AN ECONOMIC ANALYSIS OF FARMING SYSTEMS IN TANK COMMANDS OF NORTHERN KARNATAKA

Thesis submitted to the
University of Agricultural Sciences, Dharwad
in partial fulfillment of the requirements for the

Degree of

Master of Science

in

AGRICULTURAL ECONOMICS

By

GIREESHAYYA UDAGATTI

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

NOVEMBER, 2005

ADVISORY COMMITTEE

DHARWAD
NOVEMBER, 2005

(B. K. NAIK)
MAJOR ADVISOR

Approved by :

Chairman : _____
(B. K. NAIK)

Members : 1. _____
(G. S. DASOG)

2. _____
(S. M. MUNDINAMANI)

3. _____
(V. S. KULKARNI)

4. _____
(R. A. YELEDHALLI)

C O N T E N T S

LIST OF TABLES

Contd….

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

Contd…..

Contd…..

I. INTRODUCTION

Water is referred to as Adam's ale in the oxford English dictionary. This describes succinctly the utility of this vital resource. All living things live on, in or by water. Barring air, no other resource, natural or man-made is as crucial to life as water. The very presence of this vital resource, water, has made the 'Mother Earth' a unique planet not only in the solar system, but also perhaps, in the entire universe. The most precious natural resource of ours, water covers three-fourth of earth's surface. Its abundance as well as its scarcity has been instrumental in shaping the life and culture of the people inhabiting a particular region (Hiremath, 1998).

The role of water, a scarce resource in Indian farming as an instrument to economic development, hardly needs any emphasis in view of the fact that the monsoon in India is generally capricious in its incidence and variable in its amount. The average annual rainfall in India is about 120 cm but its distribution is temporally and spatially uneven. Even though India has two distinct monsoon periods, bulk of rainfall (75 per cent) occurs during southwest monsoon confined to a narrow time span from June to September. Indeed, (as reported by Sawant, 1991) "The entire rainfall in the country occurs within the narrow space of a few days, in fact within about 300 hours".

Irrigation is both a productive and protective input in agriculture development in arid and semi arid regions in India. Irrigation is the cradle, where HYV's seeds and fertilizer consumption resulted in green revolution during the late 1960's and early 1970's (Rao, 1984). It has been largely responsible in enhancing crop productivity and inducing commercialisation through crop diversification and specialisation and by reducing production risks and contributing to food and economic security.

Importance of Tank Irrigation

Irrigation tank are small reservoirs impounding run off water and they are concentrated in peninsular India. Tanks played a vital role in agricultural development in the dry regions of peninsula for centuries. These tanks are common property resources supporting the village economy and the livelihood of farming communities. Tanks provide surface and ground water irrigation and serve water needs of rural households and livestock. They also impound silt by the process of sedimentation which can also be used to supplement nutrients and improve water-holding capacity of soils.

Historically tanks were built by village communities, private individuals and the state. In Karnataka the tanks have been constructed in a chain considering the technical features, in such a way, overflows of one tank are lead to subsequent tank(s) in a cascading manner, so that wastage of water is minimised. Further, the storage in tanks enriches the water table by recharging aquifers. This ecological function is more crucial in recharging ground water than the role of tanks in surface irrigation. Further, in view of the present energy crisis, gravity irrigation is favourable to lift irrigation. Historically an institutional system evolved and prevailed in maintaining tanks as a source of water for villages. This tradition of tanks as a major source of irrigation continued till mid sixties in the semi/arid regions.

Development of irrigation tanks over time

In the southern semi arid tropic of India, tank irrigation systems existed since vedic times. Historians and anthropologists have pointed out that there is a dialectic relationship between population density and the intensity of tank irrigation, one reinforcing the other. At different levels of population density, the growth of tank irrigation area varied (Oppen and Rao, 1980). Initially tanks were technically and economically feasible and are increased when the population density crosses a minimum threshold level. Beyond certain limit the population pressure may tend to adversely affect the existing tank irrigation systems and special measures are required to preserve the capital invested in irrigation tanks.

Status of tank irrigation in peninsular India

Highlighting India's water governing institutions and the history of their decay Chandrakanth and Romm (1990) opined that irrigation tanks exerted positive externalities by recharging the ground water resource and also by providing tank silt. The policy derived from the historical understanding of the relations between tank institutions and aquifer conditions indicates revitalization of tank systems for surface irrigation, ground water management and silt fertilization.

Umashankari (1991) while assessing tank irrigation in Chittur district of Andhra Pradesh, opined that non-participation of farmers in cleaning the channels, encroachment of tank bed, inadequate repairs, weed infestation and siltation were responsible for disintegration of the conventional tank management. It was suggested that the tank management should be transferred to the farmers in the tank command to formulate rules and regulations and government should adopt a need-based approach to promote them.

Having surveyed 32 tanks in Andhra Pradesh and Maharashtra, Oppen and Subba Rao (1980) indicated that in areas of dense population, tank irrigation has been declining due to deforestation, soil erosion, siltation, tank bed cultivation and lack of administrative structure to provide timely repair and maintenance. High water use efficiency and command area utilization were associated with some tanks whose rate of return worked out to be high (23 per cent). Upon simulation, they found that a 20 per cent increase in the area could be irrigated by improved water control and by closing sluices on rainy days.

Historical perspective of community management

Tanks constitute the traditional irrigation system in the peninsular states of southern India – particularly Karnataka. They have been a major source of irrigation in this region for several centuries. Many of them date back to millennia, as testified by inscriptions. They are perfectly suited to the peculiar physical characteristics of the state. That is, unlike the wide plains in Northern India, most of the hilly region in Karnataka, for instance, are of generally undulating character, where there is probably not a square mile in the whole state that is absolutely flat or level.

Karnataka accounts for 10 per cent of all the tanks in the country. The vast majority of these tanks were designed centuries ago. The historical evidence dating the creation of the tank system also provide very valuable evidence of the system of management adopted and exercised by the local bodies in that period. Hundreds of stone inscriptions have been discovered relating to tanks and village organization, belonging to various places and various times in South India covering a span of time from the 2nd to the 16th century AD from the Pallava, Pandya, early Chola, later Imperial Chola and Vijayanagara empires which at one time or another included in the modern states of Tamil Nadu, Karnataka, Andhra Pradesh and Kerala.

The declines in multipurpose rainwater harvesting structure have its crucial impact not only on the economic scenario of rural Karnataka, but have far reaching impacts on socio-cultural and environmental aspects. In spite of the fact that the decline of tank irrigated area is a common phenomenon through out the country, for Karnataka it assumes greater significance. While the national average irrigated area is around 32 per cent, Karnataka has only 20 per cent of its net cropped area under irrigation. The problem is compounded by the fact that 54 per cent of the geographical area of the state is drought-prone compared to only 16 per cent in the country. The improvement of the tank system is critical to enhance the utility of these tanks in the dry area for supplementary irrigation. This will also help meet drinking water problems as well as recharge underground water. The reasons for the neglect of tank system can be summarised as follows:

- The abolition of ownership by the government.
- The declining capital expenditure and lower allocations for maintenance and repairs on tank system.
- Poor management of integrated tank system, including its structures and distribution system.
- Involvement of multiple agencies and lack of co-ordination among them.
- Increased access to alternative sources of water (both surface and ground water) and method of extraction and government's support on massive scale for ground water extraction.
- Poor technical capabilities in location and construction on new tanks and their size hampered the water regulation and capacity of century old upstream/downstream tanks in recent decades.
- Growing conflicts between tank bed cultivators (including unauthorized) and command farmers.
- No participation and control by local communities.
- Poor policy and programme support for traditional water management institutions and their neglect.
- Equating tank irrigation with canal irrigation and undermining the role of communities resulted in de-linking community from tank systems.

Karnataka represents the 6th largest state in the country with a total geographical area of 19.2 M ha and a cultivable area of 10.7 m ha. Presently 20 per cent of cultivable area is under irrigation.

Surface water resource in the state is also unevenly distributed. Historically tank irrigation was the prime source of irrigation for agriculture till independence. The presence of about 36,508 tanks in 26,876 villages of the state indicate their importance. More than half of the number of tanks were built by the Hoysala rulers between the eleventh and thirteenth century. They were managed and maintained by village community with the help of 'Neerganti', who was given inam land from the government and grains from the atchkatdars (Command area farmers).

The neglect of tank irrigation, which was basically sustaining the village economy lead to the decrease in efficiency and reliability of performance. Thus tank irrigation become inferior to other modes of irrigation.

Management of Tanks in Karnataka

The original ownership of all tanks is with the state government. The government has delegated the authority of managing the tanks irrigating less than 2000 hectares of command area to the department of minor irrigation (DMI). After the formation of the Panchayat system in 1987, tanks with more than 40 ha of command area continued with DMI, but tanks with les than 40 ha of command area were handed over to Zilla Panchayath.

Multiple government agencies still have a role in tank system, particularly in the tanks having a command area over four hectares. The departments of fishery, forestry, revenue, agriculture and horticulture have certain roles in the annual water cycle of the tanks in Karnataka.

Over a period, due to poor maintenance of tanks, the capacity of tanks has reduced. On an average, tanks get filled up every other year though, the frequency depends on the location, rainfall, topography, soil, land use and run off conditions (Somashekar Reddy, 2001).

Encroachment in the tank bed area is a major problem. There is no single agency that deals with identification of encroaches, going through the appropriate mechanism and following it up at the legal stage for eviction. The complication is also due to the fact that ownership and management positions are not clear and there is no tank level institution to pursue the matter. With multiple agencies looking after individual component of tank systems, there is no effort to go beyond narrow departmental interests (Somashekar Reddy, 2001).

Karnataka has 36,508 tanks with a command area of around 6,85,000 ha. The actual irrigated area by tanks is estimated to be less than 2,40,000 ha (35% of the total potential). The Table 1.1 gives the details of region and size wise distribution of tanks in Karnataka. Northern plateau has 15 per cent of the total tanks in the state. Malnad region has 25 per cent of the total tanks in the state. Generally tanks in this region are small and mainly rainfed rice is grown. In southern plateau, tanks are well distributed and account for 60 per cent of the total tanks. About 38 per cent of the tanks in Karnataka have a command area of less than four ha and 1.4 per cent of the tanks have a command area of more than 200 ha. Tanks with command area of 4 to 20 ha form about 50 per cent and the tanks with a command area of 20 to 200 ha about 10 per cent of the total tanks.

Table 1.1. Region and size wise distribution of tanks in Karnataka

I.	Region	Total	Per cent
1.	Northern plateau	5476	15
2.	Malnad	9127	25
3.	Southern plateau	21904	60
II.	Size of command area (ha)		
1.	Less than four hectares	13142	38
2.	4-20 hectares	18254	50
3.	20-200 hectares	3650	10
4.	More than 200 hectares	511	2
III.	Total tanks in Karnataka	36508	100

Source: Palanisami, K., Tank Irrigation in India – A Revival for Prosperity.

Jala Samvardhane Yojana Sangha (JSYS)

JSYS is a registered society established by Government of Karnataka. It serves as the nodal agency in the state for Community Based Tank Management. JSYS has been

formed to help facilitate the transfer of tank system development and management from the state back to communities.

JSYS has the objective of working for the minor irrigation sector, which is imbued with necessary ingredient of expertise, experience and professionalism and to develop and strengthen water sector in minor irrigation with participatory systems in tanks and ground water for improving the livelihood of the rural people. JSYS is overseen by a governing council chaired by Minister of Water Resources and reports directly to an Executive Committee chaired by the Additional Chief Secretary.

JSYS – state project unit is headed by an Executive Director and has a team of multidisciplinary specialists to support the state project unit. JSYS has established nine District Project Units with a team of specialists for multiple disciplines who over see the activities at the district level.

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, pigs and poultry as well as fishery, bee keeping, sericulture *etc*. Although in India farming is not commercialised to a large extent, it remains that the farmers 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 interacting in the system (Anonymous, 1978). 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 farmer's perspective occupies pride of place in India's agricultural research agenda. Farming systems concept, after 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 at 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.

Farming system approach in analysing the problems of agriculture is gaining lot of importance in recent years. Such a study throw light on the problems associated with different farming systems and enable the academicians and policy makers to formulate and implement appropriate policies for a balanced, integrated and overall agricultural development in tank commands.

Keeping all these aspects in view, the presents study has been undertaken to investigate, in tank commands of northern Karnataka with the following specific objectives.

1. To identify the existing farming systems in the selected tank commands rejuvenated by the Jala Samvardhane Yojana Sangha (JSYS)
2. To analyse the cost and returns structure and resource use efficiency in selected tank commands of selected districts
3. To analyse the impact of On-Farm Demonstrations/farmer field schools on socio-economic conditions of the farmers
4. To identify the problems in different farming systems in the tank commands and to suggest appropriate policy measures.

HYPOTHESIS

1. Farmers are following more than one farming systems in the study area.
2. Farming systems adopted by the sample farmers are economically viable.
3. Resource use efficiency of different farming systems in selected tank commands is poor.
4. Demonstrations/farmer field schools have positive impact on socio-economic conditions of the farmers.
5. The farmers in tank commands taking up different farming systems face some problems.

II. REVIEW OF LITERATURE

In this chapter a view of past research in the field has been compiled to enable better understanding of the farming systems 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 Cost and returns in different farming systems
2.3 Resource use efficiency of major farming systems in selected tank commands
2.4 Impact of demonstrations on socio-economic conditions of the farmers
2.5 Constraints in different farming systems

2.1 FARMING SYSTEMS-CONCEPTS AND DEFINITIONS

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

Biggs (1985) has elaborated that farming systems perspective have manifold objectives, ranging from increasing the body of knowledge about farming systems to solving the problems in different farming situations with the overall aim to increase the productivity of given farming systems.

Bowden *et al*. (1985) explained the research paradigm for system agriculture. According to them, agriculture is a complicated human activity involving uncertainty and change. There is a need for system thinking considering agriculture with a sense of its complex wholesomeness and to take active and feasible action. According to them, Farming System Research is primarily concerned with the adoption of existing agricultural research to provide technology, relevant to farm resources.

Norman and Collinson (1985) defined the Farming Systems Research (FSR) as a research methodology for understanding the real world farming systems and problems. The primary objectives of FSR according to them, is to improve the well being of individual farming families by increasing the productivity of their farming systems given the constraints imposed by resources and environment. FSR, in a sense, is an farm research consisting of development and dissemination of relevant improved technology and implementation of appropriate policy. In Farming Systems Research farm as a whole is viewed in a comprehensive manner.

Remenyi (1985) described the usefulness and effectiveness of farming System Research in terms of multi disciplinary and complexity of farming. The five critical characteristics of farming systems research in terms of its relation to small holders, multi disciplinary and holistic approach, and inclusion of farmer in research aiming at generating viable technology and lastly testing and verifying the research results.

Sabrani *et al*. (1985) explained the main aims of Farming System Research are to develop stable cropping pattern, maintenance of soil fertility, efficient utilization of land and labour and the provision of sustained cash income. According to them, future needs of Farming system Research are to impart training, regular research, evaluation and formulation of nation wide Farming System Research network.

Girish (1987) described the systems analysis and design, essentially, consisting of understanding the current system, verifying the current system with end users, manipulating the current system model to arrive at a new system and selecting an alternative system. The system analysis should be carried in a phased manner. Evaluation and feedback are very essential for a systems analysis and design.

Amir and Knipscheer (1989), opined that farming system is the conceptual artifice that includes a collection of inter-dependent and interactive elements that act together to accomplish a given task.

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 serve 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*. (1991) 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 which within the operational unit or within the combination of such units results in maximum agricultural production. It involves all-out integrated efforts for improvement of the use of farm resources such as land, labour and capital *etc*., through their efficient utilization to maximise farm returns.

Sharma *et al*. (1991) viewed farming systems as a set of agro-economic activities that are inter-related interact among themselves in a particular agrarian setting. In this attempt to examine the changes in the farming systems in the recent past and the strength and direction of the trends now in process and features calling for adjustment in policy response, they tried to identify farming followed in different agro-climatic zones of Himachal Pradesh. They indicated that vegetable based and trust based farming systems are the herbenger of profitability and surplus in the agrarian economy.

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

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-ecosystem 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 mere than one option to provide him the opportunity to exercise his own decision.

Naik (1998) in his socio-economic study of the farming systems in Uttara Kannada district viewed farming system as a complex human activity involving farm enterprises which are inter related and interact for the available resources and environment. It also involves application of highly sophisticated technology on one side and the physical, social and economic factors on the other. He concluded that the successful attainment of total agricultural development depends to a large extent on farming system approach.

Channabasavanna and Biradar (2002) defined farming system as an unique and reasonably stable arrangement of farm family enterprises that the household manages according to its physical, biological, economic and socio-cultural environment in accordance with household's goal, preference and resource and the farm wastes are better recycled for productive purposes in the integrated system with the judicious mix of agricultural enterprises like crop production, horticulture, silviculture, sericulture, dairy, poultry, piggery, fishery *etc*., suited to the given agro-climatic conditions and socio-economic status of the farmers would being prosperity to the farmers considering farm as a unit and effective planning is based on integration of all enterprises.

The literature reviewed so far under this heading indicated nature and wide scope of farming system. Farming systems are flexible and liable for modification due to change in income.

2.2 COST AND RETURNS IN DIFFERENT FARMING SYSTEMS

Dhongade and Dangat (1985) studied the cost and income structure of farm business in Sina command area (Maharashtra). The per hectare cost of irrigated *kharif* hybrid jowar worked out to Rs. 4303.49. With an average yield of 23.75 quintals, a gross return was Rs. 6329 and profit obtained at cost C formed Rs. 2024.40 per hectare. In the case of irrigated *rabi* jowar, farmers incurred Rs. 2144.70 as cost and obtained grain yield of 8.15 quintals per hectare. Thus, the net profit at cost C worked out to be Rs. 583.05 with gross returns of Rs. 2723.75. The per hectare total cost of cultivation of wheat worked out to Rs. 2778.61. With the gross value of produce being Rs. 2932.30 per hectare, the net returns worked out to be marginal (Rs. 153.69). The net returns in sugarcane was found to be relatively higher (Rs. 21560.3/ha) with an average cost of cultivation being Rs. 9443.70.

Prakash *et al*. (1985) conducted a field experiment to know the production potential and the net returns of double cropping under rainfed conditions in Uttar Pradesh. The net returns were high in maize-pea system (Rs. 4309/ha) followed by soybean-wheat (Rs.4037/ha) and maize-wheat (Rs. 4029/ha).

Benecka and Chula (1986) compared the returns from grain maize production by various co-operatives farms in Czechoslovia. The study indicated that large farms obtained greater yields per hectare than that obtained by small farms because of superior technology

and greater labour resources. The consumption of seed, fertilizers, pesticides, herbicides was higher on large farms. The higher cost incurred by large farmer was covered by the higher out put realised by these farms. As a result, larger co-operative farms emerged more profitable than the small ones.

Srikanthamurthy (1986) in his study on resource productivity in agriculture in Bangalore district observed that the cost of cultivation of paddy per acre was highest on marginal farms and lowest on large farms. Thus the existence of scale of economies was noticed in the cultivation of paddy. But the study did not notice economics of scale in ragi production.

Singh *et al*. (1987) conducted a study in Sultanpur of Uttar Pradesh in order to compute the cost of production and profitability in paddy on different farm sizes. The cost of cultivation per ha of paddy came to Rs. 2657.5 and it varied from Rs. 2407.14 on marginal farms to Rs. 3116.50 on large farms. The use of higher quantities of resources by large farms resulted in higher yield and higher value of output per hectare of paddy. The average net income was Rs. 1544.11 per hectare which increased with an increase in the size of holdings. They opined that higher expenditure incurred by large farmers by way of using modern farm inputs such as fertilizers, irrigation, plant protection and hired human labour resulted in higher production, productivity and income on these farmers as compared to small and marginal farmers.

Gadre and Mahale (1988) worked out the per hectare returns from cotton and its non-commercial competing crops in Vidarbha region and reported that the cost of cultivation (cost C) per hectare was Rs. 3848.00 for hybrid cotton followed by mung-safflower (Rs. 1984) and tur as sole crop (Rs. 1845). The same for desi improved cotton, mung-gram and mung-wheat worked out to Rs. 1541, Rs. 1495 and Rs. 1404, respectively. Measuring the profitability of different cropping systems on the basis of net returns per hectare, tur (sole crop) gave the highest returns per hectare (Rs. 2905) followed by mung-safflower (Rs. 2627) and mung-wheat (Rs. 1805). Net returns for hybrid cotton, desi improved cotton and mung-wheat sequence worked out to Rs.1062, Rs.888 and Rs.948, respectively. They inferred that on the basis of net returns per hectare, all the substitute crops were more profitable than hybrid cotton (except mung-wheat sequence) as well as desi improved cotton too. They also concluded that for cotton crop, there are economically good substitute crops like tur, mung-safflower and mung-gram available for the Vidarbha region.

Chahal and Chahal (1989) studied the economics of irrigated crops in Punjab and concluded that the variable costs per hectare were highest for paddy followed by maize, sugarcane, wheat, cotton and groundnut. While the gross returns to fixed resources were maximum for sugarcane followed by wheat, paddy, cotton, groundnut and maize. Among the crop combinations, the annual returns to fixed farm resources were highest for sugarcane followed by paddy-wheat, cotton-wheat, groundnut-wheat and maize-wheat. The returns to fixed farm resources per unit of irrigation were the lowest for paddy-wheat combination followed by cotton-wheat, sugarcane and maize-wheat. They concluded that cotton and groundnut should be encouraged in their respective farming areas, as their returns per unit of irrigation were higher than sugarcane.

Kaligouda (1989) based on his study of Ghataprabha command area (Karnataka) reported that sugarcane, *kharif* maize, cotton and chilli were the most important crops yielding a net income of Rs. 4100.00, Rs. 205.41, Rs. 296.00 and Rs. 470.82 per acre respectively. Similarly, wheat, khalpi, Bengal gram and *rabi* maize were major crops in the *rabi* with a net income of Rs.160.78, Rs.153.25, Rs.239.88 and Rs.540.52 per acre, respectively.

Setty *et al*. (1990) conducted an experiment on cropping system at Agricultural Research Station, Siruguppa during 1987-88 to find out suitable cropping sequences for Tungabhadra Project Area. Among the various sequences tried, maize-bengalgram produced the highest net return (Rs. 6370/hectare with a BCR 2.50) followed by maize-wheat sequence (Rs. 3693/hectare with a BCR 1.60).

Timothy Randir and Krishnamoorthy (1990) studied on productivity variation and water use in forms of Madurantakam tankfed area of Chengalpattu district (Tamil Nadu) and concluded that there was a positive influence of farm area on the productivity, which is due to the presence of supplemental irrigation on farms of larger area and computed that there was productivity variation due to farm size even under homogenous irrigation situations indicating existing potential for increasing productivity of marginal farms through community tanks. The cropping intensity was found as most determining, factor in the farm income followed by labour and capital and study suggests that employment opportunities can be created in the

area due to low levels of labour use credit facilities need to be provided to the farmers in the form of short term credit since capital has a scope to improve the productivity.

Thiruvenkatachari *et al*. (1991) studied the economics of groundnut production under rainfed conditions in Tamil Nadu. Their study showed that cost A , constituted 61.05 per cent of the total cost (cost C) in the case of marginal farms, whereas it was 77.27 per cent in the case of small farmers and 82.06 per cent in the case of big farms. Cost B accounted for 74.7 per cent of the total cost in the case of marginal farms, 90.27 per cent in the case of small farms and 94.80 per cent in the case of big farms. The groundnut cultivation was more profitable under small and big farm conditions.

Singh and Grover (1992) in their study on wheat based crop sequences in different agro-climatic area of Punjab observed that variable costs of wheat-paddy (Rs. 2027.35/ha) sequence were higher than wheat-cotton (Rs. 2002.13/ha), wheat-maize (Rs. 1887.35/ha) and in wheat-potato (Rs. 1503/ha) sequences. However, returns over variable costs were higher in wheat-maize (Rs. 2023.56/ha) sequence followed by wheat-paddy (Rs. 1823/ha), wheat-cotton (Rs. 1248.65/ha) and wheat-potato (Rs. 857.35/ha) sequences.

Singh (1992) while studying the economics of farming system in Kangra district (Himachal Pradesh) observed that holdings were small and fragmented. It was suggested that consolidation should be given priority and norms should be devised to maintain the minimum size/number of fragments on the farm further suggested that profitable farming systems such as vegetable based and dairy based should be encouraged. Appropriate input supply base and market infrastructures development, inter sectoral linkages among various sub-systems forms. Strong input bondage and complementarily linkages among cereals, livestock (dairy), agro-forestry and Common Property Resources (CPR), pronounced technological gaps in all the important component of farming systems was identified and it was recommended that farmers should be educated/ trained about the balanced use of critical inputs like quality seeds, chemical fertilizers, herbicides *etc*. in crops and quality seed and fodder in case of dairying by extension agencies. This study reveals a holistic perspective may be kept while formulating any strategy for the overall development of farm economy. Various alternative plans in this study portrayed cascading effect of reallocation of land, technological adoption and inclusion of subsidiary enterprises for enhancing farm income and employment.

Rangaswamy *et al*. (1992) in a study to evolve a economically viable and sustainable farming for small and marginal farmers in rice based wetlands of Coimbatore opined that the net profit worked out under Integrated Farming Systems (IFS) 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.

Anonymous (1993) estimated the cost of production of irrigated bajra was Rs.4257.47 per ha which 60 per cent was accounted by variable costs. The production was 12.44 quintals of main product valued at Rs.3983.23 the net profit over total cost was Rs.582.73 per ha.

Anonymous (1993) estimated the cost of production of irrigated groundnut in northern dry zone at Rs.8496.11 per ha with variable costs accounting for 68.05 per cent. Seed cost was a single largest item of expenditure accounting for 26.13 per cent of the total cost (Rs.2219.93). Large quantity of labour was also used 94.98 mandays per ha amounting to Rs.1233 per ha. Expenditure on fertilizer was Rs.103.34. The average yield obtained was 10.82 quintals per ha worth Rs.8400.61 and average net profit realised was Rs.609.44 per ha.

Prasad (1993) while studying the economics of groundnut production in different zones of Karnataka found that the cost of production was highest in the north eastern dry zone (Rs.3248.30 per ha) followed by northern dry zone (Rs.3165 per ha) and central dry zone (Rs.2848.28 per hectare). The total cost was lowest in the southern dry zone (Rs.1107.07 per ha). He attributed higher seed cost accounted for a large proportion of the total cost. It varied from 36.53 per cent in northern dry zone to 44.76 per cent in northeastern dry zone of the total cost.

Reddy (1994) compared the costs and returns for sunflower in three zones *i.e.*, Central Dry Zone (CDZ), North Eastern Dry Zone (NEDZ) and Northern Dry Zone (NDZ) of Karnataka. The cost of cultivation was high in CDZ (Rs. 4893.26) compared to NDZ (Rs. 2829.21) and NEDZ (Rs. 2151.93) because of increased use of inputs and high rental value of land. The return per unit of investment was also high in case of CDZ (0.63) when compared to NDZ (0.35) and NEDZ (0.40). Seed cost, human and bullock labours and rental value of land formed components of total cost in all zones. All zones used more than recommended

quantities of seed per hectare. However, the use of FYM and fertilizer was for less than the recommended levels in all the zones.

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

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.

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

Mohandas and Thomas (1997) studied the economics of rice production in Kuttonad area of Kerala. They reported that cost of cultivation of paddy for state was Rs. 13,108.05 for marginal farms (class I), Rs. 13,309.72 for small farmers (class II) and Rs. 13,858.13 for large farmers (class III).Rental value of own land recorded the highest expenditure in class I and II which accounted for 24.19 per cent (Rs. 3171.30) and 22.38 per cent (Rs.3112) respectively. However, the highest item of expenditure was fertilizer in class III which came to 22.39 per cent (Rs. 3100.75) of the total cost. Gross returns was highest in marginal farmer (Rs. 15,857.45) followed by small farmers (Rs. 15,560) and (Rs. 15,387.50) large farmers. The net returns and input output ratio was also found to be highest in marginal farmers (Rs. 2748.25 and Rs. 1.21) followed by small farmers (Rs. 2250.28 and 1.17) and large farmers (Rs. 1529.37 and 1.11).

Kandasamy (1998) while studying for 3 years on the economics of integrated farming systems at Pariyar in Tamil Nadu made a comparative analysis of comparison of integrated farming system over sole cropping or crop husbandry alone. Computed that among the different farming system practices, dairy-based system was more profitable than others. The mean annual net income under the treatment was Rs. 6,090 per ha with the per day income of Rs. 1668 and provided additional employment of 217 mandays per year. The next best system was dairy cum poultry based mixed farming having a mean annual net income of Rs. 5,899 per ha with per day income of Rs. 16.16. Poultry based mixed farming gave only a marginal mean annual income, net income of Rs. 2,287 with per day income of Rs. 6.27 over pure cropping system which recorded mean annual net income of Rs. 2,219 with per day income of Rs. 6.08. Farmers method of sole cropping could give the least mean annual net income of Rs. 1,902 and Rs. 5.21 of per day income.

Govardhan (1998) examined the economics of cropping system in left bank canal command area of Tungabhadra project. The cost of cultivation per hectare was higher in mid reach (Rs. 30,499.31), then in other reaches (Rs. 27,591.86 for head reach and Rs. 27,374.93 for tail reach). The gross returns was higher in mid reach of (Rs. 63,403.48). The net returns over cost C was Rs. 36,937.09 for head reach, Rs. 36,904.17 for mid reach and Rs. 35,813.34 for tail reach. A decreasing tendency of B:C ratio was noticed as one moved from head reach to tail reach (Rs.2.34 for head reach, Rs. 2.21 for mid reach and Rs. 2.20 for tail reach).

Ganesh (2000) made a 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 on small and larger farms respectively.

Neelappa Shetty (2002) studied the technical and allocative efficiency of paddy production in TBP area. The per hectare cost of cultivation paddy was Rs.26,192, and Rs. 25,938 in Bellary and Raichur districts. The variable costs (85%) constituted the major portion of the total cost of cultivation. The expenditure on human labour was found to be the major item of variable cost. The fixed cost per hectare was estimated to be Rs. 33,896, Rs. 3746 respectively for Bellary and Raichur districts farmers. Rental value of value formed the major

item of fixed cost. The gross returns per hectare of paddy cultivation was Rs. 42,842 and Rs. 40,735 for farmers in Bellary and Raichur districts.

Sandeep (2002) studied on cropping systems in Bidar district of Karnataka revealed that under irrigated conditions the per hectare net profit was found highest in sugarcane cropping system in case of both small (Rs.52016.66) and large farms (Rs.42217.04) with a benefit cost ratio of 3.36 and 3.12 respectively. Under rainfed conditions the net profit was highest in red gram cropping system in case of both small (Rs.12595.00) and large farms (Rs.12491.25) with a benefit cost ratio of 2.40 and 2.34 respectively. The ratio of MVP to MFC was greater than one for human labour, bullock labour, seeds, FYM and fertilizers indicating the scope for using additional unit of these inputs to increase gross income.

Verma (2002) studied the economics of onion and found that cost of cultivation over cost A_1, cost B_1, cost C_1 and cost C_3 were worked out to Rs.21790.24, Rs.22309.05, Rs.24499.05, Rs.24949.28, Rs.27139.28 and Rs.29853.20, respectively. The per ha yield on an average was 263.75 qtl per ha. The average gross return was Rs.72, 531.25 per ha. It was highest at Rs.74,580 on large farms and lowest at Rs.70,218.50 on small farms. The average yield and gross return increases with the increase in farm size, because large sized farmers had incurred higher investment per hectare on modern inputs. The average net returns over cost A_1, cost B_1, cost C_1, C_2 and C_3 were calculated at Rs.50741.01, Rs.50222.20, Rs.48032.20, Rs.47, 581.97, Rs.45, 391.97 and Rs.42, 678.05 per hectare of onion respectively. The average cost of production per quintal of onion was worked out be Rs.102.89 on cost C_2 and Rs.113.18 on cost C_3. The average family labour income and farm business income were calculated at Rs.45, 318.28 and Rs.46, 459.66 per hectare respectively. The average input-output ratio at cost A_1, cost B_1, cost B_2, cost C_1, C_2 and cost C_3 worked out to be 1:3.32, 1:3.25, 1:2.96, 1:2.90, 1:2.97 and 1:2.42 respectively.

Narasimham *et al*. (2003) studied cost and returns of paddy in Yanam region of Union Territory and Pandicherry. The study highlighted that the cost of production of paddy per hectare was found highest among all the size groups. The total costs were high on large farms in both crop I (*kharif*) and crop II (*rabi*) with Rs.18, 094.26 and Rs.19, 071.29, respectively. Rental value on own land in the cost of production of crop II was more than crop I in all size groups. Gross returns per hectare was the highest on large farms followed by medium and small farms in both crop I and crop II. Net returns also showed direct relation with the farm size.

Hymajyothi (2003) undertaken an investigation in small (1-2 she buffaloes), medium (3-4 she buffaloes) and large herd size (5 and above she buffaloes) milk producers in west Godavari district of Andhra Pradesh to examine economics of buffalo milk production. Expenditure on fodder and concentrates formed the major share in the total cost of milk production in all the categories of milk producers. The average cost of buffalo milk production was Rs.7.95 per litre for small herd size milk producer Rs.7.92 per litre for medium herd size milk producer and Rs.7.86 for large herd size milk producer. However, net returns per litre of buffalo milk were found to be highest in small herd size milk producers followed by medium and large herd size milk producers.

Prashanthakumar (2003) conducted study in three dry zones of northern Karnataka with an overall objective of identifying and analysing the optimality of different animal based farming systems. The relevant data was collected from both primary and secondary sources and were analysed using tabular, functional and linear programming techniques. The results showed that sugarcane during *kharif* and bengalgram during *rabi* were found to be most profitable crop in Zone-I, while in Zone-II, chilli (*kharif*) and Bengal gram (*rabi*) were most remunerative, similarly onion (*kharif*) and maize (*rabi*) turned out to be most profitable crops in Zone-III. Across the selected zones, milk production increased with the farm size and ranged from 4.5-5.0 litre/day/animal. In milk production, green fodder, concentrates and labour were significantly contributing factors in all the three Zones, while dry fodder coefficient was significant in Zone-I and Zone-III. Seed coefficient was highly significant for all the crops and systems in Zone-I and Zone-III barring groundnut, while labour was the important input conditioning the crop production in Zone-II.

Nagpure *et al*. (2004) in their study on economics of sugarcane production in Vidarbha region of Maharashtra state estimated that per hectare cost of cultivation in Suru crop at cost A, B and C was estimated to Rs.35,178.86, Rs.53,207.91 and Rs.54,011.11 respectively. In case of ratoon it was estimated to Rs.25,612.88, Rs.42,326.52 and Rs.43,162.62 respectively. The net income per hectare of Rs.15,766 was worked out higher in case of ratoon crop as against Rs.11,334 from Suru crop.

The efficiency of per rupee investment in the cultivation of ratoon vis-à-vis of suru crop at cost C was estimated to 1.36 and 1.21 respectively.

2.3 RESOURCE USE EFFICIENCY OF MAJOR FARMING SYSTEMS IN SELECTED TANK COMMANDS

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.

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

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.

Nagaraj *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.

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.

Verma (2002) employed Cobb-Douglas production function for evaluating resource use efficiency in onion. The marginal value product of seed, manures and fertilizers, human labour and machine power were (Rs. 0.15, Rs. 1.51, Rs. 0.69 and Rs. 0.28) found to be positive on small farms while it had negative value on bullock labour, plant protection and irrigation (Rs. –0.13, Rs. –0.49 and Rs. –0.47) respectively. This implies that the small farms were utilizing seed, manures and fertilizers, human labour and machine power under utilized and bullock labour, plant protection and irrigation excessively on the farms. In case of large farms, marginal value product of seed, manures and fertilizers, human labour, bullock labour and plant protection were (Rs. 0.80, Rs. 0.34, Rs. 0.18, Rs. 0.01 and Rs. 0.15) found to be positive while it had negative value of machine power and irrigation respectively arrived at Rs.–0.16 and Rs-0.01 implying that large farms were utilizing seed, manures and fertilizers, human labour, bullock labour and plant protection under utilized while machine power and irrigation were excessively used by the large farms, Indicating there is scope for increasing their use up to the optimum level where the efficiency of the input use is maximum.

