48407.6		33200.9		48017.0		15361.5
IV	Output/ Returns									
1	Main product		99.3	141500.0	139.2	69615.0	210.1	126087.0	18.9	11702.0
2	Byproduct								17.5	2435.0
	Gross returns			141500.0		69615.0		126087.0		14137.0
V	Net returns at TVC			117247.2		48588.1		99656.0		1610.2
VI	Net returns at TC			93092.4		36414.1		78070.0		-1224.5
VII	Returns per rupee invested at TVC			5.8		3.3		4.8		1.13
VIII	Returns per rupee invested at TC			2.9		2.1		2.6		0.92

Appendix V. Contd…..

			FS-2		FS-3				FS-4	
Sr. No	Particulars		Paddy(Rabi)		Paddy(Kharif)		Paddy(Rabi)		Paddy (Kharif)	
I	Variable cost		AV.Size	0.52	AV.Size	1.07	AV.Size	0.2	AV.Size	0.98
1	Human labour	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
a	Male		95.7	4925.0	96.7	4682.0	102.6	4774.0	66.6	2841.0
b	Female		109.1	3078.0	83.2	2848.0	65.0	2080.0	64.7	1793.0
2	Bullock labour	MD	12.8	697.0	15.2	753.0	21.4	894.0	11.7	517.0
3	Machine labour	FD	0.0	0.0	0.0	0.0	0.3	42.0	3.8	570.0
4	Seed	KG	84.3	1089.0	72.8	865.0	92.6	1262.0	69.8	949.0
5	FYM	KG	11.4	2982.0	6.5	1510.0	6.3	1154.0	5.3	1420.0
6	Fertilizer	N0	262.0	648.0	133.5	615.0	114.3	582.0	117.2	626.0
7	PPC			240.0						
8	Irrigation Charges							400.0		
9	Rabbing Material								1.8	432.0
10	Vermicompost	kg							3.4	17.0
11	Miscellaneous charges									
12	Interst on working capital			546.4		450.9		431.5		366.6
	Total Variable Cost (TVC)			14205.4		11723.9		11619.5		9531.6
II	Fixed cost (FC)									
1	Land revenue and taxes			11.5		11.5		11.5		11.5
2	Depreciation charges			113.0		154.0		154.0		119.0
3	Rental value			2935.3		2182.2		2627.0		2098.2
4	Interest on fixed capital			354.0		484.0		484.0		380.0
5	Amartization cost			0.0		0.0		0.0		0.0
	Total fixed cost (TFC)			3413.8		2831.7		3276.5		2608.7
III	Total cost			17619.2		14555.6		14896.0		12140.2
IV	Output/ Returns									
1	Main product		21.8	13917.0	19.3	11615.0	21.3	13888.0	17.4	10966.0
2	Byproduct		22.6	3695.0	2.2	1478.0	20.0	1874.0	18.4	1623.0
	Gross returns			17612.0		13093.0		15762.0		12589.0
V	Net returns at TVC			3406.6		1369.1		4142.5		3057.4
VI	Net returns at TC			-7.2		-1462.6		866.0		448.8
VII	Returns per rupee invested at TVC			1.24		1.12		1.36		1.32
VIII	Returns per rupee invested at TC			1.00		0.90		1.06		1.0

Appendix V. Contd…..

