AN ECONOMIC ANALYSIS OF COCONUT BASED FARMING SYSTEMS IN TUMKUR DISTRICT OF KARNATAKA

RAJESHWARI Y.G.

DEPARTMENT OF AGRICULTURAL ECONOMICS
COLLEGE OF AGRICULTURE, DHARWAD
UNIVERSITY OF AGRICULTURAL SCIENCES,
DHARWAD - 580 005

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RAJESHWARI Y.G.

DEPARTMENT OF AGRICULTURAL ECONOMICS
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CERTIFICATE

This is to certify that the thesis entitled "**AN ECONOMIC ANALYSIS OF COCONUT BASED FARMING SYSTEMS IN TUMKUR DISTRICT OF KARNATAKA**" *submitted by* **Miss RAJESHWARI Y.G.,** *for the degree of* **MASTER OF SCIENCE (AGRICULTURE)** *in* **AGRICULTURAL ECONOMICS** *to the University of Agricultural Sciences, Dharwad, is a record of research work carried out by her during the period of her study in this university, under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.*

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MAJOR ADVISOR

Approved by :

Chairman : _____ 8/11/04
(N. R. MAMALE DESAI)

Members : 1. _____
(L. B. KUNNAL)

2. _____
(S. B. HOSAMANI)

3. _____
(N. BASAVARAJ)

4. _____
(Y. N. HAVALADAR)

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Rajeshwari Y.G.
(**Rajeshwari Y.G.**)

CONTENTS

LIST OF TABLES

Contd.....

Contd.....

LIST OF FIGURES

LIST OF APPENDICES

Introduction

I. INTRODUCTION

Coconut (*Cocos nucifera L.*) a versatile tree is appropriately called as "Kalpavriksha" or "The tree of Heaven". Today it forms an important component of socio-economic and cultural lives of nearly 80 million people of the world, in about 92 countries, primarily of Asia and the pacific region.

Historians believe that coconut has spread to other parts of the world from India. A few others feel that many of the tropical regions where coconuts presently grow received their first coconut trees via the sea. Others feel it was brought to the different regions of the tropics by explorers and sea travelers.

Early Sanskrit writings reveal that the people of India were using coconuts as their staple food and various forms in everyday needs. The coconut palm in India has a history of 3,000 years. It was known as Kalpavriksha, which means "tree that gives all that is necessary for living".

Coconut is food, beverage and oil seed. In its tender form coconut milk is consumed as a beverage. The kernel of matured coconut forms an ingredient in many food preparations. Copra, its dried kernel, is the richest source of cooking oil with oil content of 68 per cent. The branded coconut oil in small packs is mainly marketed as hair oil and body oil. Refined coconut oil, which also serves industrial purposes, is mainly used in the manufacture of biscuits, chocolates and other confectionery items, ice-cream, pharmaceutical products and costly paints. The oil is also used for manufacturing margarine, soaps, creams, shampoos and other

cosmetics. It is also used as a fat source in the preparation of filled milk and infant milk powder. The residue from copra after extraction of oil is useful. The leftover cake forms industrial applications and is used to manufacture mixed cattle feed. It is an important source of vegetable protein and feeding milch animal to increases the fat content of their milk and advances lactation.

The coconut tree, apart from the nut has even more purposes in its other parts. The husk serves as the raw material for the manufacture of coir and coir products. The coir pith can also be used for soil conditioning. The husk is also used as mulching material and desiccant in plantations and is an ideal medium to grow orchids. Coconut leaves are mainly used for handicrafts. The uses of coconut are so varied and numerous that no space is enough to enumerate all of them. And technology and research keep on adding to the list.

The annual world production of coconut is 51 billion nuts from an area of 11.9 million hectares (Punchihewa, 2000). More than 75 per cent of this is contributed by the four major players *viz.*, India, Indonesia, Philippines and Srilanka and India has attained the top position in the production of coconut. It had an area of 1.89 million hectares and a production of 12,821 million nuts in the year 2001-2002 (Singhal, 2003). Coconut is an important crop of South India where it occupies an area of 1.7 million hectares, which accounts for 92 per cent of all India coconut area. In India among the coconut producing states, Karnataka ranks third in area (310.3 million hectares) and production (1611.5 million nuts).

It is small wonder that the economies of coastal tracts in India are closely linked with the Coconut crop, as it is the single largest provider of

livelihood for millions. The contribution of the crop to the total vegetable oil in the country is close to six per cent and the foreign exchange earned by the crop is more than 4,000 million Rupees per annum and much of this is coverd by way of export of coir and coir products (Anonymous, 2004).

Indian agriculture is characterised by mixed farming involving a system of combining crop production with one or more of the livestock enterprises like rearing of cattle, sheep, goat, sericulture, pigs and poultry as well as fishery, bee keeping *etc.* Although in India, farming is not commercialized to a large extent, it remains that the farmer has to make decisions regarding his business of farming, with a view to attain maximum welfare.

During the past few decades' considerable attention has been focused on the plight of the rural poor in developing countries. One aspect of this emphasis has been to direct agricultural research specifically to the needs and aspirations of farmers with limited resources. Generally technologies offered to the small farmers have come from a top-down approach. By that we mean research would be largely initiated and conducted on experimental stations and then offered to farmers to accept or reject. As a result, farmers rejected many of the proposed changes because the suggested improvements were impracticable or too risky or the farmers lacked adequate inputs or suitable markets. In short, the technologies were not suitable because the researchers did not know or consider the conditions of farmers. Therefore, research, extension and other programmes are needed to correct these deficiencies, if small farmers in developing countries are to be helped. One approach that

considers farmers' conditions specifically is called farming system research.

In its broadest sense the term farming systems research is any research that views the farm in a holistic manner and considers interactions in the system. A farming system is a complex, interrelated matrix of soils, plants, animals, powers, 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 with a farming systems perspective has various objectives ranging from increasing the body of knowledge about farming systems to solving problems in different farming systems.

Today, farming systems research with a farmers' perspective occupies pride of place in India's agricultural research agenda. Farming systems concept, offer tracing the evolution of general systems theory as a system referring to crop combination or enterprise mix in which the products and/or the by-products of one enterprise serve as inputs for the production of other enterprises (Maji, 1991). The whole farming rather than the individual crops/enterprises need to be considered in the decision making under the farming systems approach.

In the conference of Indian Society of Agricultural Economics during 1991, the status of the farming systems research in the country was assessed and noted that there are no clear cut emphasis on farming systems research at present (Grewal, 1991).

Indian farming is dominated by small and marginal farmers accounting for about 75 per cent of the total holdings but commanding

only about 26 per cent of the total cultivated area. The land acquired by these categories of farmers is meager and it provides very low levels of income and limited employment to the farm family. Therefore, there is utmost urgency to develop location specific optimum farming systems, which will be helpful to raise the standard of living of these farm families by ensuring enough employment opportunities to them. To ensure this, the Government of India accorded top priority on regional development by exploiting the agricultural potential of the region for which it has the comparative advantage.

In Karnataka Tumkur district ranks first in area and production of coconuts (Anonymous, 2001-02). In the major coconut growing taluks of this district the area under coconut is observed to be more than 30 per cent. Hence, in the study area coconut based farming systems forms an important means to generate employment and income. In the district with the coconut, other plantation crops, field crops, livestock enterprises like dairy, poultry, sheep and sericulture are also being practicing. Few studies have been made in isolation but no systematic study has been made to know the impact of coconut based farming system on income and employment generation of coconut based farms.

In this view the present study is modest attempt to study in depth the coconut based farming systems in holistic approach encompassing vivid dimensions with the following objectives.

1. To identify the different coconut based farming systems and resource use patterns followed by the farmers in study area

2. To estimate the levels of income and employment generation under different coconut based farming systems

3. To determine optimum coconut based farming system models for achieving stability in the production and income levels of the farmers

4. To identify the constraints associated with coconut based farming systems and to suggest appropriate policy measures

Hypotheses

1. Farmers are following more than one coconut based farming systems in the study area.

2. Identified coconut based farming systems are economically viable.

3. Development of optimum coconut based farming system models considering the resource endowments.

4. The farmers taking up different coconut based farming systems face several problems.

Presentation of the study

The entire study is presented in six chapters. The chapter I gives introductory note highlighting the rationale of the study, specific objectives and hypotheses, while chapter II represents the reviews of the studies made in the past that are relevant to the objectives of the present investigation. Chapter III explains the methodology adopted in the study, including the delineation and description of the study area and crops, sampling frame, nature and sources of data, analytical tools and techniques used. The results of the study are presented in chapter IV and are discussed in chapter V. The summary and policy implications are presented in chapter VI.

Review of Literature

II. REVIEW OF LITERATURE

In this chapter a review of past research in the field has been complied to enable better understanding of the farming system concept, research in various region, method of analysis on the research subject. The different aspects covered under the review are present as follow.

2.1 Farming System Concepts and Definitions

2.2 Income and Employment Generation in different Farming Systems

2.3 Analytical Tools

2.4 Constraints of Farming Systems

2.1 FARMING SYSTEM CONCEPTS AND DEFINITIONS

Farming System Research (FSR) approach is of recent origin. The views of different researchers and authors in this regard are narrated.

Norman (1978) has defined the farming system as the pattern of resource allocation and processes of resource use in a farming unit gives the flexibility to apply it, in any specific instance, to a geographical unit, an economic unit or to a unit displaying a particular technical pattern of resource use.

Maji (1991) referred farming system specifically to a crop combination or enterprise-mix in which the products and/or the by-products of one enterprise serves as the input for the production of other enterprise(s). It takes into account the consumption needs of the family, the economic factors like relative profitability of the technically feasible

enterprises, availability of farm resources, infrastructure and institutions such as irrigation, marketing facilities including storage and transportation and credit, besides the agro-biological considerations, namely, interdependence if any among the various enterprises and the references of the individual farmers.

Deoghare *et al.* (1991a) defined farming system as the entire gamut of all farm activities and related decisions with regard to development, management and allocation of all the farm resources within the operational unit or within the combination of such units results in maximum agricultural production. It involves integrated efforts for improvement of the use of farm resources such as land, labour and capital *etc.*, through their efficient utilization to maximize farm returns.

Sharma *et al.* (1991) viewed farming systems as a set of agro-economic activities that are inter related among themselves in a particular agrarian setting.

Singh (1994) made a critical study on present status and the future prospects of farming systems research in India. The author opined that the farming systems research in the complex diverse and risk prone agro-ecosystems that characterize the majority of agriculture in the country. He opined that in the farming systems research approach, the scientists have to go to the farmer with more than one option to provide him the opportunity to exercise his own decision.

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

2.2 INCOME AND EMPLOYMENT GENERATION IN DIFFERENT FARMING SYSTEMS

Rajbanshi and Shreshtha (1980) based on their study on the economics of integrated farming systems in Nepal for a period of two years opined that in the first year the farmer concentrated on cereal crops while in the second year he added piggery, combine duck raising with fish culture and used improved varieties of cereals. The first year income was Rs. 9,058 while that of second year turned out to Rs. 10,592 from crops above and a total of Rs. 15,660 from duck-fish culture.

Rangaswamy *et al.* (1992) in a study to evolve a 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 system was 100 per cent higher than the 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 finally concluded that farming system combining cropping, poultry, fisheries and mushroom production enhance the net income of the low land rice farmer.

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. The system also generated 92 mandays of employment.

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

Korikanthimath *et al.* (1996) conducted a study for three years on mixed cropping of *Arabica* coffee with cardamom v/s 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.

Korikanthimath *et al.* (1997) in their study carried out on mixed cropping of *Areca catechu* and cardamom in comparison with mono culture of *Areca catechu* concluded that the cost of cultivation was higher in mixed cropping than under mono culture and correspondingly, the net return realised in mixed cropping was also 1.56 times higher than in mono culture. The increment net gain in mixed cropping was Rs. 58,211 per hectare. Benefit cost ratio was higher by 1.01 times under mixed cropping compared with monoculture.

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

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.

2.3 ANALYTICAL TOOLS

2.3.1 Cobb-Douglas Production Function

Bal *et al.* (1983) employed the Cobb-Douglas model to study the resource use efficiency, factor share and productivity of various factors in crop cultivation in the central districts of Punjab at two points of time, namely 1972-73 and 1980-81. It was noted that elasticities of production (in value terms) of human labour, draught labour and rental value of land had, declined in 1980-81 over 1972-73, but that of irrigation had decreased. The average level of use of other factors had increased over the period. It advocated substitution of human labour with other factors, mainly with irrigation, fertilizer and weedicides.

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 could be 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 (1996) indicated that the feed concentrate was the most important input affecting milk production. The regression

coefficients of this input were positive and statistically significant in all the equations fitted, indicating that the farmers could increase their milk output by feeding more concentrates to the animals on both the groups of households. The regression coefficients of green fodder and dry fodder were also positive and significant in most of the equations fitted. The analysis indicated that milk yield was higher in the winter season. The optimization of resources with the existing capital indicated the possibility of increasing the milk output in crossbred cows and buffaloes by diverting a part of funds from green fodder, dry fodder and labour to concentrates.

Nagraj *et al.* (1996) in their study 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 analysing 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) make 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.

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 techniques is being used for complex farm planning purposes.

Sirohi and Gangawar (1968) assessed the possibility of increasing net farm returns through reorganisation of resources using solutions from linear programming technique. The results showed that, by the reorganisation of resources the net income could be increased to the extent of 24 to 42 per cent.

Kahlon *et al.* (1975) conducted a linear programming study by including milch animals with crop activities and developed optimum plans under existing and improved technology levels. They concluded that incomes of small, medium and large farmers would increase by 44.06, 66.95 and 76.96 per cent, respectively, over the existing plan by adopting recommended technology. Crossbreed cows were the most profitable and entered the solution. The study did not account for the other farm enterprises like poultry, honey bees, *etc.*

Vijayakumar (1976) examined the credit needs of irrigated and unirrigated farms under existing and improved technology situations in Bangalore south taluks of Karnataka state using linear programming technique. He concluded that optimum plans with additional capital through borrowings under improved technology would result in substantial increase in income of both the categories of farmers.

Nanda *et al.* (1978) optimised the crop production pattern in different agro climatic zones of Himachal Pradesh using he linear programming technique. The findings indicated sub-optimality in resource allocation including land, especially in the lower and middle hills where diversification of agriculture was observed. The normative cropping pattern tended towards specialisation. It was also found that the colour was surplus and the credit was scarce.

Suryaprakash (1978) studied the impact of credit and services provided by the Farmers Service Society, Hesaraghatta, Bangalore district on the net farm returns under existing and improved technology situations with existing and additional credit supply by using linear programming technique. He concluded that improved technology and adequate capital always work together and the optimum plans with adequate credit under improved technology indicated the highest net returns. The liberalisation scale of finance without considering the relevance of improved technology would fair to deliver the goods to the farmers.

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 used 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 optimisation 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 Galaglikar (1985) used linear programming to study the impact of dairy enterprises on the cost and returns in 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.

Gajanana and Sharma (1990) used a linear programming to assess the impact of credit and technology on income and employment of small, marginal and large farmers in Tumkur district of Karnataka. They concluded that the optimization of resources under different farm sizes could be achieved by merely reallocating the resources. The study also indicated that liberal credit and improved technology would increase the income prospects and enlarge the employment opportunities.

Deoghare *et al.* (1991a) examined the impact of credit and technology on income and employment on small farms practicing different farming systems in Karnal district of Haryana. Linear programming was used for optimisation of net returns of various crops, dairy and poultry activities. Adoption of recommended technology even with restricted capital investment resulted in higher net farm income and better utilisation of human labour. With relaxation of capital constraint more profitability could be generated with more opportunities for human labour employment.

Deoghare *et al.* (1991b) also studied the impact of mixed farming systems on income and employment of small farms in Karnal district of Haryana. The results revealed the utility of mixed farming system under which the farmers could gain higher net returns and thus raise themselves above poverty line. The study also indicated that the combinations of crop + dairy, crop + poultry and crop + poultry + dairy enterprises were more promising and beneficial in that order. He further showed the potentiality to increase the net farm income on bullock-operated farms with relaxed credit constraints along with adoption of recommended technology.

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, an increase of 144.41 per cent.

Neelakanta 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. Inter allied an assessment of the impact of resources, optimally credit and recommended technology was also made. Rational use of existing technology enabled to realise 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, would, besides increasing the net farm returns, also facilitate 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 as suggested by Hazel (1971) 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 plants 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 (1994) in his study on sectoral interdependency and block level planning in West Garo hills district of Meghalaya, used linear programming models to achieve optimal allocation of resources. By converting input-output model into linear programming model, he could show that by allocating the existing available capital there is potential of generating 8,328.37 thousand mandays of employment against the prevailing 6,942.81 thousand mandays in Padanggiri block of Meghalaya. An additional employment of 5,332.67 and 6,508.56 thousand mandays could be created when the prevailing level of capital was increased by 10 per cent and 20 per cent respectively.

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.

From the review of literature it is observed that the profit maximisation approach using optimisation technique is normative. The studies made so far have come out unanimously that profit generated on Indian farms are sub-optimal and there is scope for increasing net profit through reorganisation of existing resources.

2.4 CONSTRAINTS OF FARMING SYSTEMS

Martin (1971) pointed out that agriculture was a complex sector in any economy; so planning might be difficult but not impossible. He observed that the farmers were generally scattered over a wide area with

smallholdings and were often illiterate and tradition bound, more so in developing countries. They generally operated at the subsistence level with very low input use. Development could occur when farmers took rational decisions based upon market conditions and commercial outlook. Extension facilities would play a vital role in agricultural transformation on modern lines. He further concluded that planning should be done keeping in view the local conditions and farmers' co-operation.

Shah (1979) highlighted the problems and prospects of farming in hill areas. He emphasized the need for identification and evolution of appropriate farming systems, socio-economic and technological factors determining cropping pattern, integration of agro-based forestry, animal husbandry incorporating ecological considerations. The optimal farming systems for hills would include consideration of different farming activities like cultivation of field and plantation crops, animal husbandry, fisheries, medicinal herbs, fodder grasses *etc.*, which was determined according to the soil capacity and potentiality of the area and justified in terms of economic viability and social acceptability. The study pointed out that the existing extension network was weak and stressed the need for developing a cadre of well-trained persons on Hill farming systems. Inter disciplinary co-ordination and feedbacks to the research stations were other important considerations.

Khanna (1983) in northern region of India observed that the 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 do not allow the full capacity are of even a pair of bullocks use the other two main problems of farming in hills.

Thakur and Sharma (1984) analyzed the weaknesses of the farm sectors responsible for slow progress of agriculture. Irrigation, lack of HYV seeds, very low use of fertilizers and lack of extension facilities to translate improved technology to farmer's fields were found to be some of the main constraints.

Thakur and Sharma (1985) have shown that the main bottlenecks faced by the farmers in Himachal Pradesh was one of marketing, *i.e.* both for the purchase of inputs required by them and the sale of their output. Farmers were mainly at the mercy of the traders who exploit them. This discourages the farmers from adopting innovations on the production front, including that of optimum farming system. 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. However, they have pointed out that the interest of the farmers need to be safeguarded further by establishing their own organization for the procurement of inputs and for the sale of their produce so that farming became remunerative.

Rangaswamy (1986) pointed out the constraints for dry land farming areas inhibiting the adoption of key inputs *viz.*, availability of quality seeds, fertilizers and pesticides in dry farming areas. He revealed that the farmers were uncertain about the outcome of crops and 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 of small farmers owing 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 jointly own the costly farm implements can 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 pointed out that farmers lost less by using less amounts of fertilizers and marginal farmers needed very small amounts of fertilizer. Their study 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 infrastructural/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.* He also suggested the measures for the development of agriculture in the state.

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

The earlier researchers felt that agriculture is complex sector, so planning is difficult, but not impossible. The factors like administration and infrastructure play a vital role in any farming ventures. The constraint identified by these researchers will throw light in dealing with farming systems more effectively.

Methodology

III. METHODOLOGY

The present study has been an attempt to examine some important aspects of the selected farming systems, such as income and employment generation, input use efficiencies in these systems and problems faced by the farmer respondents. The methodology adopted for the study is presented in the subsequent sections.

3.1 DESCRIPTION OF THE STUDY AREA

Karnataka accounts for 4.59 per cent of the total coconut area in the state. Tumkur district occupies the first place in Karnataka state as regards to coconut cultivation with an area of 83,818 hectares, which is about 27 per cent of the total state of area 3,10,399 hectares as per figures available for year 1999-2000 (Thomas, 2002). In the study area, along with coconut cultivation, other enterprises like field crops, dairying, sheep rearing, sericulture, poultry, bee keeping, piggery are also extensively practiced.

3.1.1 Location and Area

The study was undertaken in the three talukas of Tumkur district namely Tiptur, Gubbi and Chikkanayakanahalli (Fig. 3.1).

Tumkur district is in the *Maidan* tract and is situated in the east central part of Karnataka with a geographical area of 10.65 lakh hectares. It lies between 12°45' and 14°12' North Latitude and between 76°21' and 77°31' East Longitude.