Sunanda and Narender (2003) while studying resource productivity of mesta farms in Srikakulam district of Andhra Pradesh observed that mesta fibre accounts for 70 per cent of raw jute. The cultivation involves intensive human labour in addition to manures and fertilizers, seed and cattle labour. The Cobb-Dauglas production function analysis for these variables indicated constant returns to scale on all farm size groups. The marginal value product to opportunity cost ratios for all farm size groups indicated resource use efficiency and revealed the scope of adjustments and reorganisation of resources, so as to obtain high returns in mesta cultivation.

2.4 IMPACT OF DEMONSTRATION ON SOCIO-ECONOMIC CONDITIONS OF THE FARMERS

Sundaramurthy (1985) conducted and operational at research project on integrated pest management on cotton in Tamil Nadu. Wherein the per hectare net profit earned by IPM adopter was Rs. 4845 while that earned by non-IPM adopter was Rs. 3402. Thus additional profit of Rs. 543 per hectare earned by IPM adopter was due to the impact of IPM techniques.

Ray and Chahal (1986) observed a wide gap between the national demonstration yield and the actual yield with respect to groundnut. The gap was very high in the states of Andhra Pradesh (15.89 q/ha), Maharashtra (6.84 q/ha) and Karnataka (5.82 q/ha) poor management practices like untimely sowing, improper seed rate.

Sundaramurthy (1987) conducted an operational research project on integrated control of cotton insects in 1987 in Tamil Nadu, wherein appropriate insecticides were used at action threshold level under supervision. The mean quantity of insecticides used in non-project area was found to be 2682 gms per hectare as against 2808 gms per hectare in project area. A marginally higher quantity of insecticides used in the project area was due to continued pressure of migrates of *Heliothis armigera* from sorghum crop. The results indicated that the per hectare net profit earned by IPM farmer was Rs. 8910, while non-IPM farmer earned Rs. 7656.

Ramamoorthy (1989) evaluated the economic impact of integrated pest management (IPM) on cotton cultivation and reported that the per hectares net profit earned by IPM-adopter's was Rs. 2087 as against Rs. 1601 earned by non-adopters. The additional profit of Rs. 486 per hectare earned by IPM-adopter was due to cumulative impact on IPM techniques.

Pandurangadu and Raju (1990) conducted a study on economics of pesticides used on cotton farms in Guntur districts of Andhra Pradesh. The study revealed that an alarming rise in the cost of cultivation of cotton was largely attributed to the increased use of expensive insecticides hence, not only as an economy measure but also to avoid side-effects, farmers were advised to adopt integrated pest management technology.

Anonymous (1992) conducted a study on integrated pest management in Guntur and Prakasam districts of Andhra Pradesh. In both the districts, farmers used the package of plant protection recommended by sandoz. They experienced an increase in yield of 3-4 quintals per acre, which represented a significant increase of more than 80 per cent. Also, the total number of application of pesticides was reduced. Educating the farmers on the right use of technology and by adoption of integrated pest management practices, *Helliothis* on cotton can be managed effectively.

Patil (1992) reported that in the demonstration on integrated pest management on cotton, the net profit from the IPM block was about Rs. 1029 per acre whereas that from the farmers block was minus Rs. 55 per acre, mainly due to high cost of plant protection chemicals used by the farmers in their traditional practices.

Suryawanshi and Prakash Manindire (1993) studied the impact of viable technology for promoting oilseeds in Maharashtra. The data from frontline demonstrations laid out by the centers of All India Co-ordinated Research Project on oilseeds in Maharashtra laid out along adjacent plots of farmers following traditional practices were used to show the comparative production potentials and benefits accruing from viable technology. At the national level, the recommended technology increased the yield by 36 to 45 per cent in groundnut, 35 per cent in sesamum, 21 to 47 per cent in sunflower, 21 to 63 per cent in safflower and 77 per cent in niger crop. In Maharashtra, the productivity on demonstration plots increased by 53 per cent in groundnut, 22 to 48 per cent in sunflower and safflower over that obtained by the farmers following traditional practices. The analysis showed that significant yield difference were due to the adoption of improved technologies. The yield difference in case of *kharif* groundnut, summer groundnut, sesamum, sunflower and safflower were 56, 20, 200, 226 and 640 per cent, respectively.

Balappa (1997) in his study indicated that IPM farmers realised (14.83%) more net returns (Rs. 5,362.42/ha) than non-IPM farmers (Rs. 3,401.56/ha). Further, production function estimates indicated positive influence of plant protection chemicals in case of IPM farmers (0.1900) where as, it was negative in case of non-IPM farmers (0.3000). The returns to scale was increasing in case of IPM farmers (1.33) whereas, it was decreasing in case of non-IPM farmers (0.50) as indicated by sum of output elasticities.

2.5 CONSTRAINTS IN DIFFERENT FARMING SYSTEMS

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 imparts, saving the farmers from the proverbial exploitations by the traders. However, they have pointed out that the interest of the farmers need to be safe guarded further by establishing their own organisation for the procurement of inputs and for the sale of their produce so that farming become 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 by investing less. He stressed the need for developing suitable strategies to stabilize the farm income in dry areas.

Chitins and Bhikgaokar (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 (1) technology, (2) credit and economic service and (3) supply and (4) information transfer. They firmly advocated the adequate supply of inputs, timely advice and training through demonstrations.

Shah and Kube (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 well being 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 in to 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, lack of need based extension network, regional imbalances, stagnation in area under HYV's *etc*. He also suggested the measure 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, extension problems included non-availability of package of practices. The important problem was absence of market regulation and information.

Vyas and Patel (2001) studied on constraints faced by milk producers in adoption of dairy technology revealed that non availability of loan facilities for purchase of milch animals and fodder, non availability of artificial insemination and milk marketing facilities, lack of knowledge of scientific animal feeding as well as preservation practices and lack of pasture land were the main constraints expressed.

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

Basavaraj and Kunnal (2002) identified the constraints in production, marketing and processing of soybean in Belgaum district. It was observed that severe problem faced by growers is rust disease leading to heavy loss, high labour wages, non availability of quality seeds in marketing farmers experience problem of price fluctuation, low price for the produce,

problem of transportation and delayed payment of sale when produce was sold out to co-operative society. The other problem were inadequate power supply and non-availability of labour at times faced by the processor.

Rajkumar and Hari Singh (2002) studied problems in vegetable production. The problems reported were poor quality seeds (42.2%), insufficient availability of seed (40%), high cost of seed (31%) and non-availability of seed at appropriate time (12.2%). Insufficient availability of irrigation water and lack of FYM. The other problems noticed were high cost of fertilizer, poor state of fertilizer and plant protection delivery system in the district. High wages and shortage of labour was also one of the constraint.

Prashanthakumar (2003) pointed out the problems faced by the sample farmers in production of different crops in selected zones of northern Karnataka. He observed that problems like price fluctuation, lack of storage facility and incidence of pests and diseases were reported as severe problems under FS-I in zone I. Lack of knowledge about source of availability of seeds and incidence of pests and diseases were the severe constraint in sunflower production under FS-I in zone II constraints in Bengal gram production too followed by the non-availability of seeds in time under both the farming situations in both zone I and zone II. Problems like non-availability of seeds in time, lack of storage facility, pest and disease incidence, price fluctuation were severe in many of the crop cultivation. In milk production problem on non-availability of credit, non-availability of pasture land, artificial insemination facility, improved breeds, lack of knowledge of scientific feeding, efficient marketing facility and cost of feed materials were severely confronted, which need immediate attention.

Ramesh (2003) studied the Agricultural Research prioritisation for Agro climatic zones 1, 2 and 3 of northern Karnataka. He observed that among the socio-economic constraints, fluctuations in prices of output, non-availability of agro chemicals, non-availability of labour during peak season and unawareness of improved technology were the most severe constraints faced by the farmers in the study area. Ranking of constraints based on yield loss indicated that most of the crops across zones were most affected by rainfall, pests, diseases and weeds.

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

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

Hirala Jana (2004) conducted a study to know the constraints faced by the growers. High cost of chemicals, lack of technical guidance were found crucial problems, followed by shortage of labour when needed, high labour charge, non-availability of paddy weeder and non availability of chemicals in local market.

III. METHODOLOGY

This chapter deals with the description of the study area, sampling procedure adopted, method of survey, nature and sources of data, techniques employed for analysing the data and concepts used in the study. The chapter is presented under following heads.

3.1 Description of the study area
3.2 Sampling procedure adopted
3.3 Nature and sources of data
3.4 Analytical techniques employed
3.5 Concepts used in the study

SPECIAL FEATURES OF THE STUDY

The different sources of irrigation are available to raise the crop. Among them, tank irrigation is one of the age old established practice in most of the semi-arid tropical parts of India and particularly in southern (Peninsular) India. They constitute the most important minor irrigation source of surface water covering 1\3rd of irrigated area. Currently tank irrigation is considered as a neglected source and tanks are under-utilized due to mismanagement. So, tank irrigation deserves immediate attention as tank irrigated area is dwindling over the years at all India level. After realizing the importance of tanks and after studying the reasons for neglect and degradation of tank systems, Government of Karnataka has launched a project by establishing an autonomous independent body called "Jala Samvardhane Yojana Sangha" (JSYS) during 2002. This autonomous body operates in about 2,000 tanks located in 9 districts coming under the drought prone area of the state. In particular, it operates in 6 districts of northern Karnataka by covering about 512 tanks with an objective of instituting the sustainable tank management system through enhancing the productivity in the tank commands to improve the standard of living of farmers/people who are directly or indirectly depending on tank commands for their livelihood.

3.1 DESCRIPTION OF THE STUDY AREA

Karnataka is the eighth largest state in India with an area of 1,91,791 sq. km. It is situated between 11.5° and 19.0°north latitude and between 74° and 78° eastren longitude in the southern plateau. According to 2001 census, Karnataka had a total population of 44.81 million comprising 22.86 million males and 21.95 million females with an overall literacy rate of 55.98 per cent. The average annual rainfall of the state is about 1139 mm, from both southwest and northeast monsoons. The temperature ranges from 21.5°C to 31.7°C. Important crops grown in the state are jowar, paddy, ragi, maize, bajra and wheat among cereals; red gram, green gram, and bengal gram among pulses; groundnut, sunflower, safflower and sesamum among oilseed crops; chilli, sugarcane, cotton and tobacco among commercial crops; onion, brinjal, potato and tomato among vegetable crops; mango, sapota, grape, guava, pomegranate and banana among fruit crops and coconut among the plantation crops.

The study has been conducted in tanks commands of Jala Samvardhane Yojana Sangha managed tanks in Northern Karnataka comprising mainly Bagalkot, Koppal and Haveri districts. The study area is depicted in Fig-1. The study concentrated mainly on identifying the existing farming systems in the study area, to analyse the cost and returns of major farming systems and their resource use efficiencies, to know the impact of Farmers Field Schools (FFS) / On-Farm Demonstrations (OFD) on socio-economic conditions of farmers, which were conducted in selected tanks and also to identify the problems of farming systems in the study area.

3.1.1 Salient features of the study districts

3.1.1.1 Bagalkot district

The Bagalkot district falls under the Northern Karnataka. District is situated between 15°49 and 16°46 north latitude and 74°59 and 76°20 east longitude. The district has total geographical area of 658877 hectares of which an area of 434749 hectares is under cultivation, accounting 65.98 per cent of the total area of the district. The details of the land use pattern of the district during the year 2003-04 are presented in the table 3.1. According to the 2001 census, the total population of district was 16.51 lakhs with a 8.34 Lakhs male and 8.17 Lakhs female with a literacy percentage of 57.81 per cent, 71.31 per cent and 44.1 per cent respectively. Of total agricultural holdings, marginal and small holdings constitute 23.94 per cent. The details of demographic features are shown in the table 3.2.

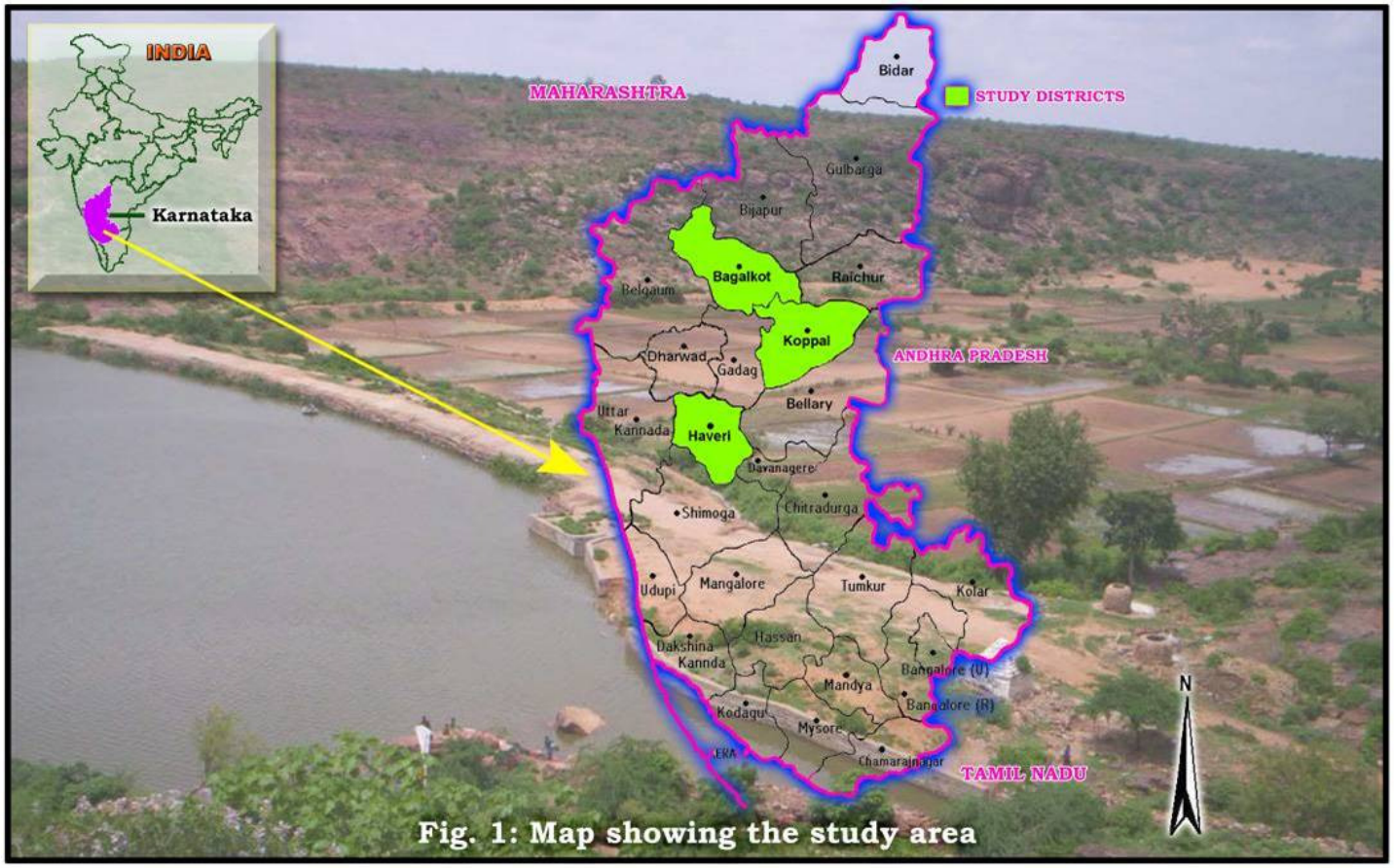


Fig 1: Map showing the study area

Table 3.1. Land Utilization Pattern in Selected Districts for the year 2003-04

(in hectares)

Sl. No.	Particulars	Districts		
		Bagalkot	Koppal	Haveri
1	Total Geographical area	658877	552495	485156
2	Area under forest	81126 (12.31)	29451 (5.33)	47454 (9.78)
3	Land not available for cultivation i. Non-Agricultural uses ii. Barren	53642 (8.14) 28832 (4.37) 24810 (3.76)	55497 (10.04) 38870 (7.03) 16627 (3.00)	37360 (7.70) 31567 (6.50) 5793 (1.19)
4	Other uncultivated land i. Cultivated waste ii. Permanent pasture iii. Trees and grooves	5676 (0.86) 2035 (0.30) 3429 (0.52) 212 (0.032)	17453 (3.15) 2568 (0.46) 14675 (2.65) 210 (0.038)	17303 (3.56) 2989 (0.61) 12395 (2.55) 1919 (0.39)
5	Fallow land i. Current fallow ii. Other fallow	83684 (12.70) 73718 (11.18) 9966 (1.51)	174069 (31.50) 126070 (22.81) 47999 (8.68)	36614 (7.54) 31348 (6.46) 5266 (1.08)
6	Net Sown Area i. Area sown more than once*	434749 (65.98) 43007 (9.89)	276025 (49.95) 120602 (43.69)	346428 (71.40) 89450 (25.81)
7	Gross cropped area	477756	396627	435878
8	Cropping intensity (%)	109.89	143.69	125.82
9	Net irrigated area i. Gross irrigated area as % of net sown area ii. Area under tank irrigation*	177842 (26.99) 40.90 1056 (0.59)	30739 (5.56) 11.13 1784 (5.80)	58875 (12.13) 16.99 8049 (13.67)

Source: District at a glance (2003-04) for Bagalkot, Koppal and Haveri

Note: Figures in parentheses indicate percentage to total geographical area.

* denotes percentage to respective totals.

Table 3.2. Demographic features of the study area

Sl. No.	Particulars	Bagalkot	Koppal	Haveri
1.	Total geographical area (ha)	658877	552495	485156
2.	Number of inhibited villages (No.)	623	596	675
3.	Total population (No.)	1651892	1193496	1439116
	a. Rural	1173372 (71.03)	995224 (83.38)	1140096 (79.22)
	b. Urban	478520 (50.50)	198272 (16.61)	299022 (20.77)
	c. Male	834247 (50.50)	602026 (50.44)	740469 (51.45)
	d. Female	817645 (49.49)	591470 (49.55)	698647 (48.54)
4.	Population density (persons/sq.km)	251	216	296
5.	Literacy rate (%)	57.81	77.52	68.09
	a. Male (%)	71.31	74.70	77.94
	b. Female (%)	44.1	50.08	57.60
6.	Normal rainfall (mm)	562	571.9	752.8
7.	Number of rainy days (Average)	37	28	50.4
8.	Agricultural holdings (ha)	522095 (100)	451135 (100)	381797 (100)
	a. Marginal holdings (<1 ha)	29574 (5.66)	29789 (6.60)	32328 (8.47)
	b. Small holdings (1-2 ha.)	95422 (18.28)	98114 (21.75)	103176 (27.02)
	c. Semi medium holdings (2-4 ha)	149722 (28.68)	147073 (32.60)	124921 (32.72)
	d. Medium holdings (4-10 ha)	1877071 (35.83)	132128 (29.29)	94225 (24.68)
	e. Large holdings (> ha)	60306 (11.55)	44031 (9.76)	27147 (7.11)

Source: District at a glance (2003-04) for Bagalkot, Koppal and Haveri

Note: Figures in parentheses indicate percentage to total geographical area.

* Denotes percentage to respective totals.

The average annual rainfall of this district is 562 mm, the mean temperature of the area varies from 21°C to 42°C.

The major crops grown in the district are jowar, bajra, wheat, maize, bengal gram, groundnut, sunflower and sugarcane. The information on cropping pattern of the district is presented in the table 3.3.

3.1.1.2 Koppal district

The district is located in the Northern part of Karnataka. The district lies between 15°74 to 16°07north latitude and between 75°53 to 77°83 east longitude. The district has a total geographical area of 552495 hectares with a total cultivated area of 276025 hectares accounting for 49.95 percent to the total geographical area of the district. The land use pattern of the district during 2003-04 is presented in table 3.1. The total population of the district is 11.93 lakhs comprising male (8.3 lakhs) and female (8.1 lakhas). The literacy percentage of the district is about 77.52 percent where 74.70 per cent of male and 50.08 percent female are literate. Marginal and small holdings together account for 28.35 per cent of the total agricultural holdings. The average annual normal rainfall of the district is 571.9 mm, received from both the southwest and northeast monsoons.

Paddy, jowar, bajra, wheat, maize, groundnut, bengal gram, sunflower and some vegetables are the important crops grown in the district. The details of cropping pattern are presented in the table 3.3.

3.1.1.3 Haveri district

Haveri district falls under the northern transitional tract of Karnataka state. It geographically lies within the interior of deccan peninsula between 14°28 and 14°59 north latitudes and 75°05 and 75°38 east longitudes. The total geographical area of the district is 485156 hectares of which 346425 hectares is under cultivation, accounting for about 71.40 per cent of the total geographical area.

According to the 2001 census, the total population of district was 14.39 lakhs with a male population of about 7.40 lakhs and that of female population is around 6.98 lakhs. The literacy percentage was 68.09 per cent, 77.94 per cent and 57.6 per cent in that order. Out of total agricultural holdings marginal and small holdings together forms a share of 35.49 per cent. The details of demographic features are shown in the table 3.2.

The average annual rainfall of the district is 752.8 mm. The mean temperature of the area varies from 16°C to 42°C.

Paddy, jowar, wheat, maize, ragi, bengal gram, red gram, groundnut, cotton, sunflower, sugarcane and some vegetables are the major crops of the district. The details of cropping pattern are depicted in the table 3.3.

3.2 SAMPLING PROCEDURE

Multistage sampling technique was adopted for selection the study area and sample respondents for collection of information required for the study.

In the first stage, three districts viz, Bagalkot, Koppal and Haveri districts were selected from northern part of Karnataka where Jala Samvardhane Yojana Sangha is managing the tanks based on all variabilities of agro-climatic conditions.

At the second stage, based on number of On-Farm Demonstrations/ Farmer's Field School conducted, the tanks were considered from each of the selected districts.

At The third stage sample respondents were selected from each of tank commands, twelve farmers were selected randomly giving due importance so that majority of the demonstrating farmers are included in the study. The number of farmer respondents so selected from each tank command are depicted in Fig.2. Thus, in all, 144 farmers were selected from study area.

3.3 NATURE AND SOURCES OF DATA

For evaluating the specific objectives of the study, necessary data was obtained from both secondary and primary sources. District level secondary data on land utilization pattern, net sown area, area sown more than once, irrigated area, demographic features and cropping pattern of the district etc., were collected from District Statistical Office. The data pertaining to selected tank commands obtained from the District Project Unit (DPU) and Cluster Facilitating Team (CFT) of Jala Samvardhane Yojana Sangha, Community Based Tank Management Consultancy Project, (CBTMCP) University of Agricultural Sciences, Dharwad.

Table 3.3. Area under major crops in the study area (in hectares)

Sl. No.	Crops	Districts		
		Bagalkot	Koppal	Haveri
i.	Cereals			
1	Paddy	127 (0.052)	42437 (22.50)	58134 (26.57)
2	Jowar	162812 (67.55)	69131 (36.66)	62967 (28.78)
3	Bajra	24007 (9.96)	50669 (26.87)	344 (0.15)
4	Wheat	23327 (9.67)	12264 (6.50)	1362 (062)
5	Maize	30456 (12.63)	11486 (6.09)	81991 (37.48)
6	Ragi	0	0	2370 (1.08)
7	Other cereals and miner millets	271 (0.11)	2568 (1.36)	11558 (5.28)
	Total*	241000 (50.76)	188555 (47.68)	218726 (56.61)
ii.	Pulses			
1	Bengal gram	26669 (48.69)	20762 (33.89)	1330 (4.01)
2	Red gram	2749 (5.01)	11252 (18.36)	6277 (18.93)
3	Black gram			
4	Green gram			
5	Other pulses	25349 (46.28)	29248 (47.74)	25548 (77.05)
	Total*	54767 (11.54)	61262 (15.49)	33155 (8.59)
iii.	Oil seeds			
1	Groundnut	15897 (14.62)	45078 (34.50)	NA
2	Sunflower	81081 (74.60)	68116 (52.14)	NA
3	Others	11699 (10.76)	17434 (13.34)	NA
	Total*	108677 (22.89)	130628 (33.04)	32494 (8.40)
iv.	Commercial crops			
1	Sugarcane	58694 (94.02)	668 (12.18)	5763 (6.62)
2	Cotton	3511 (5.62)	4684 (85.41)	80825 (92.96)
3	Mulberry cultivation	220.4 (0.35)	132 (2.40)	353.94 (0.40)
	Total*	62425.4 (13.15)	5484 (1.38)	86941.94 (22.51)
v.	Horticultural crops			
	i. Fruits	3409 (43.06)	2541 (26.67)	3519 (23.35)
	ii. Vegetables	4507 (56.93)	6985 (73.32)	11548 (76.64)
	Total*	7916 (1.66)	9526 (2.41)	15067 (3.89)
	Grand total	474785.4 (100)	395455 (100)	386383.94 (100)

Source: District at a glance (2003-04) for Bagalkot, Koppal and Haveri
Note: Figures in parentheses indicate percentage to respective totals.
* Figures in parentheses indicate percentage to respective grand total.

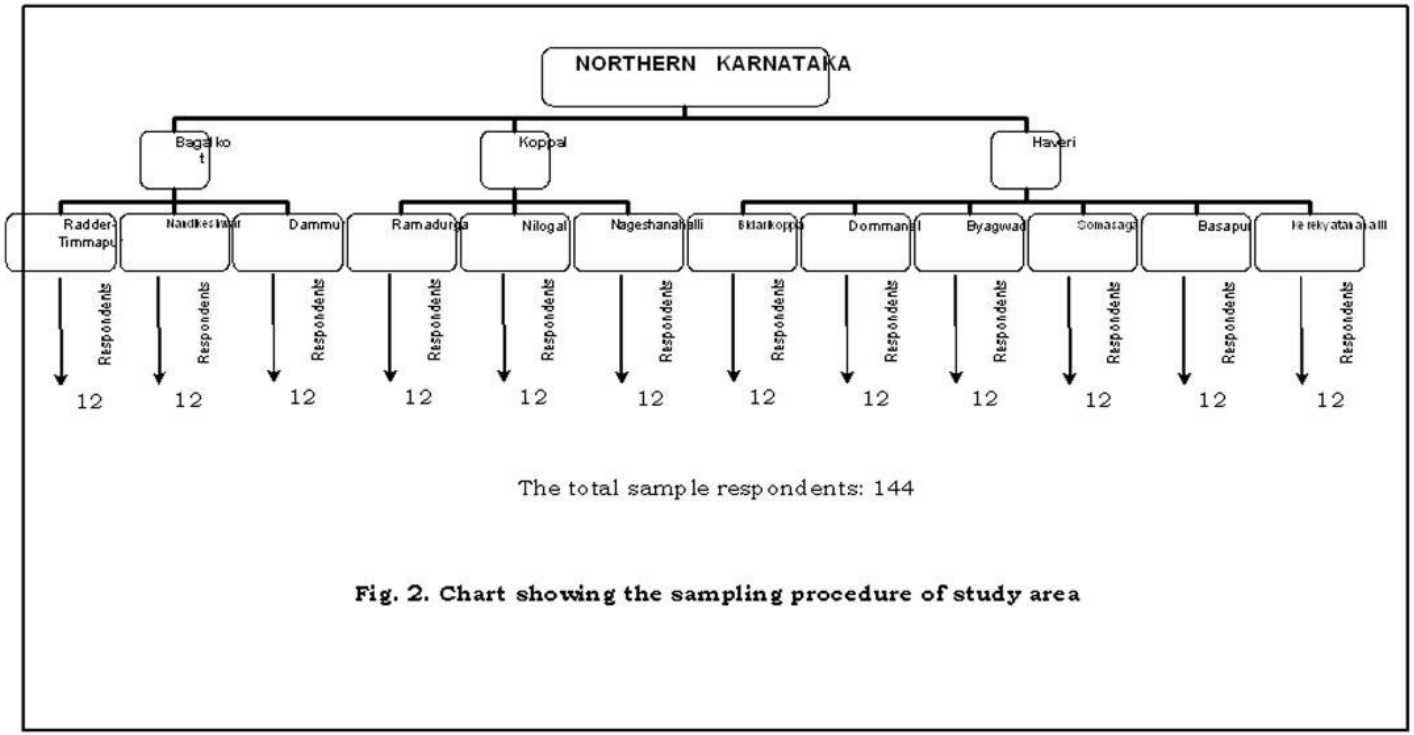


Fig. 2. Chart showing the sampling procedure of study area

Fig 2: Chart showing the sampling procedure of study area

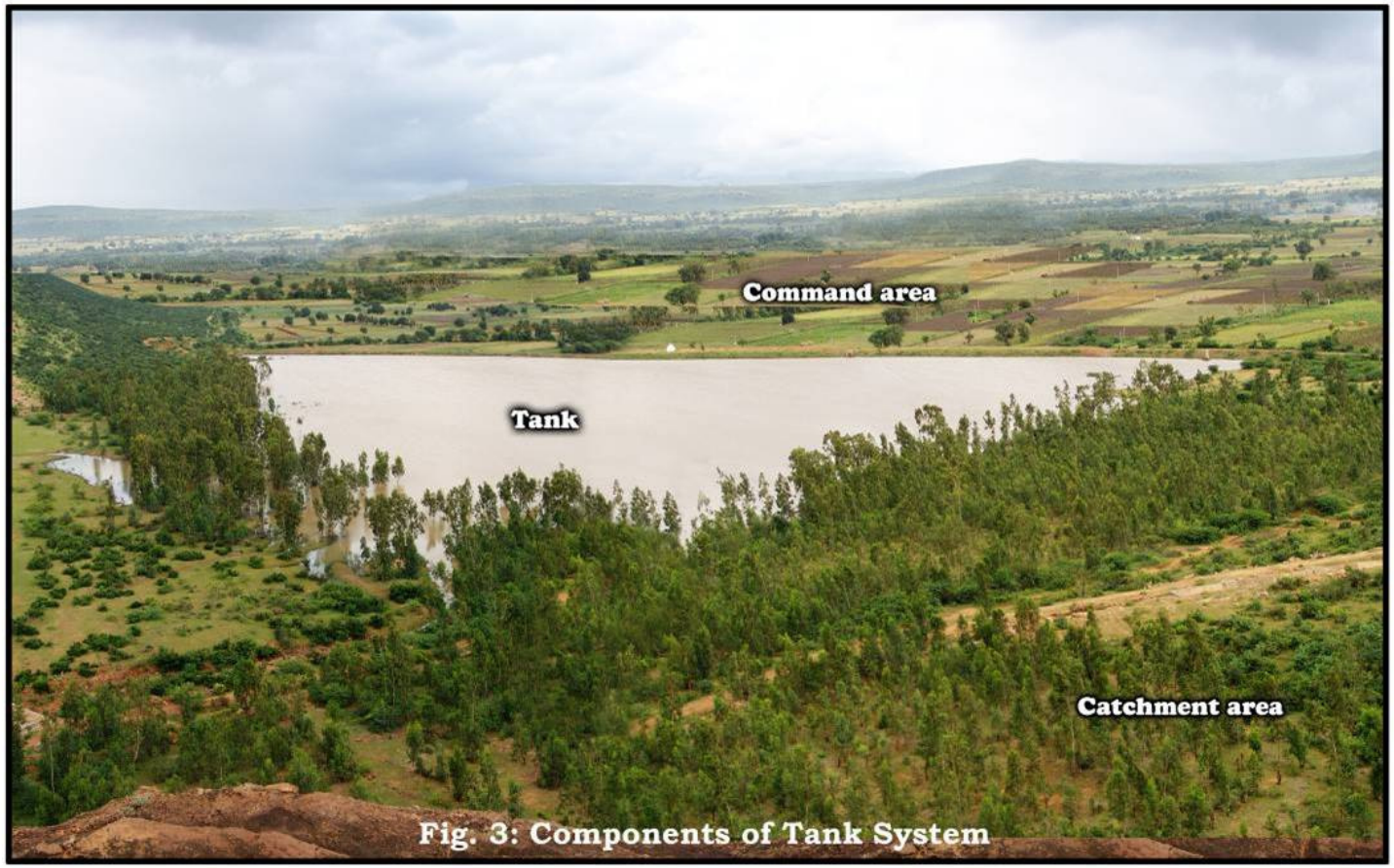


Fig 3: Components of Tank System

Primary data were collected through personal interview method using pre-tested and well structured schedules designed for the purpose. The information so collected for the study pertained to the agricultural year 2003-04.

3.4 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 devices were employed.

3.4.1 Tabular analyses

Tabular analyses involving the computation of means, percentages etc., were employed to present the data regarding demographic features, socio-economic profile, cropping systems, costs and returns, impact of on-farm demonstrations and farmers field school and constraints expressed by the farmers.

3.4.1.1 Cost and returns concepts in field crops

The total cost were divided into two broad classes,

A. Variable or operational costs
B. Fixed costs

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

A. 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 seeds, manures and fertilizers, plant protection chemicals, labour charges and miscellaneous charges.

a. Seed:

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

b. Farmyard manure:

It was valued at the actual purchase price and self-produced FYM was valued at prevailing market prices.

c. Labour:

Hired labour was accounted at the actual wages paid by the farmer. Female labour was converted into male equivalents by multiplying female labour units by 0.70 (conversion factor based on wages paid). Family labour was imputed at the prevailing wages rates as those paid to the hired labour.

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

d. Fertilizer and plant protection chemicals:

The cost of fertilizers and plant protection chemicals were considered at prices prevailed in the market.

e. Miscellaneous costs:

Miscellaneous cost include repair charges, threshing, bagging and marketing charges actually paid by the sample farmers.

f. Interest on working capital:

It is the interest on the entire working cost of the enterprise at the prevailing bank rate (8.5 per cent) for the crop period.

B. Fixed costs

a. Land revenue:

Land revenue was calculated at the rates levied by the government.

b. Land rent:

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

c. Depreciation:

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

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

d. Interest on fixed capital

This was calculated at the rate of 9.5 percent on the book value of the asset/ livestock, as the case may be for the study year.

C. Returns

The gross returns were calculated by taking the actual output prices obtained by the farmer in the market. The same was used for imputing the value of the produce retained for home consumption. The same method was also allowed for the evaluation of by products of various enterprises. Gross returns include values of both the main product and by-product. Net returns were calculated by deducting the total cost of production from gross returns.

3.4.1.2 Cost and returns in livestock enterprises

The cost and returns in livestock enterprises under each farming system in the study area is calculated per animal, later arrived at cost and returns of livestock enterprises per hectare by taking average number of dairy animals reared per hectare of land owned by sample respondents in each farming system by using the formula:

$$\text{Number of dairy animals / hectare} = \frac{\text{Total number of dairy animals reared}}{\text{Total land holding of respondents in ha}}$$

The costs in livestock enterprises include establishment cost and operational cost.

A. Establishment costs

Establishment cost include cost on building, machinery and equipments. The actual cost of animals purchased and the imputed value at prevailing market rates for animals born on the farm were considered as establishment costs.

In 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).

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

B. Operational costs

Operational costs include cost on feed, hay, green fodder, veterinary charges, depreciation on machinery, equipments and building, labour wages and miscellaneous expenses.

Feed and concentrates

Purchase price plus transportation costs and self-produced feed were evaluated at actual costs.

Fodder and hay

The actual purchase cost plus transport costs and stocking charges. Self produced fodder and hay were valued at actual production charges. Veterinary and medicine charges were calculated at actual costs what the farmers were incurred.

C. Returns

The price received by farmers on sale of milk were obtained along with the yield of milk. The returns were calculated accordingly. The valuation of by-products, manure in case of dairy were added to the total returns.

In dairy, local cows, cross breed cows and buffaloes were clubbed to work out costs and returns.

However, to express the cost and returns for the Farming Systems, the per hectare values are converted in to per farm by multiplying the per hectare values by average farm size of the concerned farming systems.

3.4.2 Production function analysis

Efficiency is an important concept in production economics when resources are meager and opportunities for developing and adopting better technologies are competitive. Indiscriminate use of resources at the farm level builds a high cost structure into the production process. It is difficult to asses the level of efficiency of a farmer unless one is sure of the conditions in which he operates. It is possible to raise the crop productivity by improving the level of efficiency without actually increasing the resource use. Estimates on the extent of insufficiency could also help to decide whether to improve efficiency to develop new technologies to raise the crop productivity.

The production functions were not estimated separately for the different Farming Systems due to insufficiency of the sample, instead Cobb-Douglas type of production function was fitted to know the resource use efficiency of farmers in the selected tank commands as a whole in each of the study district.

Under the tank commands considered for the study, the resource use efficiency was studied together for the identified Farming Systems in each of the district as a whole 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. This was done with a view to determine the extent to which the important resources have been quantified, to explain the variability in the gross returns of the farming systems and to determine whether the resources are optimally used in these tank commands.