			FS-4									
Sr. No	Particulars		Paddy(Rabi)		Cow pea (Kharif)		wal		Gram (Harabhara)		Green Gram(mung)	
I	Variable cost		AV.Size	0.13	AV.Size	0.1	AV.Size	0.16	AV.Size	0.1	AV.Size	0.12
1	Human labour	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
a	Male		131.2	4765.0	98.0	4900.0	122.0	6486.0	148.6	10023.0	92.6	6021.0
b	Female		61.0	1872.0	61.3	2453.0	84.0	3360.0	57.0	1995.0	106.3	4252.0
2	Bullock labour	MD	21.4	742.0	5.3	170.0	14.8	480.0	4.3	106.0	3.8	239.0
3	Machine labour	FD	0.5	73.0	5.3	1316.0	8.0	1200.0	8.7	1770.0	6.8	1634.0
4	Seed	KG	86.3	1227.0	5.3	1766.0	52.8	1320.0	29.3	566.0	51.6	773.0
5	FYM	KG	6.8	1200.0	20.0	5266.0	7.6	2376.0	9.3	1093.0	8.4	3263.0
6	Fertilizer	N0	182.9	1073.0	320.0	2187.0	150.0	1052.0	200.0	1293.0	128.9	887.0
7	PPC				4.2	1617.0	3.1	938.0	3.9	1221.0	5.3	1576.0
8	Irrigation Charges			424.0								
9	Rabbing Material											
10	Vermicompost	kg										
11	Miscellaneous charges											
12	Interst on working capital			438.1		787.0		688.5		722.7		745.8
	Total Variable Cost (TVC)			11814.1		20462.0		17900.5		18789.7		19390.8
II	Fixed cost (FC)											
1	Land revenue and taxes			11.5		11.5		11.5		11.5		11.5
2	Depreciation charges			119.0		119.0		119.0		119.0		119.0
3	Rental value			3015.8		5625.0		4307.3		5190.0		5899.0
4	Interest on fixed capital			380.0		380.0		380.0		380.0		380.0
5	Amartization cost			0.0		0.0		0.0		0.0		0.0
	Total fixed cost (TFC)			3526.3		6135.5		4817.8		5700.5		6409.5
III	Total cost			15340.4		26597.5		22718.3		24490.2		25800.3
IV	Output/ Returns											
1	Main product		24.0	16874.0	13.6	33750.0	7.6	25844.0	10.8	31140.0	10.7	35394.0
2	Byproduct		23.8	1221.0								
	Gross returns			18095.0		33750.0		25844.0		31140.0		35394.0
V	Net returns at TVC			6280.9		13288.0		7943.5		12350.3		16003.2
VI	Net returns at TC			2754.6		7152.5		3125.7		6649.8		9593.7
VII	Returns per rupee invested at TVC			1.53		1.65		1.4		1.7		1.8
VIII	Returns per rupee invested at TC			1.2		1.27		1.1		1.3		1.4

Appendix V. Contd…..

			FS-5							
Sr. No	Particulars		Paddy (Kharif)		Paddy (Rabi)		Mango		Cashewnut	
I	Variable cost		AV.Size	1.82	AV.Size	0.85	AV.Size	0.37	AV.Size	0.13
1	Human labour	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
a	Male		62.4	3289.0	61.7	3194.0	143.4	8604.0	109.2	5845.0
b	Female		71.7	2543.0	83.4	3007.0	81.0	3239.0	88.7	3852.0
2	Bullock labour	MD	12.0	641.0	8.2	403.0				
3	Machine labour	FD	2.2	336.0	1.7	255.0				
4	Seed	KG	80.8	1086.0	71.5	1059.0				
5	FYM	KG	5.6	1202.0	8.4	1998.0	18.0	5587.0	4.2	859.0
6	Fertilizer	N0	89.5	490.0	138.3	782.0	481.7	3462.0	176.1	1260.0
7	PPC				2.4	120.0	3.8	2073.0	1.4	1408.0
8	Irrigation Charges					159.0				
9	Rabbing Material									
10	Vermicompost	kg			5.3	27.0				
11	Miscellaneous charges							2707.0		
12	Interst on working capital			383.5		433.8		1026.9		529.0
	Total Variable Cost (TVC)			9970.5		11437.8		26698.9		13753.0
II	Fixed cost (FC)									
1	Land revenue and taxes			11.5		11.5		10.5		10.3
2	Depreciation charges			155.0		155.0		465.0		465.0
3	Rental value			1927.0		2404.3		10575.2		7005.3
4	Interest on fixed capital			398.0		398.0		1196.0		1196.0
5	Amartization cost			0.0		0.0		526.4		639.2
	Total fixed cost (TFC)			2491.5		2968.8		12773.1		9315.8
III	Total cost			12462.0		14406.6		39472.0		23068.8
IV	Output/ Returns									
1	Main product		17.3	9992.0	20.2	12695.0	4741.0	63451.0	14.4	42032.0
2	Byproduct		20.1	1570.0	21.6	1731.0				
	Gross returns			11562.0		14426.0		63451.0		42032.0
V	Net returns at TVC			1591.5		2988.2		36752.1		28279.0
VI	Net returns at TC			-900.0		19.4		23979.0		18963.2
VII	Returns per rupee invested at TVC			1.16		1.26		2.38		3.06
VIII	Returns per rupee invested at TC			0.93		1.00		1.61		1.82