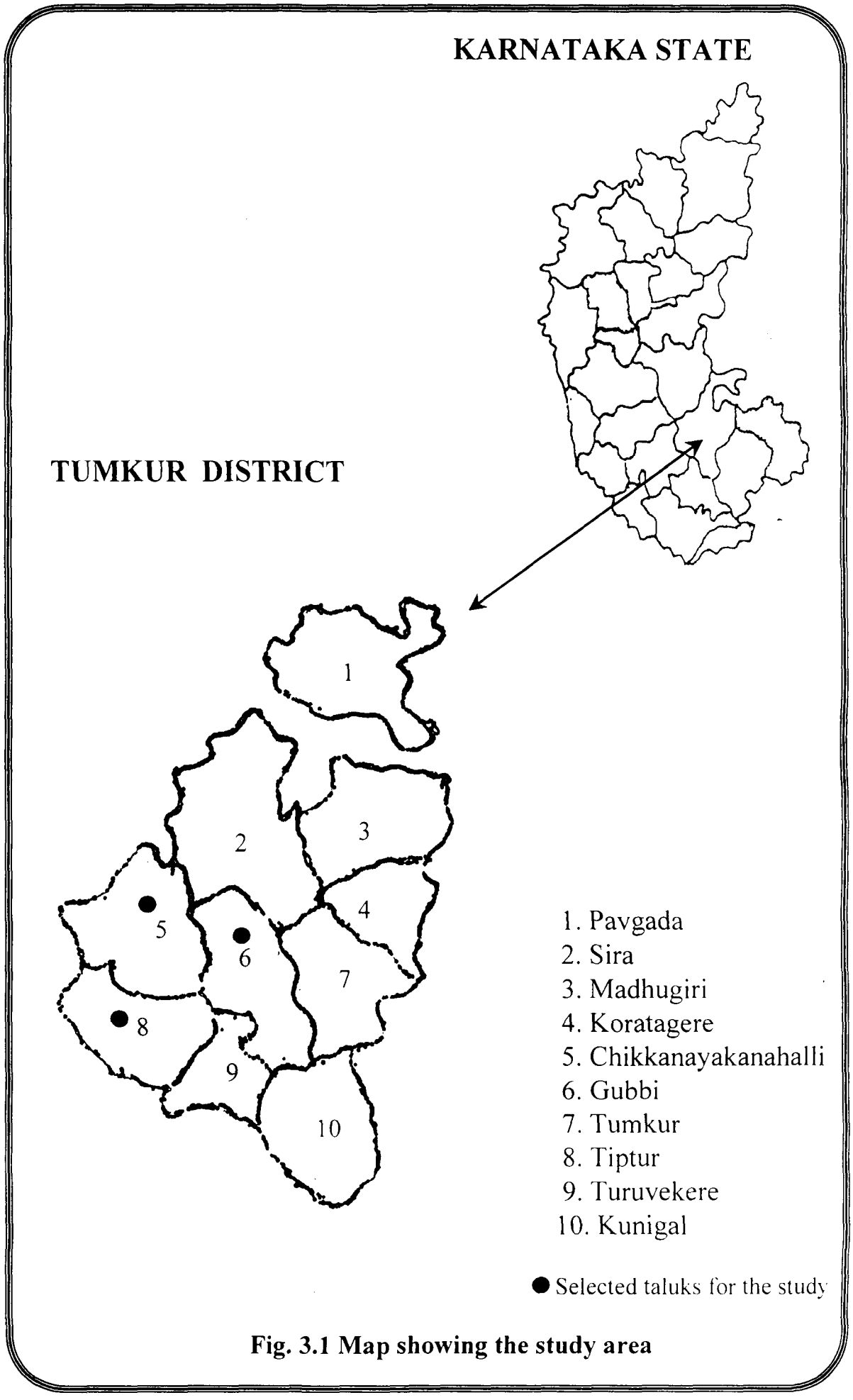

Fig. 3.1 Map showing the study area

3.1.2 Population and Literacy

Some basic statistics pertaining to Tumkur district and the selected taluks for the year 2001-02 is provided in Table 3.1.

Tumkur district comprises of 10 taluks with a total population of 25,79,516. More than 70 per cent of the population live in rural areas and are agriculturally oriented. Majority of the land holders in the district are classified as marginal (48.53%) followed by small (25.6%), medium (17%) and large farmers (1.11%). The literacy rate of the district was 67 per cent. The three taluks selected for the study, namely Chikkanayakanahalli, Gubbi, Tiptur had higher proportions of rural population, as well slightly higher proportion of literacy.

3.1.3 Topography, Rainfall, Climate and Soil Type

Tumkur district receives an annual rainfall ranging between 700-715 mm. spread over 50 rainfall days, during the period from May to November. The years 2002-03 and 2003-04, have recorded precipitations, which were less than the average. The maximum temperature of 38°C is experienced during the months of April-May while the minimum temperature of 10°C is experienced during the month of November-December.

The soils of the district are predominantly sandy loams, with lesser areas of red loams. The soils are derived from granite, gneisses and schists. The soils are red to brownish in colour, shallow and fairly deep and intermixed with fairly large amount of coarse gravel and pebbles. The pH range is between eight to nine. Being well drained, they lack adequate

Table 3.1. Selected Statistics of the Study Area for the Year 2001-02

Sl. No.	Particulars	Tumkur	Chikkanayakanahalli	Gubbi	Tiptur
1.	Taluks (number)	10	-	-	-
2.	Hoblis (number)	50	5	6	4
3.	Total villages (number)	2738	234	346	234
a)	Inhabited (number)	2537 (92.60)	226 (96.50)	325 (93.90)	222 (94.80)
b)	Uninhabited (number)	181 (7.34)	8 (3.50)	21 (6.10)	9 (5.20)
4.	Cities & towns (number)	12	NA	NA	NA
5.	Population*(number)	2579516	209539 (8.10)**	256144 (9.90)**	216826 (8.40)**
a)	Rural (number)	2072836 (80.35)	187179 (89.50)	239342 (93.40)	163783 (75.50)
b)	Urban (number)	506680 (19.64)	22360 (10.70)	16802 (6.60)	53043 (24.50)
c)	Male (number)	1311941 (50.85)	105561 (50.30)	129617 (54.15)	109629 (50.50)
d)	Female (number)	1267575 (49.10)	103978 (49.70)	176527 (45.85)	107197 (49.50)
e)	Literates (number)	1733176 (67.19)	146677 (70.30)	173896 (67.89)	162944 (75.15)
6.	Agricultural holdings*	419173	40492 (9.65)**	48453 (11.55)**	42064 (10.00)**
a)	Marginal holdings (<1 ha)	203464 (48.53)	18810 (46.40)	24698 (50.90)	23385 (55.50)
b)	Small holdings (1-2 ha)	107342 (25.60)	10808 (26.60)	12450 (25.60)	10194 (24.20)
c)	Semi medium holdings (2-4 ha)	71288 (17.00)	7433 (18.30)	7887 (16.20)	5945 (14.10)
d)	Medium holdings (4-10 ha)	32248 (7.69)	3162 (7.56)	3089 (6.30)	2303 (5.40)
e)	Large holdings (>10 ha)	4831 (1.11)	279 (0.689)	329 (0.679)	237 (0.563)

Source: District Statistical Office, Tumkur.
*Figures in parenthesis denote percentage of respective totals
**Figures in parenthesis indicate share of individual taluks from the district total

water holding capacity. The soils of the district are conducive for growing plantation crops in general coconut crop in particular. These crops also support the cultivation of field crops such as ragi, groundnut, greengram *etc.*

3.1.4 Agriculture and Livestock Enterprises

Agriculture being the main occupation in district, more than 70 per cent of the work force is engaged in agriculture.

Tables 3.2 and 3.3 briefly presents the land utilisation and cropping pattern and status of the major agricultural sub enterprises of the study district and selected taluks.

More than half of the study district and taluk is under cultivation and the proportion of irrigation in the cultivated area incase of Chikkanayakanahalli is 14.8 per cent, in case of Gubbi 26.4 per cent and Tiptur 26.3 per cent. The sources of irrigation for the district are tube wells and tanks and river only in Gubbi taluk.

Ragi, being the staple crop of the region, dominates the cropping pattern of the taluks and the district, while coconut dominates among the plantation crops. Paddy, oilseeds, jowar are the other predominant field crops.

Dairying concentrated by indigenous and breed cows and indigenous buffaloes. Sheep rearing, poultry and sericulture are other non-crop enterprises of the region. The Karnataka milk federation has a network of milk procurement centres and dairying is supported by

Table 3.2. Agricultural Economy of the Study Area for the Year 2001-02

(Area in hectares)

Sl. No.	Particulars	Tumkur	Chikkan ayakana halli	Gubbi	Tiptur
1.	Land utilization pattern				
a.	Total geographical area	1064755	112998	122057	76510
b.	Total forest area	45177 (4.24)	8235 (7.28)	10090 (8.20)	595 (0.77)
c.	Total grazing area	84922 (7.90)	5204 (4.60)	4106 (3.36)	7449 (9.70)
d.	Net sown area	574739 (53.9)	59596 (52.79)	74042 (60.60)	52836 (69.05)
e.	Area sown more than once	52476 (4.42)	3974 (3.51)	6646 (5.40)	6720 (8.78)
f.	Gross cropped area	627215 (58.4)	63570 (56.25)	80688 (66.10)	59556 (77.8)
2.	Irrigation				
a.	Net irrigated area	142450 (13.30)	8875 (7.85)	19560 (16.02)	13902 (18.10)
b.	Net irrigated area as percentage of net sown area	24.7	14.8	26.4	26.3
3.	Area under major crops**				
a.	Paddy	50221 (8.00)	1982 (3.10)	4685 (5.80)	2094 (3.50)
b.	Ragi	164206 (26.18)	21387 (33.60)	24996 (30.90)	21070 (35.30)
c.	Jowar	3853 (6.10)	1176 (1.84)	168 (0.23)	1580 (2.60)
d.	Chickpea	360 (0.50)	54 (0.084)	13 (0.20)	110 (0.18)
e.	Red gram	9001 (1.43)	913 (1.43)	388 (0.48)	384 (0.64)
f.	Oilseeds	148454 (23.60)	1719 (2.70)	1995 (2.47)	13141 (2.22)
g.	Coconut	101831 (17.70)	23017 (38.60)	20838 (28.14)	22640 (42.84)

Source: District Statistical Office, Tumkur.

Note: *Figures in parenthesis indicates percentage to total geographical area
**Figures in parenthesis indicates percentages to total gross cropped area

Table 3.3. Livestock, Sericulture Economy of Tumkur District for the Year 2001-02

Sl. No.	Particulars	Tumkur district	Chikkanayakanahalli	Gubbi	Tiptur
1.	Cattle (number)	598258	66292	69517	48954
2.	Buffaloes (number)	268778	20657	25807	17492
3.	Sheep and goats (number)	1238358	128368	103915	62726
4.	Poultry birds (number)	800083	52902	88572	47077
5.	Veterinary hospitals (number)	224	19	24	16
6.	Silk cocoon production (tons)	16408	123	144	69
7.	Mulberry cultivated area (ha)	9482	170	141	102

Source: District Statistical Office, Tumkur.

government veterinary hospitals. The farmers sell most of their silk cocoon produce to the Ramanagaram and Bangalore silk markets.

3.2 FARMING SYSTEM IN TUMKUR DISTRICT

It can be observed from Table 3.2 that coconut cultivation occupies nearly 15 per cent of the net cultivated area perennially. In Tumkur district out of the three taluks selected for the study, coconut cultivation occupied nearly one-third of their net cultivated area. Preliminary visits to these taluks indicated that coconut was seldom grown as a sole crop and was with other agricultural enterprises such as cultivation of other plantation crops, field crops, fodder crops, livestock enterprises such as dairy, poultry, sericulture, sheep and goat rearing *etc.*

3.3 SAMPLING DESIGN

Tumkur district was selected for the study as it had the largest coconut area in Karnataka (Appendix I). The top three taluks namely Chikkanayakanahalli, Gubbi and Tiptur taluks which had highest area under coconut in Tumkur district (Appendix II) were selected.

A pilot survey was conducted in three taluks in order to identify the prominent coconut based farming systems prevailing within them. Subsequently five prominent coconut based farming systems were identified for the study. A multistage random sampling frame was chosen to select the farmers following the identified farming systems in the taluks. A total of 15 villages were selected at random at the rate of 5 villages per taluk. From each of these villages 10 farmers were selected at random. Random sampling of the farmers was repeated until two farmers

were sampled for each farming system in each village. Thus the total sample size of 150 farmers chosen equally across five identified farming system. Only those enterprises which contributes at least 10 per cent of the total area or total gross returns of the sample farmers were considered and the area under coconut should be more than or equal to 50 per cent of the total area.

Here farming system-I means coconut + greengram followed by ragi + dairy, farming system-II indicates coconut + greengram + groundnut followed by ragi + dairy, farming system-III is coconut + paddy + greengram followed by ragi + dairy, farming system-IV means coconut + greengram followed by ragi + dairy + sheep and farming system-V means coconut + arecanut + ragi + dairy. Here afterwards these farming systems are mentioned as farming system-I, farming system-II, farming system-III, farming system-IV and farming system-V. Distribution of sample farmers across the taluks and farming systems are given in the Table 3.4.

3.3.1 Nature and Source of Data

The study was based on primary data and required secondary data was collected from Statistical Office, Tumkur. The offices of the Department of Agriculture, Horticulture, Sericulture and Animal husbandry both at Tumkur district and in the selected taluk level.

Primary data were collected through personal interview method using pre-tested schedules designed for the purpose. The information so collected for the study pertained to the agricultural year 2001-02 because the year 2002-03 was severe drought year in the study area.

31

Table 3.4. Sampling Frame of the Study

Stage	Sample unit	Number Of units	Name of the unit	Selection criteria
1.	District	One	Tumkur	Highest coconut area in Karnataka
2.	Taluk	Three	Chikkanayakanahalli Gubbi Tiptur	Highest coconut area in Tumkur district
3.	Villages	15 at the rate of 5 villages per each taluk	**Chikkanayakanahalli taluk** 1. Hoysalagatte 2. Mathigatta 3. Soralamavu 4. Yellenahalli 5. Haliyaru **Gubbi taluk** 1. Gubbi 2. Kadaba 3. Nittur 4. Rampura 5. Mathigatta **Tiptur taluk** 1. Kodagaehalli 2. Alkurkae 3. Tiptur 4. Thimbalapura 5. Bannihalli	Random
4.	Farmers	150 @ 30 farmers per identified farming system	-	Random

3.4 COST CONCEPTS USED IN THE STUDY

Different concepts and statistical tools used in the study discussed in this section.

3.4.1 Establishment Cost and Apportionment/Amortized cost

The establishment costs in the case of perennial crops were the actual costs incurred by the farmer in establishing and nurturing the crop till its bearing stage. It includes the costs incurred for the material, labour and incidental costs. These costs were then apportioned equally for every year of the life of the perennial crop.

The bearing stage in the case of coconut was seven years since traditional varieties such as Arsikere Tall were cultivated in study area while the life span of the same was taken as 60 years, similarly for arecanut, its bearing stage required seven years and having a life span of 50 years.

The actual cost of animals where purchased and the imputed value at prevailing market rates for animals born on the farm were considered as establishment costs.

3.4.2 Variable or Operational Costs

These were the costs incurred by the farmers for the enterprise, which were productive. Broadly these were the actual costs along with incidental charges incurred towards labour and material costs.

Seeds: The actual purchase price plus transportation costs incurred if any, farm produced seeds were imputed at prevailing market rates.

Farmyard Manure: It was valued at the actual purchase price, self-produced FYM was valued at market prices.

Fertilizers: At purchase prices plus transport and other incidental charges.

Plant Protection Chemicals: Price prevailed in the market.

Feeds and Concentrates: At purchase prices plus transport costs, self-produced feeds were evaluated at actual costs.

Fodder and Hay: The actual purchase cost plus transport and stocking charges. Self-produced fodder was evaluated. Self produced fodder and hay was valued at actual production charges. Veterinary and medicine charges. At actual cots what the farmers were incurred.

Labour: Hired labour was accounted for the actual wages paid by the farmer. Family human labour was imputed at the prevailing wage rates for comparison purpose. Labour in all enterprise was converted into mandays by multiplying female and child labour by 0.70 and 0.50 respectively.

Bullock labours both owned and hired were accounted at the prevailing hire rates.

Marketing Costs: These were the costs incurred by the farmer in preparing, packing, transporting and selling their products.

Miscellaneous Costs: These are the other incidental costs incurred in the operation of enterprise. The included cost are of perishable implements like ropes, baskets, repairs and maintenance of implements used *etc.*

Interest on Working Capital: It is the interest calculated on the entire working cost of the enterprise at the prevailing bank rate for half of the cropping period.

3.4.3 Fixed Costs

Land Revenue: Where field crop enterprises were involved, the land revenue was accounted at the rates fixed by the government.

Land Rent: The prevailing land rents for agricultural enterprises was imputed for the sample since all land holdings were observed to be owner operated.

Depreciation: The depreciation rates, life span and junk value for various agricultural implements and machinery were decided in consultation with the farmer consequently, the depreciation was calculated using the straight line method as shown below.

$$\text{Depreciation} = \frac{\text{Purchase value} - \text{Junk value}}{\text{Life span}}$$

In the case of livestock enterprises, Depreciation was calculated using the diminishing balance method. At the end multiply already available written down value of animal by r/100 (Roy, 1990).

$$\text{Depreciation} = \frac{\text{Value of animal x rate of interest}}{100}$$

Interest on Fixed Capital: This was calculated at the rate of 10 per cent on the book value of the asset/livestock, as the case may be for the study year.

Electricity Costs: These were levied on Horsepower basis and were included under fixed costs.

3.4.4 Returns

The returns from crop and livestock, where sold, were evaluated at the actual price obtained for them. Such of the quantities that were retained for seed or consumption were evaluated at the rates prevailing at harvest time. The same method was also followed for the evaluation of byproducts of various enterprises.

3.5 ANALYTICAL TOOLS AND TECHNIQUES

For assessing quantitatively the objectives and hypothesis outlined for the purpose of the present study, following analytical tools, techniques and statistical device were employed.

3.5.1 Tabular Analysis

Tabular analysis involving the computation of means, percentages *etc.* was employed to present the data regarding, the socio-economic profile, cropping systems, enterprise analysis, costs and returns, employment generation, constraints and opinions expressed by the farmers.

3.5.2 Functional Analysis

To study resource productivity and allocative efficiency in different farming systems a modified Cobb-Douglas type function was fitted

separately. This was done with a view to determine the extent to which the important resources that have been quantified, explain the variability in the gross returns of the farming systems and to determine whether the resources are optimally used in these farming systems.

Heady and Dillon (1963) indicated that the Cobb-Douglas type function has been the most popular of all possible algebraic forms in the farm firm analysis as it provides

a. Comparison

b. Adequate fit

c. Computational feasibility

d. Sufficient degrees of freedom

They further indicated that Cobb-Douglas type function has the greatest use in diagnostic analysis, reflecting the marginal productivities at mean levels of returns.

The general form of the function is $y = ax_i^{bi}$ where, 'x_i' is the variable resource measure, 'y' is the output, 'a' is a constant and 'bi' estimates extent of relationship between x and y and when x is at different magnitudes. The 'b' coefficient also represents the elasticity of production. The equation is in log linear form by the method of ordinary least squares.

This type of function allows for either constant or increasing or decreasing return to scale. It does not allow for total product curve embracing all the three simultaneously. The returns to scale can be estimated directly by getting the sum of 'bi' coefficients. The return will be

increasing, constant and decreasing as summation of 'bi' is greater or equal or less than unity, respectively. Test was conducted to see if the sum of b coefficients were significantly different from unity. Functions of the following form were fitted for different farming systems.

$Y = ax_1^{b1} .x_2^{b2} .x_3^{b3}.....x_n^{bn} . ei$

On linearisation it becomes

$logy = loga + b_1logx_1 + b_2logx_2 + b_3logx_3 + ...+b_nlogx_n + ei$

Production function for farming system as a whole

$logy = loga + b_1logx_1 + b_2logx_2 + b_3logx_3 + b_4logx_4 + b_5logx_5 + b_6logx_6 + b_7logx_7 + b_8logx_8 + ei$

Where,

Y = Gross returns in rupees

a = Intercept

x_1 = Land in acres

x_2 = Number of cows

x_3 = Cost of fertilizer + cost of FYM

x_4 = Bullock labour and human labour cost

x_5 = PPC + veterinary charges

x_6 = Cost of feeds and concentrates

x_7 = Cost of seeds

x_8 = Number of sheep

bi = Elasticities of production (i = 1 to 8)

ei = Error term

Note: x_8 only pertain to farming system-IV.

Returns to Scale

The returns to scale was estimated directly by getting the sum of 'bi' coefficients. The returns will be increasing, constant or diminishing based

on whether value of summation of 'bi' is greater, equal or less than unity respectively.

Resource use Efficiency

The ratio of the MVP's to MFC's of individual resources were used to judge the allocative efficiencies. The computed Marginal Value Product (MVP) was compared with the Marginal Factor Cost (MFC) or opportunity cost of the resource to draw inferences. A resource is said to be optimally allocated when its MVP = MFC.

The marginal value products (MVP's) were calculated at the geometric mean levels of the variables using the formula.

$$\text{MVP of } xi^{th} \text{ resource} = bi \frac{\bar{y}}{\bar{x}i}$$

Where,

$\bar{Y}$ = geometric mean of gross returns in different farming systems.

$\bar{x}i$ = geometric mean of i^{th} independent variable

bi = regression coefficient elasticity of production i^{th} dependent variable

This analysis was carried out in order to identify the possibilities of increasing gross returns under a given farm situation.

In imputing the marginal cost of the selected inputs the average per acre value of land, average per animal value of cows, average per animal value of sheep were taken as its marginal cost. The marginal cost of all

other inputs was considered as one, since those inputs have been measured in value terms in regression analysis.

3.5.3 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, shows what activities to undertake and how much of each resource to allocate to each activity so that the net farm returns are maximised in a year. Linear programming technique was chosen because among the various analytical tools available for allocation of available limited farm resources among alternative enterprise, it is the most powerful and efficient tool of analysis. The traditional tool of budgeting becomes less efficient when the number of variables or constraints and real variables are large and unique solutions are desired.

3.5.3.1 Selection of Process or Activities

The sample farmers were found to follow crop, dairy and sheep enterprises. The crop activities under taken by them were in the following order.

The coconut and arecanut were perennial crops. In *kharif* season farmers were found to have grown, greengram, groundnut and paddy. Similarly during *rabi* season ragi was the major crop. Details of the activities carried out in different farming system is detailed in the Table 3.5.

Table 3.5. Activities carried out in different Farming Systems

Sl. No.	Activities	Farming system - I	Farming system - II	Farming system- III	Farming system - IV	Farming system V
1.	Coconut	X1	X1	X1	X1	X1
2.	Arecanut	–	–	–	–	X2
3.	*Kharif* greengram	X3	X3	X3	X3	–
4.	*Kharif* groundnut	–	X4	–	–	–
5.	*Kharif* paddy	–	–	X5	–	–
6.	*Rabi* ragi	X6	X6	X6	X6	X6
7.	Dairy	X7	X7	X7	X7	X7
8.	Sheep	–	–	–	X8	–

3.5.3.2 Mathematical Formulation of the Model

In linear programming analysis, a linear functions of a number of variables to be maximised subject to a number of constraints in the form of linear equalities and inequalities. In mathematical form, one-year linear programming model can be expressed in the following way.

$$\text{Maximize } Z = \sum_{j=1}^{n} Cj\ Xj \text{ (objective function)}$$

Subject to

1) $$\sum_{j=1}^{n} Cij\ Xij \geq bi \quad (i=1 \ldots\ldots k)$$

2) $$\sum_{j=1}^{n} aij\ Xij \leq bi \quad (i=k+1 \ldots\ldots m)$$

3) $$\sum_{j=1}^{n} aij\ Xij = bi \quad (i=m+n \ldots\ldots n)$$

4) $$\sum_{j=1}^{n} xj \geq 0$$

Where,

Z = net returns from all crops activities included in the model

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

Xj = Level of j^{th} activity

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

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

3.5.3.3 Activities used in the Model

The activities (Xjs) 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 following in particular. Farming system was considered as an activity, thus different crop/livestock rotations followed of farmers of each farming system constituted the activities of the model. In case of dairy and sheep rearing animal was regarded as separate activity.