Heady and Dillon (1964) 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 measures, 'y' is the output, 'a' is a constant and 'bi' estimates the extent of relationship between x and y 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.

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

On linearization it becomes

$\log y = \log a + b_1\log x_1 + b_2\log x_2 + b_3\log x_3 + \ldots\ldots\ldots\ldots + b_n\log x_n$

Production function for farming system as a whole

$\log y = \log a + b_1\log x_1 + b_2\log x_2 + b_3\log x_3 + b_4\log x_4 + b_5\log x_5 + b_6\log x_6 + b_7\log x_7$

Where,

Y = Gross returns in rupees
a = Intercept
x_1 = Land in acres
x_2 = Number of milch cattle
x_3 = Bullock labour and human labour cost
x_4 = Cost of feeds and concentrates
x_5 = Cost of seeds
x_6 = Expenditure on other resources (Cost of fertilizer + cost of FYM+ PPC + veterinary charges)
x_7 = Number of sheeps
bi = Elasticities of production (i=1 to 7)

Allocative 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.

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

Where,

y = geometric mean of gross returns in different tank commands

xi = 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, were taken as its marginal cost. The marginal cost of all other inputs were considered as one, since those inputs have been measured in value terms in regression analysis.

3.5 CONCEPTS USED IN THE STUDY

3.5.1 On-Farm Demonstrations (OFD)

The University of Agricultural Sciences, Dharwad is entrusted with the responsibilities of improving agricultural productivity and promoting practices that improve efficient resource use in tank command areas. In order to fulfill the responsibility, On-Farm Demonstrations were initiated to demonstrate new crop or variety or other technology on cereal crops, pulses, oilseeds and commercial crops grown in the command area. Emphasis was given to demonstrate cultural practices to promote Integrated Water Management, Nutrient Management and Integrated Pest and Disease Management practices, improved production technologies which results in increasing the profitability under tank command area. Demonstration plots were conducted along with check plots to show the impact of demonstrations to farmers under the same situation, both in terms of yield and reduced cost of cultivation. View of On-Farm Demonstrations conducted in the study area is shown in plate 3.1.In this context, impact of On-Farm Demonstration over check plots, cost and returns comparison were done in subsequent chapter.

3.5.2 Farmers Field Schools (FFS)

Farmers field schools approach is a non-formal, farmer centered educational process and an innovative, participation-oriented programme conducted by University of Agricultural Sciences, Dharwad to build the technical knowledge of tank command farmers to empower them to solve their own problems in farming and to upsurge farmers self-confidence and decision making ability through group discussion, meeting with a final focus to achieve profitability of farming in tank command areas. With this endorsement, Farmers Field School plot were compared with check plot in terms of cost and returns to asses the impact of farmers field schools (FFS) on farmers yield and net returns. Plate 3.2 gives the view of Farmers Field School conducted in the study area. List of On-Farm Demonstrations/ Farmers Field School conducted in the study area are presented in the table 3.4.

Table 3.4. On-Farm Demonstrations/Farmers Field School conducted in the study area during 2003-04

Sl. No.	District	Village	Activity taken	Name of the crop
1.	Bagalkot	Radder-Timmapur	OFD	Sunflower
		Nandikeshwar	FFS	Groundnut
		Dammur	FFS	Groundnut
2.	Koppal	Ramadurga	OFD	Bajra
		Nilogal	OFD	Groundnut
		Nageshanahalli	FFS	Paddy
3.	Haveri	Bidarikoppa	OFD	Paddy
		Dommanal	OFD	Maize
		Byagwadi	OFD	Ridgegourd
		Somasagar	FFS	Cotton
		Basapur	FFS	Cotton
		Kerekyatanahalli	FFS	Cotton

Plate 3.1: View of On-Farm Demonstrations Conducted in the study area

Plate 3.1: View of On-Farm Demonstrations Conducted in the study area

Plate 3.2: View of Farmers Field Schools Conducted in the study area

Plate 3.2: View of Farmers Field Schools Conducted in the study are

IV. RESULTS

This chapter presents the results that emerged from the analysis of data collected for achieving the set objectives of the study, under the following heads.

4.1 Socio-economic characteristics of sample farmers
4.2 Identification of major farming systems in the study area
4.3 Cost and returns structure of major farming systems
4.4 Resource use efficiency under different farming systems in the selected tank commands
4.5 Impact of on-farm demonstrations/farmers field schools on socio-economic conditions of the farmers
4.6 Constraints associated with different farming systems in the tank commands

4.1 SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLE FARMERS

The information on socio-economic characteristics of the sample respondents is presented in Table 4.1. The average age of the sample respondents was 42.94 years, 41.63 years and 42.83 years in Bagalkot, Koppal and Haveri districts, respectively. The average family size of the sample farmers was 6.02, 5.96 and 5.18 in Bagalkot, Koppal and Haveri districts respectively. With regard to literacy rate the proportion of illiterates was found to be highest in Bagalkot district (27.77) compared to Koppal (19.44) and Haveri (8.33) district. Literate sample respondents possessing education ranging from primary to college level. In Bagalkot district 22.22 per cent, 19.44 per cent, 16.66 per cent and 13.88 per cent of the respondents had an education level upto primary school, secondary school, high school and college level education respectively. In Koppal district 27.77 per cent, 38.88 per cent, 11.11 per cent and 2.77 per cent of the respondents had an education level upto primary school. secondary school, high school and college education level respectively. In Haveri district 40.97 per cent, 36.11 per cent, 8.33 per cent and 6.94 per cent had an education level up to primary school, secondary school, high school and college level education respectively.

The occupational pattern of the sample respondents revealed that, proportion of sample respondents who were involved mainly on agriculture and allied activities constituted 97.22 per cent each in Bagalkot and Koppal districts and 95.83 per cent in Haveri district. As far as pattern of land holding was concerned, about 53.84 per cent, 74.02 per cent and 74.32 per cent of cultivable land were irrigated under rainfed agriculture and 46.15 per cent, 25.97 per cent and 25.67 per cent of the land were in Bagalkot, Koppal and Haveri district respectively.

4.2 IDENTIFICATION OF MAJOR FARMING SYSTEMS IN THE STUDY AREA

Based on the production activities taken up by the sample respondents, the existing farming systems were identified in each of the districts and results are presented in the Table 4.2 and Fig. 4. The number of farming systems followed by farmers was found to be four each in Bagalkot and Koppal districts and five in Haveri district. Among them based on per cent of adoption by the sample respondents, farming system-I and farming system-II in Bagalkot and Koppal districts and farming system-I, farming system-II and farming system-III in Haveri district were identified as the major farming systems and are considered for further analysis.

In Bagalkot district, major farming systems *were*, farming system-I : sunflower + maize + hy. jowar followed by groundnut + dairy, farming system-II : maize + hy. jowar + bajra followed by groundnut + dairy. Here afterwards these farming systems will be mentioned as farming system-I and farming system-II in Bagalkot district.

The prominent farming systems identified in Koppal district were farming system-I: hy. jowar + sunflower + bajra + *kharif* groundnut followed by *rabi* groundnut + dairy and farming system-II: hy. jowar + bajra + sesamum followed by groundnut + sheep. Here onwards these farming systems are represented as farming system-I and farming system-II in Koppal district.

The major farming systems identified in Haveri district were farming system-I: maize + cotton + dairy, farming system-II: maize + cotton + paddy + dairy; and farming system-III: cotton + hy. jowar + paddy + dairy.Now onwards these farming systems were mentioned as farming system-I, farming system-II and farming system-III respectively in Haveri district.

It was revealed from the table 4.2 that sunflower, maize, hy. jowar and groundnut were major crops in Bagalkot district. In Koppal district the major crops were hy. jowar, bajra and groundnut. Whereas in Haveri district, maize, cotton and paddy were the major crops.

Table 4.1. Socio economic characteristics of the sample respondents

Sl. No.	Particulars	Units	Districts		
			Bagalkot	Koppal	Haveri
1.	Average age	Years	42.94	41.63	42.83
2.	Family size	Nos.			
	i. Adult male		2.36 (39.20)	2.13 (35.73)	2.31 (44.59)
	ii. Adult female		1.97 (32.72)	1.63 (27.34)	1.76 (33.97)
	iii. Children		1.69 (28.07)	2.20 (36.91)	1.11 (21.42)
	Total family size		6.02	5.96	5.18
3.	Education level	Nos.			
	a. Illiterate		10 (27.77)	7 (19.44)	6 (8.33)
	b. Primary		8 (22.22)	10 (27.77)	29 (40.27)
	c. Secondary		7 (19.44)	14 (38.88)	26 (36.11)
	d. High school		6 (16.66)	4 (11.11)	6 (8.33)
	e. College		5 (13.88)	1 (2.77)	5 (6.94)
	Sub total		36	36	72
4.	Occupational pattern	Nos.			
	a. Agriculture + Allied activities		35 (97.22)	35 (97.22)	69 (95.83)
	b. Agriculture + Allied activities + Business		1 (2.77)	1 (2.77)	3 (4.16)
	Sub total		36	36	72
5.	Average size of land holding	Ha			
	i. Rain fed		0.84 (53.84)	1.71 (74.02)	1.65 (74.32)
	ii. Irrigated		0.72 (46.15)	0.60 (25.97)	0.57 (25.67)
	Average land holding (Total)		1.56	2.31	2.22

Note: figures in parentheses indicates percentage to respective total

The dairy enterprise was found to be the most common in all the identified farming systems, except in Koppal district where sheep rearing was found in farming system-II, though not as a commercial enterprise, but as a subsidiary activity.

Among the identified prominent farming systems, only those enterprises which have contributed at least 10 per cent share in the net cropped area or contributed at least 10 per cent to the gross returns were considered to work out the cost and returns of different enterprises in each farming systems.

4.2.1 Average Farm Size in the identified Major Farming Systems

The farm size in the identified major farming systems revealed that, the farm size was found to be the largest (Table 4.3) in Farming System-II of Haveri district (1.305 ha) followed by Farming System-I and II in Koppal district (1.25 and 1.10ha), Farming System-III in Haveri district (1.08ha) and almost equal in Farming System-I of both Bagalkot and Haveri districts (0.906 and 0.90 ha) and least was observed in Farming System-II of Bagalkot district.

4.2.2 Cropping pattern Under Different Farming Systems in Bagalkot District

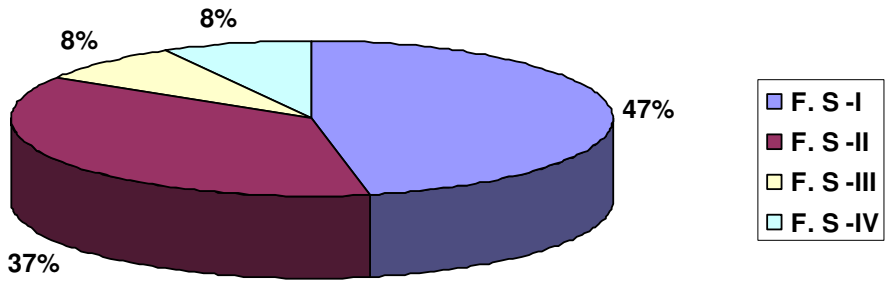
It is revealed from the results presented in Table 4.4 that major crops grown during *kharif* season include sunflower and maize in farming system-I, which contributed 39.34 per cent and 12.07 per cent of the gross cropped area respectively. In farming system-II, maize (26.26%), bajra (19.96%) and hy. jowar (15.73%) were the main crops.

Table 4.2. Farming Systems identified in the study area

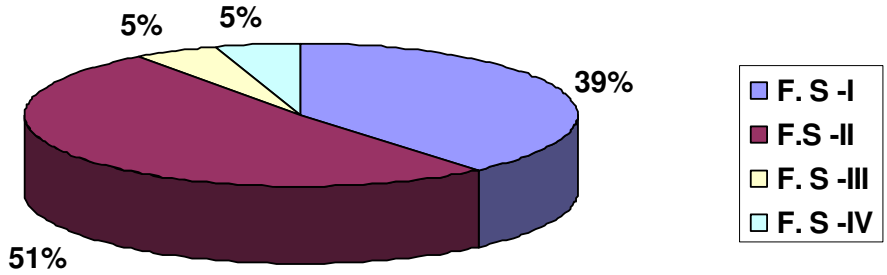
Sl. No.	Farming systems	Enterprises	No. of farmers	Adoption %
I.	Bagalkot district			
1.	Farming system-I	Sunflower + Maize + Hy. Jowar flowed by Groundnut + Dairy	17	47
2.	Farming system-II	Maize + Hy. jowar + Bajra followed by Groundnut + Dairy	13	37
3.	Farming system-III	Sunflower + Hy. jowar + Dairy	3	8
4.	Farming system-IV	Sunflower + Bajra	3	8
	Total		36	100
II.	Koppal district			
1.	Farming system-I	Hy. jowar + Sunflower + Bajra + *kharif* Groundnut followed by *rabi* Groundnut + Dairy	14	39
2.	Farming system-II	Hy. jowar + Bajra + Sesamum flowed by Groundnut + Sheep rearing	18	51
3.	Farming system-III	Sunflower + Dairy	2	5
4.	Farming system-IV	Sunflower + Bajra	2	5
	Total		36	100
III.	Haveri district			
1.	Farming system-I	Maize + Cotton + Dairy	29	40
2.	Farming system-II	Maize + Cotton + Paddy + Dairy	22	31
3.	Farming system-III	Cotton + Hy. jowar + Paddy + Dairy	10	14
4.	Farming system-IV	Maize + Hy. jowar + Cotton + Dairy	5	7
5.	Farming system-V	Maize + Dairy	6	8
	Total		72	100

Note: Major farming systems in the study area are indicated by bold letters and are considered for further analysis

Bagalkot District



Koppal District



Haveri District

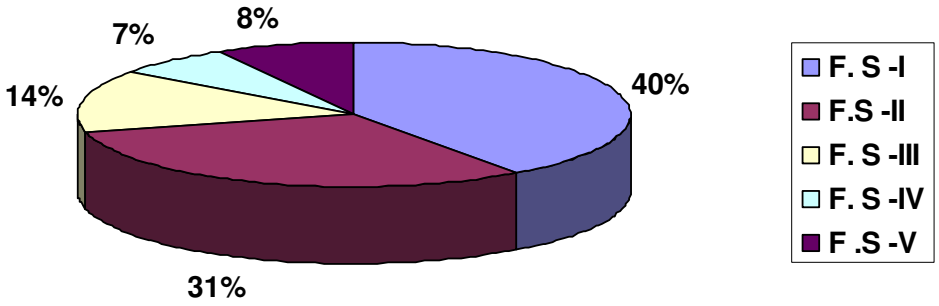


Fig. 4 Adoption of the identified Farming Systems in the study area.

Table 4.3 Average Farm Size in the identified Major Farming Systems in the study Area

(in hectares)

SI No.	Farming Systems	Farm Size
Bagalkot district		
1	Farming system-I	0.906
2	Farming system-II	0.556
Koppal district		
3	Farming system-I	1.25
4	Farming system-II	1.10
Haveri district		
5	Farming system-I	0.90
6	Farming system-II	1.305
7	Farming system-III	1.08

Table 4.4. Cropping Pattern Under Major Farming Systems identified in Bagalkot District

(Area in hectares)

Sl. No.	Particulars	FS-I		FS-II	
		Area	Per cent	Area	Per cent
I.	*Kharif* season				
1.	Sunflower	19.10	39.34	-	-
2.	Maize	5.86	12.07	4.04	26.26
3.	Bajra	1.21	2.49	3.07	19.96
4.	Hy. jowar	2.63	5.41	2.42	15.73
5.	Groundnut	-	-	0.80	5.20
	Sub-total (I)	28.80	59.32	10.33	67.17
II.	*Rabi* season				
1.	Groundnut	18.95	39.03	4.45	28.93
2.	Wheat	0.40	0.82	-	-
3.	Sunflower	-	-	0.60	3.90
	Sub-total (II)	19.35	39.86	5.05	32.83
III.	Horticulture crops				
1.	Onion	0.40	0.82	-	-
	Sub-total (III)	0.40	0.82	-	-
	Gross cropped area (I+II+III)	48.55	100	15.38	100
	Net cropped area	30.89		14.46	
	Cropping intensity (%)	157.17		106.36	

Note: FS-Farming System

Table 4.5. Cropping Pattern Under Major Farming Systems identified in Koppal District

(Area in hectares)

Sl. No.	Particulars	FS-I		FS-II	
		Area	Per cent	Area	Per cent
I.	*Kharif* season				
1.	Hy. jowar	14.16	27.26	9.91	29.04
2.	Sunflower	12.54	24.14	-	-
3.	Groundnut	4.04	7.77	0.40	1.17
4.	Navane	1.21	2.33	1.21	3.54
5.	Sesamum	3.23	6.21	3.64	10.66
6.	Bajra	5.05	9.72	8.90	26.08
7.	Maize	2.42	4.66	1.61	4.71
8.	Paddy	0.40	0.77	-	-
9.	Redgram	1.61	3.10	1.61	4.71
10.	Cotton			0.80	2.34
	Sub-total (I)	44.66	86.00	28.08	82.30
II.	*Rabi* season				
1.	Groundnut	4.85	9.33	2.83	8.29
2.	Bengalgram	2.02	3.88	1.61	4.71
3.	Paddy	-	-	0.80	2.34
4.	Greengram	-	-	0.40	1.17
	Sub-total (II)	6.87	13.23	5.64	16.53
III.	Horticulture crops				
1.	Tomato	0.40	0.77	-	-
2.	Onion			0.40	1.17
	Sub-total (III)	0.40	0.77	0.40	1.17
	Gross cropped area (I+II+III)	51.93	100	34.12	100
	Net cropped area	44.11		31.04	
	Cropping intensity (%)	117.72		109.92	

Note: FS-Farming System

During *rabi* season groundnut was the major crop in both the farming systems, occupying maximum area of 39.03 per cent and 28.93 per cent respectively. Among the vegetable crops onion was grown in 0.82 per cent of the gross cropped area in farming system-I. The cropping intensity was found to be highest in farming system-I (157.17%) and 106.36 per cent in farming system-II.

4.2.3 Cropping pattern Under Different Farming Systems in Koppal District

It is apparent from the results presented in the Table 4.5 that, in *kharif* season, hy. jowar (27.26%), sunflower (24.14%), maize (9.72%) and groundnut (7.77%) were observed to be major crops under the farming system-I. In the farming system-II the major crops observed were hy. jowar (29.04%), bajra (26.08%) and sesamum (10.66%).

During *rabi* season groundnut was the major crop grown in both the farming systems occupying an area of 9.33 per cent and 8.29 per cent followed by bengal gram (3.88%) and (4.71%). Among the horticultural crops, tomato was grown in 0.77 per cent of the gross cropped area in farming system-I and onion in 1.17 per cent of the gross cropped area in farming system-II. The cropping intensity was around 117.72 per cent and 109.92 per cent in farming system-I and farming system-II respectively.

4.2.4 Cropping pattern Under Different Farming Systems in Haveri District

Among different crops grown in Haveri district in *kharif* season. maize (40.64%) and cotton (38.53%) occupied maximum area in farming system-I. Whereas, in farming system-II, the major crops were paddy, maize and cotton, with a share of 37.35 per cent, 17.27 per cent and 16.43 per cent respectively (Table-4.6). The area under maize was highest with a percent share of 43.64 to the gross cropped area followed by paddy (26.77%) and hy. jowar (15.84%) in farming system-III.

During *rabi* season, greengram (3.95%), sunflower (1.97%) and horsegram (0.65%) were the major crops grown in farming system-I. In farming system-II greengram (3.89%), blackgram (3.89%), bengalgram (3.33%) and cowpea (2.21%) were the major crops grown. Blackgram and bengalgram both with a share of 3.92 per cent to total gross cropped area followed by greengram (1.96%) were the major crops grown in farming system-III.

Among the horticultural crops brinjal, ridgegourd and cucumber were grown by the farmers in 4.9 per cent, 2.45 per cent and 1.63 per cent of the area in farming system-I, while no such production activity was observed in farming system-II and in farming system-III only chilli was grown by the farmers in 1.96 per cent of the gross cropped area. Cropping intensity in these systems were117.45 percent, 91.16 per cent and 109.09 per cent accordingly in farming systems -I, II and III.

4.3 COSTS AND RETURNS OF DIFFERENT ENTERPRISES IN IDENTIFIED MAJOR FARMING SYSTEMS

The cost and returns computed for different enterprises under major farming systems in the study districts are presented below:

4.3.1 Bagalkot district

4.3.1.1 Costs 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 4.7 and Fig.5.

Sample farmers under this farming system were having on an average two milch animals per farm. Hence the cost and returns were worked out for the same. The total cost of cultivation worked for the farming system-I as a whole as Rs.77073.55 gross returns and net returns were Rs.105375.57 and Rs.28301.99 respectively. For the system as a whole, rabi groundnut as a enterprise, was found to be most expensive as its contribution to the total cost of the farming system was the highest (24.59%). The other enterprises consider to be expensive were maize (22.83%), sunflower (18.85%) and hy. jowar (18.31%). Least expensive among the enterprises was dairy with the contribution of just 15.42 per cent of total cost to the farming system as a whole.The variable as well as fixed costs also followed the same pattern as that of total cost as for as share of the cost of various enterprises included in the farming system to the total cost of the system is concerned.

The benefit cost ratio was observed to be highest in groundnut (1.74) followed by dairy (1.40), sunflower (1.28), hy. jowar (1.19), maize (1.13) and for the farming system as a whole it was 1.36.

Table 4.6. Cropping Pattern Under Major Farming Systems identified in Haveri District

(Area in hectares)

Sl. No.	Particulars	FS-I		FS-II		FS-III	
		Area	Per cent	Area	Per cent	Area	Per cent
I.	*Kharif* season						
1.	Maize	24.88	40.64	12.54	17.27	-	-
2.	Cotton	23.59	38.53	11.93	16.43	8.90	43.64
3.	Groundnut	0.80	1.30	2.02	2.78	0.40	1.96
4.	Paddy	2.42	3.95	27.11	37.35	5.46	26.77
5.	Hy. Jowar	-	-	5.46	7.52	3.23	15.84
6.	Ragi	-	-	1.21	1.66	-	-
	Sub-total (I)	51.69	84.43	60.27	83.05	17.99	88.23
II.	*Rabi* season						
1.	Horsegram	0.40	0.65	0.40	0.55	-	-
2.	Greengram	2.42	3.95	2.83	3.89	0.40	1.96
3.	Sunflower	1.21	1.97	1.41	1.94	-	-
4.	Blackgram	-	-	2.83	3.89	0.80	3.92
5.	Bengalgram	-	-	2.42	3.33	0.80	3.92
6.	Cowpea	-	-	1.61	2.21	-	-
7.	Redgram	-	-	0.80	1.10	-	-
	Sub-total (II)	4.03	6.59	12.30	16.95	2.00	9.81
III.	Horticulture crops						
1.	Brinjal	3.00	4.90	-	-	-	-
2.	Ridgegourd	1.50	2.45	-	-	-	-
3.	Cucumber	1.00	1.63	-	-	-	-
4.	Chilli	-	-	-	-	0.40	1.96
	Sub-total (III)	5.50	8.98	-	-	0.40	1.96
	Gross cropped area (I+II+III)	61.22	100	72.57	100	20.39	100
	Net cropped area	52.17		79.60		18.69	
	Cropping intensity (%)	117.45		91.16		109.09	

Table 4.7. Cost and returns of different enterprises Under Farming System-I in Bagalkot District

(Rs./farm)

Sl. No.	Particulars	Sunflower	Maize	Hy. jowar	*Rabi* groundnut	Dairy	Farming system as a whole
	Costs						
1.	Total variable cost	12273.39 (18.07)	15620.70 (22.99)	12118.20 (17.85)	16683.12 (24.56)	11224.52 (16.53)	67919.94 (100)
2.	Total fixed cost	2262.02 (24.72)	1971.85 (21.55)	1994.45 (21.79)	2266.36 (24.75)	658.89 (7.19)	9153.57 (100)
3.	Total cost	14535.42 (18.85)	17592.57 (22.83)	14112.66 (18.31)	18949.48 (24.59)	11883.42 (15.42)	77073.55 (100)
	Returns						
4.	Gross returns	18693.08 (17.74)	19963.65 (18.94)	16902.38 (16.04)	33110.42 (31.43)	16706.04 (15.85)	105375.57 (100)
5.	Net returns	4157.66 (14.69)	2371.11 (8.38)	2789.71 (9.86)	14160.93 (50.03)	4822.58 (17.04)	28301.99 (100)
6.	B:C ratio	1.28	1.13	1.19	1.74	1.40	1.36

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

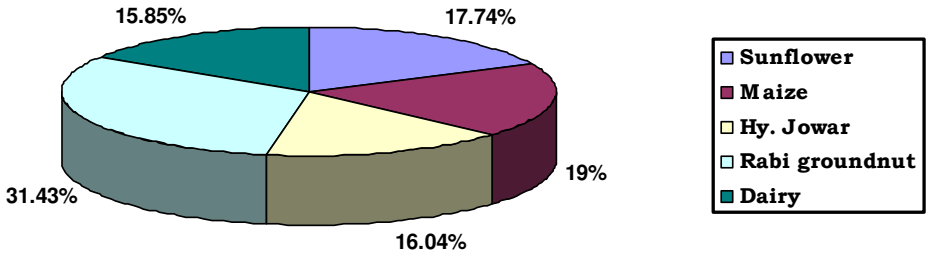
Table 4.8. Cost and returns of different enterprises Under Farming System-II in Bagalkot District

(Rs./farm)

Sl. No.	Particulars	Maize	Hy. jowar	Bajra	*Rabi* groundnut	Dairy	Farming system as a whole
	Costs						
1.	Total variable cost	8479.66 (26.35)	7391.01 (22.96)	3226.64 (10.02)	9550.51 (29.67)	3541.93 (11.01)	32189.75 (100)
2.	Total fixed cost	1030.50 (20.99)	1382.62 (28.18)	832.68 (16.97)	1391.56 (28.36)	269.91 (5.50)	4907.27 (100)
3.	Total cost	9510.17 (25.64)	8773.64 (23.65)	4059.32 (10.94)	10942.08 (29.49)	3811.84 (10.28)	37097.05 (100)
	Returns						
4.	Gross returns	10598.49 (20.86)	10386.50 (20.44)	4170.26 (8.21)	19417.21 (38.21)	6242.75 (12.28)	50815.21 (100)
5.	Net returns	1088.31 (7.93)	1612.85 (11.76)	110.93 (0.81)	8475.13 (61.78)	2430.90 (17.72)	13718.12 (100)
6.	B:C ratio	1.11	1.18	1.02	1.77	1.63	1.36

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

Farming System –I



Farming System –II

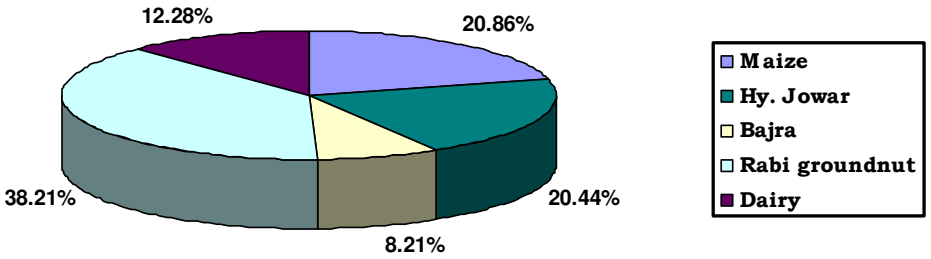


Fig. 5 Enterprises Contribution to gross returns of the Farming Systems in Bagalkot District

4.3.1.2 Costs and returns of different enterprises under farming system-II

The cost and returns per farm under farming system-II are presented in Table 4.8 and Fig.5. The dairy enterprises consisted of one dairy animal per farm under the farming system-II. For the farming system as a whole, it was observed that the total cost per farm was Rs.37097.05 and gross returns was Rs.508150.21 and net returns was Rs13718.12. Among the five enterprises included in the system, share in total variable cost of the system was the highest in rabi groundnut (29.67%), followed by maize (26.35%), hy. jowar (22.96%), bajra (10.02%) and dairy (11.00%).

The contribution of individual enterprise to net returns was maximum with respect to groundnut (61.78%) followed by dairy (17.72%), hy. jowar (11.76%), maize (7.93%) and the least was observed in case of bajra (0.81%). Under this farming system maximum benefit for each rupee invested was observed in groundnut (1.77) followed by dairy (1.63), hy. jowar (1.18), maize (1.11) and least was in bajra (1.02). The B:C ratio for the system as a whole was 1.36.

4.3.2 Koppal district

4.3.2.1 Costs and returns of different enterprises in farming system-I

The cost incurred and returns realized from hy. jowar, sunflower, bajra, *kharif* groundnut, *rabi* groundnut and dairy and their share to total cost and returns were calculated and presented in the Table 4.9 and Fig.6. The dairy enterprise under this farming system had one milch animal per farm of land. It was observed that the expenditure made towards cultivation was highest in *kharif* groundnut (25.74%) followed by *rabi* groundnut, hy. jowar, sunflower, dairy and bajra with 24.38 per cent, 18.39 per cent, 14.86 per cent, 10.09 per cent and 6.54 per cent share to the total variable costs of the system. Among the enterprises, highest share in total cost was observed in *kharif* groundnut with 25.13 per cent followed by *rabi* groundnut, hy. jowar, sunflower, dairy and bajra with 24.09 per cent, 18.68 per cent, 15.52 per cent, 9.37 per cent and 7.21 per cent respectively. The total cost of farming system as a whole was Rs.126210.55. The gross returns under this farming system was Rs.170766.86 The contribution of *kharif* groundnut to the net returns was 36.41 per cent followed by *rabi* groundnut (25.34%), sunflower (22.91%), dairy (8.57%), hy. jowar (5.40%) and least was in bajra (1.37%). The net returns obtained from the farming system as a whole was Rs.44556.23. The returns per rupee of expenditure was highest in sunflower with a value of 1.52, followed by *kharif* groundnut, *rabi* groundnut dairy, hy. jowar and bajra with B:C ratio of 1.51, 1.37, 1.32, 1.10 and 1.06 respectively and for the system as a whole it was 1.35.

4.3.2.2 Costs and returns of different enterprises in farming system-II

The per farm cost and returns of enterprises considered under the farming system-II in Koppal district were calculated and presented in the Table 4.10 and Fig.6. Information furnished in the table indicates that, among five enterprises of the system, share in total variable cost was accounted to be highest in groundnut (35.36%), followed by sesamum (21.55%), hy. jowar (20.76%), sheep rearing (12.60%) and comparatively less in bajra with 9.73 per cent. Under this system, the share of total cost of individual enterprise to total cost of system as a whole was highest in groundnut accounting to 33.46 per cent. Further, sesamum, hy. jowar, sheep enterprises shares were 22.08 per cent, 19.92 per cent and 14.36 per cent respectively, whereas it was 10.18 per cent in bajra.

The total cost of the farming system as a whole was Rs.79031.07, whereas the gross returns and net returns were observed to be Rs.110912.35 and Rs.31881.28 accordingly. The highest contribution to net returns of the system was by groundnut (59.69%) followed by sesamum (20.35%), sheep enterprise (11.84%) and hy. jowar (7.54%) and least was observed in bajra (0.58%).

The returns for per rupee expenditure was maximum in groundnut (1.71) followed by sesamum (1.37), sheep rearing (1.33), hy. jowar (1.15) and bajra (1.02) and it was 1.40 for the system as a whole.

4.3.3 Haveri district

4.3.3.1 Costs and returns of different enterprises under farming system-I

The per farm cost and returns of enterprises considered under the farming system-I in Haveri district were calculated and presented in the Table 4.11 and Fig.7. Information given in the table indicates that among the three enterprises of the system the share in total variable cost of system was the highest in cotton, accounting 44.75 per cent followed by maize (38.23%) and dairy (17.02%).

Table 4.9. Cost and returns of different enterprises Under Farming System-I in Koppal District

(Rs./farm)

Sl. No.	Particulars	Hy. jowar	Sunflower	Bajra	*Kharif* groundnut	*Rabi* groundnut	Dairy	Farming system as a whole
	Costs							
1.	Total variable cost	20344.48 (18.39)	16435.51 (14.86)	7228.57 (6.54)	28460.36 (25.74)	26958.75 (24.38)	11153.18 (10.09)	110580.85 (100)
2.	Total fixed cost	3241.67 (20.75)	3139.20 (20.08)	1869.56 (11.96)	3262.65 (20.87)	3446.43 (22.05)	670.16 (4.29)	15629.67 (100)
3.	Total cost	23586.17 (18.68)	19574.71 (15.52)	9098.13 (7.21)	31723.01 (25.13)	30405.18 (24.09)	11823.35(9.37)	126210.55 (100)
	Returns							
4.	Gross returns	25995.22 (15.22)	29780.62 (17.44)	9709.56 (5.68)	47943.57 (28.08)	41696.51 (24.42)	15641.38 (9.16)	170766.86 (100)
5.	Net returns	2409.03 (5.40)	10205.90(22.9 1)	611.42 (1.37)	16220.55 (36.41)	11291.30 (25.34)	3818.03 (8.57)	44556.23 (100)
6.	B:C ratio	1.10	1.52	1.06	1.51	1.37	1.32	1.35

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

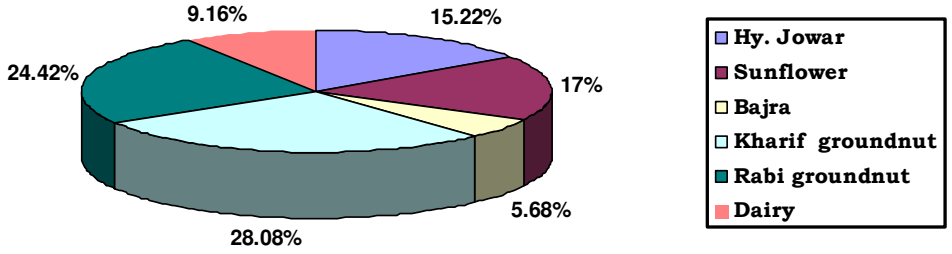
Table 4.10. Cost and returns of different enterprises Under Farming System-II in Koppal District

(Rs./farm)

Sl. No.	Particulars	Hy. jowar	Bajra	Sesamum	*Rabi* groundnut	Sheep rearing	Farming system as a whole
	Costs						
1.	Total variable cost	13749.82 (20.76)	6441.01 (9.73)	14272.86 (21.55)	23420.53 (35.36)	8342.29 (12.60)	66226.51 (100)
2.	Total fixed cost	1988.41 (15.53)	1603.99 (12.53)	3180.94 (24.84)	3021.56 (23.60)	3009.64 (23.50)	12804.54 (100)
3.	Total cost	15738.24 (19.92)	8045.00 (10.18)	17453.81 (22.08)	26442.09 (33.46)	11351.93 (14.36)	79031.07 (100)
	Returns						
4.	Gross returns	18141.62 (16.36)	8230.06 (7.42)	23938.85 (21.58)	45473.81 (40.99)	15128.01 (13.65)	110912.35 (100)
5.	Net returns	2403.37 (7.54)	185.05 (0.58)	6485.04 (20.35)	19031.72(59.69)	3776.08 (11.84)	31881.28 (100)
6.	B:C ratio	1.15	1.02	1.37	1.71	1.33	1.40

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

Farming System –I



Farming System –II

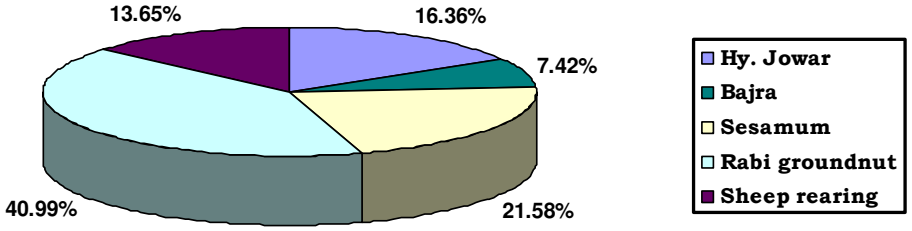


Fig. 6 Enterprises Contribution to gross returns of the Farming Systems in Koppal District

Table 4.11. Cost and returns of different enterprises Under Farming System-I in Haveri District

(Rs./farm)

Sl. No.	Particulars	Maize	Cotton	Dairy	Farming system as a whole
	Costs				
1.	Total variable cost	12545.50 (38.23)	14681.62 (44.75)	5585.20 (17.02)	32812.32 (100)
2.	Total fixed cost	2230.49 (45.11)	2284.35 (46.19)	430.29 (8.70)	4945.13 (100)
3.	Total cost	14775.99 (39.13)	16965.97 (44.94)	6015.49 (15.93)	37757.45 (100)
	Returns				
4.	Gross returns	17569.74 (33.22)	26347.59 (49.81)	8977.89 (16.97)	52895.22 (100)
5.	Net returns	2793.74 (18.46)	9381.63 (61.97)	2962.40 (19.57)	15137.77 (100)
6.	B:C ratio	1.18	1.55	1.49	1.40

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

Table 4.12. Cost and returns of different enterprises Under Farming System-II in Haveri District

(Rs./farm)

Sl. No.	Particulars	Maize	Cotton	Paddy	Dairy	Farming system as a whole
	Costs					
1.	Total variable cost	20735.69 (29.46)	21003.80 (29.84)	21211.94 (30.13)	7440.40 (10.57)	70391.83 (100)
2.	Total fixed cost	2732.98 (27.24)	3362.67 (33.52)	3253.42 (32.43)	683.74 (6.81)	10032.81 (100)
3.	Total cost	23468.68 (29.19)	24366.47 (30.29)	24465.37 (30.42)	8124.38 (10.10)	80424.90 (100)
	Returns					
4.	Gross returns	26700.93 (23.72)	39909.33 (35.44)	33231.68 (29.51)	12761.43 (11.33)	112603.37 (100)
5.	Net returns	3232.25 (10.05)	15542.85 (48.30)	8766.29 (27.24)	4637.05 (14.41)	32178.47 (100)
6.	B:C ratio	1.13	1.64	1.35	1.57	1.40

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

The share of total cost of individual enterprises to the total cost of the system was accounted maximum in cotton with 44.94 per cent followed by maize and dairy with 39.13 per cent and 15.93 per cent.