Appendix VI. Per hectare cost and returns of other enterprises in farming systems in southern central plains and hills

			Dairy Sys-1		Dairy Sys-2		Dairy Sys-3		GOAT Sys-3		Dairy Sys- 4	
			AV.Size	1.8	AV.Size	1.36	AV.Size	1.62	AV.Size	7.19	AV.Size	1.88
Sr. No	Particulars	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
I	Variable cost											
1	Humal labour											
a	Male	MD	40.0	2022.0	151.2	2196.0	101.9	1754.0	18.0	232.0	80.5	1426.0
b	Female	FD	12.0	478.0	18.5	297.0	12.5	342.0	0.3	5.0	12.9	229.0
2	Feed (poultry)	KG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
3	Dry fodder	KG	28.9	3074.0	27.1	3694.0	27.3	2967.0			23.6	2897.0
4	Green fodder	N0	69.8	2108.0	33.2	1593.0	27.1	2535.0	2.7	242.0	24.0	2472.0
5	Medicine / Vetarnery exp			182.0	0.0	164.0		106.0		13.7		117.0
6	chicks (poultry)											
7	Paddy straw (husk)											
8	Concentrates	kg	441.8	2710.0	340.7	1790.0	461.3	2796.0	17.4	91.8	416.8	2364.0
9	Electricity charges											
10	Miscellaneous charges											
11	Interst on working capital			1268.9		1168.1		1260.0		70.1		1140.6
12	Total Variable Cost (TVC)			11842.9		10902.1		11760.0		654.6		10645.6
II	Fixed cost (FC)											
1	Depreciation charges			410.0		529.0		374.0		57.0		322.0
2	Interest on fixed capital			435.0		559.0		316.0		112.0		375.0
3	Imputed value of animal			1252.0		893.0		900.0		152.0		917.0
4	Total fixed cost (TFC)			2097.0		1981.0		1590.0		321.0		1614.0
III	Total cost			13939.9		12883.1		13350.0		975.6		12259.6
IV	Output/ Returns											
1	Milk		955.0	16063.0	842.9	13198.0	1166.0	18930.0	44.0	450.0	996.8	16084.0
2	FYM /poultry sheet		2.6	531.0	4.9	1013.0	2.4	507.0	0.2	96.0	1.8	397.0
	Sale of animal /bird		0.1	465.0	0.2	464.0	0.1	199.0	0.5	850.0	0.1	726.0
	Gross returns			17059.0		14675.0		19636.0		1396.0		17207.0
V	Net returns at TVC			5216.1		3772.9		7876.0		741.4		6561.4
VI	Net returns at TC			3119.1		1791.9		6286.0		420.4		4947.4
VII	Returns per rupee at TVC			1.4		1.3		1.7		2.1		1.6
VIII	Returns per rupee at TC			1.2		1.1		1.5		1.4		1.4

Appendix VI. Contd…..

			POULTRY sys -4		Dairy Sys - 5	
			AV.Size	13.33	AV.Size	3.23
Sr. No	Particulars	unit	Quantity	Value	Quantity	Value
I	Variable cost					
1	Humal labour					
a	Male	MD	16.52	908	51.62	1135
b	Female	FD	11.87	475	16.03	521
2	Feed (poultry)	KG	10.78	10785		
3	Dry fodder	KG			20.73	2359
4	Green fodder	N0			24.19	2277
5	Medicine / Vetarnery exp			189		116
6	chicks (poultry)		1000	1131		
7	Paddy straw (husk)		201	527		
8	Concentrates	kg			384.99	2404
9	Electricity charges					
10	Miscellaneous charges					
11	Interst on working capital			1681.8		1057.44
12	Total Variable Cost (TVC)			15697		9869.44
II	Fixed cost (FC)					
1	Depreciation charges			522		264
2	Interest on fixed capital			675		203
3	Imputed value of animal			0		1092
4	Total fixed cost (TFC)			1197		1559
III	Total cost			16894		11428.4
IV	Output/ Returns					
1	Milk				991.1	16414
2	FYM /poultry sheet		240	644	1.56	334
	Sale of animal /bird		925	29600	0.05	267
	Gross returns			30244		17015
V	Net returns at TVC			14547		7145.56
VI	Net returns at TC			13350		5586.56
VII	Returns per rupee at TVC			1.9268		1.72401
VIII	Returns per rupee at TC			1.7902		1.48883