The disposal activities are the derived activities to take care of the inequalities of the model. They are needed to convert the inequalities into qualities for the solution of the problem. However, these activities were automatically generated by the computer under QSB programming model.

3.5.3.4 Resource Levels and Constraints

One of the most important components of the LP model is the identification of resource limitations (b's) in each farming systems.

Land Constraint

The total land owned by the farmer was taken as operational holding of the farmer. Whole land was classified as *kharif* irrigated land, *kharif* dry land, *rabi* irrigated land, *rabi* dry land and summer irrigated land.

Labour Constraint

Both human and bullock labour availability were estimated from number of days human labour worked and bullock labour employed on his farm in each production phase, *i.e. kharif, rabi* and summer. Women labour and child labour were converted into male equivalents and included in the model. The formula used for conversion was male equivalent of female labour = 0.75 x total number of female labour days and male equivalent of child labour = 0.5 x total number of child labour days. Conversion factor 0.75 or 0.5 were taken based on the ratio of wage paid to the men labour v/s women labour and child labour.

The restrictions with regard to both human labour and bullock labour were imposed for all three seasons *i.e. kharif, rabi* and summer in the model.

Capital Constraint

It is 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 sufficient to meet the requirement of different agricultural operations. Nevertheless, it may also limit the scope for adoption of improved production practices.

For the availability of capital, the constraint was set depending on the expenditure made on different inputs.

The details of the various restrictions used in the model for different farming systems were given below.

Resource Availability/Restrictions for all the Farming System in General

Land Restriction

b_1 = *Kharif* irrigated land (ha)

b_2 = *Kharif* dry land (ha)

b_3 = *Rabi* irrigated land (ha)

b_4 = *Rabi* dry land (ha)

b_5 = Summer irrigated land (ha)

b_6 = Number of dairy animals available (No.)

Labour Restriction

Human Labour Restriction

b_7 = Labour availability during *kharif* (mandays)

b_8 = Labour availability during *rabi* (mandays)

b_9 = Labour availability during summer (mandays)

Bullock Labour Restriction

b_{10} = Labour availability during *kharif* (pair days)

b_{11} = Labour availability during *rabi* (pair days)

b_{12} = Labour availability during summer (pair days)

Capital Restriction

b_{13} = Capital availability (Rs.)

These are the common restrictions for all the farming systems in the study area.

The restrictions that differ from farming system to farming system are given below.

Farming System – I

Minimum Restriction

b_{14} = Area under coconut (ha)

b_{15} = Area under *kharif* greengram (ha)

b_{16} = Area under *rabi* ragi (ha)

Farming System – II

Minimum Restriction

b_{17} = Area under coconut (ha)

b_{18} = Area under *kharif* greengram (ha)

b_{19} = Area under *kharif* groundnut (ha)

b_{20} = Area under *rabi* ragi (ha)

Farming System – III

Minimum Restriction

b_{21} = Area under coconut (ha)

b_{22} = Area under *kharif* greengram (ha)

b_{23} = Area under *kharif* paddy (ha)

b_{24} = Area under *rabi* ragi (ha)

Farming System – IV

Minimum Restriction

b_{25} = Area under coconut (ha)

b_{26} = Area under *kharif* greengram (ha)

b_{27} = Area under *rabi* ragi (ha)

b_{28} = Number of sheep

Farming System – V

Minimum Restriction

b_{29} = Area under coconut (ha)

b_{30} = Area under arecanut (ha)

Maximum Restriction

b_{31} = Area under *rabi* ragi (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.

Programming Model

The input co-efficient included in this study refer to land, labour and capital. Land is classified into *kharif* irrigated land, *kharif* dry land

rabi irrigated land, *rabi* dry land and summer irrigated land. Labour included both family and hired. It also included both human and bullock labour. Capital refers to funds required to meet the cost of seeds, fertilizers, farm yard manure, PPC, dry fodder, green fodder, concentrates, veterinary expenses, marketing expenses.

The average prices that the sample farmers paid and received are considered as the input-output prices in this study. The input-output coefficient in the model refer to per hectare (crops) or per animal (dairy and sheep).

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 of the existing crop alternatives with existing cultivation practices and the available resources to the farmers.

Optimum Plans

Plan-1

These models are similar to the existing plan with the reallocation of existing resources by using programming technique.

Plan-2

These models are similar to optimum plan with relaxation of labour, capital and number of animals. These models would help to examine the effect of increased capital and reallocation of land 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.

Each of these models was designed separately for the five systems. Thus there are 15 models in this study.

Results

IV. RESULTS

In this chapter keeping in view the objectives of the study the results are presented under the following heads.

4.1 Social Characteristics of Sample Farmers

4.2 Identified Coconut based Farming Systems in the Study Area

4.3 Income and Employment Generation in different Coconut based Farming Systems

4.4 Resource use Efficiency in different Coconut based Farming Systems

4.5 Optimum Farm Plans for different Coconut based Farming Systems

4.6 Constraints and Prospects Associated with different Coconut based Farming Systems

4.1 SOCIAL CHARACTERISTICS OF SAMPLE FARMERS

The information on social characteristics of the study area presented in Table 4.1 revealed that, majority of the farmers belonged to the middle age group in all the selected taluks of the district. In Chikkanayakanahalli and Gubbi taluks it was 82 per cent. In Tiptur taluk 86 per cent of the farmers belonged to the middle age group.

In the selected taluks with respect to family size, majority of the farmers had large family size, of 56 per cent, 58 per cent and 60 per cent for Chikkanayakanahalli, Gubbi and Tiptur taluks respectively. Further it was also observed that in the selected taluks majority of the coconut growing farmers were educated. The highest literacy level was observed in

Table 4.1. Social Characteristics of Sample Farmers

(N=150)

Sl. No.	Particulars	Chikkanayakanahalli		Gubbi		Tiptur	
		Number	Per cent	Number	Per cent	Number	Per cent
I.	**Age**						
a.	Young age (≤ 35 years)	7.00	14.00	8.00	16.00	5.00	10.00
b.	Middle age (36-54 years)	41.00	82.00	41.00	82.00	43.00	86.00
c.	Old age (>55 years)	2.00	4.00	1.00	2.00	2.00	4.00
II.	**Family size**						
a.	Small family (≤ 6 members)	22.00	44.00	21.00	42.00	20.00	40.00
b.	Large family (>6 members)	28.00	56.00	29.00	58.00	30.00	60.00
III.	**Education level**						
a.	Illiterate	5.00	10.00	3.00	6.00	-	-
b.	Literate	45.00	90.00	47.00	94.00	50.00	100.00
1.	Primary school	6.00	12.00	9.00	18.00	15.00	30.00
2.	Middle school	22.00	44.00	23.00	46.00	20.00	40.00
3.	High school	12.00	24.00	10.00	20.00	12.00	24.00
4.	College	5.00	10.00	5.00	10.00	3.00	6.00

Tiptur taluk (100%) followed by Gubbi taluk (94%) and Chikkanayakanahalli taluk (90%). In Chikkanayakanahalli, among the sample farmers 44 per cent had middle school education, 24 per cent of the farmers had high school education, and 12 per cent of them attained education level of primary school. Whereas incase of Gubbi taluk out of 94 per cent of the literate farmers, 46 per cent of them studied up to middle school level and only 10 per cent of them were educated upto college level.

In Tiptur taluk all the sample farmers were educated. Of which 40 per cent had middle school education and 30 per cent, 24 per cent and six per cent of them had primary school, high school and college education respectively.

4.2 IDENTIFIED COCONUT BASED FARMING SYSTEMS IN THE STUDY AREA

4.2.1 Coconut based Farming Systems in the Study Area

Different coconut based farming systems were practiced by the farmers in the study area. During the study period 13 different coconut based farming systems observed are presented in Table 4.2. Among these farming systems 28.88 per cent of the farmers were practising coconut + greengram – ragi + dairy enterprises, 17.77 per cent of the sample farmers were following coconut + paddy + greengram – ragi + dairy enterprises, 11.11 per cent of the farmers were practising coconut + arecanut + ragi + dairy enterprises, 10.00 per cent of farmers had adopted coconut + greengram + groundnut-ragi + dairy activities and 8.88 per cent of farmers followed coconut + greengram – ragi + dairy + sheep rearing

Table 4.2. Identified Coconut based Farming Systems in the Study Area

(N=90)

Sl. No.	Farming Systems	System number	Number	Per cent
1.	Coconut + Greengram – Ragi + Dairy	I	26	28.88
2.	Coconut + Greengram + Groundnut – Ragi + Dairy	II	9	10.00
3.	Coconut + Paddy + Greengram – Ragi + Dairy	III	16	17.77
4.	Coconut + Greengram – Ragi + Dairy + Sheep rearing	IV	8	8.88
5.	Coconut + Arecanut + Ragi + Dairy	V	10	11.11
6.	Coconut + Greengram + Paddy – Ragi + Sheep rearing	VI	4	4.44
7.	Coconut + Arecanut + Paddy – Ragi + Dairy	VII	5	5.55
8.	Coconut + Ragi + Dairy + Sericulture	VIII	5	5.55
9.	Coconut + Paddy – Ragi + Sericulture	IX	2	2.22
10.	Coconut + Ragi + Dairy + Poultry	X	2	2.22
11.	Coconut + Fishery	XI	1	1.11
12.	Coconut + Greengram – Ragi + Pottery	XII	1	1.11
13.	Coconut + Piggery	XIII	1	1.11

53

enterprises. The other coconut based farming systems in the study area were coconut + arecanut + paddy – ragi + dairy (5.55%), coconut + ragi + dairy + sericulture (5.55%), coconut + greengram + paddy – ragi + sheep rearing (4.44%), coconut + paddy – ragi + sericulture (2.22%), coconut + arecanut + paddy + poultry (2.22%), coconut + fishery (1.11%), coconut + greengram – ragi + pottery (1.11%) and coconut + piggery (1.11%). Among these farming systems top five coconut based farming systems were selected for the study.

4.2.2 Average Farm Size in the Identified Coconut based Farming Systems in the Study Area

The farm size in the identified farming systems (Table 4.3), revealed that the farm size was found to be the largest in farming system-III (4.02 ha) followed by farming system-V (3.77 ha), farming system-II (3.49 ha), farming system-I (3.12 ha) and farming system IV (2.88 ha).

4.2.3 Cropping Pattern of Sample Farmers under different Coconut based Farming Systems in Chikkanayakanahalli taluk

It is revealed from the results presented in Table 4.4 that the major crops grown in *kharif* season include green gram and fodder crops in farming system-I, which contributed 10.47 per cent and 4.94 per cent of the total cropped area. In farming system-II groundnut (10.25%) and greengram (7.54%) were the main crops followed by fodder crops (3.38%). In System-III greengram and paddy observed to be the major crops, which contributed 11.38 and 6.64 percent to the total area. In farming system-IV greengram was the major crop with an area share of 11.14 per cent

Table 4.3. Average Farm Size in the Identified Coconut based Farming Systems in the Study Area

(in hectares)

Sl. No.	Particulars	Farm size
1.	Farming System I	3.12
2.	Farming System II	3.49
3.	Farming System III	4.02
4.	Farming System IV	2.88
5.	Farming System V	3.77

Table 4.4. Cropping Pattern of Sample Farmers under different Coconut based Farming Systems in Chikkanayakanahalli Taluk

(hectares)

(N=50)

Sl. No.	Particulars	Farming System-I		Farming System-II		Farming System-III		Farming System-IV		Farming System-V	
		Area	%	Area	%	Area	%	Area	%	Area	%
I.	**Land used for field crops**										
a.	*Kharif* season										
1.	Greengram	5.30	10.47	3.90	7.54	7.20	11.38	5.40	11.14	1.25	2.81
2.	Groundnut	0.48	0.94	5.30	10.25	0.60	0.94	1.25	2.57	0.50	1.12
3.	Paddy	0.50	0.98	1.25	2.41	4.20	6.64	1.00	2.06	-	-
4.	Fodder crops	2.50	4.94	1.75	3.38	2.50	3.95	2.00	4.12	1.50	3.38
5.	Other crops	2.00	3.95	1.50	2.90	2.00	3.16	1.75	3.61	1.50	3.38
	Sub total	10.78	21.30	13.70	26.49	16.50	26.08	11.40	23.52	4.75	10.71
b.	*Rabi* season										
1.	Ragi	7.50	14.82	5.65	10.92	10.00	15.81	8.00	16.51	5.00	11.27
2.	Other crops	1.50	2.96	4.00	7.73	3.75	5.92	3.15	6.50	-	-
	Sub total	9.00	17.79	9.65	18.86	13.75	21.39	11.15	23.01	5.00	11.27
c.	Summer season										
1.	Fodder crops	3.00	5.93	2.00	3.86	3.00	4.74	3.70	7.63	3.00	6.76
2.	Other crops	1.00	1.97	1.20	2.32	1.50	2.37	1.20	2.47	-	-
	Sub total	4.00	7.90	3.20	6.18	4.50	7.11	4.90	10.11	3.00	6.76
	Sub total (a+b+c)	23.78	47.00	26.55	51.33	34.75	54.92	27.45	56.64	12.75	28.74
II.	**Land used for plantation crops**										
1.	Coconut	9.76	19.29	9.80	18.9	12.00	18.97	8.25	17.02	9.00	20.29
2.	Coconut+Arecanut	1.25	2.47	1.20	2.32	2.00	3.16	0.60	1.23	3.00	6.76
3.	Coconut+Banana	0.80	1.58	0.50	0.96	-	-	1.00	2.06	0.50	1.12
4.	Coconut+Arecanut +Vanila	-	-	-	-	-	-	-	-	0.90	2.02
5.	Arecanut	-	-	0.40	0.77	-	-	-	-	1.50	3.38
6.	Coconut+Annuals	13.00	25.69	12.00	23.20	14.00	22.13	9.00	18.57	14.00	31.56
	Sub total	24.81	49.04	23.90	46.20	28.00	44.26	18.35	38.90	28.90	65.16
III.	**Perennial crops**										
1.	Forest crops	0.80	1.58	0.50	0.96	-	-	1.35	2.78	1.50	3.38
2.	Fruit crops	1.20	2.37	0.75	1.45	0.50	0.79	0.80	1.65	1.20	2.70
	Sub total	2.00	3.95	1.25	2.41	0.50	0.79	2.15	4.43	2.70	6.08
	Total (I+II+III)	50.59	100	51.7	100	63.25	100	48.45	100	44.35	100

followed by fodder crops (4.12%). Under farming system-V fodder crops were the major crops (3.38%).

During *rabi* season ragi was the major crop in all the five farming systems with a share of 14.82 per cent, 10.92 per cent, 15.81 per cent, 16.51 per cent and 11.27 per cent, respectively in farming systems-I, II, III, IV and V.

The fodder crops were the major summer season crops with the percent share of 5.93 per cent, 3.86 per cent, 3.7 per cent, 4.74 per cent, 7.63 per cent and 6.76 per cent respectively in farming systems-I, II, III, IV and V.

Among the plantation crops coconut was the major tree crop, which was cultivated as a monocrop and combined with other perennials and annuals.

In Chikkanayakanahalli under respective farming systems, cultivation of coconut with annuals was popular which contributed 25.69 per cent, 23.2 per cent, 22.13 per cent, 18.57 per cent and 31.56 per cent to the total area. However, cultivation of coconut as a monocrop was also observed and its share was 19.29 per cent, 18.90 per cent, 18.97 per cent and 17.02 per cent and 20.29 per cent in farming systems-I, II, III, IV and V respectively. The cultivation of coconut along with other plantation sole crop *viz.*, arecanut was observed which was more popular under farming system-V (3.38%). Among the plantation crops arecanut as an intercrop with Coconut accounts for the major share (6.76%).

The other perennial crops like forest crops and fruit crops were also cultivated by farmers which was about 3.95 per cent, 2.41 per cent, 0.79

per cent, 4.43 per cent and 6.08 per cent respectively in farming systems-I, II, III, IV and V.

4.2.4 Cropping Pattern of Sample Farmers under different Coconut based Farming Systems in Gubbi taluk

In Gubbi taluk greengram was the major crop during the *kharif* season accounting for 22.69 per cent, 8.77 per cent, 11.68 per cent and 14.04 per cent of the total area under farming systems-I, II, III and IV respectively while under farming system II during the *kharif*, the share of groundnut in total area was 9.21 per cent. Fodder crops occupied a considerable area in all the five systems with 8.35 per cent, 4.38 per cent, 5.74 per cent, 5.50 per cent and 4.52 per cent respectively in farming systems-I, II, III, IV and V.

During *rabi* minor millet ragi occupied highest area indicating its share in the total area as 18.10 per cent, 11.40 per cent, 17.62 per cent, 19.27 per cent and 10.47 per cent respectively in systems-I, II, III, IV and V.

In all the farming systems of the taluk, area under plantation crops, especially coconut was higher. Share of coconut as a monocrop in the total area was 17.27 per cent, 19.70 per cent, 21.07 per cent, 14.04 per cent and 13.57 per cent respectively under the farming systems-I, II, III, IV and V and coconut with annuals was 22.28 per cent, 15.35 per cent, 11.49 per cent, 19.27 per cent and 13.48 per cent respectively in farming system-I, farming system-II, farming system-III, farming system-IV and farming system-V respectively. Under the identified farming systems, arecanut was grown as a second sole plantation crop along with coconut

Table 4.5 Cropping Patterns of Sample Farmers under different Coconut based Farming Systems in Gubbi Taluk (hectares)

(N=50)

Sl. No.	Particulars	Farming System-I		Farming System-II		Farming System-III		Farming System-IV		Farming System-V	
		Area	%	Area	%	Area	%	Area	%	Area	%
I.	**Land used for field crops**										
a.	*Kharif* season										
1.	Greengram	4.20	11.69	4.00	8.77	6.10	11.68	5.10	14.04	1.10	2.48
2.	Groundnut	-	-	4.20	9.21	-	-	0.20	0.55	0.30	0.67
3.	Paddy	0.10	0.27	1.20	2.63	5.30	10.15	1.20	3.30	1.30	2.94
4.	Fodder crops	3.00	8.35	2.00	4.38	3.00	5.74	2.00	5.50	2.00	4.52
5.	Other crops	1.25	3.48	1.00	2.19	1.50	2.87	1.50	4.12	0.50	1.13
	Sub total	7.30	20.33	12.40	27.19	15.90	30.45	10.00	27.53	5.10	11.53
b.	*Rabi* season										
1.	Ragi	6.50	18.10	5.20	11.40	9.20	17.62	7.00	19.27	4.50	10.17
2.	Other crops	0.50	1.39	2.30	5.04	2.10	4.02	0.20	0.55	0.30	0.67
	Sub total	7.00	19.49	7.60	16.66	11.30	21.64	7.20	19.82	4.80	10.85
c.	Summer season										
1.	Fodder crops	2.00	5.57	2.20	4.82	1.80	3.44	1.72	4.73	2.00	4.52
2.	Other crops	1.50	3.28	1.20	2.63	1.40	2.68	2.10	5.78	0.20	0.45
	Sub total	3.50	9.74	3.40	7.45	3.20	6.13	3.82	10.51	2.20	4.97
	Sub total (a+b+c)	17.80	49.56	23.40	51.31	30.40	58.23	21.02	57.87	12.10	27.36
II.	**Land used for plantation crops**										
1.	Coconut	6.20	17.27	9.00	19.70	11.00	21.07	5.10	14.04	6.00	13.57
2.	Coconut+Arecanut	1.20	3.34	3.00	6.57	2.5	4.78	0.70	1.92	4.20	9.50
3.	Coconut+Banana	1.50	4.17	1.20	2.63	1.40	2.68	-	-	0.50	1.13
4.	Coconut+Arecanut +Vanila	-	-	-	-	0.20	0.38	-	-	1.50	3.39
5.	Arecanut	0.20	0.55	1.50	3.28	0.50	0.95	2.00	5.50	8.95	20.24
6.	Coconut+Annuals	8.00	22.28	7.00	15.35	6.00	11.49	7.00	19.27	5.96	13.48
	Sub total	17.10	47.60	21.7	47.58	21.6	41.37	14.8	40.74	27.11	61.32
III.	**Perennial crops**										
1.	Forest crops	1.00	2.78	0.20	0.43	0.20	0.38	0.50	1.37	3.00	6.78
2.	Fruit crops	-	-	0.30	0.65	-	-	-	-	2.00	4.52
	Sub total	1.00	2.78	0.50	1.09	-	-	0.50	1.37	5.00	11.30
	Total (I+II+III)	35.90	100	45.6	100	0.20	0.38	36.32	100	44.21	100

and its share in the total area was maximum in farming system V (20.24%).

Among the perennials, forest and fruits crops share in the total area was 2.78 per cent, 1.09 per cent 1.37 per cent and 11.30 per cent with respect to system-I, II, IV and V.

4.2.5 Cropping Pattern of Sample Farmers under different Coconut based Farming Systems in Tiptur Taluk

Among the different field crops grown in Tiptur taluk in *kharif* season, greengram (10.65%) and fodder crops (4.73%) constituted a greater proportion of the total area in the farming system-I. Groundnut (11.45%) followed by greengram (9.17%) and fodder crops were important crops of the farming System-II, whereas in farming System-III greengram (11.50%), paddy (9.17%) and fodder crops (3.85%) were found to be important. In farming system-IV green gram and fodder corps were the major crops whose share in the total area was 11.94 per cent and 11.35 per cent respectively. The area under fodder crops in the farming system IV (5.01%) and in farming system V (4.26%) was observed to be important.

During the *rabi* season, ragi was the major crop in all the farming systems. The percent share of ragi to the total area was 14.43, 12.84, 12.89, 11.94 and 12.79 respectively in farming system-I, II, III, IV and V.