The contribution of cotton to net returns was the highest *i.e.* 61.97 per cent followed by dairy (19.57%) and maize (18.46%). Further, for the farming system as a whole, the total cost was Rs.37757.45, whereas the gross returns realized from the system was Rs.52895.22 and net returns was Rs.15137.77. The returns per rupee of expenditure for this farming system was 1.40 and was the highest in cotton with a ratio of 1.55 followed by dairy (1.49) and maize (1.18).

4.3.3.2 Costs and returns of different enterprises in farming system-II

The cost incurred and returns realized from different enterprises was calculated and presented in the Table 4.12 and Fig.7. Under this farming system dairy enterprise consisted of one milch animal per farm which was resulted based on average number of dairy animals reared per farm by sample respondents. It was observed that among the four enterprises included in the farming system, the highest share in the total variable cost of the system was contributed by paddy (30.13%) and was almost equal in case of maize (29.46%) and cotton (29.84%) followed by dairy (10.57%). Similar trend was noticed even with sharing of total cost of the system.

Among the enterprises, the contribution of individual enterprises to the net returns was highest in cotton (48.30%), followed by paddy (27.24%), dairy (14.41%) and least was in maize (10.05%).

Returns per rupee of expenditure was maximum in cotton with a ratio of 1.64, followed by dairy (1.57), paddy (1.35) and maize (1.13). The benefit cost ratio for the system as a whole was 1.40.

The total cost of the farming system as a whole was Rs.80424.90. The gross returns and net returns obtained were Rs.112603.37 and Rs.32178.47 in that order.

4.3.3.3 Costs and returns of different enterprises in farming system-III

The cost incurred and returns realized from cotton, hy. jowar, paddy and dairy and their share to the total cost and returns were calculated and presented in the Table 4.13 and Fig.7. The dairy enterprise under this farming system was having two milch animals per farm of land. Hence, cost and returns were calculated for the same. It was observed that, among the four enterprises considered, expenditure made towards cultivation in terms of total variable cost was maximum in paddy (29.81%), followed by cotton (28.92%) and almost equal share was observed in both hy. jowar (20.99%) and dairy (20.28%).

The contribution of cotton enterprise to the net returns of the farming system was the highest (41.52%), dairy enterprise contribution stood next to cotton with 40.58 per cent. The contribution of paddy was 10.19 per cent and that of hy. Jowar was 7.71 per cent. All the four enterprises together constituted a total cost of Rs.70128.33 for the system. For the farming system as a whole gross returns was Rs.91821.97, whereas the net returns realized from the system was Rs.21693.60 with returns per rupee expenditure of 1.31. Further, the benefit cost ratios of individual enterprise were dairy-1.65, cotton-1.44, hy. Jowar-1.11 and paddy-1.10.

4.3.4 Comparative economics of major farming systems in the study area

The seven farming systems identified as major farming systems across the study area, irrespective of the district are compared with respect to their returns generating capacity, costs involved, net returns and benefit cost ratio. The outcome of the analysis are presented in Table 4.14 and Fig.8.

Among the farming systems studied, farming system-I of Koppal district appears to be the most productive in terms of maximum profit generation as reflected by highest net returns (Rs.35,645/ha). Next best to follow the list are FS-I of Bagalkot district (Rs.31238/ha), FS-II of Koppal district (Rs.28983/ha), FS-II of Bagalkot (Rs.24673/ha), FS-II (Rs.24658/ha), FS-III (Rs.20087/ha) and FS-I (Rs.16820/ha) of Haveri district.

The total cost incurred for the farming systems also followed more or less same pattern as that of net returns, where in maximum cost incurred was in FS-I of Koppal district (Rs.100968/ha) and least was in FS-I of Haveri district (Rs.41953/ha).

Simply, the net returns will not speak clearly about the performance of a farming system. How each rupee invested would result into output is also a more sophisticated measure. Hence, the B:C ratios were worked out. The results say that benefit cost ratio of all the farming systems studied were between 1.31 to 1.40. Maximum BCR was of 1.40 was noticed in FS-II of Koppal district, FS-I and II of Haveri district.

Table 4.13. Cost and returns of different enterprises Under Farming System-III in Haveri District

(Rs./farm)

Sl. No.	Particulars	Cotton	Hy. jowar	Paddy	Dairy	Farming system as a whole
	Costs					
1.	Total variable cost	17723.86 (28.92)	12861.31 (20.99)	18266.81 (29.81)	12428.57 (20.28)	61280.55 (100)
2.	Total fixed cost	2909.52 (32.88)	2305.78 (26.06)	2684.77 (30.35)	947.72 (10.71)	8847.79 (100)
3.	Total cost	20633.38 (29.42)	15167.09 (21.63)	20951.57 (29.88)	13376.29 (19.07)	70128.33 (100)
	Returns					
4.	Gross returns	29640.02 (32.28)	16839.37 (18.34)	23164.14 (25.23)	22178.44 (24.15)	91821.97 (100)
5.	Net returns	9006.64 (41.52)	1672.26 (7.71)	2212.55 (10.19)	8802.15 (40.58)	21693.60 (100)
6.	B:C ratio	1.44	1.11	1.10	1.65	1.31

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

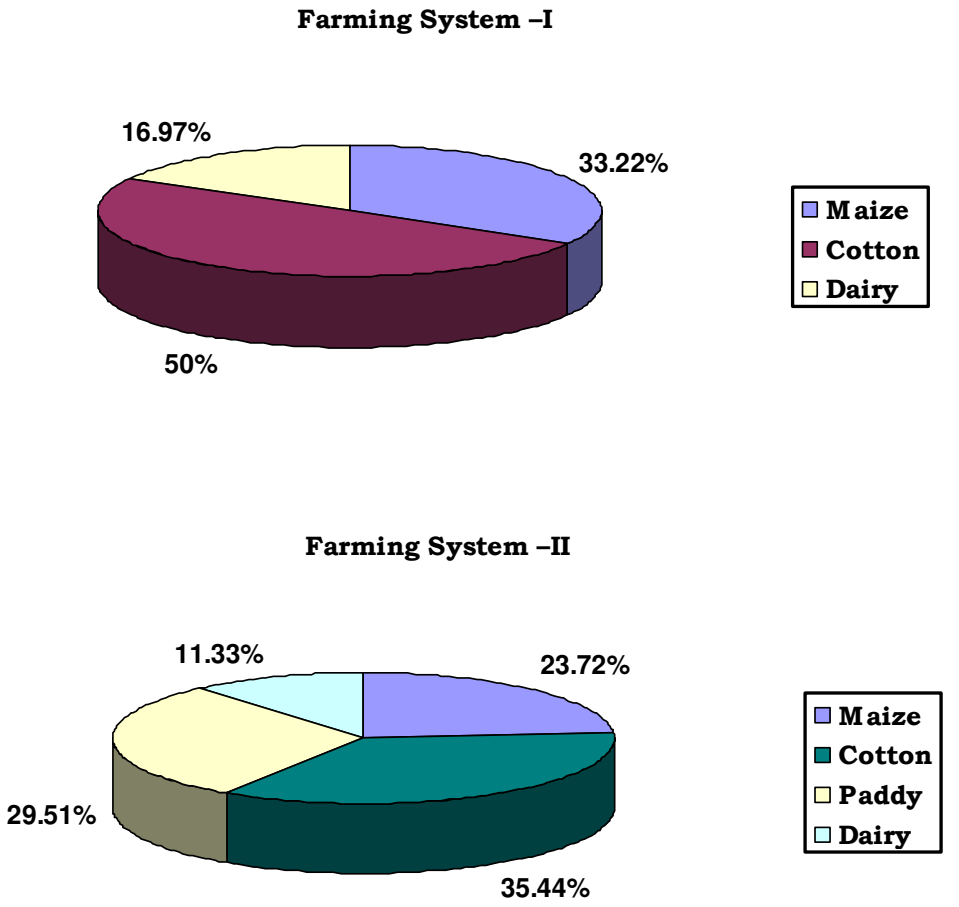


Fig. 7 Enterprises Contribution to gross returns of the Farming Systems in Haveri District

4.4 RESOURCE USE EFFICIENCY UNDER DIFFERENT FARMING SYSTEMS IN THE SELECTED TANK COMMANDS

4.4.1 Estimated production function coefficients and MVP to MFC ratios

The regression coefficients and MVP to MFC ratios for various resources used under all the farming systems in the selected tank commands of each of the districts were computed and the results are presented in Table 4.15.

4.4.1.1 Bagalkot district

Analysis of production function revealed that in Bagalkot district, the regression coefficients of all the resources were positive except for land (-0.0437), milch cattle (-0.00814) and feed (-0.00649). The coefficients of labour and expenditure on other resources (fertilizer cost + FYM cost and PPC + veterinary charges) were positive and significant at one per cent level, whereas cost of seeds was statistically significant at five per cent level and coefficients of all other resources were non-significant. The variable included in the function explained 85.5 per cent variation in the dependent variable as indicated by value of coefficient of multiple determination (R^2) was 0.855.

The ratios of MVP to MFC were less than unity for land (-0.0049), number of mulch cattle (-0.018) and cost of feed and concentrates (-0.046). For other variables such as labour cost (1.40), cost of seeds (1.96) and expenditure on other resources (fertilizer cost + FYM cost and PPC + veterinary charges) (2.87) the ratios were greater than unity.

4.4.1.2 Koppal district

In case of Koppal district the regression coefficient of all the resources were positive except for land (-0.00717), milch cattle (-0.14) and sheep (-0.0279). Among these variables, the coefficients for number of milch cattle and cost of feed and concentrates were significant at ten per cent level and cost of seeds and labour was significant at one per cent and five per cent level, respectively. For other resources the coefficients were non-significant. It would be observed that the fitted production function found to be good fit to the data as revealed by 'F' value of 18.146, which is significant (Table 4.15). The coefficient of multiple determination (R^2) was 0.941. The summation of regression coefficient indicated increasing returns to scale (1.21).

The ratios of MVP to MFC were less than unity for land (-0.00055), number of milch cattle (-0.47), number of sheep (-0.18) and expenditure on other resource (0.99). For other variables such as labour cost (2.21), cost of feed and concentrates (1.27) and cost of seeds (6.43) the ratios were greater than unity.

4.4.1.3 Haveri district

The estimated coefficients for the resources used under all the farming systems in the tank commands of Haveri district revealed that, land (-0.00318) and number of milch cattle (-0.0304) were found to be negative. On contrary the regression coefficients for labour cost (0.565), cost of feed and concentrates (0.395), cost of seeds (0.183) and expenditure on other resources (0.236) were positive. Among these variables cost of feed and concentrates (0.395) and cost of seeds (0.183) were significant at one per cent level and labour cost (0.565) and expenditure on other resources (0.236) were significant at five per cent and ten per cent level respectively (Table 4.15) For other resources it was non-significant. The coefficient of multiple determination (R^2) was 0.892. The summation of regression coefficients indicated increasing returns scale of (1.34). The Cobb-Douglas production function observed to be significant at one per cent level revealed by 'F' value of 53.836.

The ratios of MVP to MFC were less than unity (Table 4.15) and showed negative values for land (-0.00017) and number of milch cattle (-0.041), where as these ratios were greater than one with respect to labour cost (1.57), cost of feed and concentrates (2.32), cost of seeds (7.13) and expenditure on other resources (1.28).

Table 4.14. Comparative economics of Major Farming Systems in the Study Area

(Rs./ha)

Sl. No.	Particulars	Bagalkot		Koppal		Haveri		
		FS-I	FS-II	FS-I	FS-II	FS-I	FS-II	FS-III
	Costs							
1.	Total variable cost	74966.83 (88.46)	57895.27 (86.77)	88464.70 (87.61)	60205.92 (83.79)	36458.14 (86.90)	53940.29 (87.52)	56741.25 (87.38)
2.	Total fixed cost	9739.69 (11.54)	8826.07 (13.23)	12503.75 (12.39)	11640.50 (16.21)	5494.59 (13.10)	7687.98 (12.48)	8192.41 (12.62)
3.	Total cost	85070.16 (100.00)	66721.35 (100.00)	100968.46 (100.00)	71846.43 (100.00)	41952.73 (100.00)	61628.29 (100.00)	64933.66 (100.00)
	Returns							
4.	Gross returns	116308.59	91394.29	136613.51	100829.41	58772.49	86286.12	85020.36
5.	Net returns	31238.42	24672.94	35645.00	28982.96	16819.75	24657.82	20086.68
6.	B:C ratio	1.36	1.36	1.35	1.40	1.40	1.40	1.31

Note: FS-Farming system

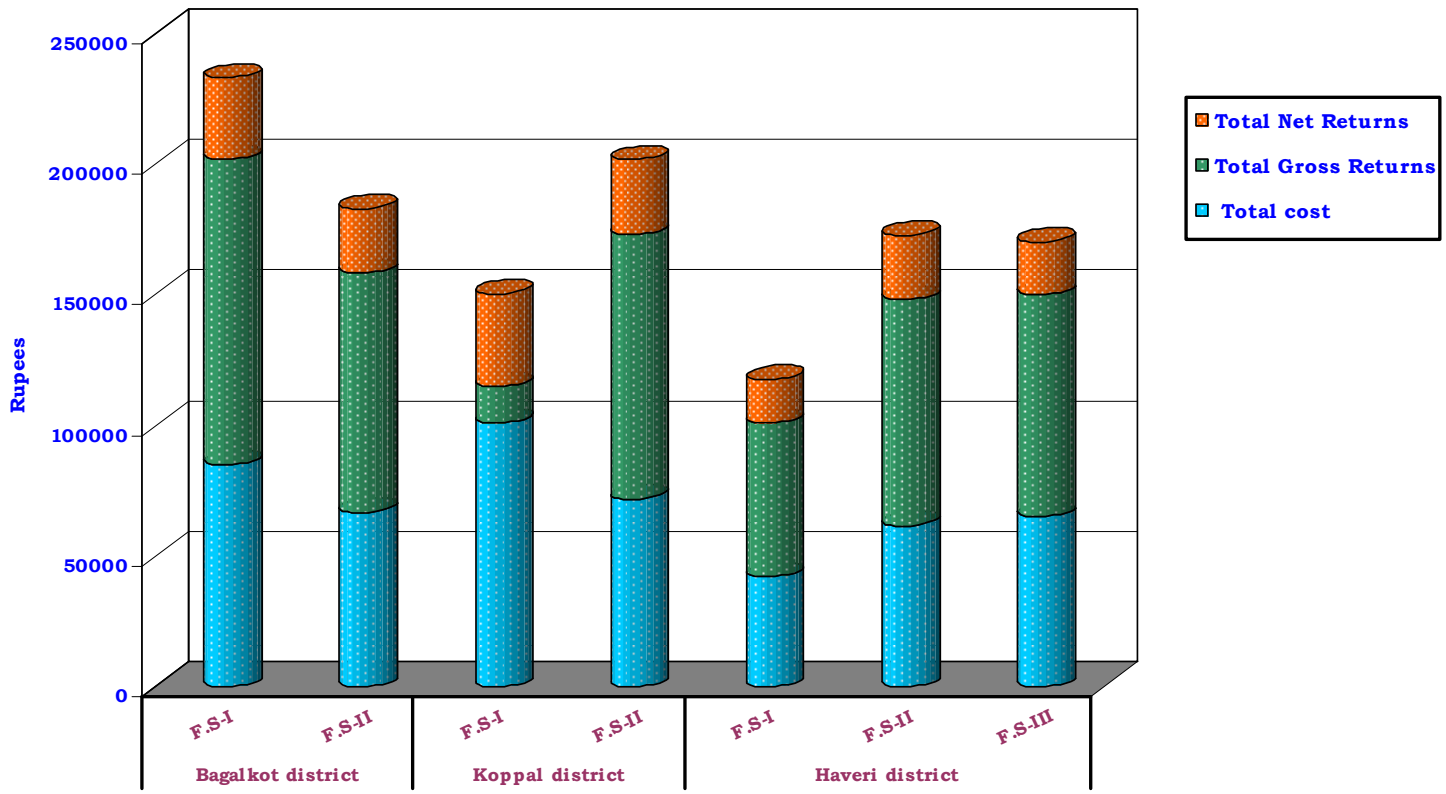


Fig.8.Comparative economics of major Farming Systems in the study area

Fig.8.Comparative economics of major Farming Systems in the study area

Table 4.15. Production function estimates

Sl. No.	Particulars	Parameters	Bagalkot		Koppal		Haveri	
			Regression coefficients	MVP:MFC ratios	Regression coefficients	MVP:MFC ratios	Regression coefficients	MVP:MFC ratios
1	Intercept	A	0.744		-0.703		-0.638	
2	Land in acres	b_1	-0.0437 (0.108)	-0.0049	-0.00717 (0.087)	-0.00055	-0.00318 (0.034)	-0.00017
3	Number of milch cattle	b_2	-0.00814 (0.081)	-0.018	-0.14* (0.63)	-0.47	-0.0304 (0.038)	-0.041
4	Labour cost (Rs.)	b_3	0.451*** (0.109)	1.40	0.787** (0.316)	2.21	0.565** (0.222)	1.57
5	Cost of feeds and concentrates (Rs.)	b_4	-0.00649 (0.015)	-0.046	0.156** (0.084)	1.27	0.395*** (0.106)	2.32
6	Cost of seeds (Rs.)	b_5	0.139** (0.068)	1.96	0.278*** (0.051)	6.43	0.183*** (0.038)	7.13
7	Expenditure on other resources	b_6	0.419*** (0.134)	2.87	0.169 (0.115)	0.99	0.236* (0.126)	1.28
8	Number of sheep	b_7	-	-	-0.0279 (0.033)	-0.18	-	-
9		R^2	0.855		0.941		0.892	
10		Returns to scale	0.95		1.21		1.34	
11		F-value	28.602***		18.146***		53.836***	

Note: Figures in parentheses indicates the respective standard error,
*** Significant at 1 per cent level, ** Significant at 5 per cent level, * Significant at 10 per cent level

4.5 IMPACT OF ON-FARM DEMONSTRATIONS/FARMERS FIELD SCHOOL ON SOCIO-ECONOMIC CONDITIONS OF FARMERS

4.5.1 Economic impact of on-farm demonstrations/farmers field schools on sample farmers

To assess the impact of On-Farm Demonstrations (OFD)/Farmers Field Schools (FFS) on economic conditions of the sample farmers, the cost and returns computed for the demonstration plot and compared with control plots with similar situation. The gross returns and net gain/loss of demonstrated plot over control plots are illustrated in the Table 4.16, 4.17, 4.18 and Fig. 9 under the following sub-headings.

While calculating the cost and returns structure of on-farm demonstration/farmers field school plots with control plots the fixed cost was taken same for both the plots as they were compared under similar conditions.

4.5.1.1 Costs and returns structure of different crops in on-farm demonstrations/farmers field school plots in different tank commands of Bagalkot district

The cost and returns structure for sunflower crop in on-farm demonstrations in Radder-Timmapur and groundnut crop in farmers field school in Nandikeshwar and Dammur tank commands were calculated and presented in the Table 4.16 and Fig.9.

a. Impact of on-farm demonstration on sunflower in Radder-Timmapur tank command

The per hectare cost of cultivation of sunflower was worked for OFD plot and control plots. It was observed that total variable cost for OFD and control plots were Rs.13356.78 and Rs.13546.79 in that order. Similarly total cost in OFD and control plot accounted for Rs.15853.50 and 16043.51. Due to technological interventions a substantial difference in yield was observed with a yield of 14.92 quintal and 12.65 quintal per hectare in OFD and control plots respectively (Appendix XXX).

The gross return realized from OFD plot was Rs.29725.26 and for control plot Rs.20632.54. The benefit cost ratio was 1.87 for OFD plot and 1.28 for control plot.

General notion of cost increase with improved practices was quite reversed and OFD plot accounted reduced cost to the extent of Rs.190.01 over control plot and gross returns was increased by Rs.9092.72, whereas net additional return was Rs.9289.73.

b. Impact of Farmers Field Schools on groundnut in Nandikeshwar tank command

It was observed from the table that, the total variable cost incurred on groundnut in FFS plot (Rs.18550.03) was slightly more than the control plot (Rs.18414.04). The net additional expenditure was Rs.135.99 in FFS plot.

The per hectare gross returns obtained from FFS plot was Rs.40913.00 and control plot was Rs.36545.72. The net returns realized in FFS and control plots were Rs.19861.46 and Rs.15630.17 respectively.

An increase of Rs.4367.28 was observed in gross returns in FFS plot, whereas additional net returns received from FFS was Rs.4231.29 in groundnut crop. The B:C ratio worked out to be 1.94 in FFS plot and 1.74 for control plot.

c. Impact of farmers field school on groundnut in Dammur tank command

It was observed from the table that the total variable cost for groundnut was more in case of FFS plot which was Rs.18508.03 and in control plot it was Rs.1717719. The total costs were Rs.21010.84 and Rs.19680.00 in FFS and control plots respectively. The gross return was Rs.39866.85 in FFS plot and Rs.34923.04 in control plot. Whereas net return in FFS and control plots were Rs.18856.01 and Rs.15243.04 respectively. The B:C ratios were 1.89 and 1.77 in that order (Appendix XXXII).

The increase in cost over control plot was Rs.1330.84 and an increase in gross return over control plot was Rs.4943.81. Net additional return in FFS plot was Rs.3612.97 over control plot.

4.5.1.2 Cost and returns of different crops in On-Farm Demonstrations/Farmers Field Schools plots in different tank commands of Koppal district

Per hectare cost and returns realized for crops like bajra, groundnut and paddy under OFD/FFS plots and control plot in Ramadurga, Nilogal and Nageshanahalli tank commands are depicted in the Table 4.17 and Fig.9.

a. Impact of on-farm demonstration on bajra in Ramadurga tank command

In on-farm demonstration plot, the total variable cost and total cost were Rs.6305.71 and Rs.7801.36 respectively for bajra crop. Whereas in control plots these costs were Rs.5782.86 and Rs.7278.51 in that order.

The gross return was Rs.9985.20 and Rs.7767.65 respectively for OFD and control plots. The net returns realized was more in OFD plot (Rs.2183.84) compared to (Rs.489.14) control plot. The increase in total cost in OFD plot over control plot was Rs.522.35 and increase in gross returns and net returns realized in OFD plot over control plot were Rs.2217.55 and Rs.1694.70 respectively. The benefit cost ratio for OFD plot and control plots were 1.28 and 1.06 in that order.

b. Impact of on-farm demonstration on groundnut in Nilogal tank command

It is interesting to note that the total cost incurred on groundnut production in OFD plot (Rs.19522.29) was less than that of control plot (Rs.22768.29). The technological interventions in OFD plot resulted in a substantial increase in yield (25.61quintals) in OFD plot, which was just 21.39 quintal in control plot. OFD plot accounted reduced cost to the extent of Rs.3246 over control plot. Whereas, increase in gross returns was observed in OFD plot (Rs.3763.14). The net gain in returns was Rs.7009.15. The benefit cost ratio observed was 1.90 and 1.51 for OFD plot and control plots respectively.

c. Impact of Farmers Field Schools on paddy in Nageshanahalli tank command

The farmers field school conducted on paddy crop on this tank command clearly indicated that, the increase in cost was quite reversed and FFS plot accounted reduced cost of Rs.1949.41 over control plot. Whereas, increase in gross returns was observed in FFS plot Rs.2374.39. The net gain in returns were Rs.4323.81. The B:C ratio were observed to be more in FFS plot with 1.66 and 1.35 for control plots.

4.5.1.3 Cost and returns structure of different crops in On-Farm Demonstration/Farmers Field Schools plots in different tank commands of Haveri district

The cost and returns structure for paddy, maize, ridgegourd, cotton in on-farm demonstration/farmers field school plots in Bidarikoppa, Dommanal, Byagwadi, Somasagar, Basapur and Kerekyatanahalli tank commands were calculated and presented in Table 4.18 and Fig.9.

a. Impact of on-farm demonstration on paddy in Bidarikoppa tank command

It was revealed from the Table 4.18 that the total variable cost in case of OFD plot (Rs.15605.45) was less than that of control plot (Rs.16913.71). The respective total cost for OFD and control plots were Rs.18091.35 and Rs.19399.61, with the gross return of Rs.25315.35 and Rs.21448.28 in that order. Whereas net returns realized was more in OFD plot Rs.7224.00 and, it is only Rs.2048.66 in case of control plot. The benefit cost ratio observed was 1.39 and 1.10 in OFD and control plots respectively. It is interesting to note that a substantial reduction in cost was observed in OFD plot over control plot. Further, an increase in gross returns (Rs.3867.07) and net gain including reduced cost of cultivation (Rs.5175.34) was observed in OFD plot.

b. Impact of on-farm demonstration on maize in Dommanal tank command

In on-farm demonstration plot, in Dommanal village, the total variable cost and total cost were Rs.14472.55 and Rs.16950.87 respectively for maize crop, whereas in control plots these costs were Rs.13939.45 and Rs.16417.77 in that order. The gross return was Rs.22386.54 and Rs.19521.94 respectively, for OFD and control plots. The net returns realized was more in OFD plot (Rs.5435.67) when compared to Rs.3104.16 in control plot. The increase in total cost in OFD plot over control plot was Rs.533.10 and increase in gross returns and net returns realized in OFD plot over control plot were Rs.22386.54 and Rs.19521.94 respectively. The benefit cost ratio for OFD plot and control plots were 1.32 and 1.18 respectively.

c. Impact of on-farm demonstration on ridgegourd in Byagwadi tank command

It is observed from the table that, the total variable cost incurred in ridgegourd OFD plot (Rs.4926.41) was more than control plot (Rs.4861.81). The net additional expenditure was Rs.64.60 in OFD plot over control plot.

The per hectare gross returns obtained from OFD plot was Rs.8880.00 and control plot was Rs.6960.00. The net returns realized in OFD and control plots were Rs.2572.47 and Rs.717.07 respectively. An increase of Rs.1920.00 was observed in gross returns in OFD plot, whereas additional net returns received from demonstration was Rs.1855.40 in ridge gourd crop. The B:C ratio worked out were 1.41 in OFD plot and 1.11 for control plot.

d. Impact of Farmers Field Schools on cotton in Somasagar tank command

It was interesting to note that the increase in cost was quite reversed and FFS plot accounted reduced cost of Rs.1461.93 over control plot. Whereas, increase in gross returns was observed in FFS plot Rs.4539.61. The net gain in returns was Rs.6001.54. The benefit cost ratio observed were 1.94 and 1.55 for FFS plot and control plot respectively.

e. Impact of Farmers Field Schools on cotton in Basapur tank command

Table 4.16. Cost and returns of different crops in OFD/FFS plots and control plots in different Tank Commands of Bagalkot District

(Rs./ha)

Sl. No.	Particulars	Radder-Timmapur		Nandikeshwar		Dammur	
		Sunflower		Groundnut		Groundnut	
		OFD plot	Control plot	FFS plot	Control plot	FFS plot	Control plot
1.	Total variable cost	13356.78	13546.79	18550.03	18414.04	18508.03	17177.19
2.	Total fixed cost	2496.72	2496.72	2501.51	2501.51	2502.81	2502.81
3.	Total cost	15853.50	16043.51	21051.54	20915.55	21010.84	19680.00
4.	Gross returns	29725.26	20632.54	40913.00	36545.72	39866.85	34923.04
5.	Net returns	13871.76	4589.03	19861.46	15630.17	18856.01	15243.04
6.	B:C ratio	1.87	1.28	1.94	1.74	1.89	1.77
7.	Increase\decrease in cost in OFD/FFS over control plot	-190.01		135.99		1330.84	
8.	Increase in returns	9092.72		4367.28		4943.81	
9.	Additional net returns	9289.73		4231.29		3612.97	

Table 4.17. Cost and returns of different crops in OFD/FFS plots and control plots in different Tank Commands of Koppal District

(Rs./ha)

Sl. No.	Particulars	Ramadurga		Nilogal		Nageshanahalli	
		Bajra		Groundnut		Paddy	
		OFD plot	Control plot	OFD plot	Control plot	FFS plot	Control plot
1.	Total variable cost	6305.71	5782.86	19522.29	22768.29	14304.96	16254.36
2.	Total fixed cost	1495.65	1495.65	2610.12	2610.12	2493.04	2493.04
3.	Total cost	7801.36	7278.51	22132.41	25378.41	16798.00	18747.41
4.	Gross returns	9985.20	7767.65	42118.00	38354.86	27839.28	25464.89
5.	Net returns	2183.84	489.14	19985.59	12976.44	11041.28	6717.47
6.	B:C ratio	1.28	1.06	1.90	1.51	1.66	1.35
7.	Increase\decrease in cost in OFD/FFS over control plot	522.35		-3246		-1949.41	
8.	Increase in returns	2217.55		3763.14		2374.39	
9.	Additional net returns	1694.70		7009.15		4323.81	

Table 4.18. Cost and returns of different crops in OFD/FFS plots and control plots in different Tank Commands of Haveri District

(Rs./ha)

Sl. No.	Particulars	Bidarikoppa		Dommanal		Byagwadi		Somasagar		Basapur		Kerekyatanahalli	
		Paddy		Maize		Ridgegourd		Cotton		Cotton		Cotton	
		OFD plot	Control plot	OFD plot	Control plot	OFD plot	Control plot	FFS plot	Control plot	FFS plot	Control plot	FFS plot	Control plot
1.	Total variable cost	15605.45	16913.71	14472.55	13939.45	4926.41	4861.81	14850.98	16312.91	15167.24	16094.87	15473.84	16410.98
2.	Total fixed cost	2485.90	2485.90	2478.32	2478.32	1381.12	1381.12	2538.17	2538.17	2576.76	2576.76	2694.00	2694.00
3.	Total cost	18091.35	19399.61	16950.87	16417.77	6307.53	6242.93	17389.15	18851.08	17744.00	18671.63	18167.84	19104.98
4.	Gross returns	25315.35	21448.28	22386.54	19521.94	8880.00	6960.00	33814.72	29275.11	33632.90	30581.86	30020.88	27444.47
5.	Net returns	7224.00	2048.66	5435.67	3104.16	2572.47	717.07	16425.57	10424.03	15879.90	11910.23	11853.04	8339.49
6.	B:C ratio	1.39	1.10	1.32	1.18	1.41	1.11	1.94	1.55	1.89	1.64	1.65	1.44
7.	Increase\decrease in cost in OFD/FFS over control plot	-1308.26		533.10		64.60		-1461.93		-927.63		-937.14	
8.	Increase in returns	3867.07		2864.60		1920.00		4539.61		3051.04		2576.41	
9.	Additional net returns	5175.34		2331.51		1855.40		6001.54		3969.67		3513.55	

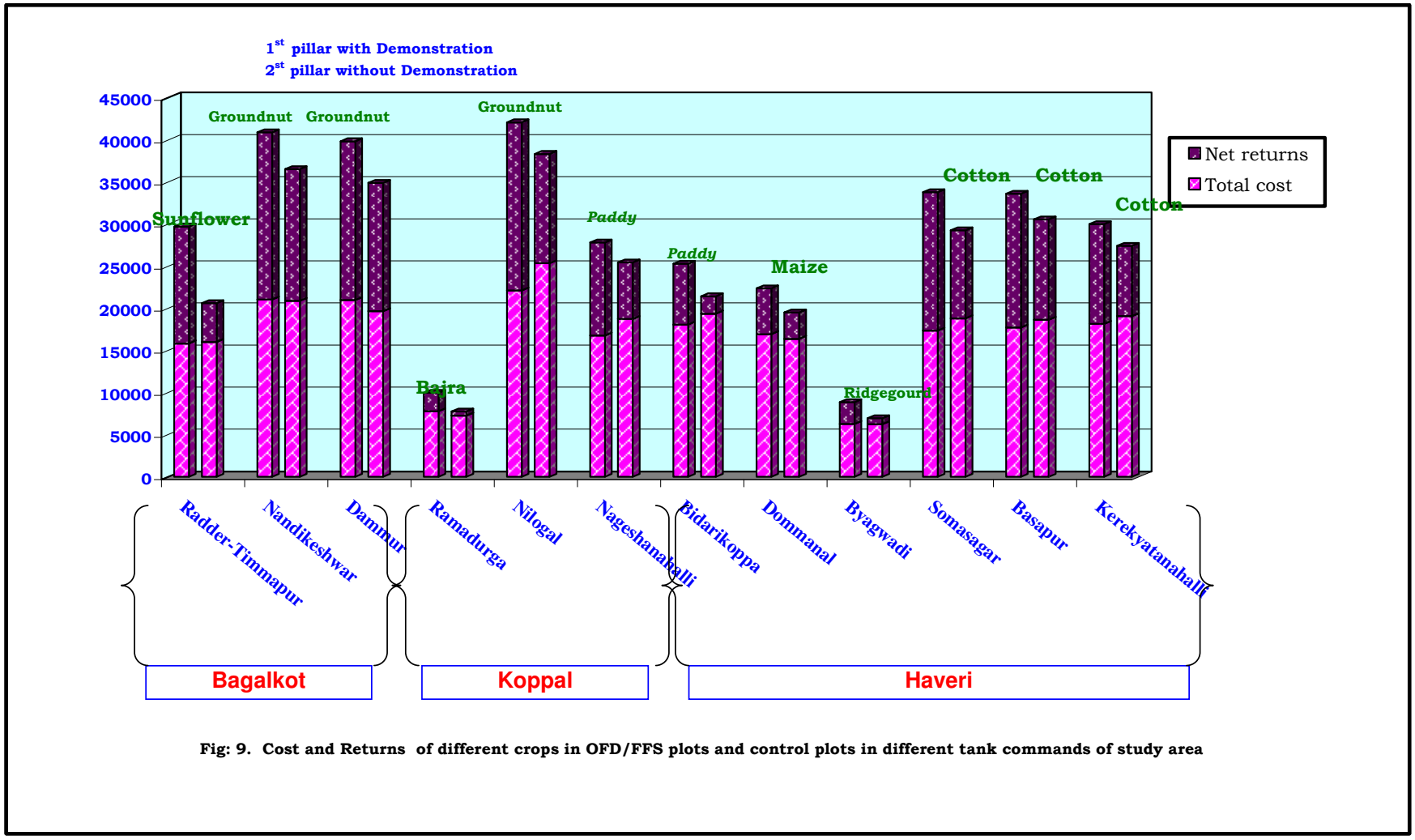


Fig: 9. Cost and Returns of different crops in OFD/FFS plots and control plots in different tank commands of study area

Fig: 9. Cost and Returns of different crops in OFD/FFS plots and control plots in different tank commands of study area

The results presented in the Table 4.18 revealed that the total variable cost (Rs.15167.24) and total cost (Rs.17744.00) were less in FFS plot than control plot where total variable cost was Rs.16094.87 and total cost was Rs.18671.63. The gross return in case of FFS plot was Rs.33632.90 and in control plot was Rs.30581.86, with a returns per rupee of expenditure of 1.89 and 1.64 in that order.