Appendix VII. Per hectare cost and returns of crops grown under farming systems in southern coastal plains

			FS-1						FS-2			
Sr. No	Particulars		Paddy(Kharif)		Mango		Cashew		Paddy (Kharif)		Coconut	
I	Variable cost		AV.Size	0.71	AV.Size	0.57	AV.Size	0.16	AV.Size	0.76	AV.Size	0.39
1	Human labour	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
a	Male		103.2	4985.0	96.7	5808.0	93.8	5031.0	97.7	5412.0	111.1	7778.0
b	Female		98.5	3098.0	55.3	2209.0	56.6	2393.0	89.7	3010.0	56.3	2253.0
2	Bullock labour	MD	21.5	1081.0					35.4	873.0		
3	Machine labour	FD										
4	Seed	KG	80.7	1271.0					71.6	1042.0		
5	FYM	KG	8.5	2435.0	14.2	3430.0	6.3	1243.0	6.3	1348.0	10.1	3233.0
6	Fertilizer	N0	122.0	550.0	392.0	2683.0	257.8	1795.0	107.5	524.0	591.6	3957.0
7	PPC				1.0	143.0	0.8	343.0	0.3	62.0	1.1	385.0
8	Irrigation Charges											211.0
9	Rabbing Material											
10	Vermicompost	kg							18.2	91.0	49.3	246.0
11	Miscellaneous charges											230.0
12	Interst on working capital			536.8		1712.8		1296.6		494.5		2169.8
	Total Variable Cost (TVC)			13956.8		15985.8		12101.6		12856.5		20462.8
II	Fixed cost (FC)											
1	Land revenue and taxes			11.5		8.5		8.5		11.5		11.5
2	Depreciation charges			141.0		423.0		423.0		1166.0		1166.0
3	Rental value			2841.0		8293.0		4546.7		2605.5		10821.7
4	Interest on fixed capital			414.0		1242.0		1242.0		1284.0		1284.0
5	Amartization cost			0.0		767.0		522.7		0.0		930.9
	Total fixed cost (TFC)			3407.5		10733.5		6742.9		5067.0		14214.0
III	Total cost			17364.3		26719.3		18844.5		17923.5		34676.9
IV	Output/ Returns											
1	Main product		22.6	15704.0	967.0	49758.0	8.8	27280.0	21.9	14298.0	11069.0	64930.0
2	Byproduct		21.3	1342.0					20.2	1335.0		
	Gross returns			17046.0		49758.0		27280.0		15633.0		64930.0
V	Net returns at TVC			3089.2		33772.2		15178.4		2776.5		44467.2
VI	Net returns at TC			-318.3		23038.7		8435.5		-2290.5		30253.1
VII	Returns per rupee invested at TVC			1.2		3.1		2.3		1.22		3.17
VIII	Returns per rupee invested at TC			1.0		1.9		1.4		0.87		1.87

Appendix VII. Contd…..