In the study area plantation crops assumed greater importance and their per cent share to the total area was 49.34, 44.72, 44.58, 41.33 and 64.33 with respect to farming systems I, II, III, IV and V. The share of Coconut as a monocrop, to the total area was 20.11, 18.80, 20.18, 16.96

Table 4.6. Cropping Pattern of Sample Farmers under different coconut based Farming Systems in Tiptur Taluk (hectares)

(N=50)

Sl. No.	Particulars	Farming System-I		Farming System-II		Farming System-III		Farming System-IV		Farming System-V	
		Area	%	Area	%	Area	%	Area	%	Area	%
I.	**Land used for field crops**										
a.	*Kharif* season										
1.	Greengram	4.50	10.65	4.00	9.17	6.30	11.50	5.00	11.94	0.40	0.85
2.	Groundnut	-	-	5.00	11.45	0.20	0.36	-	-	0.20	0.42
3.	Paddy	1.00	2.36	-	-	5.00	9.17	-	-	0.10	0.21
4.	Fodder crops	2.00	4.73	1.70	3.89	2.10	3.85	4.75	11.35	2.00	4.26
5.	Other crops	1.50	3.55	1.30	2.98	1.25	2.29	2.10	5.01	1.20	2.55
	Sub total	9.00	21.30	12.0	27.52	13.60	24.95	11.85	28.31	3.90	8.31
b.	*Rabi* season										
1.	Ragi	6.10	14.43	5.60	12.84	7.00	12.89	5.00	11.94	6.00	12.79
2.	Other crops	2.20	5.20	2.30	5.27	5.00	9.17	4.10	9.79	2.10	4.47
	Sub total	8.30	19.64	7.90	18.11	12.00	22.01	9.10	21.74	8.10	17.27
c.	Summer season										
1.	Fodder crops	2.10	4.97	2.30	5.27	3.00	5.50	2.00	4.77	2.00	4.26
2.	Other crops	1.30	3.07	1.90	4.35	1.50	2.75	1.30	3.10	1.50	3.19
	Sub total	3.40	8.04	4.20	9.63	4.95	8.25	3.30	7.88	3.50	7.46
	Sub total (a+b+c)	20.70	48.99	24.10	55.27	30.10	55.28	24.25	57.94	15.50	33.04
II.	**Land used for plantation crops**										
1.	Coconut	8.50	20.11	8.20	8.80	11.00	20.18	7.10	16.96	12.00	25.5
2.	Coconut+Arecanut	0.10	0.23	0.20	0.45	0.10	0.18	0.20	0.47	2.00	4.26
3.	Coconut+Arecanut +Vanila	-	-	-	-	-	-	-	-	1.20	2.55
4.	Arecanut	-	-	0.10	0.22	-	-	-	-	3.00	6.39
5.	Coconut+Annuals	12.25	28.99	11.00	25.22	13.00	23.35	10.00	23.89	12.00	25.5
	Sub total	20.85	49.34	19.50	44.72	24.50	44.58	17.30	41.33	30.20	64.33
III.	**Perennial crops**										
1.	Forest crops	0.20	0.47	-	-	0.30	0.55	0.20	0.47	1.20	2.55
2.	Fruit crops	0.50	1.18	-	-	-	-	0.10	0.23	-	-
	Sub total	0.70	1.65	-	-	0.30	0.55	0.30	0.71	1.20	2.55
	Total (I+II+III)	42.25	100	43.60	100	54.50	100	41.85	100	46.90	100

and 25.50 per cent under the respective farming systems. The coconut + annuals share in the total area was 28.99 per cent, 25.22 per cent, 23.35 per cent, 23.89 per cent and 25.5 per cent under farming system-I, II, III, IV and V respectively. The major perennials in the region were forest crops and fruit crops. The percent share of perennials to the total area was 1.65 per cent, 0.55 per cent, 0.71 per cent and 2.55 per cent respectively in the farming system-I, farming system-III and farming system-IV and farming system V.

4.2.6 Livestock Possession in different Farming Systems in Selected Taluks of the Study Area

Dairy and sheep rearing were the major enterprises in the study area (Table 4.7). The total numbers of dairy animals with the sample farmers were 103 in Chikkanayakanahalli taluk, 101 and 100 numbers in Gubbi and Tiptur taluks respectively. Whereas the number of sheep in Chikkanayakanahalli, Gubbi and Tiptur taluks were observed to the 490, 381 and 410 respectively.

The percent share of possession of dairy animals was relatively more in farming system-IV (22.33%) when compared to farming system-V (21.35%) in Chikkanayakanahalli and similar trend was also observed in Gubbi and in Tiptur taluks. Further keeping of dairy animals was conspicuous under remaining farming systems also.

In the study area the sheep rearing activity was observed only under farming system-IV. The number of sheep differs from taluk to taluk, which was highest in Chikkanayakanahalli (490) followed by Gubbi(410) and Tiptur taluk (381).

Table 4.7. Livestock Possession in different Farming Systems in Selected Taluks of Study Area

(N=150) (In numbers)

Sl. No.	Particulars	Chikkanayakanahalli		Gubbi		Tiptur	
		Dairy	Sheep	Dairy	Sheep	Dairy	Sheep
1.	Farming System-I	19 (18.44)	-	20 (19.80)	-	18 (18.00)	-
2.	Farming System-II	18 (17.4)	-	19 (18.81)	-	21 (21.00)	-
3.	Farming System-III	21 (20.38)	-	17 (16.83)	-	20 (20.00)	-
4.	Farming System-IV	23 (22.33)	490 (100)	24 (23.76)	381 (100)	22 (22.00)	410 (100)
5.	Farming System-V	22 (21.35)	-	21 (20.79)	-	19 (19.00)	-
	Total	103	490	101	381	100	410

Note: Figures in parentheses indicate percentage to total

4.3 INCOME AND EMPLOYMENT GENERATION IN DIFFERENT COCONUT BASED FARMING SYSTEMS

4.3.1 Net Farm Income from Identified Farming Systems in the Study Area

Farming system at farm level aims at the efficient use of available resources to improve or maximise the overall farm income. On the other hand it also tries to minimize the production risk by diversifying the farming activities, which helps in spreading risks on various enterprises instead of one activity. Information on the net farm income from the identified farming systems in the study area is presented in Table 4.8. From the table it is observed that the overall net returns of Rs.76,487 was highest under farming system V. While it was Rs.42,781 under farming system IV and Rs.42,246 under farming system I. Among the selected taluks, Gubbi taluk farmers realised highest net returns of Rs.85,600 under farming system V. The net return for Tiptur and Chikkanayakanahalli under farming system V were Rs.72,000 and Rs.71,861 respectively. Under farming system IV and I the net returns for the selected taluks were relatively less when compared to the farming system V.

4.3.2 Human Labour Employment in different Farming Systems

Labour employment plays an important role in the realization of any farm family goals through different farming activities. The quantum of employment generated under various farming systems by the farmers in the study area were worked out for human labour and the details are given in the Table 4.9. It could be seen from the table that among the

Table 4.8. Net Farm Income from Identified Farming Systems in the Study Area

(Rupees/farm)

Sl. No.	Farming Systems	Chikkanay akanahalli	Gubbi	Tiptur	Overall
1.	**Farming System-I**	-	-	-	-
a.	Total cost	121884	123020	122242	122382
b.	Gross Returns	163891	165520	164473	164628
c.	Net Returns	42007	42500	42231	42246
2.	**Farming System-II**				
a.	Total cost	109185	110059	109631	109625
b.	Gross Returns	145733	146899	146328	146320
c.	Net Returns	36548	36840	36697	36695
3.	**Farming System-III**				
a.	Total cost	126253	126639	126460	126450
b.	Gross Returns	164153	164654	164422	164409
c.	Net Returns	37900	38016	37962	37959
4.	**Farming System-IV**				
a.	Total cost	100694	87720	98776	95730
b.	Gross Returns	145694	126920	146996	138511
c.	Net Returns	45000	39200	44143	42781
5.	**Farming System-V**				
a.	Total cost	149991	178664	150281	159645
b.	Gross Returns	221852	264264	150264	236132
c.	Net Returns	71861	85600	72000	76487

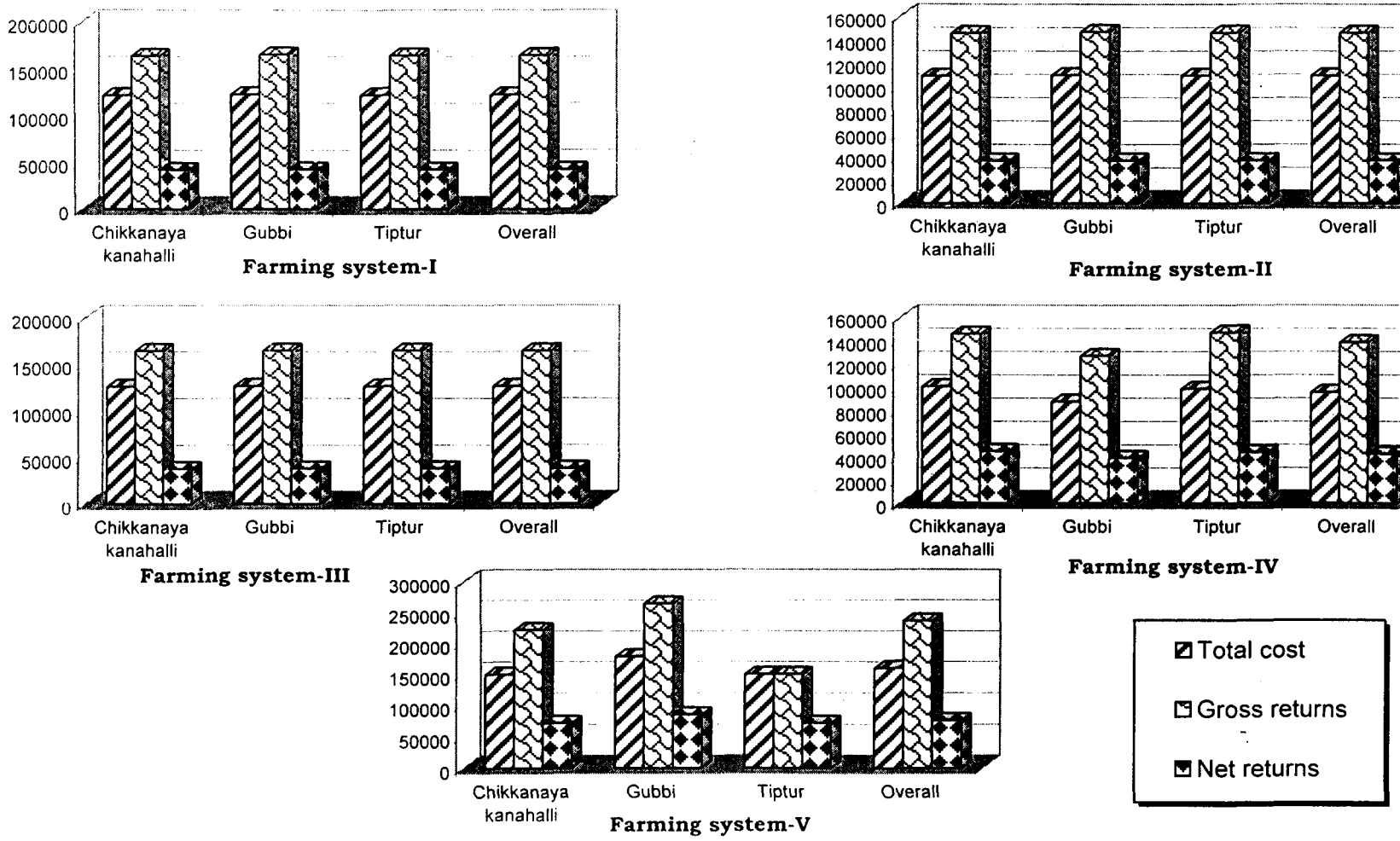

Fig. 4.1. Net Farm Income from Identified Farming Systems in the Study Area

Table 4.9. Human Labour Employment in different Farming Systems

(Man days/farm)

Sl. No.	Farming Systems	Chikkanay akanahalli	Gubbi	Tiptur	Overall
1.	Farming System-I	398.0	395.0	399.2	397.7
2.	Farming System-II	460.6	453.0	459.0	457.2
3.	Farming System-III	246.4	241.4	239.4	242.4
4.	Farming System-IV	362.0	322.0	337.8	340.6
5.	Farming System-V	430.0	452.0	409.8	430.6

identified farming systems, the human labour requirement was the highest under farming system II (457.20 mandays), followed by farming system-V, farming system-I, farming system-IV and farming system-III. Similar pattern was observed for three taluks of the study area. However, under farming system-IV (322 mandays per farm) and farming system-V (452 mandays per farm), the labour requirement varied greatly between the taluks. Further, per farm human labour employment under farming system II, was observed to be maximum in Chikkanayakanahalli (460.00 mandays), Gubbi (453.00 mandays) and Tiptur (459.00 mandays) taluks. On the contrary the per farm labour employment was relatively less under farming system III followed in Chikkanayakanahalli (246.40 mandays), Gubbi (241.40 mandays) and Tiptur taluks (239.40 mandays).

4.3.3 Bullock Labour Employment in different Farming Systems

The quantum of bullock labour employed under various farming systems followed by the farmers in the study area was worked out and the details are given in Table 4.10. It can be seen from the table that among the five identified farming systems, the farming system-II required highest bullock labour (196.4 pairdays) followed by farming system-V (173.5 pairdays), farming system-I (162 pairdays), farming system-III (160.3 pairdays) and farming system-IV (86.3 pairdays). There was no marked difference observed among the selected taluks in the employment of bullock labour under identified five farming systems.

4.3.4 Cost and Returns of different Enterprises in Identified Farming Systems

The costs and returns observed for different enterprises for identified farming systems are presented under the following broad heads.

Table 4.10. Bullock Labour Employment in different Farming Systems

(Pair days/farm)

Sl. No.	Farming Systems	Chikkanay akanahalli	Gubbi	Tiptur	Overall
1.	Farming System-I	160.0	163.0	161.0	162.0
2.	Farming System-II	198.0	196.0	195.2	196.4
3.	Farming System-III	165.0	159.0	158.9	160.3
4.	Farming System-IV	88.0	84.5	86.4	86.3
5.	Farming System-V	172.0	174.0	174.5	173.5

4.3.4.1 Cost and Returns of different Enterprises in Farming System-I

The per farm cost, returns and respective per cent share of enterprises in farming system-I were calculated and presented in the Table 4.11. The total cost of cultivation observed for the farming system I was Rs.1,22,322 and the net returns was Rs. 42,246. Further with the existing enterprises in farming system-I the maximum share of 80.96 per cent in total cost was occupied by coconut, followed by dairy (11.60%). For the remaining enterprises *i.e.*, greengram and ragi, 4.19 per cent and 3.25 per cent of the total cost was observed.

Under farming system I the percent contribution of different enterprises to the net returns was observed to be maximum with respect to coconut and accounted 49.51 per cent, which was followed by dairy, whose share was 47.92 per cent. The net returns contribution from ragi (1.04%) and greengram (0.39%) to the total were comparatively less.

4.3.4.2 Cost and Returns of different Enterprises in Farming System-II

The cost and returns per farm from the identified activities under farming system II are presented in Table 4.12. For the system as a whole, it was observed that the total cost per farm was Rs. 1,09,625 and the net return was Rs. 36,695. In farming system-II the major share in total cost (74.62%) was occupied by coconut. Under the system, in the total net returns the share of Coconut was 35.97 per cent. The dairy maintenance cost and net returns were 11.98 per cent and 56.28 per cent respectively. In the total cost, groundnut cultivation cost was observed to be 4.17 per

Table 4.11. Cost and Returns of different Enterprises in Farming System-I

(Rupees/farm)

Sl. No.	Particulars	Coconut	Greengram	Ragi	Dairy
1.	Amortized establishment cost	56805 (46.42)	-	-	-
2.	Total variable cost	37478 (30.62)	3864.3 (2.15)	3313 (2.70)	12600 (10.2)
3.	Total fixed cost	4800 (3.92)	1210 (0.98)	660 (0.53)	1596
4.	Total cost	99084 (80.96)	5129 (4.19)	3973 (3.25)	14196 (11.60)
5.	Gross returns	120000 (72.89)	5775 (3.51)	4413 (2.68)	34440 (20.92)
6.	Net returns	20916 (49.51)	646.7 (1.53)	440 (1.04)	20244 (47.92)
7.	Returns/rupee expenditure	1.21	1.13	1.10	2.36
	Farming System as a whole				
a.	Total cost	122382			
b.	Gross returns	164628			
c.	Net returns	42246			

Note: Figures in parentheses indicate percent share of individual enterprise to farming system as a whole

Table 4.12. Cost and Returns of different Enterprises in Farming System-II

(Rupees/farm)

Sl. No.	Particulars	Coconut	Groundnut	Greengram	Ragi	Dairy
1.	Amortized establishment cost	45400 (41.04)	-	-	-	-
2.	Total variable cost	32000 (29.19)	3278 (2.99)	2800 (2.55)	5396 (4.92)	11536 (10.52)
3.	Total fixed cost	4400 (4.01)	848 (0.77)	840 (0.76)	1080 (0.98)	1596.5 (1.45)
4.	Total cost	81800 (74.62)	4577 (4.17)	3640 (3.32)	6476 (5.91)	13132 (11.98)
5.	Gross returns	95000 (64.93)	6466 (4.42)	4050 (2.77)	7020 (4.80)	33784 (23.09)
6.	Net returns	13200 (35.97)	1889 (5.15)	410 (1.12)	544 (1.48)	20652 (56.28)
7.	Returns/rupee expenditure	1.16	1.41	1.11	1.08	2.57
	Farming Systems as a whole					
a.	Total cost			109625		
b.	Gross returns			146320		
c.	Net returns			36695		

Note: Figures in parentheses indicate percent share of individual enterprise to Farming System as a whole

cent and 5.14 per cent of net return was contributed to the total net returns. The shares of greengram and ragi costs were found to be 3.32 per cent and 5.90 per cent respectively and the respective net returns was 1.11 per cent and 1.48 per cent.

4.3.4.3 Cost and Returns of Different Enterprises in Farming System-III

Per farm cost and returns for the different enterprises under farming system-III was calculated and presented in the Table 4.13. It was observed that among the five enterprises included in farming system, in the total cost the major per cent of cost accounted towards coconut (77.29%) followed by dairy, which was 9.38 per cent. Greengram, ragi, paddy enterprises costs share in the total cost were observed to be 5.15 per cent, 3.96 per cent and 4.22 per cent respectively. The total cost incurred on these enterprises under the farming system was Rs. 1,26,450.

Among the enterprises, the contribution of individual enterprises net returns to total net returns was maximum with respect to coconut, which was 50.77 per cent. Whereas, in the total net returns the dairy enterprise share was 42.39 per cent. The net returns percent share for greengram, ragi and paddy were 3.60 per cent, 1.36 per cent and 1.88 per cent respectively. These enterprises put together brings net returns of Rs.37,959 under farming system III.

4.3.4.4 Cost and Returns of different Enterprises in Farming System-IV

The cost incurred and returns realised from coconut, greengram, ragi, dairy and sheep and their percent share to total cost and returns

Table 4.13. Cost and Returns of different Enterprises in Farming System-III

(Rupees/farm)

Sl. No.	Particulars	Coconut	Greengram	Ragi	Paddy	Dairy
1.	Amortized establishment cost	55200 (43.61)	-	-	-	-
2.	Total variable cost	37680 (29.79)	4970 (3.93)	4225 (3.34)	4368 (3.45)	10726 (8.48)
3.	Total fixed cost	4848 (3.83)	1540 (1.21)	787.5 (0.62)	966 (0.76)	1.40 (0.90)
4.	Total cost	97728 (77.29)	6510 (5.15)	5012 (3.96)	5334 (4.22)	11866 (9.38)
5.	Gross returns	117000 (71.16)	7875 (4.79)	5530 (3.36)	6048 (3.68)	27956 (17.00)
6.	Net returns	19272 (50.77)	1365 (3.60)	518.0 (1.36)	714 (1.88)	16090 (42.39)
7.	Returns/rupee expenditure	1.19	1.20	1.103	1.13	2.35
	Farming System as a whole					
a.	Total cost			126450		
b.	Gross returns			164409		
c.	Net returns			37959		

Note: Figures in parentheses indicate percent share of individual enterprise to Farming System as a whole

were calculated and presented in the Table 4.14. It was observed that among the five major enterprises considered under this system, expenditure made towards coconut cultivation accounted maximum and its share in the total cost was 69.15 per cent, followed by dairy (14.07%) and sheep enterprise (7.88%). Further, greengram and ragi accounted less percent share to the total cost and were found to be 4.95 per cent and 3.93 per cent respectively. The total cost of the farming system as a whole was Rs.95,730.

The contribution of coconut to net returns was less *i.e.*, 27.1 per cent while, the dairy enterprises contributed maximum percent share to the total net income *i.e.*, 38.17 per cent and sheep enterprise stood next to dairy, whose contribution was 31.42 per cent to total net income. The percent share of greengram and ragi to the total net income was 2.13 per cent and 1.17 per cent respectively. The total net returns obtained form the farming system as a whole was Rs. 42,781.

4.3.4.5 Cost and Returns of different Enterprises in Farming System-V

Per farm cost and returns of enterprises considered under the farming system-V were calculated and presented in the Table 4.15. Information given in the table indicates that, among the four enterprises of the system cost towards coconut accounted 67.38 per cent of the total cost whereas for arecanut it was 23.02 per cent. Further, in the total cost of the system, respective costs share of dairy and ragi enterprises were 7.20 per cent and 2.40 per cent.

Table 4.14. Cost and Returns of different Enterprises in Farming System-IV

(Rupees/farm)

Sl. No.	Particulars	Coconut	Greengram	Ragi	Dairy	Sheep
1.	Amortized establishment cost	37120 (38.77)	-	-	-	-
2.	Total variable cost	25080 (26.19)	3689 (3.85)	3146 (3.28)	11596 (12.11)	6354 (6.63)
3.	Total fixed cost	4000 (4.17)	1053 (1.09)	618.8 (0.64)	1513 (1.58)	1200 (1.25)
4.	Total cost	66200 (69.15)	4742 (4.95)	3765 (3.93)	13469 (14.07)	7554 (7.89)
5.	Gross returns	77800 (56.17)	5655 (4.08)	4264 (3.08)	29792 (21.50)	21000 (15.16)
6.	Net returns	11600 (27.11)	913 (2.13)	499 (1.17)	16323 (38.16)	13446 (31.42)
7.	Returns/rupee expenditure	1.17	1.19	1.13	1.82	2.77
	Farming System as a whole					
a.	Total cost	95730				
b.	Total gross returns	138511				
c.	Total net returns	42781				

Note: Figures in parentheses indicate percent share of individual enterprise to Farming System as a whole

Table 4.15. Cost and Returns of different Enterprises in Farming System-V

(Rupees/farm)

Sl. No.	Particulars	Coconut	Arecanut	Ragi	Dairy
1.	Amortized establishment cost	60320 (37.78)	19500 (12.22)	-	-
2.	Total variable cost	40755 (25.5)	16000 (10.02)	3182 (1.99)	10269 (6.43)
3.	Total fixed cost	6500 (4.07)	1250 (0.78)	646 (0.40)	1222 (0.76)
4.	Total cost	107575 (67.38)	36750 (23.02)	3829 (2.40)	11491 (7.20)
5.	Gross returns	126425 (53.54)	80000 (33.88)	4279 (1.81)	25428 (10.77)
6.	Net returns	18850 (24.64)	43250 (56.55)	450 (0.59)	13936 (18.22)
7.	Returns/rupee expenditure	1.17	2.17	1.11	2.21
	Farming System as a whole				
a.	Total cost	159645			
b.	Gross returns	236132			
c.	Net returns	76487			

Note: Figures in parentheses indicate percent share of individual enterprise to Farming System as a whole

The per cent share of arecanut to the net returns was observed to be maximum, which was 56.55 percent followed by coconut (24.64%), dairy (18.22%) and ragi (0.59%).