It was observed that the expenditure in FFS plot over control plot was less by Rs.927.63, gross return was more by Rs.3051.04 and net return was more by Rs.3969.67.

f. Impact of farmers field school on cotton in Kerekyatanahalli tank command

It was observed from the Table 4.18 that the total variable cost was less in FFS plot (Rs.15473.84) when compared to control plot (Rs.16410.98). In the total cost also similar pattern was observed with values Rs.18167.84 and Rs.19104.98 respectively.

The net returns realized was Rs.11853.04 in FFS plot and Rs.8339.49 in control plot. The B:C ratio was more in FFS plot (1.65) over control plot (1.44). The decrease in cost in FFS plot over control plot was to the extent of Rs.937.14 and increase in gross returns was Rs.2576.41 and increase in net additional returns was Rs.3513.55. crop.

4.5.2 Impact of On-Farm Demonstrations/Farmers Field Schools on social conditions of the farmers

The social and economic factors play prominent role in studying the impact of OFD/FFS on socio-economic conditions of the farmers. Hence the results related to social impact were presented in the Table 4.19. It can be observed from the table that, in all the districts more than 90.00 per cent of the farmers were aware about OFD/FFS conducted in their area. Regarding farmers participation in OFD/FFS conducted, it was agreed by 91.66 per cent of farmers in Bagalkot district, 88.88 per cent in Koppal district and 94.44 per cent in Haveri district, that they actively participate in these activities.

Further, the programmes attended by sample farmers in the OFD/FFS activities were listed, and it was observed that 8.33 per cent, 5.55 per cent and 6.94 per cent of the farmers attended trainings in Bagalkot, Koppal and Haveri districts respectively. Analysis of farmers who attended field schools revealed that participation was more in Haveri district (88.88%) followed by Koppal district (77.77%) and Bagalkot district (72.22%). As far as participation in group discussion is concerned, 80.55 per cent in Bagalkot, 75.00 per cent in Koppal and 93.05 in Haveri district attended the programme. In the case of field days, it was observed that 77.77 per cent, 66.66 per cent and 75.00 per cent of sample farmers of Bagalkot, Koppal and Haveri districts actively participated in the field days respectively.

On an average 6.93, 7.23 and 4.90 farmers adopted the demonstrated technology in each of the tank commands in Bagalkot, Koppal and Haveri districts accordingly. With respect to dissemination of technology by the beneficiaries is concerned, on an average, each beneficiary disseminated the demonstrated technology to 18.03, 29.61 and 33.49 farmers in Bagalkot, Koppal and Haveri districts respectively. In respect of continuation of demonstrated technology, it was reported that about 88.88 per cent in Bagalkot district, 80.55 per cent in Koppal district and 97.22 per cent of sample farmers in Haveri district agreed to continue the demonstrated technology.

Change in yield of the crops due to demonstrated technology was agreed by highest number of sample farmers in Koppal (72.22%) district followed by Haveri (61.11%) and Bagalkot districts (47.22%). Further, economy in cost of cultivation was agreed by maximum number of farmers in Haveri (66.66%) district, followed by Bagalkot (50.00%) and Koppal (27.70%) districts.

About 94.44 per cent of the farmers both in Bagalkot and Koppal district and 92.05 per cent of the farmers in Haveri district expressed that the gain in knowledge was due to OFD and FFS conducted in the tank commands.

More than 70.00 per cent of the sample farmers both in Koppal and Haveri district and 66.66 per cent in Bagalkot district opined that OFD/ FFS are beneficial to them Whereas, negative attitude about OFD/FFS was expressed by comparatively less number of sample farmers (5.55 per cent in Koppal and 2.77 per cent in Bagalkot district), whereas none of farmers had negative opinion about OFD/FFS in Haveri district.

Need for change in the present method of organizing OFD/FFS was expressed by hardly 8.33 per cent of farmers in Koppal district, 2.77 per cent in Haveri district and none in Bagalkot district.

Table 4.19. Social impact of On-Farm Demonstrations/Farmers Field Schools in Sample Tank Villages

(in number of farmers)

Sl. No.	Particulars	Bagalkot	Koppal	Haveri
1.	Awareness of OFD/FFS conducted	34 (94.44)	33 (91.66)	70 (97.22)
2.	Farmers participation in OFD/FFS	33 (91.66)	32 (88.88)	68 (94.44)
3.	Programmes attended			
	i. Training	3 (8.33)	2 (5.55)	5 (6.94)
	ii. Field school	26 (72.22)	28 (77.77)	64 (88.88)
	iii. Groups discussion	39 (80.55)	27 (75.00)	67 (93.05)
	iv. Field days	28 (77.77)	24 (66.66)	54 (75.00)
4.	Number of farmers adopted the demonstrated technology	6.93	7.23	4.90
5.	Dissemination of demonstrated technology			
	i. Within the village	12.68	20.86	24.04
	ii. Outside the village	5.35	8.75	9.45
	Total	18.03	29.61	33.49
6.	Number of farmers agree to continue	32 (88.88)	29 (80.55)	70 (97.22)
7.	Type of change observed			
	i. Yield change	17 (47.22)	26 (72.22)	44 (61.11)
	ii. Economy in cost of cultivation	18 (50.00)	10 (27.70)	24 (66.66)
8.	Gain in knowledge level	34 (94.44)	34 (94.44)	67 (93.05)
9.	Opinion about OFD/FFS			
	i. Positive	24 (66.66)	28 (77.77)	54 (75.00)
	ii. Negative	1 (2.77)	2 (5.55)	0 (0.00)
	iii. Cant say	11 (30.55)	6 (16.66)	18 (25.00)
10.	Need for change in present method of OFD/FFS	0 (0.00)	3 (8.33)	2 (2.77)

Note: Figures in parentheses indicates percentage to total sample respondents of respective district

4.6 CONSTRAINTS ASSOCIATED IN DIFFERENT FARMING SYSTEMS IN THE TANK COMMANDS

The constraints associated with different farming systems in the tank commands of selected districts are grouped under two heads namely production constraints and marketing constraints and elaborated in the Table 4.20.

4.6.1 Production constraints

In the study area more than 90.00 per cent of the sample respondents opined that exogenous factors like drought and irregularities of rainfall which are beyond the control of farmers were major constraint.

Tiny land holding was the production constraint for 88.88 per cent, 72.22 per cent and 55.55 percent of the respondents in Haveri, Koppal and Bagalkot district respectively.

About 88.88 per cent, 91.66 per cent and 97.22 per cent of sample farmers in Bagalkot, Koppal and Haveri districts expressed non-availability of adequate water was one of the important production constraint.

Misutilizing the tank water other than agriculture and allied activities was one of the production constraint for 33.33 per cent, 38.88 per cent and 29.16 per cent of the farmers in Bagalkot, Koppal and Haveri districts. About 58.33 percent, 55.55 per cent and 68.05 per cent of sample respondents mentioned non-availability of alternative source of irrigation. Lack of awareness of recommended cropping sequences was articulated by sample respondents to the extent of Haveri (90.27%), Koppal (86.11%) and Bagalkot (83.33%). Non-availability of quality seeds was uttered by 75.00 per cent of sample respondents in Bagalkot, 61.11 per cent in Koppal and 58.33 per cent in Haveri district.

High cost of inputs was mentioned by 58.33 per cent, 47.22 per cent and 63.88 per cent of the respondents accordingly in Bagalkot, Koppal and Haveri districts. Nearly 69.44 per cent, 50.00 per cent 66.66 pr cent of sample respondents in Bagalkot, Koppal and Haveri districts indicated lack of credit availability was the major production drawback.

Scarcity of owned funds was mentioned by 61.11 per cent of farmers in Bagalkot, 52.77 per cent in Koppal and 38.88 per cent in Haveri district.

The highest, 55.55 per cent of sample respondents in Koppal followed by 27.77 per cent in Bagalkot and 11.11 per cent in Haveri stated the problem of lack of technical guidelines. Low yield of local breeds and seeds as a production constraint was expressed by equal per cent of sample respondents in Bagalkot and Koppal districts (27.77 per cent), whereas, in Haveri it was 15.27 per cent.

High cost of production was uttered by maximum proportion of sample respondents in Haveri district (41.66%), followed by the respondents of Bagalkot (25.00%) and Koppal (19.44%) districts.

Poor managerial support from family members in Koppal district as a product hitchy. The opinion in Bagalkot and Haveri district in this regard were 36.11 per cent and 25.00 per cent respectively.

About 27.70 per cent of respondents in Bagalkot, 13.88 per cent in Haveri and 8.33 per cent in Koppal district feels poor maintenance of the tanks was one of the major production problems.

4.6.2 Marketing constraints

Lack of market information was identified to be the major constraint for 33.33 per cent of the respondents both in Bagalkot and Koppal districts, while in Haveri district it was 47.22 per cent. About high marketing cost, it was uttered by highest percent of sample respondents in Haveri (34.72%), followed by Koppal (25.00%) and Bagalkot (16.16%) districts.

Low price for the produce was identified to be major constraint in Bagalkot, Koppal and Haveri to the extent of 66.66 per cent, 61.11 per cent and 52.77 per cent respectively. Only 8.33 per cent of sample respondents in Koppal, 11.11 per cent in Bagalkot and 37.50 per cent in Haveri district expressed lack of transportation facility to be the important marketing constraint.

Lack of storage facility as a marketing problem was identified by 4.66 per cent of the sample farmers in Haveri district, 25.00 per cent in Bagalkot district and 13.88 per cent in Koppal district.

Table 4.20. Constraints in Adoption of Farming Systems in the Tank Commands of Study Area

(per cent)

Sl. No.	Particulars	Bagalkot	Koppal	Haveri
I.	Production Constraints			
1	Exogenous factors	91.66	94.44	95.83
2	Tiny land holding	55.55	72.22	88.88
3	Non-availability of adequate water	88.88	91.66	97.22
4	Misutilization of the tank water other than agriculture and allied activities	33.33	38.88	29.16
5	Non-availability of alternative source of irrigation	58.33	55.55	68.05
6	Lack of awareness of recommended cropping sequences	83.33	86.11	90.27
7	Non-availability of quality seeds	75.00	61.11	58.33
8	High cost of inputs	58.33	47.22	63.88
9	Lack of credit availability	69.44	50.00	66.66
10	Scarcity of owned funds	61.11	52.77	38.88
11	Lack of technical guidelines	27.77	55.55	11.11
12	Low yield of local breeds and seeds	27.77	27.77	15.27
13	High cost of production	25.00	19.44	41.66
14	Poor managerial support by family member	36.11	63.88	25.00
15	Poor maintenance of tanks	27.7	8.33	13.88
II.	Marketing Constraints			
1	Lack of market information	33.33	33.33	47.22
2	High marketing cost	16.66	25.00	34.72
3	Low price for the produce	66.66	61.11	52.77
4	Lack of transportation	11.11	8.33	37.50
5	Lack of storage facility	25.00	13.88	41.66

V. DISCUSSION

The results of the study are discussed in this chapter under the following headings.

5.1 Socio-economic characteristics of sample farmers
5.2 Identification of major Farming Systems in the study area
5.3 Cost and returns of major Farming Systems
5.4 Resource use efficiency of major Farming Systems in the selected tank commands
5.5 Impact of on farm demonstrations/farmers field schools on socio-economic conditions of the sample farmers.
5.6 Constraints associated with different Farming Systems in the tank commands

5.1 SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLE FARMERS

The socio-economic characteristics of the respondents include literacy, family size, occupational pattern and land holding pattern were depicted in Table 4.1. With respect the age of the sample farmers it was observed that most of the sample farmers are of the middle age group. Because of their age obviously they were curious about new things and could take innovative decisions to adopt new technologies to enhance their farm income. The average family size of sample farmers in the study are revealed that, the family size was found to be almost similar in all the districts constituting 6.02, 5.96 and 5.18 people in Bagalkot, Koppal and Haveri districts, respectively indicating dominance of nuclear family with one or two children.

With regard to educational level of the sample respondents, it was noticed that majority of the farmers were literate in all the study districts, literacy level of sample respondents ranged from primary to college. The literacy level (72.23%) in the study area was found higher than the state level literacy (67.04%). 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 income and productivity in farm. Further, the farmers receptive capacity may ease the process and adoption of technology. Occupational pattern of sample farmers revealed that, the proportion of sample respondents who were involved in agriculture was the highest in all the district and it accounted equal percentage (97.22%) in Bagalkot and Koppal district and 95.83 per cent in Haveri district. As expected, this showed that, majority of farm families depend on agriculture and allied activities for their livelyhood and employment. The pattern of land holding of sample respondents revealed that, rainfed area ranged between 53.84 and 74.02 per cent and proportion of irrigated land was 46.15 per cent, 25.97 per cent and 25.67 per cent in Bagalkot, Koppal and Haveri district respectively. This implied a typical dry agro-climatic feature of these districts. Due to less potentiality of irrigation projects, still major portion of cultivable area depend on rainfed agriculture.

5.2 IDENTIFICATION OF MAJOR FARMING SYSTEM IN THE STUDY AREA

The type of farming system followed by farmers influenced by the availability of resources, technical know how, climate and other factors. The area selected for the study also exhibited the similar phenomenon and details are as follows.

It was observed in the present study that, most of the farmers in the tank commands are practicing different crop enterprises along with dairying or sheep rearing.

The farmers practicing other systems are negligible. Livestock are reared for manure and major quantity of milk was used for self-consumption and only a small quantity was sold in order to supplement their income. So, educational activities are needed for improving the dairying and sheep rearing on commercial lines along with their crop production.

5.2.1 Average Farm Size in the identified Major Farming Systems

The average farm size under different systems 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-II of Haveri district followed by Farming System-I and II in Koppal district, Farming System-III in Haveri and almost equal in Farming System-I of both Bagalkot and Haveri districts and least was observed in Farming System-II of Bagalkot district. Though the variation in farm size was observed among farming systems but the extent was too less.

5.2.2 Cropping Pattern Under Different Farming Systems in Bagalkot District

The proportion of area devoted to different crops in various seasons was shown in Table 4.4.

It was observed that, the major *kharif* season crops were sunflower (39.34%) and maize (12.07%) in Farming System-I. In Farming System-II maize, bajra and hybrid jowar together accounted for 61.95 per cent. In *rabi* season, groundnut was the main crop in both Farming Systems which occupied major share in the area.

It was seen from the table that, onion crop was also grown as a horticulture crop in the study area accounted hardly 0.82 per cent under Farming System-I. A small area of cultivable land was also devoted for other pulses and oilseeds crops in all the tank commands of the district. Cropping intensity was ranged between 157.17 per cent and 106.36 per cent in Farming System-I and II, respectively. It was revealed that, area under *rabi* season was more (19.35 ha) in Farming System-I than in FS-II which resulted in increased cropping intensity in Farming System-I in the study area.

5.2.3 Cropping Pattern Under Different Farming Systems in Koppal District

Hybrid jowar was the major crop under Farming System-I occupying 27.26 per cent of gross cropped area followed by maize and groundnut with 9.72 per cent and 7.77 per cent respectively. In Farming System-II, hybrid jowar, bajra and sesamum occupied 29.04, 26.08 and 10.66 per cent of the gross cropped area respectively.

During *rabi* season, groundnut was the major crop grown in both the Farming Systems. Among the horticulture crops, tomato (0.77%) and onion (1.17%) are prominent in Farming System-I and II, respectively. Cropping intensity was 117.72 per cent in Farming System-I and 109.92 in Farming System-II in the district.

5.2.4 Cropping Pattern Under Different Farming Systems in Haveri District

It was seen from the Table 4.6 that, in kharif season maize was the major crop in farming systems-I and II occupying 40.64 per cent and 17.27 per cent of gross cropped area respectively followed by cotton, paddy and groundnut crops in Farming System-I, Farming System-II and Farming System-III respectively.

In rabi season the major pulse crops are grown in almost all the farming systems and horticulture crops like brinjal, ridge gourd and cucumber were grown in Farming System-I all together accounted a share of 8.98 per cent to the gross cropped area. Chilli crop was also grown as a horticulture crop, accounted hardly 1.96 per cent under farming system-III.

5.3 COSTS AND RETURNS OF DIFFERENT ENTERPRISES IN MAJOR FARMING SYSTEMS

The cost and returns in different Farming Systems were influenced by both endogenous and exogenous factors. The costs and returns of different systems played an important role in determining the profitability of enterprises. The costs and returns of major Farming Systems are discussed district wise here under.

5.3.1 Bagalkot district

5.3.1.1 Cost and returns of different enterprises in Farming System-I

The cost and returns of selected Farming Systems in the study area and share of cost and returns of each enterprise in the whole Farming System was presented in Table 4.7. In the whole Farming System's incurred a maximum total cost on groundnut cultivation, which was because of the higher cost of cultivation due to use of higher quantities of inputs (Appendix-IV) and plant protection chemicals to control of pest and diseases menance. When compared the share of total cost to share of total returns (31.42%) was high due to better price.

In the Farming System-I, the maize enterprise has 22.83 per cent share in total cost, whereas its contribution to total returns was 18.94 per cent. The enterprises that follow the list in terms of maximum contribution to total returns were sunflower, hybrid jowar and dairy. The benefit cost ratio of dairy enterprise was observed to be high (1.40) after groundnut under Farming System-I.

5.3.1.2 Costs and returns of different enterprises under farming system -II

The farmers practicing Farming System-II (Table 4.8) incurred maximum total cost in groundnut (29.49%) followed by maize (25.64%) and hybrid jowar (23.65%). Higher quantity of seeds and fertilizers in groundnut attributed to the high cost of cultivation. The share of dairy enterprise in total cost was comparatively less (10.28%) and its contribution towards the net returns was the highest in dairy (17.72%). This was probably due to supplmenetarity of the dairy enterprise with crop production activities. The resources which are required for dairy enterprise were available within the Farming System. So, the maintenance cost is also very

low. Bajra contribution to total returns was very less because it is used as staple food but B:C ratio (1.02) was more than unity, indicating cost incurred in bajra crop can be recovered.

5.3.2 Koppal District

5.3.2.1 Cost and returns of different enterprises in Farming System-I

The farmers practicing Farming System-I incurred a maximum total cost on *kharif* groundnut cultivation followed by rabi groundnut due to use of higher quantities of inputs (Appendix - XIII) and obtained more returns because of better price.

Sunflower crop accredited maximum profit in the system as a whole and found to be the most remunerative crop as indicated by high B:C ratio with comparatively lower cost of cultivation. In the study area bajra and hy. Jowar observed less of returns per rupee expenditure, even though occupying major area, as it is used as a staple food and also supplementarity to dairy enterprise.

5.3.2.2 Costs and returns of different enterprises in Farming System II

In Farming System-II, it is evident from Table 4.10 that, comparatively high cost of cultivation was incurred in groundnut crop because of higher quantities of seeds and fertilizers used and high returns obtained due to better price and groundnut crop is a commercially important oilseed crop and farmers get good returns. Therefore they go for growing this crop.

Contribution of bajra to total returns was the least (0.58%) followed by hybrid jowar (7.54%). Even then, farmers are interested to grow these crops because these are staple food of the farmers in there region and also the supplements to other enterprises like sheep rearing, dairing *etc.*

5.3.3 Haveri District

5.3.3.1 Costs 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 enterprises in the whole farming system are presented in Table 4.11. In the whole farming system's total cost, the share of cotton was the highest (44.94%) which revealed that,in farming system-I cotton was a major commercial crop grown in this region. when compared the share of total cost to share of total returns (61.97%) was high. The returns per rupee expenditure was also high (1.55) in this enterprises the benefit cost ratio of dairy was next most remunerative enterprise after cotton under the Farming System-I with a B C ratio of 1.49.

5.3.3.2 Cost and returns of different enterprises in Farming System-II

The farmers practicing Farming System-II sustain a maximum and equal amount of total cost in paddy and cotton followed by maize and dairy which are depicted in Table 4.12. Whereas, returns per rupee of expenditure was highest in cotton because of higher price received per quintal of produce compared to other crops of the enterprise indicating that cotton is most remunerative crop. Maize generated less returns for per rupee expenditure, even then occupying major area in the study area because it requires less cultivation practices compared to other enterprises.

5.3.3.3 Cost and returns of different enterprises in Farming System-III

The per farm cost and returns of each of the enterprises in the whole Farming System was presented in Table 4.13. It was observed that, the maximum percent of total variable cost was incurred towards paddy, whereas its contribution to total net returns of the system was less than other enterprises.

The attributed reason was that the return per rupee of expenditure on paddy was less and high cost of cultivation was observed, as the higher quantities of fertilizers applied forms the major cost item (Appendix-XXXVIII).

The cotton accounted for 28.92 per cent in total variable cost and its share in the net returns was as high as 41.52 per cent. The contribution of dairy enterprise was also considerable which contributed 40.58 per cent to total net returns. The returns on per rupee of expenditure in dairy enterprise were more than unity (1.65) indicating profitability of dairy enterprise in the study area.

5.3.4 Comparative economics of major farming systems in the study area

As reflected in Table 4.14, farming system-I of Koppal district was the most profitable among the seven major farming systems identified across the study area. The system included the enterprises like, hy. jowar, sunflower, bajra, *kharif* groundnut followed by *rabi* groundnut and dairy. Oilseed enterprises included in the system were more remunerative interms of higher profit generating capacity (Table 4.9). Hence, system by itself could be able to produced maximum net returns in comparison with the other six farming systems considered for the study.

In general, it could be inferred that the farming systems which included oilseed crop enterprises in both *kharif* and *rabi* seasons have fared well in net return generation. Cotton is one of the most potential crop for net returns generation. However, it is a long duration crop giving no room for a better crop during second season. Hence, the farming systems that included cotton enterprises in Haveri district could not do on par with those systems where oilseeds have prominent place. Therefore, in order to generate high profit more and more oilseed enterprises, wherever possible, need to be included in the system.

Dairy enterprise is another potential enterprise interms of maximum profit generation. However, it is observed during the survey that dairy is not practiced on commercial lines in the study area. The farmers keep 1 or 2 milch cattle on the farms to support family requirements. Hence, effective extension efforts to persuade the farmers to keep more bovine population would augment their family income. Cooperative efforts may also be explored to establish dairy enterprises at family level.

5.4 RESOURCES USE EFFICIENCY IN THE TANK COMMANDS OF STUDY AREA

In order to maximize the profits from an enterprise, the optimum use of resources is imperative. This is examined based on the productivity of resources used in the production activity. The technique of Cobb Douglas production function was used to measure the resource use efficiency and allocative efficiency of resources under all the farming systems followed in the tank commands.

5.4.1 Estimated production function co-efficient and MVP to MFC ratios

The results of efficiency in the use and allocation of resources in the tank commands of each selected district are discussed here under.

5.4.1.1 Bagalkot district

The production function analysis for tank commands of Bagalkot district (Table 4.15) was found to be the good fit to the data as revealed by the high value of F statistic. The coefficient of multiple determination (R2) worked out to be 0.855. Thus, indicating that the six variables included in the function explain about 85.5 per cent of the variation in the total returns.

The labour cost and expenditure on other resources (fertilizer cost + FYM cost and PPC + veterinary charges) included in the function was statistically positive and significant contributor at one per cent level While, cost of seeds was found to be significant and positive contributors to the gross returns at five per cent level. This implies that, one per cent increase in labour cost and expenditure on other resources would increase gross income by 0.451 per cent and 0.419 per cent respectively. Every five per cent investment on seeds would increase gross return by 0.139. However, the estimated coefficients for all other variables such as land, number of milch cattle, cost of feed and concentrates were found to be non-significant. Thus, it indicated that expenditure on these inputs were of not influence on total gross returns to considerable extent.

The summation of regression coefficients worked out to be 0.95, which indicated decreasing returns to scale *i.e.,* one per cent increase in expenditure on all inputs would results in 0.95 per cent increase in total returns.

The MVP : MFC ratio was negative and less than one in case of land and cost of feed and concentrates which indicated that these inputs were excessively used and number of milch cattle were more than the optimality and had negative influence on return, So, these inputs were to be minimized to get the optimum level of output.

The ratios of MVP: MFC for labour cost, cost of seeds and expenditure on other resources were more than unity. This indicated that, at their average levels these resources were under utilized in the production process. There is ample scope of greater exploitation of these resources to maximize the production and increase the gross returns.

5.4.1.2 Koppal district

The results of regression analysis presented in the Table 4.15 for the tank commands of Koppal district showed that, the calculated R^2 (coefficient of multiple determination) was 0.94, which means that about 94 per cent of the variation in gross returns was explained by the seven variables included in the production function and found significant by F value at one per cent level.

The co-efficient of cost of seeds were significant positive contributor to gross returns at one per cent level of significance *i.e.,* every one per cent increase in seed cost, increases the returns by 0.278 per cent.

The elasticity coefficient for labour and cost of feed and concentrates exerted significant positive influence to the gross returns at five per cent level which means every five per cent increases in the labour and feed would results in 0.787 per cent and 0.156 per cent increase in the gross returns.

The number of milch cattle were found to have significant negative influence on total gross returns at 10 per cent level, indicating every 10 per cent increases in the milch cattle decreases the total gross return by 0.14 per cent.

The increase in expenditure on other resources (fertilizer cost + FYM cost and veterinary charges) increases gross returns but such increase was not significant. While number of sheep influence gross returns negatively but at insignificant level.

The summation of regression coefficients was more than unity, which indicates increasing returns to scale *i.e.,* one per cent increase in expenditure on all inputs would results in 1.21 per cent increase in total returns. Thus, agricultural production activities have more scope in Koppal district and attracts more investments

The ratios of MVP to MFC is negative and less than one for land indicating over utilization of resources and number of milch cattle and number of sheep were more than the optimality.

The ratio for expenditure on other resources is positive and very close to the unity. This indicates that, it is profitable to use additional units of these resources in the production process.

Comparisons of MVP to MFC ratio for variables like labour, expenditure on feed and concentrates and seeds were more than unity, exerting under utilization of these resources in the production process. The production can be encouraged by using more of these resources to enhance the profitability condition.

5.4.1.3 Haveri district

The production function analysis for tank commands of Haveri district (Table 4.15) was found to be a good fit to the data as indicated by F value at one per cent level of significance. The calculated R^2 (coefficient of multiple determination) was observed to be 0.892 for the selected variables.

The expenditure on feed and concentrates and seeds exerted a significant positive contribution to the total returns at one per cent level, whereas labour and expenditure on other resources (fertilizer cost + FYM cost and PPC + veterinary charges) were significantly positive contributor to the total returns at five and ten per cent level respectively. However, the estimated coefficients for all other variables, such as land and number of milch cattle were found to be statistically non-significant with low regression coefficients, implying that variation in the levels of these inputs will not have much significant impact on the total returns generated.

The sum of elasticities worked out to be 1.34, indicating increasing returns to scale. The MVP and MFC ratio for land were negative and less than one and number of milch cattle were more than optimality. This implies that, these resources were excessively used. So, use of these inputs needs to be reduced as revealed by negative regression coefficient.

The ratios of MVP to MFC for the variables like labour, cost of feed and concentrates, seeds and expenditure on other resources were under utilized and there is scope for investment on these resources to some extent to increase the profitability of the production process.

Thus, in the tank commands of all the selected districts having different Farming Systems, the study revealed that, there is a scope for reorganizing various resources to improve the productive efficiency. Therefore, in the all districts, the use of resources showing negative production elasticities should be decreased to achieve the optimality in the resource use and use of resources showing more than unity production elasticities should be encouraged to enhance the profitability condition.

5.5 IMPACT OF ON-FARM DEMONSTRATIONS/FARMERS FIELD SCHOOLS ON SOCIO-ECONOMIC CONDITIONS OF FARMERS

5.5.1 Economic impact of on-farm demonstrations/ farmers field schools on sample farmers

The economic impact has been assessed to know the impact of demonstration through calculating total cost, gross returns and net gain/loss of demonstrated plot over control plots and are illustrate in the Table 4.16, 4.17 and 4.18 are discussed further under

the following sub-headings. While, calculating the cost and returns of on-farm demonstrations/farmers field schools plot over control plot the fixed cost was taken same for both the plots as they were compared under similar conditions.

5.5.1.1 Costs and returns structure of different crops in OFD/FFS plots in different Tank Commands of Bagalkot district

a. Impact of on-farm demonstration on sunflower in Radder-Timmapur tank command

The per hectare cost and returns structure of on-farm demonstration plot over control plot presented in the Table 4.16 revealed that, the total cost incurred on variable inputs in OFD plot was less than that of cost incurred in control plots by Rs. 190.01. On control plots farmers used larger quantities of fertilizers (complex), plant protection chemicals and labours as compared to OFD plot. Whereas, the additional returns obtained in OFD plot over control plot was Rs. 9092.72. On demonstration plots the farmers used recommended doses of fertilizers based on soil testing reports conducted by CBTMCP field staff by fulfilling the soil nutrient requirements. On the hand the demonstration plot outputs attracted better prices over control plot outputs due to better quality parameters.

b. Impact of farmers field schools on groundnut in Nandikeshwar tank command

The cost incurred and the returns obtained are depicted in Table 4.16. It is evident from the table that, total variable cost of FFS plot over control plot was increased by Rs. 135.99 per hectare. The attributed reasons for these additional expenditure were additional cost incurred on labour. FYM, Rhizobium application and neem seed kernal extract (NSKE), which together contributed to get additional net returns of Rs.4231.29 in farmers field schools plot over control plot indicating remunerative impact on farmers income.

c. Impact of farmers field schools on groundnut in Dammur tank command

The economic impact has been assessed to know the impact of demonstration through working out the costs and returns of FFS plot over control plot and are depicted in the Table 4.16. It can be seen from the table that, increase in total cost of FFS plot was by Rs. 1330.84 over control plots. Increased cost was due to usage of required quantity of FYM, rhizobium, recommended amount of fertilizer with $ZnSO_4$ and gypsum. The net additional return was Rs. 3612.97. Use of biofertilizers, recommended dose of fertilizer application and use of NSKE for effective control of diseases, all together enhanced the returns on per rupee expenditure at a rate of 1.89 in FFS plot over 1.77 in control plot.

5.5.1.2 Koppal district

a. Impact of on-farm demonstration on bajra crop in Ramadurga tank command

The per hectare cost and returns realized from bajra crop under on-farm-demonstration over control plots were shown in the Table 4.17. It has been observed that, there was a marginal increase in total variable cost (Rs. 522.32) in OFD plot as compared to the control plot. The uttered reason was slight increase in the use of FYM, bio-fertilizers and biocontrol agents such as PSB and *Azospirillum* (Appendix XXXIII). The net additional return was Rs. 1694.70 over control plot, which led to increase in returns to each rupee of expenditure to the extent of Rs.1.28.

b. Impact of on-farm demonstration on groundnut in Nilogal tank command

The results of the demonstration conducted in the tank command presented in the Table 4.17, revealed that total variable cost was reduced considerably by Rs. 3246 in OFD plot over control plot. More seeds, higher doses of fertilizers and plant protection chemicals were used in control plots over OFD plot which led to higher input cost. But, on the contrary, in OFD plots, usage of recommended dose of fertilizer, $ZnSO_4$, gypsum, rhizobium, NSKE for seed treatments, led to a net additional returns of Rs.7009.15 per hectare.

c. Impact of farmers field schools on paddy in Nageshwanahalli Tank Command

It is evident from the Table 4.17 that, the per hectare total variable cost in paddy crop was reduced by Rs.1949.41 in farmers field schools plot over control plot. The mentioned reasons for decline in cost in FFS plots were reduced cost of labour with reduced seed rate and application of required dose of fertilizers like nitrogen, phosphorus, potash and $ZnSO_4$, use of bio-fertilizers and biocontrol agents in place of costly chemical control measure which were quite common in farmers practice. But, the enhanced net additional returns were Rs.4323.81 per hectare. These results clearly indicate the superiority of FFS over farmers practice.

5.5.1.3 Haveri district

a. Impact of on-farm demonstration on paddy in Bidarikoppa tank command

The results of the demonstration conducted in the tank command presented in the Table 4.18 revealed that the total variable cost was reduced considerably by Rs. 1308.26 in

OFD plot over control plot. Higher quantities of labour, fertilizer application and seeds led to increase in the total cost in control plot over OFD plot. But in OFD plot, recommended dose of fertilizer application, use of $ZnSO_4$ and biocontrol agents and reduced cost of labour by using weedicides (Butachlor) to control the weeds, all together led to increase in yield and better net returns (Rs.5175.34) over control plots.

b. Impact of on-farm demonstration on maize crop in Dommanal tank command

The per hectare cost and returns realized from maize crop under on-farm demonstration over control plots are shown in Table 4.18. It has been observed that, there was a marginal increase in total variable cost (Rs. 533.10) in OFD plot as compared to the control plot. There was slight increase in the use of fertilizers and plant protection chemicals in OFD plot over control plot, which led to increased variable costs in OFD plots. However, increased yield (41.13 qtl.) on OFD plot led to additional net return of Rs. 2331.51, confirming that fertilizer application as per recommendation along with top dressing of nitrogen four weeks after sowing, $ZnSO_4$ application (Appendix XXXVII) all together leads to increased returns on per rupee of expenditure (B:C ratio 1.32).

c. Impact of on-farm demonstration on ridge gourd in Byagwadi tank command

The per hectare cost and returns structure of OFD plot over control plot presented in the Table 4.18 revealed that, total variable cost of OFD plot was marginally higher than control plot by Rs. 64.60 and increase in net returns was by Rs. 1855.40 in OFD plot. The demonstration farmers used recommended quantity of fertilizers based on soil test reports (Appendix XXXVIII) and biocontrol agents like captan, tricoderma and PSB. But, this has resulted in additional net returns to OFD plot against control plot.

d. Impact of farmers field schools on cotton in Somasagar tank command

It is observed from the Table 4.18 that total cost incurred in FFS plot was less than that of cost incurred in control plots by about Rs. 1462. The reasons for reduced cost were use of more plant protection chemicals (*i.e.,* 5.55 lit/ha) and higher doses of fertilizers application and higher expenditure incurred on labour in case of control plot over FFS plot. Recommended dose of fertilizers and application of biocontrol agents used in the FFS plot resulted in increased yield and higher net additional returns of Rs.6001.54 over control plot, where these practices were not normally under taken.

e. Impact of farmers field schools on cotton in Basapur tank command

The costs incurred and the returns obtained in cotton FFS are depicted in Table 4.18. It was evident from the table that, total variable cost of FFS plot over control was marginally less by Rs. 927.63 and but net profit was higher by Rs. 3969.67. The increased return was attributed to application of biofertilizers like PSB and tricoderma, use of pheramone trap. Hence, though there is bit higher expenditure on interventions used in FFS plots, the returns were much more higher over control plot, indicating the effectiveness of use of bioagents.

f. Impact of farmers field schools on cotton in Kerekyatanahalli tank command

The per hectare cost and returns realized from cotton crop under FFS plot over control plots are shown in the Table 4.18. It has been observed that, there is marginal decrease in total variable cost (Rs. 937.14) in FFS plot as compared to the control plot. The farmers in those area are use more of fertilizers and plant protection chemicals than what is actually required. But, in FFS plots use of recommended dose of fertilizers, PPC and biofertilizers and biocontrol agents were demonstrated, which resulted in increased returns on FFS plot over control plots (increase by Rs. 3513.55).

5.5.2 Impact of on-farm demonstrations/ farmers field schools on social conditions of farmers

The information regarding social impact of on-farm demonstrations/ farmers field schools in the sample tank commands has been depicted in Table 4.19. The table revealed that, almost all the sample respondents have awareness on OFD/FFS conducted in their tank commands indicating popularity of the programme in the study area. Almost all farmers opined positively regarding farmers participation in OFD/FFS indicating that, method of approach of this programme was good in respect of effective transfer of technology.

Among the various programmes arranged for the benefit of the farmers for transfer of technology, trainings were given to the selected farmers to enhance their technical skill and they have to communicate the acquired knowledge to other farmers in the tank commands. Many farmers attended the programmes and participated group discussions, field days and field schools and had experienced the benefit of attending. While, in case of others who have not attended these programmes, the identified reason was their laggardness to accept new things.

The dissemination of demonstrated technology was observed to be highest in Haveri district. The demonstration conducted has much influence on farmers through its increased returns. Receptivity of the farmers and efforts and method adopted by the field staff also adds to rate of success. While, in case of Bagalkot and Koppal districts where both OFD and FFS were conducted, it was disseminated on an average rate of 18.03 and 29.61 members indicating the technology was suitable to the farmers field. Among the sample respondents majority of the farmers agreed to continue the demonstration.