			FS-2		FS-3					
Sr. No	Particulars		ARECANUT		Paddy(Kharif)		COCONUT		ARECANUT	
I	Variable cost		AV.Size	0.13	AV.Size	0.78	AV.Size	0.63	AV.Size	0.2
1	Human labour	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
a	Male		184.4	11986.0	94.7	4934.0	87.0	6086.0	136.2	8854.0
b	Female		54.0	2160.0	102.6	3644.0	59.1	2365.0	60.0	2340.0
2	Bullock labour	MD			18.4	934.0				
3	Machine labour	FD			0.5	73.0				
4	Seed	KG			63.7	852.0				
5	FYM	KG	17.0	5180.0	8.9	1904.0	12.3	4111.0	20.8	7283.0
6	Fertilizer	N0	546.0	2968.0	127.4	745.0	585.4	3576.0	594.0	3178.0
7	PPC		12.8	3829.0	0.0	6.1			22.3	732.0
8	Irrigation Charges			1060.0				99.4		933.0
9	Rabbing Material									
10	Vermicompost	kg			1.8	9.0	109.8	548.0		
11	Miscellaneous charges							378.0		
12	Interst on working capital			3134.8		524.0		2047.7		2686.4
	Total Variable Cost (TVC)			30317.8		13625.2		19211.1		26006.4
II	Fixed cost (FC)									
1	Land revenue and taxes			11.5		11.5		11.5		11.5
2	Depreciation charges			1166.0		1014.0		1014.0		1014.0
3	Rental value			10330.0		2988.2		12864.0		11350.0
4	Interest on fixed capital			1284.0		1530.0		1530.0		1530.0
5	Amartization cost			1088.7		0.0		930.9		1088.7
	Total fixed cost (TFC)			13880.2		5543.7		16350.4		14994.2
III	Total cost			44198.0		19168.8		35561.4		41000.7
IV	Output/ Returns									
1	Main product		1002.0	61980.0	22.6	16046.0	13577.0	77184.0	14.6	68100.0
2	Byproduct				21.9	1883.0				
	Gross returns			61980.0		17929.0		77184.0		68100.0
V	Net returns at TVC			31662.2		4303.8		57972.9		42093.6
VI	Net returns at TC			17782.0		-1239.8		41622.6		27099.3
VII	Returns per rupee invested at TVC			2.04		1.32		4.02		2.62
VIII	Returns per rupee invested at TC			1.40		0.94		2.17		1.66

Appendix VII. Contd…..

Sr. No	Particulars		FS-3				FS-4					
			MANGO		CASHEW		Paddy (Kharif)		ARECANUT		COCONUT	
I	Variable cost		AV.Size	0.8	AV.Size	0.25	AV.Size	0.67	AV.Size	0.17	AV.Size	0.56
1	Human labour	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
a	Male		78.7	4719.0	99.4	5351.0	114.4	6898.0	166.8	10844.0	231.2	16181.0
b	Female		40.1	1965.0	40.0	1686.0	85.8	2563.0	84.0	3360.0	48.4	1934.0
2	Bullock labour	MD					20.6	1288.0				
3	Machine labour	FD					0.2	24.0				
4	Seed	KG					76.3	1104.0				
5	FYM	KG	15.5	5432.0	5.5	236.0	6.7	1417.0	14.6	3221.0	12.2	4921.0
6	Fertilizer	N0	376.0	2558.0	174.2	1178.0	170.8	968.0	721.0	3655.0	652.8	4056.0
7	PPC		0.9	216.0	1.9	621.0	0.2	53.0	40.5	2958.0		
8	Irrigation Charges									354.0		103.0
9	Rabbing Material											
10	Vermicompost	kg									51.0	207.0
11	Miscellaneous charges											385.0
12	Interst on working capital			1786.8		1088.6		572.6		2884.6		3322.1
	Total Variable Cost (TVC)			16676.8		10160.6		14887.6		27276.6		31109.1
II	Fixed cost (FC)											
1	Land revenue and taxes			8.5		8.5		11.5		11.5		11.5
2	Depreciation charges			1014.0		1014.0		376.0		376.0		376.0
3	Rental value			7068.2		4353.5		3034.0		8357.7		9848.5
4	Interest on fixed capital			1530.0		1530.0		896.0		896.0		896.0
5	Amartization cost			767.0		522.7		0.0		1088.7		930.9
	Total fixed cost (TFC)			10387.7		7428.7		4317.5		10729.9		12062.9
III	Total cost			27064.5		17589.4		19205.1		38006.5		43171.9
IV	Output/ Returns											
1	Main product		787.0	42409.0	8.2	26121.0	24.7	16811.0	8.9	50146.0	8393.0	59091.0
2	Byproduct						25.4	1393.0				
	Gross returns			42409.0		26121.0		18204.0		50146.0		59091.0
V	Net returns at TVC			25732.2		15960.4		3316.4		22869.4		27981.9
VI	Net returns at TC			15344.5		8531.6		-1001.1		12139.5		15919.1
VII	Returns per rupee invested at TVC			2.54		2.57		1.22		1.84		1.90
VIII	Returns per rupee invested at TC			1.57		1.49		0.95		1.32		1.37