For the farming system as a whole total cost was Rs. 1,59,645 whereas the total net returns realised from the system was Rs. 76,487. This net returns was observed to be maximum when compared to the net returns realised under other farming systems.

4.4 RESOURCE USE EFFICIENCY IN DIFFERENT COCONUT BASED FARMING SYSTEMS

Under the different farming systems considered for the study, the resource use efficiency was studied by fitting Cobb-Douglas type of production function to the data. This tool was followed to estimate the functional relationship between the dependent variable and independent variables. The marginal value product of each explanatory variable was also computed and compared with its marginal factor cost to know the resource use efficiency of farmers and are presented under following heads

4.4.1 Estimated Cobb-Douglas Production Function Coefficients and MVP to MFC ratios

The regression coefficients and MVP to MFC ratios for various resources in each system were computed and the results are presented in Tables 4.16, 4.17, 4.18, 4.19 and 4.20.

4.4.1.1 Farming System-I

The regression coefficients of various resources of farming system-I are presented in Table 4.16. From the results presented in the Table 4.16

Table 4.16. Estimated Cobb-Douglas Production Function Co-efficients and MVP to MFC Ratios for Farming System-I

Sl. No.	Particulars	Parameters	Co-efficients	MVP: MFC Ratios
1.	Intercept	a	0.1711	-
2.	Land (ha)	b_1	-0.0853 (0.1584)	-0.48
3.	Cows (No.)	b_2	-0.1942 (0.1854)	-4.65
4.	Fertilizer and FYM cost (Rs.)	b_3	0.2491 (0.2227)	3.39
5.	Labour cost (Rs.)	b_4	0.2581 (0.2889)	1.59
6.	Capital (Rs.)	b_5	0.2679** (0.1237)	14.45
7.	Feed cost (Rs.)	b_6	0.5199** (0.2409)	42.00
8.	Seed cost (Rs.)	b_7	0.0786 (0.0886)	61.7
		R^2	0.8958*	-
		Returns to scale	1.09	-

Note: Figures in parentheses indicate their respective standard errors
* - Highly significant
**- Significant at 5 per cent level

it was found that the regression co-efficients of all resources used by farmers were positive except for land (-0.09) and number of cows (-0.19). Under this system the coefficients for capital (0.27) and feeds (0.52) were found to be statistically significant at five per cent level and for all other resources coefficients were non-significant. For the system the coefficient of multiple determination (R^2) was 0.8958. The sum of elasticities was 1.09.

The ratios of MVP to MFC were greater than unity for all resources (Table 4.16) except for land (-0.48). The MVP to MFC ratio of -4.65 for number of cows, 3.39 for FYM and fertilizer, 1.59 for labour, 14.45 for capital, 42.00 for feeds and 61.70 for seeds were observed.

4.4.1.2 Farming System-II

The regression coefficients of the resources included in the farming system-II are presented in the Table 4.17.

It can be observed from the table that, the regression coefficient for feeds cost was negative (-0.09) and for others the regression coefficients considered under system were positive. In the system coefficient for number of cows was statistically significant at 10 per cent level and for other resources was found to be non-significant.

The coefficient of multiple determination (R^2) for farming system II was 0.7772. The sum of elasticities was 2.60.

The ratio of MVP to MFC was greater than unity (table 4.17) for the resources such as land (1.73), number of cows (4.62), FYM and fertilizer (2.46). The MVP to MFC ratio shows negative values for the resources like

Table 4.17. Estimated Cobb-Douglas Production Function Co-efficients and MVP to MFC Ratios for Farming System-II

Sl. No.	Particulars	Parameters	Co-efficients	MVP: MFC Ratios
1.	Intercept	a	6.8427	-
2.	Land (ha)	b_1	0.3715 (0.3071)	1.73
3.	Cows (No.)	b_2	0.2399*** (0.1477)	4.62
4.	Fertilizer and FYM cost (Rs.)	b_3	0.2236 (0.3070)	2.46
5.	Labour cost (Rs.)	b_4	0.1944 (0.1758)	0.79
6.	Capital (Rs.)	b_5	0.0932 (0.1309)	7.20
7.	Feed cost (Rs.)	b_6	-0.0894 (0.1424)	-0.71
8.	Seed cost (Rs.)	b_7	0.0069 (0.097)	0.37
		R^2	0.7772*	-
		Returns to scale	2.60	-

Note: Figures in parentheses indicates the standard errors
* - Significant
***- Significant at 10 per cent level

feeds (-0.71) and the ratio of MVP to MFC show less than unity for the resources labour (0.79) and seed (0.37).

4.4.1.3 Farming System-III

The regression coefficients of the resources in the farming system-III are presented in the Table 4.18.

It could be observed that the regression coefficients for FYM and fertilizers (-0.58), capital (-0.10) and seeds cost (-0.18) were negative, on the contrary the regression coefficients for land (0.49), number of cows (0.24), labour (1.19) and feeds (0.04) was positive. Among these variables the coefficient for labour was significant at five per cent level and for other resources was observed to be non-significant. The coefficient of multiple determination (R^2) was 0.7264. The sum of elasticities was 3.43.

The ratios of MVP to MFC were lesser than unity (table 4.18) in case of feeds (0.43) whereas the ratios of MVP to MFC were greater than one with respect to land (2.68), number of cows (5.40) and labour (7.11). The ratio of MVP to MFC showed negative values for FYM and fertilizers (-7.23), capital (-6.19) and seeds (-73.80).

4.4.1.4 Farming System-IV

The estimated Cobb-Douglas production coefficients for the resources in the farming system-IV presented in the Table 4.19 indicates that the coefficients for all the resources were observed to be positive except for the seeds (-0.140). The resources such as land (0.49) and

Table 4.18. Estimated Cobb-Douglas Production Function Co-efficients and MVP to MFC Ratios for Farming System-III

Sl. No.	Particulars	Parameters	Co-efficients	MVP: MFC Ratios
1.	Intercept	a	5.5515	-
2.	Land (ha)	b_1	0.4903 (0.7534)	2.68
3.	Cows (No.)	b_2	0.2386 (0.3591)	5.40
4.	Fertilizer and FYM cost (Rs.)	b_3	-0.5832 (0.7288)	-7.22
5.	Labour cost (Rs.)	b_4	1.1938** (0.5573)	7.11
6.	Capital (Rs.)	b_5	-0.1028 (0.2149)	-6.19
7.	Feed cost (Rs.)	b_6	0.0414 (0.2601)	0.44
8.	Seed cost (Rs.)	b_7	-0.1824 (0.2407)	-73.80
		R^2	0.7264*	-
		Returns to scale	3.43	-

Note: Figures in parentheses indicate the standard errors
* - Significant
** - Significant at 5 per cent level

Table 4.19. Estimated Cobb-Douglas Production Function Co-efficients and MVP to MFC ratios for Farming System-IV

Sl. No.	Particulars	Parameters	Co-efficients	MVP: MFC Ratios
1.	Intercept	A	4.8204	-
2.	Land (ha)	b_1	0.4977** (0.2130)	3.17
3.	Cows (No.)	b_2	0.0886 (0.1639)	2.22
4.	Fertilizer and FYM cost (Rs.)	b_3	0.1787 (0.1615)	2.92
5.	Labour cost (Rs.)	b_4	0.0384** (0.3125)	6.27
6.	Capital (Rs.)	b_5	0.0587 (0.1969)	2.25
7.	Feed cost (Rs.)	b_6	0.4018** (0.1977)	6.39
8.	Seed cost (Rs.)	b_7	-0.1409 (0.1397)	-95.30
9.	Sheep (No.)	b8	0.2265*** (0.1441)	53.40
		R^2	0.8292*	0.8292
		Returns to scale	1.35	-

Note: Figures in parenthesis indicate the standard errors
* - Significant
**-Significant at 5 per cent level
***-Significant at 10 per cent level

labour (0.09) were statistically significant at five per cent level whereas, the number of sheep (0.23) was observed to be significant at 10 per cent level. Other resources were non-significant. The coefficient of multiple determination (R^2) was 0.8292. The sum of elasticities was 1.35.

The resources such as land (3.17), number of cows (2.22), FYM and fertilizer (2.92), capital (2.25), feed (6.39) and number of sheep (53.40) showed more than unity MVP to MFC ratio (Table 4.19) and the MVP to MFC ratio for seed was negative (-95.30).

4.4.1.5 Farming System-V

The regression coefficients of the resources used in the farming system-V is presented in the Table 4.20. The regression coefficients for land (0.49) and number of cows (0.49) were positive and significant at 10 per cent level, whereas the regression coefficients for FYM and fertilizer (0.25) and seeds (0.14) were positive but non-significant. For The other resources regression coefficients were negative and statistically non-significant. The coefficient of multiple determination (R^2) was 0.6361. The sum of elasticities was 3.49. In the study area among the systems the returns to scale was better for farming system V.

Under farming system V the MVP to MFC ratio for land (3.38), number of cows (14.2), FYM and fertilizer (4.15) and seeds (797.9) was observed to be more than unity (Table 4.20). Whereas capital (-0.87) showed negative MVP to MFC ratio. Similarly for the resources like labour (-8.20) and feed (-5.08) the MVP to MFC ratio was negative.

Table 4.20. Estimated Cobb-Douglas Production Function Co-efficients and MVP to MFC Ratios for Farming System-V

Sl. No.	Particulars	Parameters	Co-efficients	MVP: MFC Ratios
1.	Intercept	a	13.1086	-
2.	Land (ha)	b_1	0.4998*** (0.3177)	3.38
3.	Cows (No.)	b_2	0.4925*** (0.3291)	14.2
4.	Fertilizer and FYM cost (Rs.)	b_3	0.2523 (0.2463)	4.15
5.	Labour cost (Rs.)	b_4	-0.2626 (0.3188)	-8.20
6.	Capital (Rs.)	b_5	-0.0093 (0.1857)	-0.87
7.	Feed cost (Rs.)	b_6	-0.2430 (0.3111)	-5.08
8.	Seed cost (Rs.)	b_7	0.1392 (0.1306)	797.60
		R^2	0.6361	-
		Returns to scale	3.49	-
		Returns to scale	1.35	-

Note: Figures in parentheses indicate the standard errors
**-Significant at 5 per cent level
***-Significant at 10 per cent level

4.5 OPTIMUM FARM PLANS FOR DIFFERENT COCONUT BASED FARMING SYSTEMS

4.5.1 Coconut based Farming Systems in Different Plans

The basic models through optimization of existing plans *viz.*, farming system-I, farming system-II, farming system-III, farming system-IV and farming system-V were developed for the study and same plans were referred with the relaxation of labour, capital and number of animals (Table 4.21). This exercise was reformed to examine the possibilities of augmenting incomes of farmers from various activities with the relaxation of different existing resource levels and results on alternate optimum plans are presented under following heads.

Farming System-I

In Plan-1 the area under coconut decreased from 1.97 hectares to 1.42 hectares (27.91%). Similarly the area under greengram decreased from 0.52 hectares to 0.21 hectares (59.61%). The area under *rabi* ragi decreased from 1.34 hectares to 0.84 hectares (59.52%). Whereas the number of dairy animals increased from two to three (50%) (Table 4.21).

The per farm net returns increased from Rs. 42,467 to Rs. 44,562 *i.e* by 4.93 per cent.

In Plan-2 the area under coconut remained same as of plan-1. No land was allotted for *kharif* green gram while 0.29 hectares of land was allotted to groundnut. The area under ragi decreased from 1.34 hectares to 0.64 hectares (70%). The number of dairy animals remained same as that of plan-1.

Table 4.21. Coconut based Farming Systems in different Plans

Sl. No.	Activity	Farming System-I			Farming System-II			Farming System-III			Farming System-IV			Farming System-V		
		E	P-1	P-2	E	P-1	P-2	E	P-1	P-2	E	P-1	P-2	E	P-1	P-2
1.	Coconut (X_1)	1.97	1.42	1.42	1.97	1.46	1.46	2.40	2.03	2.03	1.62	0.71	0.08	2.40	1.39	0.50
2.	Arecanut (X_2)	-	-											0.50	0.75	0.75
3.	*Kharif* greengram (X_3)	0.52	0.21	0.00	0.39	-	-	0.70	0.70	0.00	0.54	0.54	1.00	-	-	-
4.	*Kharif* groundnut (X_4)	-	-	0.29	0.53	0.92	0.92	-	-	0.70	-	-	-	-	-	-
5.	*Kharif* paddy (X_5)	-	-	-	-	-	0.31	0.42	0.00	0.00	-	-	-	-	-	-
6.	*Rabi* ragi (X_6)	1.34	0.84	0.64	0.89	0.89	0.45	0.70	0.38	0.42	0.52	0.54	0.73	0.53	0.25	0.25
7.	Dairy (X_7)	2.00	3.00	3.00	2.00	3.00	3.00	2.00	3.00	3.00	2.00	3.00	3.00	2.00	4.00	6.00
8.	Sheep (X_8)	-	-	-	-	-	-	-	-	-	40.00	40.00	55.00	-	-	-
I.	Net returns per farm	42467	44562	45363	36695	44066	44188	37959	46012	47182	42481	45100	46587	76487	83872	91603
II.	Per cent change in net returns															
a.	Over existing plan	-	4.93	6.81	-	20.08	20.4	-	21.21	24.29	-	6.16	9.66	-	9.65	19.76
b.	Over Plan-I	-	-	1.79	-	-	0.27	-	-	2.54	-	-	3.29	-	-	9.21

E - Existing,
P1 - Plan-1,
P2 - Plan-2

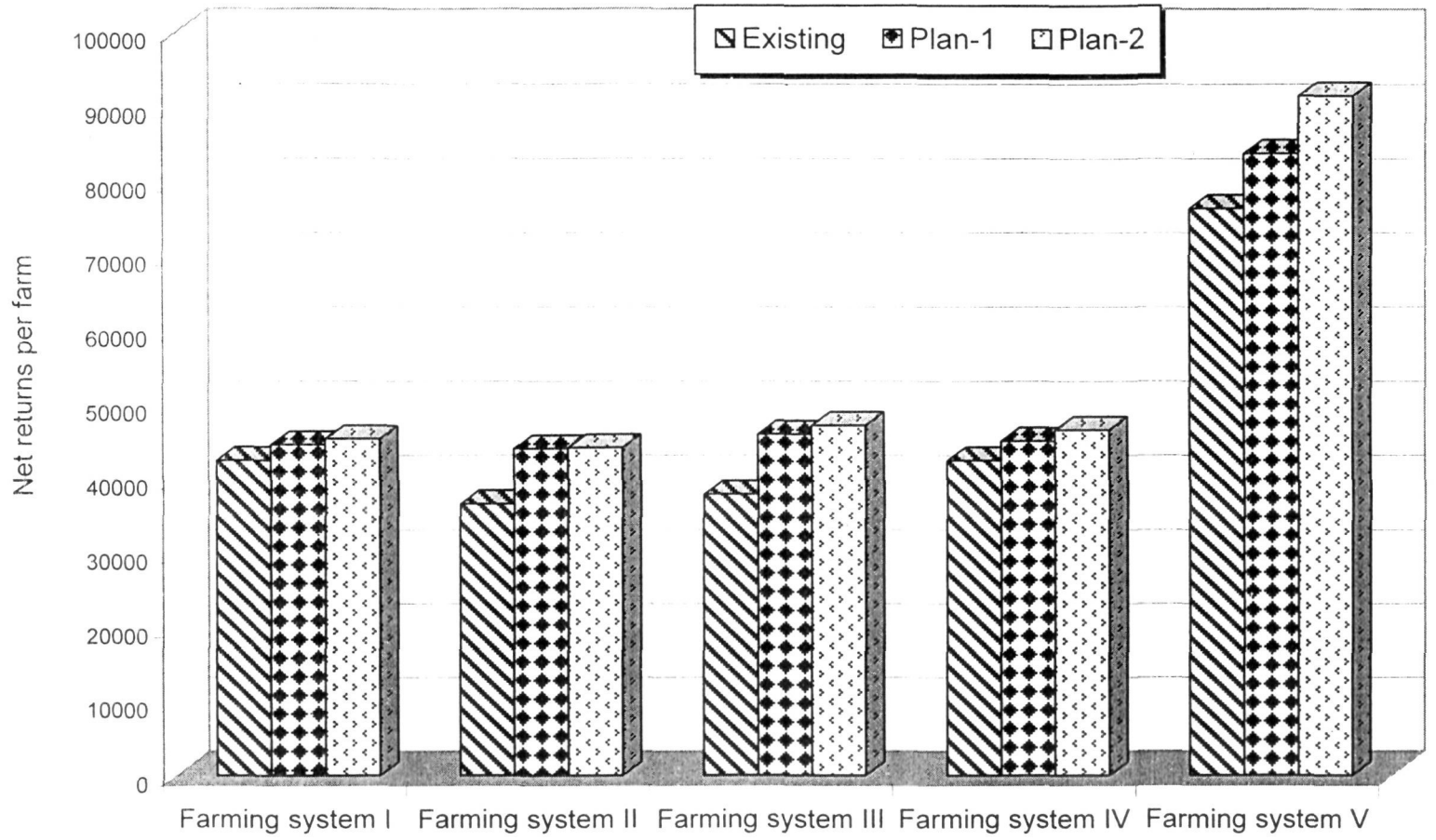

Fig. 4.2. Net Returns in Different Coconut Based Farming Systems in Different Plans

The net income increased from Rs. 42,467 to Rs. 45,363. The increase in the net income under plan-2 over existing plan was 6.81 per cent, from existing plan to plan-1 and over plan-1 was 1.79 per cent.

Farming System-II

In alternate plans of the system (plan-1 and plan-2), the area under coconut decreased from 1.97 hectares to 1.46 hectares. Greengram area in alternate Plan-1 and Plan-2 is completely eliminated while the area under groundnut increased from 0.53 hectares to 0.92 hectares in both the plans. In Plan-2, 0.31 hectares of land allotted to paddy cultivation. The area under ragi remained same as that of existing plan in Plan-1 and in Plan-2 the area under ragi decreased to 0.45 hectares. The number of dairy animals increased from two numbers to three numbers in both Plan-1 and Plan-2.

With the reallocation of resources between different enterprises the net returns increased from Rs. 36,695 to Rs. 44,066 (20.08%) in Plan-1, and Rs. 44,066 (20.40%) in Plan-2. The percent change in net returns over Plan-1 was 0.27 per cent.

Farming System-III

The area under coconut decreased from 2.4 hectares to 2.03 hectares in alternate optimum Plan-1 and Plan-2 of system III. The area under greengram remained same as that of existing in Plan-1, but in Plan-2, land is not allotted for greengram cultivation. The area under ragi over existing plan has decreased to 0.38 hectares in Plan-1 and 0.42 hectares in Plan-2. The number of dairy animals increased to three in

both the plans. The net income increased from Rs. 37,959 to Rs. 46,012 (21.21%) in Plan-1 and Rs. 47,182 (24.29%) in Plan-2. Change in net returns over Plan-1 was 2.54 per cent.

Farming System-IV

Under this system the area under coconut decreased to 0.71 hectares in Plan-1 and 0.08 hectares in Plan-2 from 1.62 hectares. The area under greengram remains same in Plan-1 (0.54 hectares) and in Plan-2 increased to 1.00 hectare. Further it is observed that, area under ragi increased to 0.54 hectares in Plan-1 and to 0.73 hectares in Plan-2. The number of dairy animals increased from two numbers to three numbers in both Plan-1 and Plan-2. The number of sheep increased from 40.00 to 55.00 under Plan-2 only.

For the enterprises included under different optimum plans the net returns increased from Rs. 42,481 to Rs. 45,100 in Plan-1 and Rs. 46,587 in Plan-2. The percentage change in net returns over existing to Plan-1 is 6.16 per cent and in Plan-2 is 9.66 per cent. The percentage increase in net returns over Plan-1 is 3.29 per cent.

Farming System-V

The area under coconut decreased from 2.40 ha to 1.39 hectares in Plan-1 and 0.50 hectares in Plan-2. The area under arecanut increased from 0.5 hectares to 0.75 hectares in both the plans. Similarly, the area under ragi decreased from 0.53 hectare to 0.25 hectares in both the plans. The relaxation towards dairy animals is increased to four in Plan-1 and six in Plan-2.

With the combination of arecanut, ragi and dairy animals along with coconut the net returns increased from Rs. 76,487 to Rs. 83,872 in Plan-1 and Rs. 91,603 in Plan-2. Percentage change in net returns over existing plan is 9.65 per cent and 19.76 per cent respectively in Plan-1 and Plan-2. Percentage change in net returns over Plan-1 is observed to be 9.21 per cent.

4.5.2 Resource Availability and Surplus under different Coconut based Farming Systems

The results presented in the Table 4.21 indicated that, optimum plans have increased the net income considerably and certain resources are also saved by the optimization. These resources can be used to increase the overall income of the systems. Information on surplus resources under different plans and farming system are presented under following heads.

4.5.2.1 Resource Availability and Surplus under different Plans of Farming System-I

The extent of resource availability under the system are presented in Table 4.22. It was observed that human labour availability in *kharif* was 115.8 mandays, 85.20 mandays in *rabi* season, 53.30 mandays in summer season. Bullock labour availability in *kharif* season and *rabi* seasons were 38.30 and 28.70 pairdays respectively. Capital availability was Rs. 44,249. The land availability was 1.97 hectares of irrigated land, in all three seasons 0.52 hectares of *kharif* dry land and 1.34 hectares of *rabi* land. In existing plan all these resources were utilized however, the net income of the farm was Rs.42,467, whereas in Plan-1 24.83 and 11.15

Table 4.22. Resource Availability and Surplus under different Plans in Farming System-I

Sl. No.	Particulars	Resource availability	Resource surplus		
			Existing	Plant-1	Plan-2
1.	*Kharif* human labour (mandays)	115.80	0.00	24.83	24.37
2.	*Rabi* human labour (mandays)	85.20	0.00	11.15	11.15
3.	Summer human labour (mandays)	53.30	0.00	0.00	0.00
4.	*Kharif* bullock labour (pairdays)	38.30	0.00	0.00	0.00
5.	*Rabi* bullock labour (pairdays)	28.70	0.00	0.00	0.00
6.	Capital (Rupees)	44249	0.00	6089	5848
7.	Irrigated *kharif* land (ha)	1.97	0.00	0.54	0.54
8.	Dry *kharif* land (ha)	0.52	0.00	0.30	0.52
9.	Irrigated *rabi* land (ha)	1.97	0v	0.54	0.54
10.	Dry *rabi* land (ha)	1.34	0.00	0.49	0.49
11.	Irrigated summer land (ha)	1.97	0.00	0.54	0.54
12.	Dairy (no.)	3.00	0.00	0.00	0.00
13.	Net farm income (Rs.)	-	42467	44562	45363

mandays of *kharif* and *rabi* human labour respectively will be remained as surplus. Under this the capital savings would be Rs.6,089. With respect to land 0.54 hectares of irrigated *kharif*, *rabi* and summer, 0.30 hectares of *kharif* dry land, 0.49 hectares of *rabi* dry land were observed to be surplus. With this resources saving pattern the net income will be improved to Rs. 44,562. Similar resource saving pattern has been observed in Plan-2 except for dry *kharif* land (0.52 hectares) and brings further improvement in the income of the plan (Rs.45,364).