More than 50 per cent of the farmers in Koppal and Haveri districts experienced yield change was due to demonstrated technology. The major interventions adopted were recommended package of practice, integrated pest and disease management practices and integrated nutrient management in demonstrated fields. Economy in cultivation was also experienced in demonstrated fields due to reduced cost of labour incurred on weeding due to use weedicides and reduced use of plant protection chemicals which were replaced by NSKE spray.

A substantial gain in knowledge about new production technology on major crops was opined by majority of the farmers. It was experienced during the survey that majority of sample respondents were not aware of recommended package of practice for the crop production in the particular region. This calls for effective role to be played by extension agencies in dissemination of information.

Positive opinion was articulated by majority of farmers towards OFD/FFS indicating the popularity of OFD/FFS in the study areas, whereas only few farmers in Bagalkot and Koppal district stated negative opinion. Biasness was observed to be the reason for controversial opinion by the farmers, remaining farmers could not give any opinion as they posses poor analyzing capacity due to lack of knowledge. Few farmers in Koppal and Haveri district expressed the need for change in present method of OFD/FFS and their attributed suggestions were on-farm demonstration need to be extended to other crops and same beneficiary should not be selected for subsequent demonstrations.

5.6 CONSTRAINTS ASSOCIATED WITH DIFFERENT FARMING SYSTEMS IN THE TANK COMMANDS

The problems associated with farmers under different Farming Systems in the tank command have been depicted under the sub-headings of production constraints and marketing constraints in Table 4.20. The results observed were discussed here under.

5.6.1 Production constraints

In the study area, almost all the sample respondents in all the districts encountered exogenous factors like drought and irregularlies of rainfall affecting the crop production, which are beyond their control. The farmers were facing problem of tiny land holdings resulted due to fragmentation and sub-division of land holding owing to law of inheritance, which were uneconomical for cultivation. Non- availability of adequate water was also uttered by majority of the farmers. However, missutilization of the tank water for other than agriculture and allied activities was observed to be meager in all the district. Due to drought condition, non-availability of alternative sources of irrigation was put forth by majority of the farmers.

Most of the farmers opined lack of awareness of recommended cropping sequences. Educating farmers on the cropping sequences which are remunerative and suitable for that region is needed to increase the crop yield levels and cropping intensity. Lack of knowledge about source of availability of quality seeds, high cost of inputs used in production together influenced negatively on the yield in farmer fields. Lack of credit availability and lack of technical guidelines were observed to be crucial in the study area. Majority of the farmers were small and marginal with low production capacity land holdings. With less propensity to save, creation of owned fund is very difficult. Low yield of local breeds and seeds was not a severe problem because milk consumption per capita was very low in the study area. High cost of production was observed in the districts indicating higher expenditure on inputs like labour, seeds, fertilizers and FYM. In the study area farmers are facing the problem of scarcity of labour for proper management of enterprises. Only few farmers expressed poor maintenance of the tanks as a problem, as in majority of the tanks rejuvenation of tanks has already been taken up by Jala Savardhane Yojana Sangha.

5.6.2 Marketing constraints

Low price for the produce was the major problem in the study area. Seasonal nature of agricultural production leads to at a time harvest and arrival into the markets, ultimately leading to price crash owing law of supply. Phasing of production would be a more

sophisticated technique to avoid price risks. But, under present situations developing scientific storage facilities for phasing of arrivals into the market would be of little solace towards price crashes. Lack of the market information, high marketing costs, lack of transportation facilities were the other associated problems which can be addressed not at individual level but at societal level.

VI. SUMMARY AND POLICY IMPLICATIONS

Holistic research on Farming Systems has been gaining the momentum in recent years and the scientists and research scholars are developing tools and techniques to discover more profitable methods to improve the farming. The present study made an attempt to identify the existing Farming Systems, analyse cost and returns, resource use efficiency in major Farming Systems and the impact of OFD/FFS on socio-economic status of farmers in selected tank commands of Northern Karnataka.

6.1 OBJECTIVES

The present study was undertaken with the following specific objectives in the tank commands of three districts of Northern Karnataka.

1. To identify the existing farming systems in the selected tank commands rejevenated by the Jala Samvardhane Yojana Sangha (JSYS)
2. To analyse the cost and returns structure and resource use efficiency in selected tank commands of selected districts
3. To analyse the impact of demonstrations/farmers field schools on socio-economic conditions of the farmers
4. To identify the problems in different farming systems in the tank commands 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 statistical and mathematical tool like functional analysis apart from simple tabular analysis involving percentage and frequencies.

6.1.1 Sampling procedure

Multistage sampling technique was adopted for selecting the sample respondents.

In the first stage, three districts such as Bagalkot, Koppal and Haveri were selected from the Northern Karnataka based on all variabilities of agro-climatic conditions, where Jala Samvardhane Yojana Sangha is managing the tanks.

In the second stage, based on number of on-farm demonstrations/ Farmers Field Schools conducted, the tanks were considered for study from the selected districts.

In third stage, sample respondents were selected randomly of about twelve from each tank command giving due importance so that, majority of the demonstrating farmers are included in the study. The total sample size so such considered was 144.

6.2 FINDINGS OF THE STUDY

6.2.1 Socio-economic characteristics of sample farmers

The average age of the sample respondents was 42.94 years, 41.63 years and 42.83 years in Bagalkot, Koppal and Haveri district respectively emphasizing the predominance of middle age person in decision making process. The literacy per cent was highest in Haveri, followed by Koppal and Bagalkot. Occupational pattern of sample respondents revealed that, the proportion of sample respondents who's occupation is agriculture was the highest. The pattern of land holding revealed that about 50-75 per cent of land was under rainfed condition.

6.2.2 Major farming systems identified in the study area

Two major farming systems were identified in the tank commands of each of Bagalkot and Koppal district and three major farming systems in Haveri district. Within the identified farming system, cost and returns were worked for the enterprises which has at least 10 per cent of contribution to net cropped area. Among the existing farming systems identified in the study area, seven farming systems were identified as major ones and considered for further study based on percentage of adoption by the sample respondents.

6.2.3 Average Farm Size in the identified Major Farming Systems

The larger farm size was observed in the case of Farming System-II of Haveri district followed by Farming System-I and II in Koppal district, Farming System-III in Haveri and almost equal in Farming System-I of both Bagalkot and Haveri districts and least was observed in Farming System-II of Bagalkot district.

6.2.4 Cropping Pattern Under Different Farming Systems in the Study Area

The major crops grown in major farming systems identified in Bagalkot district include sunflower, maize, bajra and hybrid jowar in *kharif* season followed by groundnut during *rabi* season along with dairy enterprise.

In Koppal district, major crops grown were hybrid jowar, sunflower, maize and groundnut along with dairy and sheep rearing enterprises.

In Haveri district cotton is the dominant crop in all the three farming systems followed by maize, paddy and hybrid jowar and dairy enterprise was common in all the systems.

6.2.5 Costs and returns of different enterprises in major farming systems

Bagalkot District

The estimation of costs and returns for all the farming systems revealed that in farming system-I and II, *rabi* groundnut had a maximum share in total cost followed by maize, sunflower and dairy enterprise.

Koppal District

The share of *kharif* groundnut in total cost was found to be highest (25.13%) in FS-I followed by *rabi* groundnut, hy. jowar, sunflower, dairy and bajra.

The maximum contribution to net returns was attributed by *kharif* groundnut (36.41%) followed by *rabi* groundnut and sunflower in farming system-I.

In farming system-II also *rabi* groundnut had a major share in the total cost (33.46%) followed by sesamum, hybrid jowar, sheep rearing and bajra.

Haveri District

In Haveri district, cotton had the major share (44.94%) in total cost of the farming system-I followed by maize and dairy enterprise. The contribution of cotton (61.97%) to net returns was also highest followed by dairy and maize.

In farming system-II, share in the total cost was almost equal in both paddy and cotton (30.42% and 30.29%) enterprises followed by maize and dairy enterprise. Regarding contribution by each of the enterprise towards net returns, maximum amount was contributed by cotton (48.30%) followed by paddy, dairy and maize.

Under farming system–III, out of total cost incurred, the expenditure incurred on both paddy and cotton were almost equal (29.88% and 29.42%), followed by hybrid jowar and dairy enterprise. Highest contribution to net returns was accounted by cotton (41.52%) followed by dairy, paddy and hybrid jowar.

All the seven identified farming systems in the study area were found profitable though the level of profitableness vary from one system to another.

6.3 RESOURCE USE EFFICIENCY IN THE TANK COMMANDS OF EACH DISTRICT

The Cobb-Douglas type of production function was fitted to study the resource use efficiency in major farming systems identified in the tank commands in each of the study districts.

The results of the analysis in Bagalkot district revealed that, the coefficient of multiple determination (R^2) worked out to be 0.855. The summation of elasticity coefficient was 0.95. The variables such as labour, expenditure on other resources (fertilizers +FYM cost and PPC + veterinary charges) and cost of seeds have a significant and positive influence on gross returns.

The resources like labour, seeds and other resources (fertilizers, FYM, PPC and veterinary charges) were under utilized, whereas land and feed and concentrates were over utilized and number of milch cattle were used more than optimality.

In Koppal district, the resources like seeds, labour and feed and concentrstes have significant and positive influence on gross returns. Whereas, significant and negative influence was observed with respect to number of milch cattle. The resources such as land were over utilized and number of milch cattle and sheep were used more than optimality.

Whereas, labour, feed and concentrates and seeds were under utilized. There was an increasing returns to scale, as indicated by positive and more than unity measure.

Incase of Haveri district, the results of MVP to MFC ratio revealed that cost of feed and concentrates, seeds, labour and expenditure on other resources (fertilizer + FYM cost and PPC + veterinary charges) had positive and significant influence on gross returns. The resources like labour, feed and concentrates, seeds and other resources were under utilized, whereas land were over utilized and number of milch cattle were used more than optimality.

The coefficient of multiple determination was 0.892 and there was increasing returns to scale.

6.4 IMPACT OF ON-FARM DEMONSTRATIONS/FARMERS FIELD SCHOOLS ON SOCIO-ECONOMIC CONDITIONS OF FARMERS

6.4.1 Economic impact of on-farm demonstrations/farmers field schoolss on sample farmers

In Radder-Timmapur tank command of Bagalkot district on-farm demonstration conducted on sunflower indicated that the technology interventions in demonstrated plot yielded a net return of Rs. 9092.72, with a reduced cost of Rs. 190.01 over control plot.

In Nandikeshwar tank command, due to technological interventions on groundnut crop, total cost, gross returns, net returns were higher in FFS plot compared to farmers practice.

Farmers Field Schools on groundnut crop in Dammur tank command resulted in to a benefit cost ratio of 1.89 and 1.77 in FFS plot and control plot respectively.

In Ramadurga tank command of Koppal district on-farm demonstration conducted on bajra indicated that the additional cost incurred on technology intervention on OFD plot as compared to control plot resulted in increase in the total cost by Rs 522.35 in OFD plot. This additional cost was more offset by additional gross returns and net returns of Rs. 2217.55 and Rs. 1694.70. Benefit cost ratio were for OFD plot (1.28) and control plot (1.06).

In the Nilogal tank command, on-farm demonstration conducted on groundnut crop showed that saving in cost to the extent of Rs.3246/ha is possible over the farmers current practice. An additional net returns of Rs. 7009.15 per ha can be obtained in OFD plots in comparison to control plot.

Farmers Field Schools conducted on paddy crop in Nageshanahalli tank command effectively educated farmers about the use of much effective but less costly inputs which was reflected in the reduced cost to the extent of Rs.1949 per ha in FFS plot over control. But, additional net returns were to the extent of around Rs.4300 per ha.

In Bidarikoppa tank command at Haveri district on-farm demonstration conducted on paddy crop showed that a net decrease in cost to the extent Rs. 1308.26 in OFD plot was possible by proper and required usage of inputs over control plot. Even then, the additional net returns generated was Rs. 5175 more per ha over control plot.

In Dommanal tank command, on-farm demonstration conducted on maize crop showed that the technological interventions in demonstrated plot over control plot yielded an additional net return of Rs. 2864.60 for an additional cost of Rs. 533.10. The B:C ratios worked out for OFD plot and control plot were 1.32 and 1.18 respectively.

In Byagwadi tank command, due to technological intervention in OFD on ridgegourd, there was substantial increase in total cost, gross returns, net returns and benefit cost ratio over farmers practice.

The Farmers Field Schools conducted in Somasagar tank command on cotton crop has effectively showed that production cost can be drastically reduced to the extent of Rs.1460 per ha over farmers current practice. Even then, net returns increased to the extent of Rs.6000 per ha, indicating the double benefit of adopting the technologies advocated in Farmers Field Schools.

Farmers Field Schools conducted on cotton crop in Basapur tank command revealed that the total variable cost (Rs. 15167.24) and total cost (Rs. 17744.00) were less in FFS plot than control plot, with returns per rupee of investment of 1.89 and 1.69 in that order.

In Kerekyatanahalli tank command Farmers Field Schools conducted on cotton crop effectively demonstrated the cost effective technologies which was reflected in reduced cost to the extent of Rs.900 per ha over farmers present practice, without jeopardizing the net returns.

6.4.2 Social impact of on-farm demonstration/Farmers Field Schoolss on Sample Farmers

Most of the farmers in the tank commands of selected districts were aware of on-farm demonstration and Farmers Field Schools conducted to demonstrate the new technology on various crops. Farmers in the commands participated actively in various programmes such as trainings, field schools, group discussions and field days organized under the project. Majority of the farmers who have participated in OFD/FFS have adopted the demonstrated technology in their fields. Reduced cost of cultivation, increase in yield and gain in knowledge were also attributed by the farmers. Most of the sample farmers expressed that impact created by on-

farm demonstration/farmers field schools will go a long way in enhancing the income of farmers. Only a few farmers expressed the need for some modifications in the present method of OFD/FFS.

6.5 CONSTRAINTS ASSOCIATED WITH DIFFERENT FARMING SYSTEMS IN THE TANK COMMANDS

The major constraints faced by the sample farmers were categorized under two, heads *viz*., production and marketing constraints. Among the production constraints exogenous factors namely drought and irregularities in rainfall were the major constraints. Non-availability of adequate water, non-availability of alternate source of irrigation, lack of awareness of recommended cropping sequences, high cost of inputs, lack of technical guidelines, high cost of production and low price for the produce were the crucial problems of the study area. The other problems were misutilizing the tank water for other than agriculture and allied activities, non-availability of quality seeds, lack of credit availability and low yield of local breads and seeds.

Among the marketing constraints lack of market information, storage and transportation facility were observed as severe problems.

POLICY IMPLICATIONS

Based on the findings of the investigations, the following policies can be drawn to improve the farming systems in order to stabilize the income of the farmers.

1. It is evident from the analysis of costs and returns structure of different farming systems that, farming system-I of Koppal district was the most profitable among the seven major farming systems identified across the study area. The system included the enterprises like, hy. jowar, sunflower, bajra, *kharif* groundnut followed by *rabi* groundnut and dairy. Oilseed enterprises included in the system were more remunerative interms of higher profit generating capacity. Therefore, there is need to strengthen extension machinery and also institutional efforts through Raitha Samparka Kendra's and Krishi Vignana Kendras to popularize this farming system to utilize farm resources rationally and to enhance productivity and profitability.
2. The OFD/FFS has come out successfully in communicating the technical information to farming community. Hence, the process need to be replicated in other tank commands and also on other crops.
3. It is interesting to note that, the dairy enterprise was found to be the most common activity taken up by all the sample farmers under major farming systems in all the selected tank commands in the study area. The dairy unit as a complimentary enterprise to crop production which not only utilizes farm residues but also generates additional employment opportunity to the family members during lean season in addition to adding substantial income to the farm family. Organizing dairy cooperatives and federating them to Karnataka Milk Federation (KMF) would provide phillip to the enterprise. Policy interventions on these lines are need of the hour. To enhance and stabilize income of the farmers, other allied activities of crop production such as sheep and goat rearing, agro-forestry and dry land horticulture may be encouraged.
4. The study of impact of OFD/FFS revealed that, most of the sample farmers adopted traditional method of cultivation by under or over utilizing most of the inputs in different systems of farming. To utilize inputs rationally and to enhance farmers income, it should be advised to use recommended cultivation practices, locally available organic or bio agents in order to reduce the cost of cultivation.
5. The results of production function analysis revealed that, some of the inputs namely land and feed were over utilized and milch cattle were used more than optimality. Whereas, labour, seeds and other resources (cost of fertilizers + FYM and PPC + veterinary charges) were under utilized in Bagalkot district. The resources like land were over utilized and milch cattle and sheep were used more than optimality. Labour, feed and concentrates and seeds were under utilized in Koppal and Haveri districts. Therefore, there is a scope for reorganization of these resources to optimize their use to enhance returns in the study area.
6. Constraints like non-availability of quality seeds, lack of awareness of recommended cropping sequences, high cost of inputs, lack of credit facility, scarcity of owned funds, low price for the produce and lack of storage facility were most severe in crop production. Hence, there is need to strengthen institutional support for provision of credit,

infrastructure facility and formulate appropriate policies for safe guarding the interest of the farmers.

7. During the survey it was found that farmers were using tank water in unproductive way. The water management demonstrations being conducted by community based tank management consultancy service of UAS, Dharwad would effectively teach the tank users about conservation and efficient use of tank water. Such, awareness drives need to be replicated in many more tank command areas to popularise efficient use of water.

VII. REFERENCES

AMIR, P. AND KNIPSCHEER, H. C., 1989, *Conducting On-Farm Animal Research: Procedure and Economic Analysis*. Winrock International Institute for Agricultural Development, USA and International Development Research Centre, Canada.

ANONYMOUS, 1978, CGIAR Technical Advisory Committee, *Farming Systems Research,* International Agricultural Research Centres, Rome, TAC Secretariat.

ANONYMOUS, 1992, Management of heliothis on cotton in Andhra Pradesh*. All India Co-ordinated Cotton Improvement Project, Silver Jubilee Symposium*, Ludhiana, 1992.

ANONYMOUS, 1993, *Report on Region-wise Cost of Cultivation of Crops for the Year 1992-93*. Karnataka State Department of Agriculture, Bangalore, pp: 77-161.

BALAPPA, S., 1997, Production, marketing and processing of Redgram in Gulbarga district – An Economic Analysis*. M.Sc. (Agri.) Thesis,* University of Agricultural Sciences, Dharwad.

BASAVARAJ, K. AND KUNNAL, L.B., 2002, Constraints in production, marketing and processing of soybean. *Rural India,* **65** (4): 68-71.

BENECKA, G. AND CHULA, M., 1986, Economic analysis of grain maize production. *World Agricultural Economics and Rural Sociological Abstract,* **29**(3): 188.

BIGGS, S. D., 1985, A farming systems approach: some unanswered questions. *Agricultural Administration and Extension*, **18**: 1-12.

BOWDEN, R. J., ISON, R. L., MECADM, R. D., PACKHAM, R. G. AND VALENTIN, I., 1985, A research paradigm for systems agriculture. *Proceedings of an International Workshop held at Howkesburg Agricultural College,* Richmand, N.S.W, (Australia), p.65.

CHAHAL AND CHAHAL, 1989, An economic analysis of irrigated crops in Punjab. *Agricultural Situation in India,* **23**(3): 42-46.

CHANDRAKANTH, M.G. AND ROMM, J., 1990, Groundwater depletion in India. Institutional Management Regimes. *Natural Resource Journal*, **30**(3): 486-501.

CHANDRASHEKAR, S., VASTER, LALITHA, K. C., LAKSHMI NARAYAN, M. T. AND RANGANATHA, A. D., 2001, Production constraints faced by potato growers. *Rural India,* **64**(2-3): 33-34.

CHANNABASAVANNA, A. S. AND BIRADAR, D. P., 2002, Role of farming systems in today's agriculture. *Kisan World,* **29**(10): 33-34.

CHITNIS, D. H. AND BHIKGAONKAR, M. G., 1987, Constraints causing technological gap in dry farming systems. *Journal of Maharashtra Agricultural Universities,* **12**(1): 84-88.

COLLINSON, M., 1982, Farming Systems Research, Eastern Africa: The experience of CIMMYT and National Agricultural Research Services. *MSV International Development Paper.* Eastern Lansing, Michigan State Agricultural University, Department of Agricultural Economics, pp.76-81.

DEOGHARE, P. R., SHARMA, B. M. AND GOEL, S. K., 1991, Impact of mixed farming system on income and employment on small farms in Karnal district of Haryana. *Agricultural Situation in India,* **45**(10): 665-670.

DHONGADE AND DANGAT, 1985, Cost and income structure of farm business in Sina Command area. *Progressive Farmer,* **17**(2): 54-59.

GADRE, N. A. AND MAHALE, Y. P. 1988, Comparative economics of production of cotton vis-à-vis its substitute crops in Vidarbha region. *Indian Journal of Agricultural Economics,* **34**(2): 57-60.

GANAPATHI, K. N., 1993, Economics of farming systems in Malnad region- A case study of Sagar taluk. *M.Sc. (Agri.) Thesis,* University of Agricultural Sciences, Bangalore.

GANESH, K., 2000, Evaluation of alternative farming systems in Gazani lands of Karnataka-An economic analysis. *M.Sc. (Agri) Thesis,* University of Agricultural Sciences, Dharwad.

GIRISIH, H., 1987, Structural analysis of systems and design. *The Economic Times,* p.3.

GOVARDHAN, R., 1998, An economic analysis of cropping system in left bank canal command area of Tungabhadra Project- Karnataka. *M.Sc.(Agri.) Thesis,* University of Agricultural Sciences, Dharwad.

HEADY, E.O. AND DILLON, J.L., 1964, *Agricultural Production Functions*. IOWA State University Press, IOWA, pp.108-141.

HIRALA JANA AND VERMA, H. K., 2004, Constraints faced by the growers in the adoption of recommended plant protection practices. *Rural India,* **67**(6-7): 122.

HIREMATH, G. M., 1998, Ground water use in Karnataka- An economic analysis. *M.Sc.(Agri.) Thesis,* University of Agricultural Sciences, Dharwad.

HYMAJYOTHI, S., UMAMAHESHWARA REDDY, S. AND RAJU, V. T., 2003, Economics of buffalo milk production in West Godavari District of Andhra Pradesh – A case study. *The Andhra Agricultural Journal,* **50**(1&2): 141-143.

KALIGOWDA, V. B., 1989, Economics of cropping pattern in Ghataprabha command area –A case study. *M.Sc. (Agri) Thesis,* University of Agricultural Sciences, Dharwad.

KANDASAMY, O. S., 1998, An economic analysis of integrated farming system in Dharmapuri District of Tamil Nadu. *Farming System,* **14** (1 & 2): 29-33.

KERUR, N. M., BASAVARAJ BANAKAR, H. G., SHANKARA MURTHY AND MANJUNATH, L., 1997, Sunflower production in North Karnataka – An Economic Analysis. *Karnataka Journal of Agricultural Sciences,* **10**(4): 1138.

KOPPAD, M. B. AND KHAN, H. S. S., 1996, Economic analysis of maize based farming systems on large farmers in Malaprabha Command Area, Karnataka. *Farming System* **12**(1-2): 1-4.

MAJI, C. C., 1991, Farming systems in the post green revolution belt. *Indian Journal of Agricultural Economics,* **46**(3): 403-411.

MOHANDAS, K. AND THOMAS, E. K., 1997, Economic analysis of rice production in Kuttanad areas of Kerala. *Agricultural Situation in India,* **54**(9): 555-560.

MURALIDHARAN, P. K., 1987, Resource use efficiency in kole lands in Trichur District, Kerala. *Indian Journal of Agricultural Economics,* **42**(4): 578-586.

NAGARAJ, T., KHAN, H. S. S. AND KARNOOL, N. N., 1996, Economic analysis of maize-sunflower farming system in Tungabhadra command area, Karnataka. *Farming Systems*, **12**(3-4): 28-36.

NAGARAJU, D. AND GOPAL, S., 2003, Constraints among koyas in adoption of improved dairy farming practices. *The Andhra Agricultural Journal,* **50**(3-4): 337-341.

NAGPURE, S. C., JHAKARE, A. B., KHANDARE, A. P. AND PATIL, R. K., 2004, Economics of sugarcane production in Vidarbha region of Maharashtra State. *Rural India,* **67**(6-7): 123-125.

NAIK, B. K., 1998, Farming systems in Uttara Kannada-an econometric analysis, An unpublished *M.Sc. (Agri.) Thesis,* submitted to University of Agricultural Sciences, Dharwad.

NARASIMHAN, S., RAJU, V. T. AND SHAREEF, 2003, Cost and returns paddy in Yanam Region of Union Territory of Pandicherry.

NEELAPPA SETTY, T., 2002, Technical and allocative efficiency of paddy production in TBP area–An Economic Analysis. *M.Sc. (Agri.) Thesis,* University of Agricultural Sciences, Dharwad.

NORMAN, D. AND COLLISON, M., 1985, Farming systems research in theory and practice proceedings of an *International Workshop held at Hawkesburg Agricultural College, Richmand, N. S.W. (Australia) ;* pp: 16-30.

OPPEN, M.V. AND SUBHA RAO, K.V., 1980, Tank irrigation in semi-arid tropical India: economic evaluation and alternatives for improvement. *Research Bulletin*, ICRISAT, Patancheru, Andhra Pradesh.

PALANISAMI, K., 2000, *Tank Irrigation: Revival for Prosperity*. Asian Publication Services.

PANDURANGADU, K. AND RAJU, V. T., 1990, Economics of pesticides use on cotton farms in Guntur District of Andhra Pradesh. *Agricultural Situation in India,* **45**(7): 467-469.

PATIL, B. V., 1992, Sensitivity of field collected *Helicoverpa armigera. Pestology,* **17**: 19-21.

PRAKASH, H. V., PRASAD, K. AND TANDON, J. P., 1985, Production potential and net returns of double cropping under rainfed conditions in Uttar Pradesh hills. *Annals of Agricultural Research,* **6**(2): 168-173.

PRASAD, H. K. P., 1993, Efficacy of groundnut production in Karnataka: A frontier production function analysis approach. *M.Sc. (Agri.) Thesis,* University of Agricultural Sciences, Bangalore.

PRASHANTHAKUMAR, R. W., 2003, Animal Based Farming Systems for Long Term Sustainability in Northern Karnataka- A Socio- Economic Assessment. *Ph.D Thesis*, University of Agricultural Sciences, Dharwad.

RAJESHWARI, Y. G., 2004, An economic analysis of Coconut based Farming System in Tumkur district of Karnataka. *M.Sc. (Agri.) Thesis,* University of Agricultural Sciences, Dharwad.

RAJKUMAR AND HARISINGH, 2002, Problems in vegetable production in Bharatpur district of Rajasthan. *Rural India,* **65**(2-3): 48-50.

RAMAMOORTHY, K., 1989, An economic evaluation of the impact of integrated pest management on cotton. *Annual Report,* Central Institute of Cotton Research, Nagpur, pp. 56-57.

RAMESH, P. AND KONAREDDY, 2003, Agricultural Research Prioritization for Agro-climatic zones 1, 2 and 3 of Karnataka. *M.Sc. (Agri.) Thesis,* University of Agricultural Sciences, Dharwad.

RANGASWAMY, A., VENKATSWAMY, R., PREMSHEKHAR, M., JAYANTHI, C. AND PALANIAPPAN, S. P., 1992, Integrated Farming Systems for rice based ecosystem. *Madras Agricultural Journal,* **82**(4): 290-293.

RANGASWAMY, R., 1986, Rapporteur's report on sciences and technology for dry land farming. *Indian Journal of Agricultural Economics,* **41**(3): 413-417.

RAY, A. K. AND CHAHAL, J. K., 1986, Problems of oilseeds production. A critical analysis. *Agricultural Situation in India*, **41**(5): 323-331.

REDDY, G. R. C., 1994, Economics efficiency of sunflower production in Karnataka - An Inter-zonal Comparison. *M.Sc. (Agri) Thesis,* University of Agricultural Sciences, Bangalore.

REDDY, S.S.T., 2001, *Report on Institutional Approach to Community Based Tank Management Project*, Indian Institute of Management, Bangalore.

REMENYI, J. N., 1985, Opportunities for farming systems research collaboration: Issues and recommendations. *Proceedings of an International Workshop on Agricultural Systems Research for Developing Countries, held at Howkesburg Agricultural College, Richmand, N.S.W. (Australia),* pp.7-14.

ROY, P.R., 1990, *Accounting for Cattle Depreciation and Replacement,* Discovery Publishing House, New Delhi.

SABRANI, M., KASRYNO, F. AND PEACOCK, C., 1985, Farming systems research in Indonesia. *Proceedings of an International Workshop held at Howkesburg Agricultural College, Richmand, N.S.W. (Australia),* pp. 116-118.

SANDEEP, B., 2002, An Economic Analysis of Cropping Systems in Bidar District of Karnataka. *M.Sc. (Agri.) Thesis,* University of Agricultural Sciences, Dharwad.

SAWANT, S. D., 1991, *Irrigation Water Use*. Indian Agriculture development since independence. Ed. Dantwala, M. L., Oxford and IBH Publishing Company Private Limited, New Delhi.

SETTY, R. A., JAGANNATHA, V. AND CHANNABASAVANNA, A. S., 1990, Suitable cropping sequences area of Tungabhadra Project. *Current Research,* **19**(10): 166-168.

SHAH, J. P. AND KUBE, S. B., 1987, Infrastructural constraints and strategies for promoting fertilizer uses in rainfed areas. *Fertilizer News,* **32**(8): 27-30.

SHARMA, L. R., BHATI, J. P. AND SINGH, RANVEER, 1991, Emerging-Farming Systems in Himachal Pradesh: Key issues in sustainability. *Indian Journal of Agricultural Economics,* **46**(3): 422-427.

SHARMA, V. P. AND SINGH, R. V., 1996, Economic evaluation of hill cattle development programme in Himachal Pradesh. *Agricultural Economics Research Review,* **9**(1): 1-12.

SINGH, B. K., 1992, Economic analysis of farming system in Kangra district of Himachal Pradesh. *M.Sc. (Agri.) Thesis,* Himachal Pradesh Kirshi Vishwa Vidhyalaya, Palampur.

SINGH, J. AND GROVER, D. K., 1992, Economics of wheat under different cropping systems. *Progressive Farmer,* **28**(6): 23-26.

SINGH, M. P., SINGH, R. P. AND RAI, B., 1994, Rice based cropping systems for Eastern Uttar Pradesh. *Indian Farming,* **44**(1): 19-23.

SINGH, R. I., SINGH, G. AND SINGH, J., 1987, Economics of paddy production in Sultanpur. *Indian Journal of Agricultural Economics,* **37**(5): 11-12.

SINGH, R. K., 1994, Farming systems research: present status and the future prospects in Indian context. *Agricultural Situation in India,* **49**(1): 3-12.

SRIKANTHAMURTHY, P. S., 1986, Resource productivity in Agriculture in Bangalore district, Karnataka. *M.Sc. (Agri.) Thesis,* University of Agricultural Sciences, Bangalore.

SUNANDA, N. AND NARENDER, I., 2003, Resource productivity of mesta farms in Srikakulam district of Andhra Pradesh. *The Andhra Agricultural Journal,* **50**(3-4): 327-331.

SUNDARAMURTHY, V. T., 1985, Operational research project on integrated control of pests. *Annual Report,* Central Institute of Cotton Research, Nagpur, pp. 111-112.

SUNDARAMURTHY, V. T., 1987, Operational research project on integrated control of pests. *Annual Report,* Central Institute of Cotton Research, Nagpur, pp.56-77.

SURYAWANSHI, S. D. AND PRAKASH MAHINDRE, 1993, Impact of viable technology for promoting oilseeds in Maharashtra. *Indian Journal of Agricultural Economics,* **48**(3): 420.

THAKUR, D. S. AND SHARMA, K. D., 1985, Impact of HPMC in Marketing of Apples and Producers Share in Himachal Pradesh. *Himachal Journal of Agricultural Research,* **11**(1): 50-57.

THIRUVENKATACHARI, K., VISHWANATHAN, B. N. AND SEETHARAMAN, K. S., 1991, An economic analysis of groundnut production in rainfed area – A Case study on Tamil Nadu. *Agricultural Situation in India,* **46**: 431.

TIMOTHY RANDHIR, O. AND KRISHNAMOORTHY, S., 1990, Productivity variation and water use in farms of Madhurantakam tankfed area of Chengal Pattu District, Tamil Nadu. *Indian Journal of Agricultural Economics,* **45**(1): 190.

UMASHANKARI, 1992, Tanks: major problems in minor irrigation. *Economics and Political Weekly*, **2**: 115-124.

VERMA, A. R., 2002, Economics of production, resource use efficiency and constraints: A case study of onion in Shajapur district of Madhya Pradesh. *The Bihar Journal of Agricultural Marketing,* **10**(4): 429-439.

VISHWESHWAR, S. P., 1994, Economics of hybrid cotton with special reference to pest management in Malaprabha command area. *M.Sc. (Agri.) Thesis,* University of Agricultural Sciences, Dharwad.

VIVEKANANDA, 1999, Problems and prospects of agricultural development in Karnataka. *Occasional Paper-9,* NABARD.

VYAS, H. V. AND PATEL, K. F., 2001, constraints faced by milk producers in adoption of dairy technology. *Rural India,* **64**(6): 117-124.