Appendix VII. Contd…..

			FS-4						FS-5	
Sr. No	Particulars		BRINJAL		SMOOTHGOURD		BOTTLEGOURD		COCONUT	
I	Variable cost		AV.Size	0.31	AV.Size	0.25	AV.Size	0.16	AV.Size	0.65
1	Human labour	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
a	Male		268.5	17290.0	129.3	9166.0	116.7	7002.0	128.7	9007.0
b	Female		156.0	6240.0	165.3	12042.0	279.3	12568.0	47.0	1878.0
2	Bullock labour	MD								
3	Machine labour	FD	23.7	810.0	12.7	1930.0	10.1	1515.0		
4	Seed	KG	0.4	5413.0	1.1	3003.0	0.9	7752.0		
5	FYM	KG	18.1	7106.0	16.3	3266.0	23.2	4697.0	12.3	3116.0
6	Fertilizer	N0	800.0	4098.0	433.3	2266.0	482.3	2822.0	36.9	2406.0
7	PPC		1.9	713.0	3.1	948.0	5.7	1737.0	0.5	162.0
8	Irrigation Charges			206.0		208.0		237.0		163.0
9	Rabbing Material									
10	Vermicompost	kg							19.0	92.0
11	Miscellaneous charges			2624.0						285.0
12	Interst on working capital			1771.8		1304.8		1523.7		2033.5
	Total Variable Cost (TVC)			46271.8		34133.8		39853.7		19142.5
II	Fixed cost (FC)									
1	Land revenue and taxes			11.5		11.5		11.5		11.5
2	Depreciation charges			376.0		376.0		376.0		1127.0
3	Rental value			19383.2		24317.2		15061.0		8938.8
4	Interest on fixed capital			896.0		896.0		896.0		1287.0
5	Amartization cost			0.0		0.0		0.0		930.9
	Total fixed cost (TFC)			20666.7		25600.7		16344.5		12295.2
III	Total cost			66938.4		59734.5		56198.2		31437.7
IV	Output/ Returns									
1	Main product		211.1	116299.0	208.4	145903.0	180.7	90366.0	10058.0	53633.0
2	Byproduct									
	Gross returns			116299.0		145903.0		90366.0		53633.0
V	Net returns at TVC			70027.2		111769.2		50512.3		34490.5
VI	Net returns at TC			49360.6		86168.5		34167.8		22195.3
VII	Returns per rupee invested at TVC			2.51		4.27		2.27		2.80
VIII	Returns per rupee invested at TC			1.74		2.44		1.61		1.71

Appendix VII. Contd…..