4.5.2.2 Resource Availability and Surplus under different Plans in Farming System-II

Labour resource availability with respect to *kharif*, *rabi* and summer season was 129.30, 107.60 and 57.20 mandays respectively (table 4.23). The bullock labour availability under the system for *kharif*, *rabi* and summer seasons observed to be 58.40, 44.80 and 17.60 pairdays respectively. For the crop based activities the annual capital availability was Rs. 37,203. The irrigated land availability was 1.97 hectares for *kharif*, *rabi* and summer seasons. While, the dry land availability was 0.92 hectares in *kharif* season and 0.89 hectares in *rabi* season. The number of dairy animals were three in number.

In existing plan there were no surplus resource, whereas incase of Plan-1, surplus human labour for *kharif* and *rabi* season are 18.04 mandays and 2.32 mandays respectively. The surplus bullock labour for *kharif*, *rabi* and summer season are 13.74, 4.86 and 4.52 pairdays respectively with these resource savings remaining capital surplus which is accounted to Rs. 576.31, under Plan-2, 0.50 hectares of surplus

Table 4.23. Resource Availability and Surplus under different Plans in Farming System-II

Sl. No.	Particulars	Resource availability	Resource surplus		
			Existing	Plant-1	Plan-2
1.	*Kharif* human labour (mandays)	129.30	0.00	18.04	0.00
2.	*Rabi* human labour (mandays)	107.60	0.00	2.32	19.93
3.	Summer human labour (mandays)	57.20	0.00	0.00	0.00
4.	*Kharif* bullock labour (pairdays)	58.40	0.00	13.74	3.51
5.	*Rabi* bullock labour (pairdays)	44.80	0.00	4.86	16.51
6.	Summer bullock labour (pairdays)	17.60	0.00	4.52	4.52
7.	Capital (Rupees)	37203	0.00	576.31	0.00
8.	*Kharif* irrigated land (ha)	1.97	0.00	0.50	0.50
9.	*Kharif* dry land (ha)	0.92	0.00	0.00	0.00
10.	*Rabi* irrigated land (ha)	1.97	0.00	0.50	0.50
11.	*Rabi* dry land (ha)	0.89	0.00	0.00	0.00
12.	Summer irrigated land (ha)	1.97	0.00	0.50	0.50
13.	Dairy (no.)	3.00	0.00	0.00	0.00
14.	Net farm income (Rs.)	-	36695	44066	44188

93

irrigated land is observed for *kharif*, *rabi* and summer seasons. Further 3.51 pairdays, 16.51 pairdays and 4.52 pairdays of bullock labour are going to be saved in *kharif*, *rabi* and summer seasons respectively. With this system and plan human labour savings is observed only for *rabi* season, which is accounted to 19.93 mandays. The optimum plans with this resources savings pattern the net returns have been improved from Rs.36,695 to Rs.44,066 under Plan-1 and marginally under Plan-2.

4.5.2.3 Resource Availability and Surplus under different Plans in Farming System-III

The availability of human labour resource under system-III was 197.50, 131.90, 87.50 mandays in *kharif*, *rabi* and summer seasons respectively. The bullock labour availability was 114.20 and 70.50 pairdays for *kharif* and *rabi* seasons respectively. The irrigated *kharif* land availability was 2.82 hectares and 2.4 hectares of irrigated land in *rabi* and summer seasons respectively. The availability of dry land in *kharif* and *rabi* seasons was 0.70 hectares. The number of dairy animals observed with system were three. No surplus resources were observed in the existing plan. Whereas in Plan-1, 32.78 and 15.43 mandays of human labour are observed as surplus under *kharif* and *rabi* seasons respectively. The bullock labour of 25.52 and 16.03 pairdays have been observed as surplus for *kharif* and *rabi* season respectively. Under the category of irrigated land surplus of 0.78 hectares in *kharif* season, 0.36 hectares for *rabi* and summer seasons is observed. In case of *rabi* dry land it is 0.31 hectares. The net farm income over existing plans has been increased to Rs. 46012. The surplus resources in Plan-2 are *kharif* human labour (37.47 mandays) and *rabi* human labour (13.77 mandays),

Table 4.24. Resource Availability and Surplus under different Plans in Farming System-III

Sl. No.	Particulars	Resource availability	Resource surplus		
			Existing	Plant-1	Plan-2
1.	*Kharif* human labour (mandays)	197.50	0.00	32.78	37.47
2.	*Rabi* human labour (mandays)	131.90	0.00	15.43	13.77
3.	Summer human labour (mandays)	87.50	0.00	0.00	0.00
4.	*Kharif* bullock labour (pairdays)	114.20	0.00	25.52	32.11
5.	*Rabi* bullock labour (pairdays)	70.50	0.00	16.03	15.03
6.	Summer bullock labour (pairdays)	-	-	-	-
7.	Capital (Rupees)	36058	0.00	0.00	0.00
8.	*Kharif* irrigated land (ha)	2.82	0.00	0.78	0.78
9.	*Kharif* dry land (ha)	0.20	0.00	0.00	0.00
10.	*Rabi* irrigated land (ha)	2.40	0.00	0.36	0.36
11.	*Rabi* dry land (ha)	0.70	0.00	0.31	0.27
12.	Summer irrigated land (ha)	2.40	0.00	0.36	0.36
13.	Dairy (no.)	3.00	0.00	0.00	0.00
14.	Net farm income (Rs.)	-	37959	46012	47182

kharif bullock labour (32.11 pairdays) and *rabi* bullock labour (15.03 pairdays), *kharif* irrigated land (0.78 hectares), irrigated *rabi* and irrigated summer land (0.36 hectares) and *rabi* dry land (0.27 hectares). Along with the savings made in the use of different resources the net income under Plan-2 is raised to Rs. 47182.

4.5.2.4 Resource Availability and Surplus under different Plans in Farming System-IV

The resources under farming system-IV (Table 4.25) and their availability were considered for human labour in *kharif* season (132.26 mandays), *rabi* season (125.7 mandays) and summer season (88.4 mandays). In the system the availability of bullock labour was 41.12, 30.50, and 14.25 pairdays for *kharif*, *rabi* and summer seasons respectively. The capital availability for combining different enterprises in the system was Rs. 31,726. The irrigated land availability for *kharif*, *rabi* and summer crops activities was 1.62 hectares and dry land for the cultivation of *kharif* and *rabi* seasons crops was 0.54 hectares. Along with three dairy animals and sample farmers kept sheeps and there number was 40.

There was no surplus resource under existing plan of the system. Whereas in Plan-1 12.70 and 5.37 mandays of human labour for *kharif* and *rabi* seasons observed as surplus. The bullock labours in the system and plan are 14.49, 9.02 and 7.94 pairdays for *kharif*, *rabi* and summer seasons respectively. The capital savings under Plan-1 would be Rs. 5421. Irrigated land of 0.90 hectares in all the three seasons has been remained as surplus. The net income per farm has been improved from Rs. 42,481

Table 4.25. Resource Availability and Surplus under different Plans in Farming System-IV

Sl. No.	Particulars	Resource availability	Resource surplus		
			Existing	Plant-1	Plan-2
1.	*Kharif* human labour (mandays)	132.26	0.00	12.70	3.72
2.	*Rabi* human labour (mandays)	125.70	0.00	5.37	0.00
3.	Summer human labour (mandays)	88.40	0.00	0.00	0.00
4.	*Kharif* bullock labour (pairdays)	41.12	0.00	14.49	11.86
5.	*Rabi* bullock labour (pairdays)	30.50	0.00	9.02	10.64
6.	Summer bullock labour (pairdays)	14.25	0.00	7.94	13.54
7.	Capital (Rupees)	31726	0.00	5421	8906
8.	*Kharif* irrigated land (ha)	1.62	0.00	0.90	1.53
9.	*Kharif* dry land (ha)	0.54	0.00	0.00	0.00
10.	*Rabi* irrigated land (ha)	1.62	0.00	0.90	1.53
11.	*Rabi* dry land (ha)	0.54	0.00	0.00	0.26
12.	Summer irrigated land (ha)	1.62	0.00	0.90	1.53
13.	Dairy (no.)	3.00	0.00	0.00	0.00
14.	Sheep (no.)	40.00	0.00	0.00	0.00
15.	Net farm income (Rs.)	-	42481	45100	46582

to Rs. 45,100. Whereas in Plan-2, labour for *kharif* season remain as surplus to the extent of 3.72 mandays. Surplus bullock labour is 11.86, 10.64 and 13.54 pairdays are observed for *kharif*, *rabi* and summer seasons respectively. The capital saved under the plan is accounted to Rs. 8906. Similarly possibility in saving of irrigated land under all the three seasons has been worked out at 1.53 hectares and for *rabi* dry land it is 0.26 hectares. The increased net return for the plan is Rs.46,587.

4.5.2.5 Resource Availability and Surplus under different Plans in Farming System-V

The resource availability for all the three plans was similar (Table 4.26) *i.e.*, labour availability for *kharif*, *rabi* and summer season was 172.97, 145.52 and 104.60 mandays respectively. The bullock labour availability was 88.10, 73.89 and 8.00 pairdays respectively for *kharif*, *rabi* and summer seasons. The annual capital availability was Rs. 49,917 and irrigated land availability for all the three seasons was 2.90 hectares and *rabi* dry land availability was 0.53 hectares and number of dairy animals were three.

To generate net income of Rs.76,487 under existing plan all available resource were completely utilised while in Plan-1 it is indicating the possibility of saving different resources *viz.*, human labour in *kharif* season (21.43 mandays), *rabi* season (17.01 mandays) and summer season (2.52 mandays), bullock labour under *kharif* season (28.10 pairdays), irrigated land under all three seasons (1.25 hectares) and *rabi* dry land (0.28 hectares). On the other hand with alternate Plan-2 the resources like human labour for *kharif* season (49.59 mandays), *rabi*

Table 4.26. Resource Availability and Surplus under different Plans in Farming System-V

Sl. No.	Particulars	Resource availability	Resource surplus		
			Existing	Plant-1	Plan-2
1.	*Kharif* human labour (mandays)	172.97	0.00	21.43	49.59
2.	*Rabi* human labour (mandays)	145.52	0.00	17.01	28.98
3.	Summer human labour (mandays)	104.60	0.00	2.52	8.99
4.	*Kharif* bullock labour (pairdays)	88.10	0.00	28.10	57.37
5.	*Rabi* bullock labour (pairdays)	73.89	0.00	26.70	46.20
6.	Summer bullock labour (pairdays)	8.00	0.00	0.00	0.00
7.	Capital (Rupees)	49917	0.00	0.00	0.00
8.	*Kharif* irrigated land (ha)	2.90	0.00	1.25	2.14
9.	*Kharif* dry land (ha)	-	-	-	-
10.	*Rabi* irrigated land (ha)	2.90	0.00	1.25	2.14
11.	*Rabi* dry land (ha)	0.53	0.00	0.28	0.28
12.	Summer irrigated land (ha)	2.90	0.00	1.25	2.14
13.	Dairy (no.)	3.00	0.00	0.00	0.00
14.	Net farm income (Rs.)	-	76487	83872	91603

season (28.98 mandays) and summer season (8.99 mandays) and bullock labour surplus have been remained to the extent of 57.37 and 46.20 pairdays for *kharif* and *rabi* seasons respectively. The irrigated surplus land of 2.14 hectares for all the three seasons and 0.28 hectares for *rabi* dry land have been observed.

4.6 CONSTRAINTS AND PROSPECTS ASSOCIATED WITH DIFFERENT COCONUT BASED FARMING SYSTEMS

4.6.1 Problems or Constraints under different Farming Systems

Among the problems and constraints listed by the sample farmer, all farmers in the study under identified farming system opined that mite infestation was major problem (Table 4.27) in coconut gardens. About 81 per cent of the farmers indicated lack of awareness about World Trade Organization. Other important problems mentioned were scarcity of family labour (64.00%), lack of transportation and marketing facilities (56.00%), fragmentation and division of land (51.00%). scarcity of funds (45.00%). It was also observed that, less reliable market in the context of global scenario (38.60%), low yield due to local seeds (10.60%), non availability of support price facilities (10.6%), exogenous factors (9.30%), improper cattle and sheep housing facilities (5.33%) and scarcity of water (6.00%) were some of the problems experienced by the sample farmers.

4.6.2 Prospects under different Farming Systems

In the context of prospects of the different coconut based farming systems which is given in the Table 4.28. It is observed that 100 per cent of the sample farmers expressed the integration of different enterprises

Table 4.27. Problems or Constraints under different Farming Systems

(in numbers)

Sl. No.	Particulars	F-I	F-II	F-III	F-IV	F-V	Overall
1.	Mite menace in coconut	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	150 (100)
2.	Exogenous factors	3 (10.00)	2 (6.60)	3 (10.00)	5 (16.60)	1 (3.33)	14 (9.30)
3.	Fragmentation and sub-division of land	16 (53.30)	18 (60.00)	20 (66.60)	13 (43.30)	10 (33.30)	77 (51.30)
4.	Scarcity of family labour	20 (66.60)	22 (48.80)	23 (76.60)	15 (50.00)	16 (53.30)	96 (64.00)
5.	Low yield due to local seeds	5 (16.60)	4 (13.30)	4 (13.30)	2 (6.60)	1 (3.33)	16 (10.60)
6.	Loss of reliable market in the context of global scenario	12 (40.00)	15 (50.00)	12 (40.00)	10 (33.30)	9 (53.00)	58 (38.60)
7.	Scarcity of owned funds	17 (56.60)	16 (53.30)	15 (50.00)	17 (56.60)	5 (16.60)	68 (45.30)
8.	Improper cattle and sheep housing facilities	2 (6.60)	1 (3.33)	1 (3.30)	3 (10.00)	1 (3.33)	8 (5.33)
9.	Lack of transportation and marketing facilities	15 (50.00)	16 (53.30)	17 (56.60)	17 (56.60)	20 (66.60)	85 (56.60)
10.	Lack of awareness about WTO	25 (83.30)	22 (73.30)	23 (76.60)	27 (90.00)	15 (50.00)	122 (81.30)
11.	Non-availability of support prices for all the enterprises	3 (10.00)	2 (6.60)	5 (16.60)	4 (13.30)	2 (6.60)	16 (10.60)
12.	Scarcity of water	1 (3.33)	2 (6.60)	3 (10.00)	2 (6.60)	1 (3.33)	9 (6.00)

Note: Figures in parenthesis indicate percentage to the total

Table 4.28. Prospects under different Farming Systems

(in numbers)

Sl. No.	Particulars	F-I	F-II	F-III	F-IV	F-V	Overall
1.	Maintains sustainable production system	25 (83.30)	30 (100)	27 (90.00)	22 (73.30)	25 (83.30)	129 (86.00)
2.	Provides full family employment throughout the year	15 (50.00)	12 (40.00)	13 (43.00)	12 (40.00)	15 (50.00)	67 (44.60)
3.	Enables recycling of waste within the Farming System	29 (96.60)	30 (100)	30 (100)	30 (100)	30 (100)	149 (99.30)
4.	Provides balance food diet	20 (66.60)	23 (76.60)	24 (80.00)	25 (83.30)	26 (86.60)	118 (78.60)
5.	Standard of living will be improved through efficient utilization of resources	3 (10.00)	5 (16.60)	6 (20.00)	74 (23.30)	2 (6.60)	23 (15.30)
6.	Generates income throughout the year	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	150 (100)
7.	Helps to reduce the price risk	12 (40.00)	15 (50.00)	15 (50.00)	12 (40.00)	13 (43.30)	69 (44.60)
8.	Helps in slinking production and marketing	5 (16.60)	7 (23.30)	2 (6.66)	1 (3.33)	3 (10.00)	18 (12.00)

Note: Figures in parentheses indicate percentage to the total

would help in the generating income and employment opportunities through out the year. Further farmers experienced that enterprises along with coconut enabled in recycling of farm waste within the farming system (99.00%) and in the maintenance of sustainable production without hindering resource base (86.00%). About 78.00 per cent of the farmers opined that, integration of different enterprises provides an opportunity to meet balanced food dietary requirement of the family and 44.60 per cent of them agreed with the statement that integration of enterprises would help into reducing the price risk. The other indicated prospects of integration of enterprises were standard of living improved through efficient use of resources (15.3%) and helps in slinking production and marketing of farm produces (12%).

Discussion

V. DISCUSSION

The present chapter discusses the results of the investigation presented in the previous chapter. Keeping the objectives of the study in view, the results are discussed under the following heads.

5.1 Social Characteristics of Sample Farmers

5.2 Identified Coconut based Farming Systems in the Study Area

5.3 Income and Employment Generation in different Coconut based Farming Systems

5.4 Resource use Efficiency in different Coconut based Farming Systems

5.5 Optimum Farm Plans for different Coconut based Farming Systems

5.6 Constraints and Prospects Associated with different Coconut based Farming Systems

5.1 SOCIAL CHARACTERISTICS OF SAMPLE FARMERS

The social characteristics of the sample farmers in the study area has been depicted in Table 4.1. With respect to the age of the sample farmers it was observed that majority of them belonged to middle age group. Majority of the farmers possessed large family size. This had influenced the farmers to take suitable decision to combine the labour intensive farming activities under coconut based farming system.

During the study it was noticed that majority of the farmers were literate in all the taluks. Therefore, there may not be any problem for the extension workers to educate the farmers regarding recent developments

in agriculture and other enterprises to increase their level of farm income. Further, the farmers' receptive capacity may ease the process and adoption of technology.

5.2 IDENTIFIED COCONUT BASED FARMING SYSTEMS IN THE STUDY AREA

Generally, the availability of resources, technical know how, climate and other factors do influence the farming systems adopted by the farmers in different areas. The area selected for the present study also exhibited the similar phenomena and details are given as follows.

5.2.1 Coconut based Farming Systems in the Study Area

In the study area it was observed that there were as many as 13 different coconut based farming systems practiced by the (Table 4.2) sample farmers. Among these farming systems, five farming systems were practiced by the majority of the farmers they were (i) coconut + greengram – ragi + dairy, (ii) coconut + paddy + greengram – ragi + dairy, (iii) coconut + arecanut + ragi + dairy, (iv) coconut + greengram + groundnut – ragi + dairy and (v) coconut + greengram – ragi + sheep rearing. These farming systems revealed the very diversification nature of farmers in the area. They had component of field crops, commercial crops as well as annual component.

5.2.2 Average Farm Size in the Identified Coconut based Farming Systems in the Study Area

The average farm size under different system has been indicated in Table 4.3. It was seen from the table that, the larger farm size was

observed in the case of farming system III, followed by farming system V, farming system II, farming system I and farming system IV in that order. Though the variation in farm size was observed among farming systems, but the extent was not too much.

5.2.3 Cropping Pattern of Sample Farmers under different Coconut based Farming Systems in Chikkanayakanahalli Taluk

The proportion of area devoted to different crops in various seasons has been shown in Table 4.4. It was seen that, the major *kharif* season crops were green gram and fodder crops in System-I. In System-II groundnut and green gram accounted for major share and fodder crops were also cultivated in considerable area. In system-III green gram, paddy and fodder crops were observed to be cultivated popularly. Whereas, in System-IV green gram and fodder crops were of given major importance on the contrary in system-V fodder crops and other crops were the major crop components.

In *rabi* season ragi was the main crop which accounted major share followed by other crops. Ragi being a staple food and fodder crop of the study area, cultivated in all the systems. In summer season fodder crops were the major crops in the study area followed by other crops.

It was also seen from the table that plantation crops were also grown in the study area. The Table 4.4 depicts that in the study area the major crop was Coconut crop, which was cultivated as monocrop, intercrop with annuals and perennials. Among the perennial crop arecanut was the major crop in farming system-V.

A limited area was also devoted for fruit crops in all the farming systems. Forest species were also found in all the system except system III.

5.2.4 Cropping Pattern of Sample Farmers under different Coconut based Farming Systems in Gubbi Taluk

The major crops grown in *kharif* season were green gram in first four systems, groundnut in system second, paddy in systems-III, fodder crops were given equal importance in all the systems which shows livestock enterprise was maintained by the farmers of all the systems.

Ragi was the most important crop in the *rabi* season because the crop is staple food and fodder for human beings and animals in the region. The attributed reason was in the study area, the average rainfall in the *rabi* season was comparatively less ragi was the only crop which was suited for the region. In summer season fodder crops being cultivated by the farmers for the maintenance of dairy animals.

Coconut was the important crop, which was grown mainly in the study area as a monocrop, with other perennial and seasonal crops. Among the systems, cultivation of monocrop was practiced equally. While coconut crop cultivated with perennial crop was most popular in farming system-V. The other important plantation crops of the region were arecanut, banana and vanilla, which was recently, introduced crop to the study area.

The other perennial crops like fruits and forest crops can be observed in the study area but the share was less to total area.

5.2.5 Cropping Pattern of Sample Farmers under different Coconut based Farming Systems in Tiptur Taluk

Green gram was the major crop in farming system-I, II, III, and IV, groundnut was grown major crop in farming system-II and paddy in farming system-III. Fodder crops are cultivated almost equally in all the farming systems.

Ragi was the major crop in the study area in all the farming systems. Among plantation crops coconut was the major crop in all the farming systems. The perennial crops with coconut were popular in farming system-V.

5.2.6 Livestock Possession in different Farming Systems in Selected Taluks of the Study Area

The livestock enterprise was one of the important part of farming system which acts as supplementary enterprise with crop enterprise and enhances the income level of the farmer and provides resource base like FYM to crop enterprises.

From the Table we could observe that in all the taluks there were dairy and sheep rearing was being practiced. Among those, dairy was the major enterprise where in all systems farmers are having dairy enterprise. Sheep was observed with the farmers in farming system-IV. There was no much difference between taluks and farming system in possession dairy enterprise. Whereas sheep enterprise differed from taluk to taluk. The numbers of sheep were more in Chikkanayakanahalli taluk compare to Gubbi and Tiptur taluk.

5.3 INCOME AND EMPLOYMENT GENERATION IN DIFFERENT COCONUT BASED FARMING SYSTEMS

The generation of income and employment under different farming systems has been shown in Tables 4.8, 4.9 and 4.10. The details are as follows.