Appendix I. Per hectare cost and returns of sunflower crop grown under farming system-I in Bagalkot district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	78.48	2589.81	16.14
	a. Family labour	MD	64.37	2124.20	13.24
	b. Hired labour	MD	14.11	465.61	2.90
2.	Machine labour	Hr		370.65	2.31
3.	Bullock labour	BPD	13.29	2020.68	12.59
4.	Seed	Kg	4.94	889.6	5.54
5.	FYM	Ton	9.88	3953.60	2.46
6.	Fertilizer				
	a. Nitrogen	Kg	-	-	-
	b. Phosphorus	Kg	123.55	1198.4	7.46
	c. Potash	Kg	80.31	369.41	2.30
	d. Complex	Kg	124.17	913.87	5.69
7.	PPC	Lit	2.47	680.91	4.24
8.	Miscellaneous charges	Rs.		277.99	1.73
9.	Interest on working capital	Rs.		281.87	1.75
	Total variable costs (TVC)	Rs.		13546.79	84.44
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		9.88	0.061
2.	Depreciation charges	Rs.		185.33	1.15
3.	Rental value	Rs.		2084.91	12.99
4.	Interest on fixed capital	Rs.		216.61	1.35
	Total fixed cost (TFC)	Rs.		2496.73	15.56
III.	Total cost (I+II)	Rs.		16043.51	100.00
	Returns				
	a. Main-product	Qtl.	12.65	20632.54	
	Gross returns	Rs.		20632.54	
	Net returns	Rs.		4589.03	
	B:C ratio			1.28	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix II. Per hectare cost and returns of maize crop grown under farming system-I in Bagalkot district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	98.89	3263.35	16.80
	a. Family labour	MD	66.52	2195.14	11.30
	b. Hired labour	MD	32.37	1068.21	5.50
2.	Machine labour	Hr	-	-	-
3.	Bullock labour	BPD	23.10	3511.79	18.08
4.	Seed	Kg	15.86	1507.06	7.76
5.	FYM	Ton	10.92	4368.73	22.49
6.	Fertilizer				
	a. Nitrogen	Kg	-	-	-
	b. Phosphorus	Kg	158.84	1540.71	7.93
	c. Potash	Kg	-	-	-
	d. Complex	Kg	114.70	844.22	4.34
7.	PPC	Lit	1.98	544.73	2.80
8.	Miscellaneous charges	Rs.		310.11	1.59
9.	Interest on working capital	Rs.		1350.71	6.95
	Total variable costs (TVC)	Rs.		17241.40	88.79
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		10.82	0.055
2.	Depreciation charges	Rs.		247.10	1.27
3.	Rental value	Rs.		1729.70	8.90
4.	Interest on fixed capital	Rs.		188.82	0.97
	Total fixed cost (TFC)	Rs.		2176.44	11.21
III.	Total cost (I+II)	Rs.		19417.85	100.00
	Returns				
	a. Main-product	Qtl.	43.32	20977.88	
	b. Bi-product	Ton	5.29	1057.59	
	Gross returns	Rs.		22034.94	
	Net returns	Rs.		2617.12	
	B:C ratio			1.13	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix III. Per hectare cost and returns of Hy. jowar crop grown under farming system-I in Bagalkot district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	94.54	3119.84	20.02
	a. Family labour	MD	68.30	2253.85	14.46
	b. Hired labour	MD	26.84	865.99	5.55
2.	Machine labour	Hr		444.78	2.85
3.	Bullock labour	BPD	18.04	2741.82	17.60
4.	Seed	Kg	7.41	185.33	1.18
5.	FYM	Ton	8.90	3558.24	22.84
6.	Fertilizer				
	a. Nitrogen	Kg	49.42	247.10	1.58
	b. Phosphorus	Kg	98.84	958.75	6.15
	c. Potash	Kg	-	-	-
	d. Complex	Kg	92.66	750.57	4.81
7.	PPC	Lit	-	-	-
8.	Miscellaneous charges	Rs.		321.23	2.06
9.	Interest on working capital	Rs.		1047.85	6.72
	Total variable costs (TVC)	Rs.		13375.50	85.87
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		8.90	0.05
2.	Depreciation charges	Rs.		148.26	0.95
3.	Rental value	Rs.		1853.25	11.89
4.	Interest on fixed capital	Rs.		190.98	1.22
	Total fixed cost (TFC)	Rs.		2201.394	14.13
III.	Total cost (I+II)	Rs.		15576.89	100.00
	Returns				
	a. Main-product	Qtl.	33.36	16679.25	
	b. Bi-product	Tons	4.94	1976.80	
	Gross returns	Rs.		18656.05	
	Net returns	Rs.		3079.16	
	B:C ratio			1.19	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix IV. Per hectare cost and returns of *rabi* groundnut crop grown under farming system-I in Bagalkot district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	134.74	4446.54	21.25
	a. Family labour	MD	81.91	2703.15	12.92
	b. Hired labour	MD	48.01	1584.38	7.57
2.	Machine labour	Hr	-	588.67	2.81
3.	Bullock labour	BPD	15.47	2351.21	11.24
4.	Seed	Kg	141.56	5662.46	27.07
5.	FYM	Ton	-	-	-
6.	Fertilizer				
	a. Nitrogen	Kg	72.67	363.56	1.73
	b. Phosphorus	Kg	152.61	1480.31	7.07
	c. Potash	Kg	227.33	1045.73	4.99
	d. Complex	Kg	-	-	-
7.	PPC	Lit	2.47	680.91	3.25
8.	Miscellaneous charges	Rs.		1235.50	5.90
9.	Interest on working capital	Rs.		507.35	2.42
	Total variable costs (TVC)	Rs.		18414.04	88.04
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		10.45	0.049
2.	Depreciation charges	Rs.		210.04	1.004
3.	Rental value	Rs.		2064	9.86
4.	Interest on fixed capital	Rs.		217.02	1.03
	Total fixed cost (TFC)	Rs.		2501.51	11.96
III.	Total cost (I+II)	Rs.		20915.55	
	Returns				
	a. Main-product	Qtl	20.10	34656.46	
	b. Bi-product	Tons	4.79	1889.26	
	Gross returns	Rs.		36545.72	
	Net returns	Rs.		15630.17	
	B:C ratio			1.74	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix V. Per hectare cost and returns of maize crop grown under farming system-II in Bagalkot district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	89.94	2968.17	17.35
	a. Family labour	MD	55.75	1839.61	10.75
	b. Hired labour	MD	34.17	1127.74	6.59
2.	Machine labour	Hr		494.20	2.88
3.	Bullock labour	BPD	24.71	3755.92	21.95
4.	Seed	kg	16.46	1069.70	6.25
5.	FYM	Ton	8.72	3489.05	20.39
6.	Fertilizer				
	a. Nitrogen	kg	-	-	-
	b. Phosphorus	kg	123.55	1198.44	7.006
	c. Potash	kg	-	-	-
	d. Complex	kg	102.94	833.83	4.87
7.	PPC	lit	-	-	-
8.	Miscellaneous charges	Rs.		247.10	1.44
9.	Interest on working capital	Rs.		1194.79	6.98
	Total variable costs (TVC)	Rs.		15251.19	89.16
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		12.36	0.072
2.	Depreciation charges	Rs.		197.68	1.15
3.	Rental value	Rs.		1482.60	8.66
4.	Interest on fixed capital	Rs.		160.80	0.94
	Total fixed cost (TFC)	Rs.		1853.43	10.84
III.	Total cost (I+II)	Rs.		17104.63	100.00
	Returns				
	a. Main-product	Qtl.	37.19	18073.64	
	b. Bi-product	tons	4.94	988.40	
	Gross returns	Rs.		19062.04	
	Net returns	Rs.		1957.41	
	B:C ratio			1.11	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix VI. Per hectare cost and returns of Hy. jowar crop grown under farming system-II in Bagalkot district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	94.69	3124.73	19.80
	a. Family labour	MD	52.04	1717.30	10.88
	b. Hired labour	MD	42.65	1407.43	8.91
2.	Machine labour	Hr	-	543.62	3.44
3.	Bullock labour	BPD	20.76	3154.97	19.99
4.	Seed	kg	7.41	222.39	1.40
5.	FYM	Ton	6.92	2767.52	17.53
6.	Fertilizer				
	a. Nitrogen	kg	123.55	617.75	3.91
	b. Phosphorus	kg	108.11	1048.63	6.64
	c. Potash	kg	-	-	-
	d. Complex	kg	61.78	500.38	3.17
7.	PPC	lit		-	-
8.	Miscellaneous charges	Rs.		271.81	1.72
9.	Interest on working capital	Rs.		1041.40	6.59
	Total variable costs (TVC)	Rs.		13293.20	84.24
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		7.91	0.05
2.	Depreciation charges	Rs.		187.45	1.18
3.	Rental value	Rs.		2075.64	13.15
4.	Interest on fixed capital	Rs.		215.74	1.36
	Total fixed cost (TFC)	Rs.		2086.74	15.76
III.	Total cost (I+II)	Rs.		15779.94	100.00
	Returns				
	a. Main-product	Qtl.	33.61	16802.80	
	b. Bi-product	tons	4.94	1877.96	
	Gross returns	Rs.		18680.76	
	Net returns	Rs.		2900.82	
	B:C ratio			1.18	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix VII. Per hectare cost and returns of bajra crop grown under farming system-II in Bagalkot district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	69.09	2279.94	31.22
	a. Family labour	MD	42.77	1411.51	19.33
	b. Hired labour	MD	32.89	1085.34	14.86
2.	Machine labour	Hr	-	-	-
3.	Bullock labour	BPD	11.74	1784.06	24.43
4.	Seed	kg	4.10	61.53	0.84
5.	FYM	Ton	-	-	-
6.	Fertilizer				
	a. Nitrogen	kg	-	-	-
	b. Phosphorus	kg	-	-	-
	c. Potash	kg	-	-	-
	d. Complex	kg	123.55	1000.76	13.70
7.	PPC	lit	-	-	-
8.	Miscellaneous charges	Rs.		222.39	3.04
9.	Interest on working capital	Rs.		454.64	6.22
	Total variable costs (TVC)	Rs.		5803.31	79.49
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		8.65	0.11
2.	Depreciation charges	Rs.		123.55	1.69
3.	Rental value	Rs.		1235.50	16.92
4.	Interest on fixed capital	Rs.		129.93	1.77
	Total fixed cost (TFC)	Rs.		1497.63	20.51
III.	Total cost (I+II)	Rs.		7300.94	100.00
	Returns				
	a. Main-product	Qtl.	12.97	6486.38	
	b. Bi-product	tons	2.67	1014.10	
	Gross returns	Rs.		7500.47	
	Net returns	Rs.		199.53	
	B:C ratio			1.027	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix VIII. Per hectare cost and returns of *rabi* groundnut crop grown under farming system-II in Bagalkot district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	138.87	4582.72	23.28
	a. Family labour	MD	69.76	2301.96	11.69
	b. Hired labour	MD	69.09	2279.94	11.58
2.	Machine labour	Hr		741.30	3.76
3.	Bullock labour	BPD	14.41	2189.70	11.12
4.	Seed	kg	115.79	4631.60	23.53
5.	FYM	Ton	-	-	-
6.	Fertilizer				
	a. Nitrogen	kg	-	-	-
	b. Phosphorus	kg	247.10	2396.87	12.17
	c. Potash	kg	-	-	-
	d. Complex	kg	82.36	667.10	3.3
7.	PPC	lit	1.63	449.40	2.28
8.	Miscellaneous charges	Rs.		1045.23	5.31
9.	Interest on working capital	Rs.		473.27	2.40
	Total variable costs (TVC)	Rs.		17177.19	87.28
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		12.36	0.06
2.	Depreciation charges	Rs.		296.52	1.50
3.	Rental value	Rs.		1976.80	10.04
4.	Interest on fixed capital	Rs.		217.13	1.103
	Total fixed cost (TFC)	Rs.		2502.81	12.72
III.	Total cost (I+II)	Rs.		19680.00	
	Returns				
	a. Main-product	Qtl.	19.05	32620.07	
	b. Bi-product	tons	5.76	2302.97	
	Gross returns	Rs.		34923.04	
	Net returns	Rs.		15243.04	
	B:C ratio			1.77	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix IX. Per animal cost and returns of dairy enterprise under different farming system in Bagalkot district

Sl. No.	Particulars	Units	Farming system-I			Farming system II		
			Physical quantity	Value (Rs.)	% to TC	Physical quantity	Value (Rs.)	% to TC
I	Input requirement							
	a. Dry fodder	CL	3.12	1672.32	25.49	2.85	1527.60	22.28
	b. Green fodder	CL	1.5	-	-	2.18	-	-
	c. Concentrates	Kgs	351.66	1582.47	24.12	294.38	1324.71	19.32
	d. Human labour	MD	67.45	2225.85	33.94	81.10	2676.56	39.04
	Men labour	MD	35.60	1174.80	17.91	30.40	1003.20	14.63
	Women labour	MD	45.50	1051.05	16.02	72.44	1673.36	24.40
	e. Miscellaneous charges	Rs.	-	228.63	3.48		342.45	4.99
	f. Interest on V.C	Rs.	-	485.28	7.39		499.06	7.27
	Total Variable Cost (TVC)	Rs.	-	6194.55	94.46		6370.38	92.92
	g. Depreciation	Rs.	-	363.63	5.54		485.46	7.08
	Total Cost (TC)	Rs.	-	6558.18	100.00		6855.84	100.00
II.	Returns							
	a. Milk production/day	Lit.	3.21			3.84		
	b. Lactation/days	Days	261.54			265.46		
	c. Milk production/Lactation	Lit.	839.54	7975.67		1019.36	9683.98	
	d. Dung production/year	CL	3.12	1244		3.86	1544.00	
	Gross return	Rs.		9219.67			11227.98	
	Net return	Rs.		2661.47			4372.14	
	Returns/rupee			1.40			1.63	
	Cost/litre of milk	Rs.		7.81			6.72	

Note: CL-Cart load, MD-Mandays

Appendix X. Per hectare cost and returns of Hy. jowar crop grown under farming system-I in Koppal district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	100.27	3309.01	17.53
	a. Family labour	MD	85.05	2806.71	14.87
	b. Hired labour	MD	15.22	502.30	2.66
2.	Machine labour	Hr		704.23	3.73
3.	Bullock labour	BPD	17.29	2629.14	13.93
4.	Seed	kg	7.90	237.21	1.25
5.	FYM	Ton	9.14	3657.08	19.38
6.	Fertilizer				
	a. Nitrogen	kg	123.55	617.75	3.27
	b. Phosphorus	Kg	234.74	2277.02	12.06
	c. Potash	kg	61.77	284.16	1.50
	d. Complex	kg	123.55	1000.75	5.30
7.	PPC	lit	-	-	-
8.	Miscellaneous charges	Rs.		284.16	1.50
9.	Interest on working capital	Rs.		1275.04	6.75
	Total variable costs (TVC)	Rs.		16275.59	86.26
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		8.15	0.043
2.	Depreciation charges	Rs.		235.14	1.24
3.	Rental value	Rs.		2125.06	11.26
4.	Interest on fixed capital	Rs.		224.99	1.19
	Total fixed cost (TFC)	Rs.		2593.34	13.74
III.	Total cost (I+II)	Rs.		18868.94	100.00
	Returns				
	a. Main-product	Qtl.	39.28	18819.38	
	b. Bi-product	Tons	4.94	1976.80	
	Gross returns	Rs.		20796.18	
	Net returns	Rs.		1927.23	
	B:C ratio			1.10	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XI. Per hectare cost and returns of sunflower crop grown under farming system-I in Koppal district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	86.08	2840.95	18.14
	a. Family labour	MD	85.05	2806.71	17.92
	b. Hired labour	MD	15.22	502.30	3.20
2.	Machine labour	Hr		691.88	4.41
3.	Bullock labour	BPD	12.60	1915.51	12.23
4.	Seed	kg	5.51	688.79	4.39
5.	FYM	Ton	9.38	3755.92	23.98
6.	Fertilizer				
	a. Nitrogen	kg	61.77	308.87	1.97
	b. Phosphorus	kg	-	-	-
	c. Potash	kg	-	-	-
	d. Complex	kg	123.55	1000.75	6.39
7.	PPC	lit	2.47	680.90	4.34
8.	Miscellaneous charges	Rs.		234.74	1.49
9.	Interest on working capital	Rs.		1030.05	6.57
	Total variable costs (TVC)	Rs.		13148.41	83.96
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		7.80	0.049
2.	Depreciation charges	Rs.		308.87	1.97
3.	Rental value	Rs.		1976.80	12.62
4.	Interest on fixed capital	Rs.		217.88	1.39
	Total fixed cost (TFC)	Rs.		2511.36	16.04
III.	Total cost (I+II)	Rs.		15659.77	100.00
	Returns				
	a. Main-product	Qtl.	16.06	23824.50	
	b. Bi-product	Tons	-	-	
	Gross returns	Rs.		23824.50	
	Net returns	Rs.		8164.72	
	B:C ratio			1.52	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XII. Per hectare cost and returns of bajra crop grown under farming system-I in Koppal district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	63.38	2091.57	28.73
	a. Family labour	MD	44.50	1468.58	20.17
	b. Hired labour	MD	18.87	622.98	8.55
2.	Machine labour	Hr	-	-	-
3.	Bullock labour	BPD	10.55	1603.77	22.03
4.	Seed	kg	6.72	87.37	1.20
5.	FYM	Ton	-	-	-
6.	Fertilizer				
	a. Nitrogen	kg	111.19	555.97	7.63
	b. Phosphorus	kg	117.37	1138.51	15.64
	c. Potash	kg	-	-	-
	d. Complex	kg	-	-	-
7.	PPC	lit	-	-	-
8.	Miscellaneous charges	Rs.		185.32	2.54
9.	Interest on working capital	Rs.		120.32	1.65
	Total variable costs (TVC)	Rs.		5782.86	79.45
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		6.84	0.093
2.	Depreciation charges	Rs.		160.61	2.20.
3.	Rental value	Rs.		1198.43	16.46
4.	Interest on fixed capital	Rs.		129.76	1.78
	Total fixed cost (TFC)	Rs.		1495.65	20.55
III.	Total cost (I+II)	Rs.		7278.51	100.00
	Returns				
	a. Main-product	Qtl.	12.40	6599.15	
	b. Bi-product	Tons	3.75	1168.50	
	Gross returns	Rs.		7767.65	
	Net returns	Rs.		489.14	
	B:C ratio			1.06	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XIII. Per hectare cost and returns of *kharif* groundnut crop grown under farming system-I in Koppal district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	127.08	4193.75	16.52
	a. Family labour	MD	80.94	2674.34	10.53
	b. Hired labour	MD	46.10	1521.59	5.99
2.	Machine labour	Hr		617.75	2.43
3.	Bullock labour	BPD	19.76	3004.73	11.83
4.	Seed	kg	133.43	5337.36	21.03
5.	FYM	Ton	11.51	4605.94	18.14
6.	Fertilizer				
	a. Nitrogen	kg	123.54	617.75	2.43
	b. Phosphorus	kg	164.71	1597.75	6.29
	c. Potash	kg	-	-	-
	d. Complex	kg	-	-	-
7.	PPC	lit	2.47	680.90	2.68
8.	Miscellaneous charges	Rs.		328.64	1.29
9.	Interest on working capital	Rs.		1783.69	7.02
	Total variable costs (TVC)	Rs.		22768.29	89.72
II.	Fixed Cost (FC)				
1.	Land revenue	Rs.		9.05	0.035
2.	Depreciation charges	Rs.		234.74	0.924
3.	Rental value	Rs.		2139.88	8.43
4.	Interest on fixed capital	Rs.		226.44	0.89
	Total fixed cost (TFC)	Rs.		2610.12	10.28
III.	Total Cost (I+II)	Rs.		25378.41	100.00
	Returns				
	a. Main-product	Qtl.	21.39	36378.06	
	b. Bi-product	Tons	4.94	1976.80	
	Gross returns	Rs.		38354.86	
	Net returns	Rs.		12976.44	
	B:C ratio			1.51	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XIV. Per hectare cost and returns of *rabi* groundnut crop grown under farming system-I in Koppal district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	128.88	4253.28	17.48
	a. Family labour	MD	91.32	3013.80	12.39
	b. Hired labour	MD	37.55	1239.45	5.09
2.	Machine labour	Hr	-	-	-
3.	Bullock labour	BPD	14.40	2189.70	9.002
4.	Seed	kg	247.10	988.40	4.06
5.	FYM	Ton	-	-	-
6.	Fertilizer				
	a. Nitrogen	kg	61.77	308.87	1.26
	b. Phosphorus	kg	123.50	1198.43	4.92
	c. Potash	kg	-	-	-
	d. Complex	kg	82.35	667.10	2.74
7.	PPC	lit	1.63	449.39	1.84
8.	Miscellaneous charges	Rs.		926.62	3.80
9.	Interest on working capital	Rs.		1689.58	6.94
	Total variable costs (TVC)	Rs.		21567.00	88.66
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		9.88	0.040
2.	Depreciation charges	Rs.		160.61	0.66
3.	Rental value	Rs.		2347.45	9.65
4.	Interest on fixed capital	Rs.		239.20	0.98
	Total fixed cost (TFC)	Rs.		2757.15	11.34
III.	Total cost (I+II)	Rs.		24324.15	100.00
	Returns				
	a. Main-product	Qtl.	23.05	31215.69	
	b. Bi-product	Tons	4.94	2141.51	
	Gross returns	Rs.		33357.21	
	Net returns	Rs.		9033.04	
	B:C ratio			1.37	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XV. Per hectare cost and returns of Hy. jowar crop grown under farming system-II in Koppal district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	95.45	3150.00	22.01
	a. Family labour	MD	81.04	2674.61	18.69
	b. Hired labour	MD	14.40	475.39	3.32
2.	Machine labour	Hr		284.16	1.98
3.	Bullock labour	BPD	17.29	2629.14	18.37
4.	Seed	Kg	7.75	155.17	1.08
5.	FYM	Ton	7.80	3123.34	21.83
6.	Fertilizer				
	a. Nitrogen	Kg	116.13	580.68	4.05
	b. Phosphorus	Kg	115.07	1116.22	7.80
	c. Potash	Kg	61.77	284.16	1.98
	d. Complex	Kg	-	-	-
7.	PPC	Lit	-	-	-
8.	Miscellaneous charges	Rs.		197.68	1.38
9.	Interest on working capital	Rs.		979.25	6.84
	Total variable costs (TVC)	Rs.		12499.84	87.36
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		7.61	0.053
2.	Depreciation charges	Rs.		160.61	1.12
3.	Rental value	Rs.		1482.60	10.36
4.	Interest on fixed capital	Rs.		156.82	1.096
	Total fixed cost (TFC)	Rs.		1807.65	12.64
III.	Total cost (I+II)	Rs.		14307.49	100.00
	Returns				
	a. Main-product	Qtl.	29.77	14515.58	
	b. Bi-product	Tons	4.94	1976.8	
	Gross returns	Rs.		16492.38	
	Net returns	Rs.		2184.88	
	B:C ratio			1.15	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XVI. Per hectare cost and returns of bajra crop grown under farming system-II in Koppal district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	54.13	1786.60	24.42
	a. Family labour	MD	54.13	1786.60	24.42
	b. Hired labour	MD	-	-	-
2.	Machine labour	Hr	-	-	-
3.	Bullock labour	BPD	17.29	2629.14	35.94
4.	Seed	Kg	10.37	103.78	1.41
5.	FYM	Ton	-	-	-
6.	Fertilizer				
	a. Nitrogen	Kg	148.26	741.30	10.13
	b. Phosphorus	Kg	-	-	-
	c. Potash	Kg	-	-	-
	d. Complex	Kg	-	-	-
7.	PPC	Lit	-	-	-
8.	Miscellaneous charges	Rs.		135.90	1.85
9.	Interest on working capital	Rs.		458.72	6.27
	Total variable costs (TVC)	Rs.		5855.46	80.06
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		9.68	0.13
2.	Depreciation charges	Rs.		86.48	1.18
3.	Rental value	Rs.		1235.50	16.89
4.	Interest on fixed capital	Rs.		126.50	1.72
	Total fixed cost (TFC)	Rs.		1458.18	19.94
III.	Total cost (I+II)	Rs.		7313.64	100.00
	Returns				
	a. Main-product	Qtl.	12.33	6115.82	
	b. Bi-product	Tons	3.78	1366.05	
	Gross returns	Rs.		7481.87	
	Net returns	Rs.		168.23	
	B:C ratio			1.02	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XVII. Per hectare cost and returns of sesamum crop grown under farming system-II in Koppal district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	99.50	3283.73	20.69
	a. Family labour	MD	88.14	2908.63	18.33
	b. Hired labour	MD	11.36	375.09	2.36
2.	Machine labour	Hr		710.41	4.47
3.	Bullock labour	BPD	21.00	3192.53	20.12
4.	Seed	kg	5.38	161.60	1.01
5.	FYM	Ton	7.41	2965.20	18.68
6.	Fertilizer				
	a. Nitrogen	kg	84.92	424.64	2.67
	b. Phosphorus	kg	100.37	973.60	6.13
	c. Potash	kg	-	-	-
	d. Complex	kg	-	-	-
7.	PPC	lit	-	-	-
8.	Miscellaneous charges	Rs.		247.10	1.55
9.	Interest on working capital	Rs.		1016.50	6.40
	Total variable costs (TVC)	Rs.		12975.33	81.78
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		9.26	0.058
2.	Depreciation charges	Rs.		284.16	1.79
3.	Rental value	Rs.		2347.45	14.79
4.	Interest on fixed capital	Rs.		250.88	1.58
	Total fixed cost (TFC)	Rs.		2891.76	18.22
III.	Total cost (I+II)	Rs.		15867.10	100.00
	Returns				
	a. Main-product	Qtl.	10.77	21762.59	
	b. Bi-product	Tons	-	-	
	Gross returns	Rs.		21762.59	
	Net returns	Rs.		5895.49	
	B:C ratio			1.37	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XVIII. Per hectare cost and returns of *rabi* groundnut crop grown under farming system-II in Koppal district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	141.44	4667.52	19.41
	a. Family labour	MD	102.84	3393.81	14.11
	b. Hired labour	MD	38.59	1273.70	5.29
2.	Machine labour	Hr	-	-	-
3.	Bullock labour	BPD	15.07	2291.11	9.53
4.	Seed	kg	228.32	9132.81	37.99
5.	FYM	Ton	-	-	-
6.	Fertilizer				
	a. Nitrogen	kg	123.55	617.75	2.56
	b. Phosphorus	kg	99.45	964.74	4.013
	c. Potash	kg	-	-	-
	d. Complex	kg	-	-	-
7.	PPC	lit	3.03	837.71	3.48
8.	Miscellaneous charges	Rs.		1111.95	4.62
9.	Interest on working capital	Rs.		1667.98	6.93
	Total variable costs (TVC)	Rs.		21291.39	88.57
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		7.90	0.032
2.	Depreciation charges	Rs.		276.75	1.15
3.	Rental value	Rs.		2223.90	9.25
4.	Interest on fixed capital	Rs.		238.39	0.99
	Total fixed cost (TFC)	Rs.		2746.87	11.43
III.	Total cost (I+II)	Rs.		24038.26	100.00
	Returns				
	a. Main-product	Qtl.	26.68	39363.03	
	b. Bi-product	Ton	4.94	1976.80	
	Gross returns	Rs.		41339.83	
	Net returns	Rs.		17301.56	
	B:C ratio			1.71	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XVIX. Per animal cost and returns of dairy enterprise under different farming system in Koppal district

Sl. No.	Particulars	Units	Farming system-I		
			Physical quantity	Value (Rs.)	% to TC
I.	Input requirement				
	a. Dry fodder	CL	3.30	1768.80	18.70
	b. Green fodder	CL	1.06	-	-
	c. Concentrates	Kgs	262.50	1181.25	12.48
	d. Human labour	MD	75.10	2478.39	26.20
	Men labour	MD	26.39	870.87	9.20
	Women labour	MD	69.59	1607.52	16.99
	e. Miscellaneous charges	Rs.	-	316.72	3.34
	f. Interest on V.C	Rs.	-	699.00	7.39
	Total variable cost (TVC)	Rs.	-	8922.55	94.33
	g. Depreciation	Rs.	-	536.13	5.67
	Total cost (TC)	Rs.	-	9458.68	100.00
II.	Returns				
	a. Milk production/day	Lit.	4.12		
	b. Lactation/days	Days	284.75		
	c. Milk production/Laction	Lit.	1173.17	11145.11	
	d. Dung production/year	CL	3.42	1368.00	
	Gross return	Rs.		12513.11	
	Net return	Rs.		3054.43	
	Returns/rupee			1.32	
	Cost/litre of milk			8.06	

Note: CL-Cartload, MD-Mandays

Appendix XX. Cost and returns of sheep rearing in farming system -II in Koppal district

Rs./unit

Sl. No.	Particulars	Value (Rs.)
I	Sheep cost	8896.85
II	Sheep shed and pen	3949.70
	Subtotal	12846.55
III	Equipments and tools	
	i. Baskets	26.54
	ii. Dothies	43.26
	iii. Ropes	22.51
	Subtotal	92.31
IV	Fixed cost	
1.	Interest on value of sheep	1112.10
2.	Depreciation of shed and pen	222.27
3.	Depreciation of basket dothies and ropes	33.65
	Subtotal	1368.02
V	Variable cost	
1.	Equipments	23.26
2.	Feed and fodder	590.93
3.	Medicine and veterinary service	29.44
4.	Marketing	46.67
5.	Interest on working capital	86.28
6.	Labour charge	2997.84
7.	Miscellaneous	17.53
	Subtotal	3791.95
	Grand total	5159.97
VI	Returns	
1.	Net change in flack value	2745.70
2.	Receipts from sale of sheep (No.)	
	a. Lamb rams	639.16
	b. Adult	2419.00
	Subtotal	3058.16
3.	Dead sheep and home consumption	215.43
4.	Manure (CL)	244.00
5.	Wool sold (kg)	111.60
6.	Sale of skin of the dead animal (No.)	501.48
VII.	Gross returns	6876.37
VIII.	Net returns	1716.40
IX.	B:C ratio	1.33

Appendix XXI. Per hectare cost and returns of maize crop grown under farming system-I in Haveri district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	76.13	2512.33	15.30
	a. Family labour	MD	43.61	1439.23	8.76
	b. Hired labour	MD	32.51	1073.10	6.53
2.	Machine labour	Hr		407.70	2.48
3.	Bullock labour	BPD	23.00	3496.76	21.29
4.	Seed	kg	16.28	977.03	5.95
5.	FYM	Ton	7.46	2984.96	18.18
6.	Fertilizer				
	a. Nitrogen	kg	146.30	731.53	4.45
	b. Phosphorus	kg	101.06	980.31	5.97
	c. Potash	kg	108.10	497.28	3.02
	d. Complex	kg	-	-	-
7.	PPC	lit	-	-	-
8.	Miscellaneous charges	Rs.		259.45	1.58
9.	Interest on working capital	Rs.		1092.03	6.65
	Total variable costs (TVC)	Rs.		13939.45	84.90
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		9.76	0.059
2.	Depreciation charges	Rs.		276.75	1.68
3.	Rental value	Rs.		1976.80	12.04
4.	Interest on fixed capital	Rs.		215.01	1.309
	Total fixed cost (TFC)	Rs.		2478.32	15.10
III.	Total cost (I+II)	Rs.		16417.77	100.00
	Returns				
	a. Main-product	Qtl.	35.03	18302.50	
	b. Bi-product	Tons	5.18	1219.43	
	Gross returns	Rs.		19521.94	
	Net returns	Rs.		3104.16	
	B:C ratio			1.18	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXII. Per hectare cost and returns of cotton crop grown under farming system-I in Haveri district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	130.69	4312.80	22.87
	a. Family labour	MD	61.45	2027.97	10.75
	b. Hired labour	MD	69.21	2284.01	12.11
2.	Machine labour	Hr	-	518.91	2.75
3.	Bullock labour	BPD	23.79	3616.95	19.18
4.	Seed	kg	2.41	867.60	4.60
5.	FYM	Ton	7.28	2915.78	15.46
6.	Fertilizer				
	a. Nitrogen	kg	123.55	617.75	3.27
	b. Phosphorus	kg	72.49	703.24	3.73
	c. Potash	kg	123.55	568.33	3.01
	d. Complex	kg	-	-	-
7.	PPC	lit	5.55	1532.05	8.12
8.	Miscellaneous charges	Rs.		210.03	1.11
9.	Interest on working capital	Rs.		449.46	2.38
	Total variable costs (TVC)	Rs.		16312.91	86.54
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		9.21	0.048
2.	Depreciation charges	Rs.		246.01	1.305
3.	Rental value	Rs.		2062.74	10.94
4.	Interest on fixed capital	Rs.		220.20	1.16
	Total fixed cost (TFC)	Rs.		2538.17	13.46
III.	Total cost (I+II)	Rs.		18851.08	100.00
	Returns				
	a. Main-product	Qtl.	16.38	29275.11	
	Gross returns	Rs.		29275.11	
	Net returns	Rs.		10424.03	
	B:C ratio			1.55	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXIII. Per hectare cost and returns of maize crop grown under farming system-II in Haveri district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	101.23	3340.81	18.57
	a. Family labour	MD	60.09	1983.12	11.02
	b. Hired labour	MD	41.14	1357.69	7.54
2.	Machine labour	Hr	-	358.29	1.99
3.	Bullock labour	BPD	28.51	4334.33	24.10
4.	Seed	kg	15.02	1051.65	5.84
5.	FYM	Ton	7.46	2984.96	16.59
6.	Fertilizer				
	a. Nitrogen	kg	190.93	954.67	5.308
	b. Phosphorus	kg	97.80	948.68	5.27
	c. Potash	kg	102.94	473.53	2.63
	d. Complex	kg	-	-	-
7.	PPC	lit	-	-	-
8.	Miscellaneous charges	Rs.		197.68	1.09
9.	Interest on working capital	Rs.		1244.79	6.92
	Total variable costs (TVC)	Rs.		15889.42	88.35
II.	Fixed Cost (FC)				
1.	Land revenue	Rs.		9.88	0.054
2.	Depreciation charges	Rs.		210.03	1.16
3.	Rental value	Rs.		1692.63	9.41
4.	Interest on fixed capital	Rs.		181.69	1.01
	Total fixed cost (TFC)	Rs.		2094.24	11.65
III.	Total Cost (I+II)	Rs.		17983.67	100.00
	Returns				
	a. Main-product	Qtl.	33.97	19536.34	
	b. Bi-product	Tons	4.62	924.15	
	Gross returns	Rs.		20460.49	
	Net returns	Rs.		2476.82	
	B:C ratio			1.13	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXIV. Per hectare cost and returns of cotton crop grown under farming system-II in Haveri district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	131.19	4296.50	23.01
	a. Family labour	MD	71.90	2372.90	12.70
	b. Hired labour	MD	58.29	1923.59	10.30
2.	Machine labour	Hr	-	635.04	3.40
3.	Bullock labour	BPD	22.73	3455.44	18.50
4.	Seed	kg	2.50	900.00	4.82
5.	FYM	Ton	8.03	3212.30	17.20
6.	Fertilizer				
	a. Nitrogen	kg	123.55	617.75	3.308
	b. Phosphorus	kg	53.10	515.08	2.75
	c. Potash	kg	-	-	-
	d. Complex	Kg	61.77	500.37	2.67
7.	PPC	lit	5.51	1518.94	8.13
8.	Miscellaneous charges	Rs.		256.98	1.37
9.	Interest on working capital	Rs.		443.45	2.37
	Total variable costs (TVC)	Rs.		16094.87	86.19
II.	Fixed Cost (FC)				
1.	Land revenue	Rs.		9.88	0.052
2.	Depreciation charges	Rs.		284.16	1.52
3.	Rental value	Rs.		2059.15	11.02
4.	Interest on fixed capital	Rs.		223.55	1.19
	Total fixed cost (TFC)	Rs.		2576.76	13.81
III.	Total Cost (I+II)	Rs.		18671.63	100.00
	Returns				
	a. Main-product	Qtl.	17.14	30581.86	
	Gross returns	Rs.		30581.86	
	Net returns	Rs.		11910.23	
	B:C ratio			1.64	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXV. Per hectare cost and returns of paddy crop grown under farming system-II in Haveri district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	126.31	4168.47	22.23
	a. Family labour	MD	73.53	2426.71	12.94
	b. Hired labour	MD	52.78	1741.75	9.29
2.	Machine labour	Hr	-	555.97	2.96
3.	Bullock labour	BPD	21.10	3207.55	17.10
4.	Seed	kg	78.35	1018.62	5.43
5.	FYM	Ton	7.28	2915.78	15.55
6.	Fertilizer				
	a. Nitrogen	kg	217.67	1088.35	5.80
	b. Phosphorus	kg	123.55	1198.43	6.39
	c. Potash	kg	123.55	568.33	3.031
	d. Complex	kg	-	-	-
7.	PPC	lit	-	-	-
8.	Miscellaneous charges	Rs.		259.45	1.38
9.	Interest on working capital	Rs.		1273.38	6.79
	Total variable costs (TVC)	Rs.		16254.36	86.70
II.	Fixed cost (FC)				
1.	Land revenue	Rs.		9.51	0.050
2.	Depreciation charges	Rs.		284.16	1.51
3.	Rental value	Rs.		1983.07	10.57
4.	Interest on fixed capital	Rs.		216.29	1.15
	Total fixed cost (TFC)	Rs.		2493.04	13.30
III.	Total cost (I+II)	Rs.		18747.41	100.00
	Returns				
	a. Main-product	Qtl.	35.82	23468.32	
	b. Bi-product	Tons	4.99	1996.56	
	Gross returns	Rs.		25464.89	
	Net returns	Rs.		6717.47	
	B:C ratio			1.35	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXVI. Per hectare cost and returns of cotton crop grown under farming system-III in Haveri district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	125.84	4152.98	21.73
	a. Family labour	MD	68.02	2244.87	11.75
	b. Hired labour	MD	57.82	1908.10	9.98
2.	Machine labour	Hr	-	407.71	2.13
3.	Bullock labour	BPD	23.47	3568.12	18.67
4.	Seed	kg	2.80	1008.00	5.27
5.	FYM	Ton	7.56	3024.50	15.83
6.	Fertilizer				
	a. Nitrogen	kg	123.55	617.75	3.23
	b. Phosphorus	kg	82.35	798.87	4.18
	c. Potash	kg	61.77	284.76	1.48
	d. Complex	kg	59.30	480.36	2.51
7.	PPC	lit	4.94	1361.81	7.12
8.	Miscellaneous charges	Rs.		254.51	1.33
9.	Interest on working capital	Rs.		452.16	2.36
	Total variable costs (TVC)	Rs.		16410.98	85.89
II.	Fixed Cost (FC)				
1.	Land revenue	Rs.		9.88	0.051
2.	Depreciation charges	Rs.		308.87	1.61
3.	Rental value	Rs.		2141.51	11.20
4.	Interest on fixed capital	Rs.		233.72	1.22
	Total fixed cost (TFC)	Rs.		2694.00	14.11
III.	Total Cost (I+II)	Rs.		19104.98	100.00
	Returns				
	a. Main-product	Qtl.	14.70	27444.47	
	Gross returns	Rs.		27444.47	
	Net returns	Rs.		8339.49	
	B:C ratio			1.44	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXVII. Per hectare cost and returns of Hy. jowar crop grown under farming system-III in Haveri district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	74.37	2454.44	17.47
	a. Family labour	MD	34.71	1145.61	8.15
	b. Hired labour	MD	39.65	1308.76	9.31
2.	Machine labour	Hr		457.13	3.25
3.	Bullock labour	BPD	21.62	3286.43	23.40
4.	Seed	kg	9.88	247.10	1.75
5.	FYM	Ton	6.17	247.10	1.75
6.	Fertilizer				
	a. Nitrogen	kg	123.50	617.75	4.39
	b. Phosphorus	kg	123.50	1198.43	8.53
	c. Potash	kg	-	-	-
	d. Complex	kg	-	-	-
7.	PPC	lit	-	-	-
8.	Miscellaneous charges	Rs.		243.39	1.73
9.	Interest on working capital	Rs.		932.93	6.64
	Total variable costs (TVC)	Rs.		11908.62	84.79
II.	Fixed Cost (FC)				
1.	Land revenue	Rs.		8.64	0.061
2.	Depreciation charges	Rs.		211.41	1.50
3.	Rental value	Rs.		1729.7	12.31
4.	Interest on fixed capital	Rs.		185.22	1.31
	Total fixed cost (TFC)	Rs.		2134.99	15.21
III.	Total Cost (I+II)	Rs.		14043.61	100.00
	Returns				
	a. Main-product	Qtl.	27.18	13862.31	
	b. Bi-product	Ton	4.94	1729.70	
	Gross returns	Rs.		15592.01	
	Net returns	Rs.		1548.39	
	B:C ratio			1.11	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXVIII. Per hectare cost and returns of paddy crop grown under farming system-III in Haveri district