			FS-5		FS-6					
Sr. No	Particulars		ARECANUT		Paddy (Kharif)		COCONUT		ARECANUT	
I	Variable cost		AV.Size	0.2	AV.Size	0.71	AV.Size	0.47	AV.Size	0.2
1	Human labour	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
a	Male		116.1	7546.0	106.9	5134.0	102.6	7184.0	148.9	9679.0
b	Female		96.1	4324.0	96.4	3353.0	60.9	2436.0	140.8	6334.0
2	Bullock labour	MD			18.6	1031.0				
3	Machine labour	FD								
4	Seed	KG			78.9	1085.0				
5	FYM	KG	14.6	4502.0	7.8	1412.0	16.5	4969.0	11.4	3940.0
6	Fertilizer	N0	451.2	2367.0	160.2	902.0	517.5	3115.0	502.7	2514.0
7	PPC		5.4	1858.0					4.9	1664.0
8	Irrigation Charges			241.0				140.0		341.0
9	Rabbing Material									
10	Vermicompost	kg			17.2	86.0	43.9	219.0		
11	Miscellaneous charges							587.0		840.0
12	Interst on working capital			2471.6		520.1		740.4		2996.5
	Total Variable Cost (TVC)			23309.6		13523.1		19390.4		28308.5
II	Fixed cost (FC)									
1	Land revenue and taxes			11.5		11.5		11.3		8.5
2	Depreciation charges			1127.0		239.0		717.0		717.0
3	Rental value			7995.5		3167.2		8569.3		9101.0
4	Interest on fixed capital			1287.0		560.0		1179.0		1179.0
5	Amartization cost			1088.7		0.0		930.9		1088.7
	Total fixed cost (TFC)			11509.7		3977.7		11407.4		12094.2
III	Total cost			34819.4		17500.8		30797.8		40402.8
IV	Output/ Returns									
1	Main product		8.7	47973.0	23.8	16625.0	7558.0	51416.0	9.8	54606.0
2	Byproduct				23.0	2378.0				
	Gross returns			47973.0		19003.0		51416.0		54606.0
V	Net returns at TVC			24663.4		5479.9		32025.6		26297.5
VI	Net returns at TC			13153.6		1502.2		20618.2		14203.3
VII	Returns per rupee invested at TVC			2.06		1.41		2.65		1.93
VIII	Returns per rupee invested at TC			1.38		1.09		1.67		1.35

Appendix VII. Contd…..

			FS-6			
Sr. No	Particulars		MANGO		CASHEW	
I	Variable cost		AV.Size	0.63	AV.Size	0.18
1	Human labour	unit	Quantity	Value	Quantity	Value
a	Male		74.6	4476.0	96.0	5193.0
b	Female		47.7	1906.0	69.1	3060.0
2	Bullock labour	MD				
3	Machine labour	FD				
4	Seed	KG				
5	FYM	KG	16.7	4401.0	11.2	2472.0
6	Fertilizer	N0	393.9	2575.0	209.1	1340.0
7	PPC		2.9	1003.0	0.9	909.0
8	Irrigation Charges					
9	Rabbing Material					
10	Vermicompost	kg				
11	Miscellaneous charges					
12	Interst on working capital			1723.3		1556.9
	Total Variable Cost (TVC)			16084.3		14530.9
II	Fixed cost (FC)					
1	Land revenue and taxes			8.3		8.5
2	Depreciation charges			717.0		717.0
3	Rental value			8279.7		4593.3
4	Interest on fixed capital			1179.0		1179.0
5	Amartization cost			767.0		522.7
	Total fixed cost (TFC)			10950.9		7020.6
III	Total cost			27035.2		21551.5
IV	Output/ Returns					
1	Main product		976.0	49678.0	8.6	27560.0
2	Byproduct					
	Gross returns			49678.0		27560.0
V	Net returns at TVC			33593.7		13029.1
VI	Net returns at TC			22642.8		6008.5
VII	Returns per rupee invested at TVC			3.09		1.90
VIII	Returns per rupee invested at TC			1.84		1.28

Appendix VIII. Per hectare cost and returns of other enterprises in farming systems in southern costal plains