5.3.1 Net Farm Income from Identified Farming Systems in the Study Area

The sample farmers in the study area were following highly diversified coconut based mixed farming system (Table 4.8). It was found that from the farming system-V, farmers derived maximum net farm income in all the taluks. But among the three taluks, Gubbi taluk farmers derived the highest net farm income of Rs. 85,600 per farm. The possible reason that could be attributed was with coconut crop, arecanut was popular in this region. Further, arecanut was marketed after processing which yielded additional income to farmers. Farming system-IV ranks second with respect of maximum net income in Chikkanayakanahalli and Tiptur taluks followed by Gubbi taluk which ranked third. The possible reason was among the enterprises practicing in farming system-IV, sheep raring was more popular in Chikkanayakanahalli and Tiptur taluk, where more number of sheep were maintained on the farm. But in the case of Gubbi taluk less number of sheep were maintained by the farmers. The possible reason was in Chikkanayakanahalli taluk-grazing land was available for the farmers for sheep rearing.

5.3.2 Human Labour Employment in different Farming Systems

Labour employment plays an important role in the realization of any farm family goals in the farming system. It was found (Table 4.9) that

generation of employment was the highest in farming system-II in all the taluks since the crop cultivated under this system were labour intensive, farming system-V occupied next place in terms of labour employment in this system also labour intensive activities were more where the additional labour were required for collection of arecanuts, removing and processing of arecanut. The extent of labour employment was found to be higher in farming system-I, farming system-IV and farming system-III in that order.

5.3.3 Bullock Labour Employment in different Farming Systems

The farmers maintained bullocks mainly for the cultivation purpose. Therefore efficient utilization of this resource was also an important goal in the farming system.

It was found that (Table 4.10) maximum bullock labour employment was found in farming system-II in all the taluks, where the crops were required more cultivation practices. The next place occupied by farming system-IV, where the farmers regularly use bullock labour for cultivation of field crops as well as plantation crops. In other cases comparatively in farming system-II and farming system-V, the bullock labour requirement was less.

5.3.4 Cost and Returns of different Enterprises in Identified Farming Systems

The costs and returns in farming different farming system were influenced by both endogenous and exogenous factors. The costs and return had ultimately played an important role in determining the profitability of enterprises.

5.3.4.1 Cost and Returns of different Enterprises in Farming System-I

The cost and returns of selected farming system in the study area and the share of cost and returns of each enterprise in the whole farming system was presented in Table 4.11. In the whole farming system's total cost, the share of coconut was the highest (80.96%) which revealed that in the farming system-I coconut was a major crop and the maximum resources available with the farmers were used to cultivate coconut. When compared the share of total cost to share of total returns (49.51%) was less because of high establishment cost of coconut (46.42%) and the maintenance cost was also high. The returns/rupee expenditure ratios observed to be less (1.21%).

In the farming system-I the dairy has comparatively less percent share (11.60) with respect to total cost and high percent share with net returns, similar results were observed with Alagumani and Anjugam (2000). The attributed reason was, the dairy enterprises have comparatively less cost (11.60%) and high returns per rupee spent (2.36). In the farming system farmers maintained the dairy enterprises by the by-products, which are produced within the farm, which easily converts waste materials to value added products like milk and dung.

The percent share of total returns of ragi and green gram observed to be very less when compared to the share of total cost. This was mainly because of high cost of cultivation and less value for the produce. But also still which enterprises are important to farmers, in the study area these are staple food for human beings and the by-product, which was produced, is source for livestock maintenance.

5.3.4.2 Cost and Returns of different Enterprises in Farming System-II

The farmers practicing farming system-II (Table 4.12) incurred a maximum percent share of total cost on coconut cultivation. Among total cost on coconut cultivation 41.04 per cent of cost was establishment cost which shows that coconut needs large establishment cost. When compare the total cost and total net returns per cent share of net returns to total farm returns was very less, because the return/rupee expenditure was less and coconut has large gestation period and those periods we can't earn any returns (upto 7 years). Therefore return/rupee expenditure became less. In dairy enterprise the share of total cost was comparatively less (11.98%) and the share of net return was highest (56.28%). This was because the dairy enterprise has high return/rupee expenditure. The resources, which are required for dairy enterprise, were available (fodder) with in the farming system so the maintenance cost is very low.

The share of groundnut, green gram and ragi in total cost as well as in total returns was less. Then also the farmers cultivate these crops as these are staple food crops and also provides resource base for maintenance of livestock.

5.3.4.3 Cost and Returns of different Enterprises in Farming System-III

The per farm cost and returns and per cent share of cost and returns of each enterprise in the whole farming system was presented in the Table 4.13. It was observed that in the total cost of whole farming system, the share of coconut crop was highest (77.29%) and the share of

net returns was less compared to cost, which was 50.77 per cent. Which was because of less return per rupee expenditure of the crop. In dairy enterprise the percent share of returns was highest when compare to percent share of total cost, where we can observe that the returns/rupee investment was highest. The attributed reason was in the study area dairy enterprise are maintained by the by-products which are produced by other crop enterprises. The percent share of field crops *i.e.*, green gram, ragi, paddy to total returns was less. Although these are also occupying major role as a staple food of human beings and resource base for animal enterprise.

5.3.4.4 Cost and Returns of different Enterprises in Farming System-IV

The farmers practicing farming system-IV incurred a maximum share of total cost on coconut cultivation from coconut cultivation, where as the farmers realizing comparatively less percent share of returns. Which was because of the less returns per rupee expenditure of the coconut. Where as in dairy enterprise farmers incurred less cost and getting maximum profit. Dairy enterprise has high returns per rupee expenditure compare to coconut. Incase of sheep enterprise also the share of cost was less and the share of returns was next to dairy where the returns per rupee expenditure was maximum. During the study period it was observed that except labour resource nothing was spent on maintaining sheep. In rare cases farmers are using feeds and incur on veterinary care. Although they are getting good income from this enterprise.

5.3.4.5 Cost and Returns of different Enterprises in Farming System-V

The per farm cost and returns and per cent share of cost and returns of each enterprise in the whole farming system was presented in the Table 4.15. It was observed that the maximum percent share to total cost was contributed by coconut, whereas the percent share to net income from coconut was less. The attributed reason was that the returns per rupee expenditure of coconut cultivation was less. The arecanut account 23.02 per cent to total cost. The percent share to income was highest with arecanut which was 56.5 per cent. Although the crop has high cost of cultivation, which has high returns per rupee expenditure because the arecanut in the market fetches high price. The contribution of share of dairy enterprise was also considerable which contributes 18.22 per cent to net income. The returns per rupee expenditure of dairy enterprise was highest in this farming system also.

5.4 RESOURCE USE EFFICIENCY IN DIFFERENT COCONUT BASED FARMING SYSTEMS

The technique of Cobb Douglas production function was used to measure the resource use efficiency and allocative efficiency of resources under different farming system.

5.4.1 Estimated Cobb-Douglas Production Function Coefficients and MVP to MFC Ratios

The efficiency in the use and allocation of resources were presented separately for the different farming systems under the following headings.

5.4.1.1 Farming System-I

The production function analysis of farming system-I, for different resources (Table 4.16) indicated that the elasticity coefficient of capital and feeds were statistically significant, while those of others were non significant. Gross income was significantly and positively affected by capital and feeds. A five per cent increase of capital would increase gross income by 0.26 per cent and every five per cent increase in feeds would increases gross return by 0.51 per cent. Similar results were obtained by Sharma and Singh (1996), wherein by allocating the capital for plant protection chemicals and veterinary care there was increase in the returns. The coefficient of multiple determination indicated that 89 per cent of the variation in gross income was explained by these seven selected variables included in the production function. The sum of elasticities was found to be more than unity, which indicated, increased returns to scale.

The variables land and cows had a negative influence on return and these resources were over utilised in the production process. There was ample scope of greater exploitation of remaining resources for increasing the gross returns.

5.4.1.2 Farming System-II

The production function analysis for farming system-II showed that (Table 4.17) about 77 per cent of the variation in gross returns was explained by the variables included in the production function. The elasticity coefficient for number of cows was significant at 10 per cent level *i.e.*, every 10 per cent increase in the number of cows increase the

returns to 0.23 per cent. The increase in resources like land, FYM and fertilizer, labour, capital and seeds increases positively but not significantly. The sum of elasticities was more than unity, which indicated on increasing returns to scale.

A comparison of ratio of MVP to MFC for selected variables indicated that, feed was over used and other variables like cows, fertilizer and FYM, capital were underutilized. The returns could be increased further by the use of these resources.

5.4.1.3 Farming System-III

In the case of farming system-III the FYM and fertilizer, capital, seeds have negative coefficient indicating the decrease in the gross income for the increased use of any of these resources. Labour had a positive and significant influence on gross returns at five per cent level, which is attributed to the reason that the crops grown under this system are labour intensive. Every five per cent increase in labour would increase the gross returns to the tune of 1.19 per cent. The resources *viz.*, land, number of cows, feeds also had positive effect indicating that gross return can be increased by using increased quantity of any of the these resource. These results were contradicting with the findings of Muralidharan (1987) with land resource and similar with labour resource. The coefficient of determination (R^2) value showed that nearly 72 per cent of the variation in gross income was explained by the variables considered in the production function. The return to scale was of increasing type.

The ratios of MVP to MFC for the selected variables revealed that seed, capital and feed were over utilized and there was lot of scope to enhance the return by increased use of other resources.

5.4.1.4 Farming System-IV

The production function analysis in the case of farming system-IV indicated that about 83 per cent of the total variation in the gross income was explained by the variables included in the production function. It was observed that elasticities of coefficients of land, labour, feeds and number of sheep observed to be positive and significant at five per cent except number of sheep which was significant at 10 per cent level. The results corroborated with the findings of Muralidharan (1987). The possible reasons that could be attributed were land was important resource in the system for cultivation of coconut and other crops. All the activities, which were practiced in the system, were labour intensive. The coefficients of resources *i.e.*, number of cows, FYM and fertilizer were also observed to be positive which influenced positively to the gross returns, where as the regression coefficients of seeds observed that increase in seeds keeping other resources constant decreases the returns. The sum of elasticities was observed to be more than unity, which showed an increasing returns to scale.

The resource like land, number of cows, fertilizer and FYM, labour, capital, feeds were under utilized as indicated by the ratios of MVP: MFC, which suggested that there existed a better scope for increasing the use of each of the resources by which we can increase the gross income. The seed resources show negative MVP to MFC ratio, which indicates uneconomic use of seed resource. Some units of seeds could be withdrawn from the production process in order to get increased returns.

5.4.1.5 Farming System-V

The analyzed results incase of farming system-V (Table 4.20) shows that about 63 per cent of variation in the gross returns was explained by the variables included in the production function. It was observed that elasticity of coefficient for land, number of cows FYM and fertilizer and seeds were positive, similar results were found with Nagraj *et al.* (1996) The land and number of cows are significant at 10 per cent level. Which says that every 10 per cent increase in land would increase gross income by 0.49 per cent and for every 10 per cent increase in number of cows. The gross return increase by 0.49 per cent. The elasticity of coefficient for labour, capital and feeds have negative values which shows that there will be decrease in returns if any of these resource level will increase keeping all other at constant level. The sum of elasticities of coefficient was 3.49, which shows increasing returns to scale.

The MVP: MFC ratio for the resources land, number of cows, FYM + fertilizer and seeds was more than unity which shows that the under utilization of these resources. There is a scope for increasing the returns by increasing these resources to some extent. The MVP: MFC ratios for the resources labour, capital, and feeds was less than unity, which shows uneconomic use of these resources. The ratios suggesting that by curtailment of labour, capital, feeds to some extent we can expect increased income.

5.5 OPTIMUM FARM PLANS FOR DIFFERENT COCONUT BASED FARMING SYSTEMS

Linear programming model was employed to identify to optimum farm plan, which can utilize to available resources efficiently.

5.5.1 Coconut based Farming Systems in different Plans

Farming System-I

The area under coconut decreases substantially in both the plans *i.e.*, Plan-1 and Plan-2. In *kharif* green gram, the area was decreased in Plan-1 and there was no allotment of area for green gram in Plan-2. In Plan-2 we can observe that the *kharif* groundnut come in to picture. The area under rabi ragi decreases substantially in both the plans. The number of dairy animals increased substantially in Plan-1 and Plan-2. Although the area under crops decreases the net returns increases by which we can say that the optimum plan not only increased the net returns but also saves some of the resources. From this we can say that instead of spending resource on crop enterprise if we increase number of dairy animals we can increase the net income of the farm.

Farming System-II

By the Table 4.21 we can say that the area under coconut decreases and it was same in Plan-1 and Plan-2. In both the optimum plans there was no allotment of area for green gram. The area under groundnut increased substantially in both the plans. There was reallotment of land for paddy cultivation. The area under ragi remains as that of existing plan in Plan-1 and the area decreased in Plan-2. The number of dairy animals increased substantially in both the plans.

The net returns increases substantially in both the optimum plans. By this we can concluded that instead of low earning crops we can allot the land for groundnut and by allocate the available resource to dairy

enterprise we can increase the income substantially which is the good supplementary enterprise.

Farming System-III

High-earned crops retained in Plan-1 and Plan-2 they are coconut and groundnut. The other crops are neglected. The some extent of ragi is retained in the plan. There was substantial increase in number of animals. Under this system we can say that green gram and paddy are low earning crops. Coconut and groundnut are high earning crops. Ragi was also low earning crop but it was included in the plan because it was the staple food of the region. The best supplementary enterprise in the system was dairy, which substantially increases the net income of the farm. Both the optimum plans enhanced the net income by increasing 21.21 and 24.29 per cent and saves some of the resources under the farm.

Farming System-IV

In farming system-IV most profitable enterprises are dairy and sheep raring. The area under coconut decreased substantially in both the plans. The area under green gram remains same in Plan-1 and increased in Plan-2, which is due to the restrictions on these crops as they provide fodder for dairy and sheep enterprises. The net income increased by 6.16 per cent over existing plan in Plan-1 and 9.66 per cent in Plan-2. The best supplementary enterprises under this system were dairy and sheep.

Farming System-V

The area under coconut decreases substantially in both the plans, whereas the area under arecanut increases substantially by which we can

say that which is the high earning crop. The area under ragi decreases which is still observed in the plan because of putting maximum restriction in the plan, as it was the staple food crop in the region. The number of animals increased substantially in both the plans. From this we can infer that arecanut and dairy were the best enterprises in the system, which helps in maximizing the net returns.

5.5.2 Resource Availability and Surplus under different Coconut based Farming Systems

5.5.2.1 Resource Availability and Surplus under different Plans in Farming System-I

Although the resource availability (Table 4.22) was same, the income was increased in optimum plans when compared to the existing plan. In the existing plan all the resource were utilised whereas in the optimum plans some surplus resources were available in Plan-1 and Plan-2 except for human labour for summer season and bullock labour for *kharif* and *rabi* season and dairy animals all other resources. By supplying these resources we can still increase the income.

5.5.2.2 Resource Availability and Surplus under different Plans in Farming System-II

In the Table 4.23 we can see that in existing plan there was no surplus resources. In Plan-1 except for summer human labour, dry land for *kharif* and *rabi* season all other resources were still remaining although the net income was increased from Rs. 36,695 to 44,066. In Plan-2 *kharif* human labour, summer human labour, capital and *rabi* land were completely utilized. The remaining resources were surplus and the net income was increased from Rs. 36,695 to Rs. 44,188. From this we can say that the optimum plans not only increased the income but also saves some of the resources in the farm.

5.5.2.3 Resource Availability and Surplus under different Farming System-III

From the Table 4.24 we can observe that the resource availability for all the three plans were same. In the existing plan all the resources were used and the net income generated was less when compared to optimum plans. Whereas in case of Plan-1 and Plan-2 the optimization of resources not only increased the income but also the resources were saved. Which means to say that if resources in shortage were supplied we could still increase the income.

5.5.2.4 Resource Availability and Surplus under different Plans in Farming System-IV

The resource availability was same for both the existing and optimum plans. The net farm income was more in optimum plans (Rs. 45,100 and Rs. 46,587) when compared to existing plans (Rs. 42,481). The optimum plans not only increased the income but also saved certain resources (Table 4.25). In Plan-I except for human labour for summer season, dry *kharif* land, dry *rabi* land, number of dairy animals and sheep, all other resources were surplus. If we supply these shortage resources we can still increase the farm income.

5.5.2.5 Resource Availability and Surplus under different Plans in Farming System-V

From the Table 4.26 we can say that although the resource availability was same in all the three plans the highest net income was observed in optimum plans when compared to the existing plan. Optimum

plans not only maximize income by available resources but also saves some of the resources. In Table 4.26 we can find that except for bullock labor, capital and dairy animals remaining resources were surplus. By supplying these shortage resources we can still increase the income of the farm.

5.6 CONSTRAINTS AND PROSPECTS ASSOCIATED WITH DIFFERENT COCONUT BASED FARMING SYSTEMS

Through the schedule farmers were asked to indicate the opinion about the problems they faced in different farming systems and the possible suggestions. The details are as follows.

5.6.1 Problems or Constrains under different Farming Systems

The problems encountered by farmers in different farming systems are given in Table 4.27. Among the problems mite infestation in coconut gardens was the major hurdle. During the study period it was observed that mite infested all the coconut gardens in the study area. In the study area although most of the farmers were educated they were not having any awareness about implications of the World Trade Organization (WTO). Farming system was an integration of enterprises. Therefore in the study area 64 per cent of the farmers were facing scarcity of family labour. In the study area with coconut and other crops farmers were also growing perishable commodities like vegetables and therefore they faced transportation and marketing problems.

The farmers were also facing fragmentation and sub-division of land, which was uneconomical for cultivation. In the study area the main occupation that bounds life of farmers was agriculture. Due to drought and other problems they were not able to gear up the process of capital formation. The other problems like less reliable market in the context of global scenario, low yield due to local seeds, non-availability of support prices, exogenous factors like heavy rains and drought *etc.* were also crucial in the study area. These problems need to be adjusted within the farming system by the farmers and also policy changes should be made by the administrators for the betterment of farming community on sustainable basis.

5.6.2 Prospects under different Farming Systems

The prospects of adopting farming systems as opined by the farmers has been depicted in Table 4.28. The table revealed that by integration of enterprises farmers have been getting the income throughout the year in the study area. It was observed that integration of dairy with crop activities generated continuous income by which farmers were able to combat against drought. Integration maintains sustainable production without hindering resource base and enables recycling of wastes within the farming system where crop wastes were used for dairy and the FYM was used for crops. Integration of enterprises provided balanced diet to family members, helped to reduce the price risk because of diversification of enterprises and provides family employment throughout the year. Other than these prospects, integration of enterprises enabled the farmers to improve the standard of living and helped to slinking production and

marketing. Overall, the farmers had optimistic opinion about the adoption of farming system approach in agriculture mostly to minimise risks through diversification and generation of better income besides employment for their family members. In addition, the farmers had the concern for protecting the environment and ecology by way of prospects in recycling of wastes on their farm.

—Summary and Policy Implications

VI. SUMMARY AND POLICY IMPLICATIONS

Farming system refers to the farm wherein two or more (diverse economic) enterprises are integrated with the farm resources for achieving their fuller utilization, realizing maximum profits and stabilizing returns. Thus, the primary objective of the farming system is to improve rapidly the socio-economic conditions of individual farm families by increasing modifications, intensifications, diversification of different enterprises and production techniques, keeping in view the latest technologies, constraints imposed by resources, social taboos and the environment.

6.1 OBJECTIVES OF THE STUDY

The present study was undertaken with the following objectives in Tumkur district of Karnataka.

1. To identify the different coconut based farming systems and resource use patterns followed by the farmers in study area
2. To estimate the levels of income and employment generation under different coconut based farming system
3. To determine optimum coconut based farming system models for achieving stability in the production and income levels of farmers
4. To identify the constraints associated with coconut based farming system and to suggest appropriate policy measures

The study uses primary data mainly and required secondary data. The objectives of the study were achieved by using the various statistical and mathematical tools like functional analysis and linear programming model.

6.2 FINDINGS OF THE STUDY

6.2.1 Social Characteristics of Sample Farmers

The majority of the farmers belonged to middle age group in all the selected taluks. They were 82 per cent in Chikkanayakanahalli and Gubbi taluk and 86 per cent in Tiptur taluk. The majority of the farmers had large sized family, which was 56, 58 and 60 per cent in Chikkanayakanahalli, Gubbi and Tiptur taluks respectively. It was observed that majority of the coconut growers were educated. The literacy percent was highest (100%) in Tiptur taluk followed by Gubbi(94%) and Chikkanayakanahalli taluk(90%)

6.2.2 Coconut based Farming Systems in the Study Area

In the study are there were as many as 13 different coconut based farming systems practiced by the farmers. Among these farming systems five farming systems were practised by the majority of the farmers.

6.2.3 Average Farm Size in the Identified Coconut based Farming Systems

The larger farm size was observed in case of farming system III followed by farming system V, farming system, II, farming system I and farming system IV.

6.2.4 Cropping Pattern of Sample Farmers under different Farming Systems in the Study Area

The major crops grown in all the systems were green gram and fodder crops. *Kharif* groundnut in farming system-II and paddy in farming

system-III were popularly grown and ragi in *rabi* season, fodder maize in summer season were popular in all the three taluks. Among perennial crops, coconut was the major crop in all the systems and taluks. The cultivation of perennial crops with coconut was popular in farming system-V largely in Gubbi taluk.

The main livestock enterprises in the study area were dairy and sheep. Dairy was practiced equally in all the systems and selected taluks of the study area, whereas sheep enterprise was intensively practiced in Chikkanayakanahalli taluk under farming system V.

6.2.5 Net Farm Income from Identified Farming Systems in the Study Area

The maximum net income was realised from farming system-V followed by farming system-IV, farming system-I, farming system-III and farming system-II. In Chikkanayakanahalli and Tiptur taluks maximum net income was earned from Farming system-V. Whereas in Gubbi taluk the maximum net income was realised from farming system-V.

6.2.6 Human Labour Employment in different Farming Systems

Farming system-II generated highest employment followed by farming system-V, farming system-I, farming system IV and farming system-III. Same order was found in the selected three taluks of the study.

6.2.7 Bullock Labour Employment in different Farming Systems

Under the identified farming systems, farming system-II required highest bullock labour (196.4 pair days) followed by farming system-V

(173.5 pair days), farming system-I (162 pair days), farming system-III(160.3) and farming system-IV(86.3). There was not much difference among the taluks in bullock labour employment.

6.2.8 Cost and Returns of different Enterprises in Identified Farming Systems

Farming System-I

The maximum share of 80.96 per cent of total cost was contributed by coconut, followed by dairy, greengram and ragi. The maximum share to the net returns was contributed by coconut (49.51%) followed by dairy, ragi and greengram.

Farming System-II

Coconut had a major share of 74.60 per cent in the total cost followed by dairy, groundnut, greengram and ragi. With respect to net returns dairy contributed a major portion of 56.28 per cent, followed by coconut, groundnut, ragi and greengram.

Farming System-III

Coconut had a major share in the total cost (77.29%) followed by dairy, greengram, paddy and ragi. The percent share with respect to net returns was maximum in coconut (50.77%) followed by dairy, greengram, paddy and ragi.

Farming System-IV

The coconut accounted maximum share to total cost (69.15%) followed by dairy, sheep, greengram and ragi. Dairy enterprise

contributed highest share to net returns (38.15%) followed by sheep, coconut, greengram and ragi.

Farming System-V

Coconut accounted 67.38 per cent of the total cost followed by arecanut (23.02%), dairy (7.20%) and ragi (2.40%). Whereas with respect to percent share of net returns arecanut contributed maximum share, which was 56.55 per cent, followed by coconut, dairy and ragi.

6.2.9 Resource use Efficiency in different Farming Systems

In farming system-I the labour and capital have a significant and positive influence on gross returns. All other resources were non-significant. The resources *viz.*, land and number of cows were over utilized and all the other resources were under utilized. There was an increasing returns to scale.

With respect to the farming system-II, the only resource which had positive and significant influence on gross returns was number of cows. The labour and feeds were over utilized whereas all other resources were under utilized. There was an increasing returns to scale.

In case of farming system-III labour was the only resource, which had a significant and positive influence on gross returns. Fertilizer + FYM, capital and seeds were over utilized in the system and all other resources were under utilized. There was an increasing returns to scale.

With respect to farming system-IV, land, labour, feeds and number of sheep had positive and significant effect on gross returns. All the

resources except seed were under utilized. The seeds were over utilized. There was an increasing returns to scale.

In case of farming system-V, the land and number of cows had positive and significant influence on gross returns. Labour, capital and feeds were over utilized whereas land, number of cows, FYM+fertilizer and seeds were under utilized. There was an increasing returns to scale.

6.2.10 Coconut based Farming System in different Plans

Farming System-I

In plan-1 the area under coconut decreased from 1.97 hectares to 1.42 hectares, area under greengram decreased from 0.52 hectares to 0.21 hectares. The area under *rabi* ragi decreased to 0.84 hectares from 1.34 hectares. The dairy animals increased from two to three. The net returns increased by 4.93 per cent over the existing plan. With respect to plant-2 the area under coconut remains same as that of plan-1. There was no land allotted for green gram. The area under ragi decreased to 0.64 hectares. The number of dairy animals was three. The net income increased by 6.81 per cent over the existing plan and 1.79 per cent over plan-1.

Farming System-II

In plan-1, the area under coconut decreased from 1.97 hectares to 1.46 hectares. The area under coconut remained as that of plan-1 in plan-2. There was no allotment of area for greengram in plan-1 and plan-2. The area under groundnut increased from 0.53 hectares to 0.92 hectares in both the optimum plans. In plan-2, 0.31 hectares of land was

allotted to paddy cultivation. The area under ragi remained same as existing plan in plan-1, whereas in plan-2, the area decreased to 0.45 hectares. The number of dairy animals increased from two to three in both the optimum plans. The percent increase in net returns in plan-1 was 20.08 and 20.40 in plan-2 over the existing plan.

Farming System-III

The area under coconut decreased from 2.4 hectares to 2.03 hectares in plan-1 and plan-2. The area under greengram remained as that of existing plan in plan-1. In plan-2 no area was allotted to green gram. The area under ragi decreased to 0.38 hectares in plan-1 and 0.42 hectares in plan-2. The number of dairy animals increased to three in both the plans. The increase in net returns in optimum plans was 21.21 per cent and 24.29 per cent in plan-1 and plan-2 respectively over existing plan and 2.54 per cent over plan-1.

Farming System-IV

The area under coconut decreased to 0.71 hectares in plan-1, 0.08 hectares in plan-2 from 1.62 hectares. The area under greengram remained same as existing plan, whereas in plan-2, the area under greengram increased to 1.0 hectare. The area under ragi increased to 0.54 hectares in plan-1 and 0.73 hectares in plan-2. The number of dairy animals increased from two to three in both the optimum plans.

The percent share in net income increased over existing plan was 6.16 and 9.66 in plan-1 and plan-2 respectively. The percent share increased was 3.29 in plan-2 over plan-1.

Farming System-V

The area under coconut decreased to 1.39 hectares from 2.4 hectares in plan-1 and 0.50 hectares in plan-2. The area under arecanut increased from 0.5 hectares to 0.75 hectares in both the optimum plans. The area under ragi decreased to 0.25 hectares from 0.53 hectares in both the plans. The allotted dairy animals were increased to four in plan-1 and six in plan-2. The percent increase in net returns over existing plan was 9.65 and 19.76 respectively in plan-1 and plan-2. The percentage change over plan-1 was 9.21.

6.2.11 Resource Availability and Surplus under different Coconut based Farming Systems

Farming System-I

The resource availability for all the three plans was same. There were no surplus resources in existing plan and the net income was less compared to plan-1 and plan-2 (Rs.44,562 and Rs.45,363 respectively. The optimum plans not only increased the net income but also saved the resources such as human labour, bullock labour, capital and land.

Farming System-II

The resource availability was same for all the three plans. In existing plan all the resources were used completely whereas in optimum plans some of the resources were still in excess. In existing plan the net income was less (Rs.36, 695) when compared to plan-1 (Rs.44,066) and plan-2 (Rs.44,188).

Farming System-III

Although the availability of resources were same for all the plans there was less income realised in existing plan (Rs.37, 959) when compared to plan-1 (Rs.46,012) and plan-2 (Rs..47,182). In existing plan all the resources were utilized whereas in optimum plans some of the resources were still in excess.

Farming System-IV

The resource availability was same for all the plans. The net income from existing plan was Rs.42, 481 and the net income in optimum plans was Rs.45,100 and Rs.46,582 in plan-1 and plan-2 respectively. In existing plans no resources were surplus whereas in optimum plans the resources such as human labour, bullock labour, capital and land were observed to be surplus.

Farming System-V

The net income from existing plan was Rs.76,487 whereas in optimum plans it was Rs.83,872 and Rs.91,603 in plan-1 and plan-2 respectively. Although the availability of resources was same for all the plans the income gained was less in existing plan.

6.2.12 Problems and Prospects of Coconut based Farming Systems

The major problems faced by the farmers in the study area were mite infestation in coconut gardens (100%), lack of awareness about WTO, scarcity of family labour, lack of transportation and marketing facilities, fragmentation and division of land and scarcity of funds. The

other problems were less reliable market in the context of global scenario, low yield due to local seeds, non-availability of support prices for the produce.

In the context of prospects, the major prospects of integration of enterprises were generating income throughout the year (100%). Integration of enterprises enabled recycling of wastes within the farming system, maintained sustainable production without hindering resource base, provided balanced diet for the family and helped to reduce the price risk.

POLICY IMPLICATIONS

On the basis of the study on different coconut based farming systems, the following policy implications and suggestions are suggested.

1. The study has brought out that there is an ample scope for increasing the farm income in farming systems-I, II, III, and IV by adopting recommended activities such as arecanut or other plantation crops with coconut. Therefore Farmers are suggested to grow arecanut and other plantation crops with Coconut to maximize the net returns.

2. Reallocation of resources like land, number of cows, number of sheep, labour and capital is suggested for all the farming systems.

3. During the study it was found that coconut gardens in all the farming systems had severe mite infestation. Farmers were getting low yield and poor quality nuts. Hence Department of Horticulture and Agricultural Universities have to take interest in developing strategies

for diminating this menace and for developing research and implication to the field to safeguard the coconut growers.

4. It was found that, majority of the farmers were practising coconut based farming system which mainly includes rearing of milch animals and sheep rearing in rare cases. In order to stabilize the income there is a need to take up other subsidiary enterprises like poultry, sericulture *etc.*

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Appendices

APPENDIX I

District wise statistics of coconut in Karnataka (1999-2000)

Districts	Area (ha)	Production ('000 nuts)	Production (nuts/ha)
Bagalkot	571	2728	4826
Bangalore (U)	3347	15984	4824
Bangalore (R)	14114	67405	4824
Belgaum	207	890	4393
Bellary	1174	5606	4823
Bidar	2	10	4829
Bijapur	150	717	4826
Chamarajanagar	7019	24995	3597
Chickmagalur	30041	75720	2546
Chitradurga	36609	214268	5912
Dakshina Kannada	12827	54757	4312
Davanagere	12423	72710	5912
Dharwad	348	1662	4823
Gadag	350	1671	4823
Gulberga	748	3763	5082
Hassan	48845	270410	5592
Haveri	738	3524	4823
Kodagu	776	3708	4826
Kolar	2101	10030	4822
Koppal	254	1211	4817
Mandya	16761	80063	4825
Mysore	11821	42095	3597
Raichur	90	429	4817
Shimoga	6638	23434	3566
Tumkur	83818	551484	6646
Udupi	13003	55508	4312
Uttar Kannada	5624	26748	4804
State	310399	1611530	5244

Source: Directorate of Horticulture, Government of Karnataka

APPENDIX II

Taluk wise statistics of coconut in Tumkur (2001-2002)

Sl. No.	Taluks	Area (ha)
1.	Chikkanayakanahalli	23017
2.	Gubbi	20838
3.	Koratagere	926
4.	Kunigal	5310
5.	Madugiri	1611
6.	Pavagada	610
7.	Sira	4647
8.	Tiptur	22640
9.	Tumkur	10432
10.	Turvaekere	11800
	Total	101831

Source: District Horticultural Office, Tumkur

APPENDIX III

SCHEDULE

Date of interview: | | | |

Type of farm:

Marginal	Small	Large

I. General information

1. Name of the respondent :
2. Name of the village and taluk :
3. Age and educational level of respondent :
4. Family size :
5. Size of the land holding :

6. Wages:

Male: Female: Children:

Irrigated: _____ acres

Rainfed: _____ acres

II. Farm asset position

a. Land inventory (in acres)

Sl. No.	Particulars	Dry	Irrigated	Garden	Total
1.	Area owned				
2.	Leased - in				
3.	Leased - out				
4.	Operational area				
5.	Value/acre (Rs.)				

b. Farm building

Sl. No.	Item	Year of construction	Construction cost (Rs.)	Present value (Rs.)
1.	Farm house			
2.	Cattle shed			
3.	Silk warm rearing house			
4.	Poultry shed			
5.	Pump shed			
6.	Storage shed			
7.	Any other (specify)			

c. Farm machinery and equipment

Sl. No.	Item	Number	Year of purchase	Purchase value (Rs.)	Current value (Rs.)
1.	Tractor				
2.	Power tiller				
3.	Bullock cart				
4.	Pumpset				
5.	Plough				
	i. Country				
	ii. Improved				

Sl. No.	Item	Number	Year of purchase	Purchase value (Rs.)	Current value (Rs.)
6.	Seed drill				
7.	Intercultural implements				
8.	Sprayer/duster				
9.	Spade				
10.	Sickles				
11.	Feeders and waterers				
12.	Egg trays				
13.	Weighing machine				
14.	Buckets				
15.	Chawki rearing boxes				
16.	Rearing trays				
17.	Rearing stand				
18.	Chandrikas				
19.	Hygrometer				
20.	Knives				
21.	Uzyfly net				
22.	Leaf cutter				
23.	Lighting (poultry)				
24.	Dressing equipments (poultry)				
25.	Any other (specify)				

III. Livestock possession

Sl. No.	Animals	In number	Year of purchase	Purchase value (Rs.)	Current value (Rs.)
1.	Dairy cows				
	i. Local				
	ii. Cross bred				
2.	Buffaloes				
3.	Bullock pair				
4.	Calves				
5.	Poultry				
	i. Giriraja				
	ii. Broilers				
	iii. Layers deep litter/cage system)				
6.	Sheep				
7.	Goat				
8.	Piggery				
9.	Fisheries (water-storage pond/farm pond)				
10.	Others (specify)				

IV. Cropping pattern 2001-02

Sl. No.	Crops	Season	Dry/irrigated	Area (acres)
i.	Annual			
1.				
2.				
3.				
4.				
5.				
ii.	Perennial			
1.				
2.				
3.				
4.				
5.				

V. Irrigation

Sl. No.	Source	Maximum area irrigated (acres)	Minimum area irrigated (acres)	Normal area (acres)	Cost of irrigation	Remarks
1.	Open well					
2.	Tube well					
3.	Tank					
4.	Canal					
5.	Others (specify)					
6.	Total area irrigated					

VI. Livestock maintenance

Sl. No.	Item	Quantity/month	Price (Rs.)	Total cost (Rs.)
	Dairy			
1.	Groundnut cake			
2.	Rice bran			
3.	Concentrate			
4.	Dry fodder			
5.	Green fodder			
6.	Medicines			
7.	Labour (in mandays)			
8.	Others (specify)			
	Poultry			
1.	Starter feed			
2.	Finisher feed			
3.	Medicines			
4.	Labour (in mandays)			
5.	Others (specify)			
	Fisheries			
1.	Manuring/mahuva oil cake			
2.	Feeding/fertilization			
3.	Labour (in mandays)			

Sl. No.	Item	Quantity month	Price (Rs.)	Total cost (Rs.)
	Piggery			
1.	Roughages			
2.	Concentrates			
3.	Medicines			
4.	Labour (in mandays)			
5.	Others (specify)			
	Sheep/goat			
1.	Mineral mixtures			
2.	Medicine			
3.	Green fodder			
4.	Garaging			
5.	Labour (in mandays)			
6.	Any other			

VII. Gross income from livestock

Sl. No.	Particular	Quantity per No.	Price per unit (Rs.)	Total amount (Rs.)
1.	Yield			
a.	Milk (litres)			
b.	Brollers chicken (kg)			
c.	Eggs (No)			
d.	Pork (kg)			
e.	Fish (kg)			
f.	Mutton (kg)			
2.	Manure (cartloads)			
3.	Gunny bags (No)			
4.	Sale of male caves/culled birds (No.)			
5.	Hiring out the bullocks (days)			
6.	Sale of animals (No)			
	Total			

VIII. A. Linkages between different enterprises within the farming system

1. Livestock waste used as input : Yes/No.
   If yes, used for : Crop production/Fisheries/Biogas/others
2. Sericulture waste used as input : Yes/No.
   If yes, used for : Crop/Fisheries/Biogas/Livestock/others
3. crop residue used as input : Yes/No.
   If yes, used for : Dairy/Poultry/Sheep/Goat rearing/Crop/others
4. Farm forestry practiced : Yes/No
   If yes, used as : Live hedges/Green manure/Fuel wood/Shade /Wind breakers/Multi purpose/others
5. Bee keeping practiced : Yes/No
   If yes, helps in : Pollination/Additional income/others

6. Tamarind seeds used as feed : Yes/No
   If yes, helps in : Piggery/others (specify)
7. Mango : Yes/No
   If yes, helps in : Timber for home consumption/used for implements/preparation/dry laves used as FYM/other
8. Coconut : Yes/No
   If yes, helps in : Dairy shed/fire wood/others
9. others :

B. Constraints in Integrated Farming System Approach

1. Exogenous factors (which are beyond the control of the farmers) dependence on natural resources, global warning *etc.*
2. Fragmentation and division of the holding.
3. Scarcity of family labour due to involvement in non-farming activities.
4. Low yield of local seeds resulting in reduced income.
5. Less reliable market in the context of changing global scenario.
6. Scarcity of owned funds.
7. Non-availability of good seeds, chicks, DFLS, fingerlings *etc.*, at low prices.
8. Lack of suitable poultry house, cattle shed and rearing house.
9. Lack of transportation and marketing facilities.
10. Lack of awareness of WTO.
11. Non-availability of support prices for all the enterprises.
12. Scarcity of water.

C. Prospects of Integrated Farming System Approach

1. An approach, which views the farm in a holistic manner and focuses on inter-relation and interaction between and among the farm enterprises.
2. Maintain sustainable production systems without damaging resource base/ environment.
3. Efficient utilization of all the land available within the farm.
4. Provides full family employment throughout the year.
5. Enables recycling of waste within the farming system.
6. Provides balanced food diet.
7. Standard of living will be improved through efficient utilization of all the available resources.
8. Generates income throughout the year/reduces economic instability.
9. Helps in slinking production and marketing.
10. Helps in to reduce the price risk.

IX. Cost of cultivation for annual crops (per acre)

Crop	:	Variety/hybrid	:	Wages	
Area	:	Season	: Kharif/rabi/summer	Male	: Rs.
Soil type	:	Irrigated/dry	:	Female	: Rs.
Rental value	: Rs.			Bullock pair	: Rs.
				Tractor hr	:

A. Labour used in different operation

Sl. No.	Name of the operation	No. of times	Family			Hired			Machine hours
			M	W	BP	M	W	BP	
1.	Ploughing								
2.	Manuring/fertilizing								
3.	Opening ridges and furrows								
4.	Nursery bed preparation								
a.	Sowing								
b.	Manuring								
c.	Irrigation								
5.	Transplanting								
6.	Intercultivation/earthing up								
7.	Weeding								
8.	Fertilizer application								
9.	Plant protection								
10.	Irrigation								
11.	Watch and ward								
12.	Harvesting								
13.	Threshing								
14.	Packing								
15.	Transportation and marketing								
	Total								

M = Men, W = Woman and BP = Bullock pair

B. Inputs used in production

Sl. No.	Input	Quantity	Rate (Rs.)	Amount (Rs.)
1.	Seed			
2.	Manures			
3.	Fertilizer			
a.				
b.				
c.				
4.	Bio-fertilizer			
a.	Rhizobium			
b.	Azotobacter			
c.	PSB			
5.	Plant protection			
6.	Weedicides			

Sl. No.	Input	Quantity	Rate (Rs.)	Amount (Rs.)
7.	Irrigation			
8.	Labour used			
a.	Male			
b.	Female			
c.	Bullock pair			
d.	Tractor (Hrs.)			
9.	Electricity charges			
10.	Land revenue			
11.	Interest on variable cost			
12.	Depreciation			
13.	Others (specify)			
	Total variable cost			

C. Gross returns

Item	Total production	Rate (Rs.)	Amount (Rs.)
Main product By product	Gross returns		

Gross returns - Total variable cost = net returns

Rs._____(-) Rs_____ (=) Rs._____

X. Cost of cultivation for coconut and other plantation crops (per acre)

Crop : Variety/hybrid : Wages

Area : Season : Kharif/rabi/summer Male : Rs.

Soil type : Irrigated/day : Female : Rs.

Rental value : Rs. Bullock pair : Rs.

A. Labour used in different operation

Sl. No.	Name of the operation	No. of times	Family			Hired			Machine hours
			M	W	BP	M	W	BP	
1.	Clearing the land								
2.	Ploughing								
3.	Digging the pits								
4.	Filling the pits								
5.	Manuring								
6.	Fencing								
7.	Planting								
8.	Intercultivation/earthing up.								
9.	Fertilizer application								
10.	Plant protection								
11.	Irrigation								
	Total								

M = Men, W = Woman and BP = Bullock pair

B. Inputs used during establishment

Sl. No.	Input	Quantity	Rate (Rs.)	Amount (Rs.)
1.	Planting material			
2.	Manure			
3.	Fertilizer			
a.				
b.				
c.				
4.	Plant protection			
5.	Fencing material			
	Total			

Annual cost

A. Labour used in different operation

Sl. No.	Name of the operation	No. of times	Family			Hired			Machine hours
			M	W	BP	M	W	BP	
1.	Ploughing								
2.	Replacement								
3.	Pruning								
4.	Manuring								
5.	Fence maintenance								
6.	Intercultivation/earthing up								
7.	Fertilizer application								
8.	Plant protection								
9.	Irrigation								
	Total								

M = Men, W = Woman and BP = Bullock pair

B. Inputs used

Sl. No.	Input	Quantity	Rate (Rs.)	Amount (Rs.)
1.	Planting material (replacement)			
2.	Manures			
3.	Fertilizer			
a.				
b.				
c.				
4.	Bio-fertilizer			
5.	Plant protection			
6.	Weedicides			
7.	Irrigation			

Sl. No.	Input	Quantity	Rate (Rs.)	Amount (Rs.)
8.	Labour used			
a.	Male			
b.	Female			
c.	Bullock pair			
d.	Tractor (hrs.)			
9.	Electricity charges			
10.	Land revenue			
11.	Interest on variable cost			
12.	Other (specify)			
	Total			

Generation period: How many years will take for yield realization after plantation?

C. Gross returns

Sl. No.	Item	Total production	Rate (Rs.)	Amount (Rs.)
1.	Main product			
2.	By-product			
	Gross returns (Rs.)			

Gross returns - Total variable cost = Net returns

Rs._____(-) Rs. _____ (=) Rs._____

AN ECONOMIC ANALYSIS OF COCONUT BASED FARMING SYSTEMS IN TUMKUR DISTRICT OF KARNATAKA

RAJESHWARI Y. G. 2004 Dr. N.R. MAMALE DESAI
MAJOR ADVISOR

ABSTRACT

This study was conducted in Tumkur district of Karnataka as it had the largest area under coconut cultivation in Karnataka. The top three taluks namely Chikkanayakanahalli, Gubbi and Tiptur taluks which had highest area under coconut in Tumkur district were selected with an overall objective of identifying and analysing for the different coconut based farming systems. The relevant data collected from primary source through personal interview method using pre-tested schedules for the agricultural year 2001-02 were analysed by following tabular, production function and linear programming techniques. Among the identified farming systems, top five coconut based farming systems *viz.*, farming systems I, II, III, IV and V were selected for the study. The study revealed that the net farm income was highest under farming system-V which was Rs.76,487. While it was Rs.42,781, Rs.42,246, Rs.37,959 and Rs.36,695 respectively in farming system-IV, farming system-I, farming system-III and farming system-II. The human and bullock labour requirement was the highest under farming system II. The production function analysis of farming systems for different resources indicated that the elasticity coefficient of capital and feeds were statistically significant under farming system-I. In farming system-II the coefficients for number of cows was statistically significant. In the case of farming system-III labour had positive and significant influence on gross returns. In the case of farming system-IV, the resources such as land, labour, feed and number of sheep were statistically significant. Whereas in case of farming system-V the land and number of cows were positive and significant. The study revealed that the farmers were operating closer to optimality under existing resource levels by utilising all the resources in farming systems I and IV but in farming systems II, III and V the farmers were declining from optimality and analysis revealed that the optimization not only increases the income and also saves certain resources in all the five farming systems. The problems and advantages of different coconut based farming systems were identified and suitable suggestions have been made.