			Dairy Sys-1		Dairy Sys - 2		Dairy Sys - 3		Dairy Sys -4		Dairy Sys -5		poultry Sys 6	
			AV.Size	1.89	AV.Size	1.88	AV.Size	2.47	AV.Size	2	AV.Size	1.26	AV.Size	14.75
Sr. No	Particulars	unit	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
I	Variable cost													
1	Humal labour													
a	Male	MD	61.5	2065.0	70.6	2473.0	58.4	2483.0	61.3	2834.0	54.4	2593.0	11.5	631.0
b	Female	FD	35.7	1230.0	44.8	1346.0	27.0	834.0	36.7	1125.0	39.0	1261.0	10.6	494.0
2	Feed (poultry)	KG											10.2	11978.0
3	Dry fodder	KG	19.6	1950.0	24.0	2801.0	23.2	2764.0	16.0	1539.0	20.8	2185.0		
4	Green fodder	N0	37.7	2556.0	48.6	3716.0	30.8	2571.0	39.7	3774.0	38.2	4078.0		
5	Medicine / Vetarnery exp			246.0		268.0		285.0		279.0		122.0		311.0
6	chicks (poultry)												1000.0	11118.0
7	Paddy straw (husk)												1.9	459.0
8	Concentrates	kg	384.0	2290.0	536.0	2872.0	643.0	4226.0	689.0	4354.0	648.5	4874.0		
9	Electricity charges													
10	Miscellaneous charges													
11	Interst on working capital			1240.4		1617.1		1579.6				1813.6		2998.9
12	Total Variable Cost (TVC)			11577.4		15093.1		14742.6		13905.0		14333.6		27989.9
II	Fixed cost (FC)													
1	Depreciation charges			112.0		118.0		112.0		293.0		298.0		352.0
2	Interest on fixed capital			388.0		347.0		364.0		1260.0		319.0		938.0
3	Imputed value of animal			885.0		1263.0		1117.0				1188.0		0.0
4	Total fixed cost (TFC)			1385.0		1728.0		1593.0		885.0		1805.0		1290.0
III	Total cost			12962.4		16821.1		16335.6		14790.0		16138.6		29279.9
IV	Output/ Returns													
1	Milk		1105.0	16732.0	1396.0	21888.0	1337.0	23087.0	1351.0	21915.0	1089.0	17424.0		
2	FYM /poultry sheet		2.2	486.0	2.6	821.0	2.3	689.0	2.3	515.0	2.9	664.0	2.2	498.0
	Sale of animal /bird		0.2	832.0	0.1	522.0	0.1	321.0		0.0	0.4	985.0	977.0	32478.0
	Gross returns			18050.0		23231.0		24097.0		22430.0		19073.0		32976.0
V	Net returns at TVC			6472.6		8137.9		9354.4		8525.0		4739.4		4986.1
VI	Net returns at TC			5087.6		6409.9		7761.4		7640.0		2934.4		3696.1
VII	Returns per rupee at TVC			1.6		1.5		1.6		1.6		1.3		1.2
VIII	Returns per rupee at TC			1.4		1.4		1.5		1.5		1.2		1.1

AN ECONOMETRIC ANALYSIS OF FARMING SYSTEMS IN NORTH KONKAN REGION OF MAHARASHTRA

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ABSTRACT

Farming system is one of the important solution because in this approach, different enterprises can be carefully undertaken and the location specific system can be developed through holistic way to farming.

Study was conducted in North Konkan region of Maharashtra. Study area was delineated in to five distinct clusters on the basis of agro-climatic parameters which appeared to be more appropriate than NARP classifications. Cost and returns, resource use efficiency, optimum plans and constraints were studied for existing farming systems in each region.

Study revealed necessity of promoting region specific farming systems such as Paddy + Irrigated plantations + Dairy, Paddy + Irrigated plantations + Flowers and Irrigated plantations + Dairy in north coastal plains; Paddy + Other cereals + Rainfed plantation + Dairy and Paddy + Vegetables + Poultry in northern central plains and hills, Paddy + Vegetables + Dairy, Paddy + Pulses + Dairy + Poultry and Paddy + Rainfed plantations + Dairy in southern central plains and hills. Paddy + Rainfed plantation + Dairy, Paddy + Irrigated plantations + Rainfed plantation + Dairy and Paddy + Irrigated plantations + Vegetables + Dairy in southern coastal plains regions. Balanced use of fertilizers and judicious use of labour is required so that it would be cost effective. The use of FYM and organic fertilizers should be increased. Allocation of resources and rearrangement of enterprises had greater scope in majority of farming systems. At existing resource level (optimum plan M-I) in majority of farming systems income can be increased by more than 25 per cent. At enhanced resource level income can be increased by more than 75 per cent than existing plan and more than 30 per cent than income at optimum plan M-I. Training on control of Eryophite mite, farming system models, training on processing of fruit products are necessary. Supply of the good quality seed, establishment of crop specific cooperative marketing arrangements, network of warehouses were some of the measures to facilitate and regulation of market practices in adoption of the farming systems.