Sl. No.	Particulars	Unit	Physical quantity	Value (Rs.)	% TC
I.	Variable Costs (VC)				
1.	Human labour	MD	126.14	4162.77	21.45
	a. Family labour	MD	77.71	2564.52	13.21
	b. Hired labour	MD	48.43	1598.24	8.23
2.	Machine labour	Hr		358.29	1.84
3.	Bullock labour	BPD	20.38	3098.63	15.96
4.	Seed	kg	76.60	1532.02	7.89
5.	FYM	ton	8.64	3459.40	17.83
6.	Fertilizer				
	a. Nitrogen	kg	247.10	1235.50	6.36
	b. Phosphorus	kg	123.55	1198.43	6.17
	c. Potash	kg	61.77	284.16	1.46
	d. Complex	kg	-	-	-
7.	PPC	lit	-	-	-
8.	Miscellaneous charges	Rs.		259.45	1.33
9.	Interest on working capital	Rs.		1325.03	6.83
	Total variable costs (TVC)	Rs.		16913.71	87.19
II.	Fixed Cost (FC)				
1.	Land revenue	Rs.		8.64	0.044
2.	Depreciation charges	Rs.		284.78	1.46
3.	Rental value	Rs.		1976.80	10.18
4.	Interest on fixed capital	Rs.		215.67	1.11
	Total fixed cost (TFC)	Rs.		2485.90	12.81
III.	Total Cost (I+II)	Rs.		19399.61	100.00
	Returns				
	a. Main-product	Qtl.	33.35	20015.10	
	b. Bi-product	Ton	3.58	1433.18	
	Gross returns	Rs.		21448.28	
	Net returns	Rs.		2048.66	
	B:C ratio			1.10	

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXIX. Per animal cost and returns of dairy enterprise under different farming system in Haveri district

Sl. No.	Particulars	Units	Farming system-I			Farming system-II			Farming system -III		
			Physical quantity	Value (Rs.)	% to TC	Physical quantity	Value (Rs.)	% to TC	Physical quantity	Value (Rs.)	% to TC
I	Input requirement										
	a. Dry fodder	CL	3.58	1790.00	26.78	3.06	1530.00	24.57	3.12	1560.00	25.19
	b. Green fodder	CL	2.37	-	-	1.80	-	-	1.61	-	-
	c. Concentrates	Kgs	2.61	1305.00	19.52	270.12	1350.60	21.69	253.01	1265.05	20.42
	d. Human labour	MD	72.10	2379.30	35.59	63.87	2107.71	33.85	68.32	2254.82	36.41
	Men labour	MD	32.55	1074.15	16.07	27.56	909.48	14.60	30.85	1018.05	16.43
	Women labour	MD	56.50	1305.15	19.52	51.88	1198.42	19.24	53.54	1236.77	19.97
	e. Miscellaneous charges	Rs.	-	245.32	3.67		266.66	4.28		223.33	3.60
	f. Interest on V.C	Rs.		486.16	7.27		446.67	7.17		450.77	7.27
	Total variable cost (TVC)	Rs.		6205.78	92.85		5701.64	91.58		5753.97	92.91
	g. Depreciation	Rs.		478.10	7.15		523.94	8.42		438.76	7.09
	Total cost (TC)	Rs.		6683.88	100.00		6225.58	100.00		6192.73	100.00
II.	Returns										
	a. Milk production/day	Lit.	3.66			3.68			3.60		
	b. Lactation/days	Days	246.87			234.10			249.55		
	c. Milk production/Laction	Lit.	903.54	9035.44		861.48	8614.88		898.38	8983.88	
	d. Dung production/year	CL	2.35	940.00		2.91	1164.00		3.21	1284.00	
	Gross return	Rs.		9975.44			9778.88			10267.80	
	Net return	Rs.		3291.56			3553.30			4075.07	
	Returns/rupee			1.49			1.57			1.65	
	Cost/litre of milk			7.39			7.22			6.89	

Note: CL- Cart load, MD- Man day

Appendix XXX. Cost and returns in sunflower production under OFD and control plots in Radder-Timmapur Tank Command of Bagalkot District

(Per hectare)

Sl. No.	Particulars	Unit	OFD plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	74.82	2469.06	78.48	2589.81
	a. Family labour		52.59	1735.47	64.37	2124.20
	b. Hired labour		22.23	733.59	14.11	465.61
2.	Machine labour		-	300.00	-	370.65
3.	Bullock labour	BPD	14.32	2176.64	13.29	2020.68
4.	Seed	kg	4.94	889.60	4.94	889.60
5.	FYM	Ton	10	4000.00	9.88	3953.60
6.	Fertilizer					
	a. Nitrogen	kg	64.24	321.20	124.17	369.41
	b. Phosphorus	Kg	160.62	1541.95	123.55	1198.44
	c. Potash	kg	98.84	454.66	80.31	369.41
	d. $ZnSO_4$	kg	-			
8.	PPC	lit	2.27	625.77	2.47	680.91
9.	Miscellaneous charges	Rs.		300.00		277.99
10.	Interest on working capital	Rs.		277.92		281.87
	Total variable cost (TVC)	Rs.		13356.78		13546.79
II.	Fixed Cost (FC)					
1.	Land revenue	Rs.		9.88		9.88
2.	Depreciation charges	Rs.		185.33		185.33
3.	Rental value	Rs.		2084.91		2084.91
4.	Interest on fixed capital	Rs.		216.61		216.61
	Total fixed cost (TFC)	Rs.		2496.72		2496.72
III.	Total Cost (TC)	Rs.		15853.50		16043.51
	Main-product	Qtl.	14.92	29725.26	12.65	20632.54
	Gross returns	Rs.		29725.26		20632.54
IV.	Net returns	Rs.		13871.76		4589.03
	B:C ratio			1.87		1.28
V.	Increase in cost in OFD plots over control plots			-190.01		
VI.	Increase in gross returns over control plots			9092.72		
VII.	Increase in net additional returns			9289.73		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXXI. Cost and returns in groundnut production under FFS and control plots in Nandikeshwar Tank Command of Bagalkot District

(Per hectare)

Sl. No.	Particulars	Unit	FFS plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	121.58	4012.14	134.74	4446.54
	a. Family labour		91.18	3008.94	81.91	2703.15
	b. Hired labour		30.40	1003.20	48.01	1584.38
2.	Machine labour		-	596.54	-	588.67
3.	Bullock labour	BPD	13.32	2024.64	15.47	2351.21
4.	Seed	kg	115.00	4600.00	141.56	5662.46
5.	FYM	Ton	10.00	2500.00	-	-
6.	Fertilizer					
	a. Nitrogen	kg	100.00	500.00	72.67	363.36
	b. Phosphorus	kg	75.00	720.75	152.61	1480.31
	c. Potash	kg	40.00	184.00	227.33	1045.73
	d. $ZnSO_4$	kg	20.00	300.00		
	e. Gypsum	g	5.00	400.00		
7.	Bio-fertilizers and biocontrol agent					
	1. Rhizobium	Qtl.	3.75	562.50		
8.	PPC	Lit	1.28	352.86	2.47	680.91
9.	Weedicides					
10.	1. NSKE	Lit	10.00	50.00		
	2. Biocontrol agent					
11.	Miscellaneous charges	Rs.		1235.50		1235.50
12.	Interest on working capital	Rs.		511.10		507.35
	Total variable cost (TVC)	Rs.		18550.03		18414.04
II.	Fixed Cost (FC)					
1.	Land revenue	Rs.		10.45		10.45
2.	Depreciation charges	Rs.		210.04		210.04
3.	Rental value	Rs.		2064		2064
4.	Interest on fixed capital	Rs.		217.02		217.02
	Total fixed cost (TFC)	Rs.		2501.51		2501.51
III.	Total Cost (TC)	Rs.		21051.54		20915.55
	Main-product	Qtl.	25.32	38578.05	20.10	34656.46
	Bi-product	Ton	5.92	2334.95	4.79	1889.26
	Gross returns	Rs.		40913.00		36545.72
IV.	Net returns	Rs.		19861.46		15630.17
	B:C ratio			1.94		1.74
V.	Increase in cost in FFS plots over control plots			135.99		
VI.	Increase in gross returns over control plots			4367.28		
VII.	Incrence in net additional returns			4231.29		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXXII. Cost and returns in groundnut production under FFS and control plots in Dammur Tank Command of Bagalkot District

(Per hectare)

Sl. No.	Particulars	Unit	FFS plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	127.78	4216.74	138.87	4582.72
	a. Family labour		67.89	2240.37	69.76	2301.96
	b. Hired labour		59.89	1976.37	69.09	2279.94
2.	Machine labour			933.42		741.30
3.	Bullock labour	BPD	13.38	2033.76	14.41	2189.70
4.	Seed	kg	120.00	4800.00	115.79	4631.60
5.	FYM	Ton	8.00	2000.00	-	-
6.	Fertilizer					
	a. Nitrogen	kg	50.00	404.50	82.36	667.10
	b. Phosphorus	kg	100.00	961.00	247.10	2396.87
	c. Potash	kg	25.00	115.00		
	d. $ZnSO_4$	kg	20.00	300.00		
	e. Gypsum	g	5.00	400.00		
7.	Bio-fertilizers and biocontrol agent					
	1. Rhizobium	Qtl.	3.75	562.50		
8.	PPC	Lit	1.00	275.67	1.63	449.40
9.	1. NSKE	Lit	10.00	50.00		
11.	Miscellaneous charges	Rs.		945.50		1045.23
12.	Interest on working capital	Rs.		509.94		473.27
	Total variable cost (TVC)	Rs.		18508.03		17177.19
II.	Fixed Cost (FC)					
1.	Land revenue	Rs.		12.36		12.36
2.	Depreciation charges	Rs.		296.52		296.52
3.	Rental value	Rs.		1976.80		1976.80
4.	Interest on fixed capital	Rs.		217.13		217.13
	Total fixed cost (TFC)	Rs.		2502.81		2502.81
III.	Total Cost (TC)	Rs.		21010.84		19680.00
	Main-product	Qtl.	23.62	37376.05	19.05	32620.07
	Bi-product	Ton	6.23	2490.80	5.76	2302.97
	Gross returns	Rs.		39866.85		34923.04
IV.	Net returns	Rs.		18856.01		15243.04
	B:C ratio			1.89		1.77
V.	Increase in cost in FFS plots over control plots			1330.84		
VI.	Increase in gross returns over control plots			4943.81		
VII.	Increase in net additional returns			3612.97		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXXIII. Cost and returns in bajra production under OFD and control plots in Ramadurga Tank Command of Koppal District

(Per hectare)

Sl. No.	Particulars	Unit	OFD plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	59.83	1974.39	63.38	2091.57
	a. Family labour		38.71	1277.43	44.50	1468.58
	b. Hired labour		21.12	696.96	18.87	622.98
2.	Machine labour		-	-	-	-
3.	Bullock labour	BPD	10.55	1603.77	10.55	1603.77
4.	Seed	kg	4.00	52.00	6.72	87.37
5.	FYM	Ton	5.00	1500.00	-	-
6.	Fertilizer					
	a. Nitrogen	kg	84.01	420.05	111.19	555.97
	b. Phosphorus	kg	60.00	576.60	117.37	1138.51
	c. Potash	kg	42.00	193.20	-	-
7.	Bio-fertilizers and biocontrol agent					
	1. PSB	kg	4.94	79.04		
	2. Azospirillum	kg	1.24	102.06		
8.	Miscellaneous charges	Rs.		250.00		185.32
9.	Interest on working capital	Rs.		131.20		120.32
	Total variable cost (TVC)	Rs.		6305.71		5782.86
II.	Fixed Cost (FC)					
1.	Land revenue	Rs.		6.84		6.84
2.	Depreciation charges	Rs.		160.61		160.61
3.	Rental value	Rs.		1198.43		1198.43
4.	Interest on fixed capital	Rs.		129.76		129.76
	Total fixed cost (TFC)	Rs.		1495.65		1495.65
III.	Total Cost	Rs.		7801.36		7278.51
	Main-product	Qtl.	16.21	8626.63	12.40	6599.15
	Bi-product	Ton	4.36	1358.57	3.75	1168.50
	Gross returns	Rs.		9985.20		7767.65
IV.	Net returns	Rs.		2183.84		489.14
	B:C ratio			1.28		1.06
V.	Increase in cost in OFD plots over control plots			522.85		
VI.	Increase in gross returns over control plots			2217.55		
VII.	Increase in net additional returns			1694.7		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXXIV. Cost and returns in groundnut production under OFD and control plots in Nilogal Tank Command of Koppal District

(Per hectare)

Sl. No.	Particulars	Unit	OFD plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	116.95	3859.35	127.08	4193.75
	a. Family labour		74.72	2465.76	80.94	2674.34
	b. Hired labour		42.23	1393.59	46.10	1521.59
2.	Machine labour			523.32		617.75
3.	Bullock labour	BPD	15.38	2337.76	19.76	3004.73
4.	Seed	kg	100.00	4000.00	133.43	5337.36
5.	FYM	Ton	12.00	4802.02	11.51	4605.94
6.	Fertilizer					
	a. Nitrogen	kg	75.00	375.00	123.54	617.75
	b. Phosphorus	kg	75.00	720.75	164.71	1597.75
	c. Potash	kg	25.00	115.00		-
	d. $ZnSO_4$	kg	20.00	300.00		
	e. Gypsum	g	5.00	400.00		
7.	Bio-fertilizers and biocontrol agent					
	1. Rhizobium	kg	3.75	562.50		
8.	PPC	lit				
9.	Weedicides		1.50	413.50	2.47	680.90
10.	1. NSKE	lit	10.00	50.00		
11.	Miscellaneous charges	Rs.		525.23		328.64
12.	Interest on working capital	Rs.		537.89		1783.69
	Total variable cost (TVC)	Rs.		19522.29		22768.29
II.	Fixed cost (FC)					
1.	Land revenue	Rs.		9.05		9.05
2.	Depreciation charges	Rs.		234.74		234.74
3.	Rental value	Rs.		2139.88		2139.88
4.	Interest on fixed capital	Rs.		226.44		226.44
	Total fixed cost (TFC)	Rs.		2610.12		2610.12
III.	Total cost	Rs.		22132.41		25378.41
	Main-product	Qtl	25.61	39709.03	21.39	36378.06
	Bi-product	Ton	5.02	2008.81	4.94	1976.80
	Gross returns	Rs.		42118.00		38354.86
IV.	Net returns	Rs.		19985.59		12976.44
	B:C ratio			1.90		1.51
V.	Increase in cost in OFD plots over control plots			-3246		
VI.	Increase in gross returns over control plots			3763.14		
VII.	Increase in net additional returns			7009.15		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXXV. Cost and returns in paddy production under FFS and control plots in Nageshanahalli Tank Command of Koppal District

(Per hectare)

Sl. No.	Particulars	Unit	FFS plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	119.36	3938.88	126.31	4168.47
	a. Family labour		77.26	2549.58	73.53	2426.71
	b. Hired labour		42.10	1389.30	52.78	1741.75
2.	Machine labour			300.00		555.97
3.	Bullock labour	BPD	18.00	2736.00	21.10	3207.55
4.	Seed	kg	61.77	803.06	78.35	1018.62
5.	FYM		-			
	Green manuring	Ton	4.94	617.75	7.28	2915.78
6.	Fertilizer					
	a. Nitrogen	kg	247.10	1235.50	217.67	1088.35
	b. Phosphorus	kg	79.07	759.86	123.55	1198.43
	c. Potash	kg	148.26	681.99	123.55	568.33
	d. $ZnSO_4$	kg	24.71	370.65		
7.	Bio-fertilizers and biocontrol agent					
	1. Vermicompost	kg	494.2	988.40		
	2. PSB	kg	1.23	37.06		
	3. *Azospriillum*	kg	1.23	37.06		
	4. Pseudomonas	Kg	1.23	37.06		
8.	PPC	lit	1.00	275.67		
9.	Weedicides					
10.	1. Neem cake	kg	150.00	750.00		
11.	Miscellaneous charges	Rs.		250.51		259.45
12.	Interest on working capital	Rs.		485.50		1273.38
	Total variable cost (TVC)	Rs.		14304.96		16254.36
II.	Fixed cost (FC)					
1.	Land revenue	Rs.		9.51		9.51
2.	Depreciation charges	Rs.		284.16		284.16
3.	Rental value	Rs.		1983.07		1983.07
4.	Interest on fixed capital	Rs.		216.29		216.29
	Total fixed cost (TFC)	Rs.		2493.04		2493.04
III.	Total cost	Rs.		16798.00		18747.41
	Main-product	Qtl	39.52	25710.52	35.82	23468.32
	Bi-product	Ton	6.82	2128.76	4.99	1996.56
	Gross returns	Rs.		27839.28		25464.89
IV.	Net returns	Rs.		11041.28		6717.47
	B:C ratio			1.66		1.35
V.	Increase in cost in FFS plots over control plots			-1949.41		
VI.	Increase in gross returns over control plots			2374.39		
VII.	Increase in net additional returns			4323.81		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXXVI. Cost and returns in paddy production under OFD and control plots in Bidarikoppa Tank Command of Haveri District

(Per hectare)

Sl. No.	Particulars	Unit	OFD plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	118.43	3908.19	126.14	4162.77
	a. Family labour		76.38	2520.54	77.71	2564.52
	b. Hired labour		42.04	1387.32	48.43	1598.24
2.	Machine labour			300.00		358.29
3.	Bullock labour	BPD	20.00	3040.00	20.38	3098.63
4.	Seed	Kg	75.00	1050.00	76.60	1532.02
5.	FYM	Ton	10.00	4000.00	8.64	3459.40
6.	Fertilizer					
	a. Nitrogen	kg	247.10	1235.50	247.10	1235.50
	b. Phosphorus	Kg	89.90	863.93	123.55	1198.43
	c. Potash	kg	75.00	345.00	61.77	284.16
	d. $ZnSO_4$	kg	25.00	375.00		
	e. Gypsum		-	-		
7.	Bio-fertilizers					
	1. Bavistin	g	150	22.50		
8.	PPC	lit	1.55	427.28		
9.	Weedicides (butachlor)	lit	0.981	168.00		
10	Miscellaneous charges	Rs.		200.00		259.45
11	Interest on working capital	Rs.		533.78		1325.03
	Total variable cost (TVC)	Rs.		15605.45		16913.71
II.	Fixed cost (FC)					
1.	Land revenue	Rs.		8.64		8.64
2.	Depreciation charges	Rs.		284.78		284.78
3.	Rental value	Rs.		1976.80		1976.80
4.	Interest on fixed capital	Rs.		215.67		215.67
	Total fixed cost (TFC)	Rs.		2485.90		2485.90
III.	Total cost	Rs.		18091.35		19399.61
	Main-product	Qtl	36.20	23186.82	33.35	20015.10
	Bi-product	Ton	5.32	2128.53	3.58	1433.18
	Gross returns	Rs.		25315.35		21448.28
IV.	Net returns	Rs.		7224.00		2048.66
	B: C ratio			1.39		1.10
V.	Increase in cost in OFD plots over control plots			-1308.26		
VI.	Increase in gross returns over control plots			3867.07		
VII.	Increase in net additional returns			5175.34		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXXVII. Cost and returns in maize production under OFD and control plots in Dommanal Tank Command of Haveri District

(Per hectare)

Sl. No.	Particulars	Unit	OFDplot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	72.31	2386.23	76.13	2512.33
	a. Family labour		46.94	1549.02	43.61	1431.23
	b. Hired labour		25.37	837.21	32.51	1073.10
2.	Machine labour			280.00		407.70
3.	Bullock labour	BPD	25.00	3800.00	23.00	3496.76
4.	Seed	kg	12.35	1173.25	16.28	977.03
5.	FYM	Ton	8.00	3200.00	7.46	2984.96
6.	Fertilizer					
	a. Nitrogen	kg	150.00	750.00	146.30	731.53
	b. Phosphorus	Kg	125.00	1201.25	101.06	980.31
	c. Potash	kg	75.00	344.00	108.10	497.28
	d. $ZnSO_4$	kg	20.00	300.00		
	e. Gypsum					
7	PPC	lit	1.23	339.07		
8	Miscellaneous charges	Rs.		300.00		259.45
9	Interest on working capital	Rs.		398.75		1092.03
	Total variable cost (TVC)	Rs.		14472.55		13939.45
II.	Fixed cost (FC)					
1.	Land revenue	Rs.		9.76		9.76
2.	Depreciation charges	Rs.		276.75		276.75
3.	Rental value	Rs.		1976.8		1976.8
4.	Interest on fixed capital	Rs.		215.32		215.32
	Total fixed cost (TFC)	Rs.		2478.32		2478.32
III.	Total cost	Rs.		16950.87		16417.77
	Main-product	Qtl	41.13	21489.63	35.03	18302.50
	Bi-product	Ton	3.81	896.91	5.18	1219.43
	Gross returns	Rs.		22386.54		19521.94
IV.	Net returns	Rs.		5435.67		3104.16
	B: C ratio			1.32		1.18
V.	Increase in cost in OFD plots over control plots			533.10		
VI.	Increase in gross returns over control plots			2864.60		
VII.	Increase in net additional returns			2331.51		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXXVIII. Cost and returns in ridgegourd production under OFD and control plots in Byagwadi Tank Command of Haveri District

(Per hectare)

Sl. No.	Particulars	Unit	OFD plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	47.39	1563.87	52.04	1717.32
	a. Family labour		28.40	937.20	31.20	1029.60
	b. Hired labour		18.99	626.67	20.84	687.72
2.	Machine labour					
3.	Bullock labour	BPD	8.00	1216.00	9.00	1368.00
4.	Seed	kg	0.6	150.00	1	250.00
5.	FYM	Ton	2	800.00	2	800.00
6.	Fertilizer					
	a. Nitrogen	kg	61.77	308.85	-	-
	b. Phosphorus	Kg	37.06	337.34	-	-
	c. Potash	kg	24.71	113.66	-	-
	d. Complex	kg	-	-	61.77	500.33
	e. Gypsum					
7.	Bio-fertilizers and bio-control agents					
	1. Captan	g	61.77	12.35		
	2. Trichoderma	g	61.77	9.88		
	3. PSB	g	247.10	74.13		
8.	PPC	lit	0.365	137.83		
9	Miscellaneous charges	Rs.		100.00		125.00
10	Interest on working capital	Rs.		102.50		101.16
	Total variable cost (TVC)	Rs.		4926.41		4861.81
II.	Fixed cost (FC)					
1.	Land revenue	Rs.		18.50		18.50
2.	Depreciation charges	Rs.		112.30		112.30
3.	Rental value	Rs.		1130.50		1130.50
4.	Interest on fixed capital	Rs.		119.82		119.82
	Total fixed cost (TFC)	Rs.		1381.12		1381.12
III.	Total cost	Rs.		6307.53		6242.93
	Main-product	Qtl	7.4	8880	5.8	6960
	Bi-product	Ton				
	Gross returns	Rs.		8880		6960
IV.	Net returns	Rs.		2572.47		717.07
	B:C ratio			1.41		1.11
V.	Increase in cost in OFD plots over control plots			64.60		
VI.	Increase in gross returns over control plots			1920		
VII.	Increase in net additional returns			1855.4		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XXXIX. Cost and returns in cotton production under FFS and control plots in Somasagar Tank Command of Haveri District

(Per hectare)

Sl. No.	Particulars	Unit	FFS/plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	129.96	4288.68	130.69	4312.80
	a. Family labour		53.56	1767.48	61.45	2027.97
	b. Hired labour		76.40	2521.20	69.21	2284.01
2.	Machine labour			300.00		518.91
3.	Bullock labour	BPD	20.00	3040.00	23.79	3616.95
4.	Seed	kg	3.00	1080.00	2.41	867.60
5.	FYM	Ton	8.00	3200.00	7.28	2915.78
6.	Fertilizer					
	a. Nitrogen	kg	98.84	494.20	123.55	617.75
	b. Phosphorus	kg	61.77	593.60	72.49	703.24
	c. Potash	kg	61.77	284.14	123.55	568.33
7.	Bio-fertilizers and biocontrol agent					
	1. PSB	kg	4.94	79.04		
	2. Pheramone trap	No.	5	200.00		
	3. Trichoderma	g	12	4.00		
8.	PPC	lit	2.46	678.14	5.55	1532.05
9.	Miscellaneous charges	Rs.		200.00		210.03
10	Interest on working capital	Rs.		409.18		449.46
	Total variable cost (TVC)	Rs.		14850.98		16312.91
II.	Fixed cost (FC)					
1.	Land revenue	Rs.		9.21		9.21
2.	Depreciation charges	Rs.		246.01		246.01
3.	Rental value	Rs.		2062.74		2062.74
4.	Interest on fixed capital	Rs.		220.20		220.20
	Total fixed cost (TFC)	Rs.		2538.17		2538.17
III.	Total cost	Rs.		17389.15		18851.08
	Main-product	Qtl	18.92	33814.72	16.38	29275.11
	Gross returns	Rs.		33814.72		29275.11
IV.	Net returns	Rs.		16425.57		10424.03
	B: C ratio			1.94		1.55
V.	Increase in cost in FFS plots over control plots			-1461.93		
VI.	Increase in gross returns over control plots			4539.61		
VII.	Increase in net additional returns			6001.54		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XL. Cost and returns in cotton production under FFS and control plots in Basapur Tank Command of Haveri District

(Per hectare)

Sl. No.	Particulars	Unit	FFS plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	122.79	4052.07	131.19	4296.50
	a. Family labour		65.59	2164.47	71.90	2372.90
	b. Hired labour		57.10	1884.30	58.29	1923.59
2.	Machine labour			300.00		635.04
3.	Bullock labour	BPD	21.00	3192.00	22.73	3455.44
4.	Seed	kg	3.00	1080.00	2.50	900.00
5.	FYM	Ton	9.00	3600.00	8.03	3212.30
6.	Fertilizer				61.77	500.37
	a. Nitrogen	kg	88.82	444.10	123.55	617.75
	b. Phosphorus	kg	63.72	612.34	53.10	515.08
	c. Potash	kg	63.72	293.11	-	-
7.	Bio-fertilizers and biocontrol agent					
	1. PSB	kg	4.94	79.04		
	2. Pheramone trap	no	6	300		
	3. Trichoderma	g	12	4		
8.	PPC	lit	2.15	592.69	5.51	1518.94
9	Miscellaneous charges	Rs.		200.00		256.98
10	Interest on working capital	Rs.		417.89		443.45
	Total variable cost (TVC)	Rs.		15167.24		16094.87
II.	Fixed cost (FC)					
1.	Land revenue	Rs.		9.88		9.88
2.	Depreciation charges	Rs.		284.16		284.16
3.	Rental value	Rs.		2059.15		2059.15
4.	Interest on fixed capital	Rs.		223.55		223.55
	Total fixed cost (TFC)	Rs.		2576.76		2576.76
III.	Total cost	Rs.		17744.00		18671.63
	Main-product	Qtl	18.85	33632.90	17.14	30581.86
	Gross returns	Rs.		33632.90		30581.86
IV.	Net returns	Rs.		15879.90		11910.23
	B:C ratio			1.89		1.64
V.	Increase in cost in FFS plots over control plots			-927.63		
VI.	Increase in gross returns over control plots			3051.04		
VII.	Increase in net additional returns			3969.67		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

Appendix XLI. Cost and returns in cotton production under FFS and control plots in Kerekyatanahalli Tank Command of Haveri District

(Per hectare)

Sl. No.	Particulars	Unit	FFS plot		Control plot	
			Phy. qty.	Value (Rs.)	Phy. qty.	Value (Rs.)
I.	Variable Costs (VC)					
1.	Human labour	MD	122.15	4030.95	125.84	4152.98
	a. Family labour		62.92	2076.36	68.02	2244.87
	b. Hired labour		59.23	1954.59	57.82	1908.10
2.	Machine labour			300.00		407.71
3.	Bullock labour	BPD	23.00	3496.00	23.47	3568.12
4.	Seed	kg	3.00	1080.00	2.80	1008
5.	FYM	Ton	8.50	3400.00	7.56	3024.50
6.	Fertilizer				59.30	480.36
	a. Nitrogen	kg	89.48	447.40	123.55	617.75
	b. Phosphorus	kg	58.74	564.49	82.35	798.87
	c. Potash	kg	58.74	270.20	61.77	284.76
7.	Bio-fertilizers and biocontrol agent					
	1. PSB	kg	4.94	79.04		
	2. Pheramone trap	No.	8.00	320.00		
	3. Trichoderma	g	12	4.00		
	4. Emidachlorophid	ml	1.40	119.00	4.94	1361.81
8.	PPC	lit	2.49	686.41		
9.	Miscellaneous charges	Rs.		250.00		254.51
10.	Interest on working capital	Rs.		426.34		452.16
	Total variable cost (TVC)	Rs.		15473.84		16410.98
II.	Fixed cost (FC)					
1.	Land revenue	Rs.		9.88		9.88
2.	Depreciation charges	Rs.		308.87		308.87
3.	Rental value	Rs.		2141.51		2141.51
4.	Interest on fixed capital	Rs.		233.72		233.72
	Total fixed cost (TFC)	Rs.		2694.00		2694.00
III.	Total cost	Rs.		18167.84		19104.98
	Main-product	Qtl	16.08	30020.88	14.70	27444.47
	Gross returns	Rs.		30020.88		27444.47
IV.	Net returns	Rs.		11853.04		8339.49
	B:C ratio			1.65		1.44
V.	Increase in cost in FFS plots over control plots			-937.14		
VI.	Increase in gross returns over control plots			2576.41		
VII.	Increase in net additional returns			3513.55		

Note: MD-Mandays, Hr-Hours, BPD-Bullock pair days

APPENDIX XLII

INTERVIEW SCHEDULE

AN ECONOMIC ANALYSIS OF FARMING SYSTEMS IN TANK COMMANDS OF NORTHERN KARNATAKA

Date: Schedule No.: ……

I.	General information		
1	Name	2	District:
3	Age:	4	Taluk:
5	Education:	6	Village:
7	*Type of farm: M&S/Medium/Large*	8	Tank command:
9	Social participation: Member of panchayat/co-operative/TUG member/FFS, member tank management committee member/other (specify)	10	Size of land holding: Irrigated:_____acre/ha Rainfed :_____acre/ha
11	Family size: Small */medium /large*		Male: Female: Children: *Total:*

Sl. No.	Name	Education	Age	Occupation (If agri. In mandays)	Average income/annum
1 2 3 4 5 6 7 8 9 10 11 12					

12.	Are there any permanent labourers? Yes/No if yes, wage paid Rs._____

II Farm inventory position

a. Land inventory (Acres)

Sl.No	Particulars	Dryland	Land value /Rent	Irrigated	Land value /Rent	Total
1	Area owned					
2	Leased in					
3	Leased out					
4	Fallow land					

b. Farm buildings

Sl. No.	Items	Year of construction	Construction cost (Rs.)	Present value (Rs.)
1.	Dwelling house			
2.	Farm house			
3.	Cattle shed			
4.	Poultry shed			
5.	Pump shed			
6.	Storage house			
7.	Others, if any (specify)			

c. Farm machinery and equipments

Sl. No.	Items	Number	Year of purchase	Purchase value (Rs.)	Current value (Rs.)
1.	Tractor				
2.	Power tiller				
3.	Bullock cart				
4.	Pump set (diesel/electric)				
5.	Ploughs				
	i. Wooden plough				
	ii. Iron plough				
6.	Cultivator				

c. Farm machinery and equipments (Contd…)

Sl. No.	Items	Number	Year of purchase	Purchase value (Rs.)	Current value (Rs.)
7.	Seed drill				
8.	Intercultural implements				
9.	Thresher				
10.	Sprayer/duster				
11.	Harrow				
12.	Leveler				
13	Puddler				
14.	Others, if any (specify)				
i.					
ii.					

d. Livestock/animal husbandry

Sl. No	Animals	Number	Year of purchase	Purchase value (Rs.)	Current value (Rs.)
1	Dairy cows				
	i. Local				
	ii. Crossbred				
2	Buffaloes				
	i. Local				
	ii. Crossbred				
3	Bullock pair				
4	Calves				
5	Poultry				
	i.				
	ii.				
	iii.				
6	Sheep				
7	Goat				

d. Livestock/ animal husbandry (Contd…)					
Sl. No	Animals	Number	Year of purchase	Purchase value (Rs.)	Current value (Rs.)
8	Piggery				
9	Fisheries				
	i. Tank				
	ii. Farm pond				
10	Others (specify)				

III. Cropping pattern

Annual crops

Season		Crop & Variety	Irrigated(Ha)	Dry (Ha)	Total (Ha)	Output		Value (Rs.)
						Mp (qt/t)	Bp (qt/t)	
Kharif	1							
	2							
	3							
	4							
Rabi	1							
	2							
	3							
Summer	1							
	2							
Biseason	1							
	2							
b.Hort.crops	1 2 3							

MP-Main product, BP-By product

IV. Sources of irrigation

Sl. No	Sources	Maximum area can be irrigated (acres)	Actual area irrigated (acres)	Cost of irrigation (Rs)	Remarks
1	Tank				
2	Canal				
3	Open well				
4	Tube well				
5	Others specify				
6	Total area irrigated				

V. Sources of fund

i. Owned (Rs)… …… ii. Borrowed (Rs)…….

If borrowed, what are the sources of credit?

Sl. No.	Sources of credit	Amount of loan (Rs)	Interest rate (%)	Year of loan obtained	Repayment made (Rs)	Outstanding amount (Rs)	Remarks
1.							
2.							
3.							
4.							
5.							

VI. A. constraints in integrated farming system approach

1. Exogenous factors (which are beyond the control of farmers) like drought, irregularities of rainfall *etc.* Yes/No
2. Fragmentation and Sub-division of the holding Yes/No
3. Scarcity of family labour due to involvement in non-farming activities/high cost of hired labour. Yes/No
4. Scarcity of owned funds and credit problems. Yes/No
5. Are you getting adequate water for irrigations? Yes/No

   If not, what additional facilities can be made to take irrigated crop?
6. Do you feel that tanks are well maintained? Yes/No

   If not, mention reason,
7. Do you observe wastage of water from tanks? Yes/No

   If yes, proportion of water lost,

   Little/Moderate/Large
8. Do you feel that other farmers are misutilizing the tank water? Yes/No.
9. Do you have any other sources of irrigation apart from tank water? Yes/No
10 When did the last siltation take up? Yes/No
11. Are you applying tank silt to field? Yes/No

    If no, give reasons for not applying
12. Are you aware of cropping sequences that are recommended for the regions? Yes/No
13. Are you following the same? If not, why give reasons if any.
14. Do you feel that the present system, which you are following, is better? Yes/No
    a. If not what are the next best systems.
       i.
       ii.

b. What are the problems in practicing these systems

i.

ii.

iii.

15. Are you getting adequate returns? If not, what are the problems? Yes/No

i. Low price for the produce

ii. Price fluctuations

iii. High cost of production

iv. Low yield of local breeds and seeds. Resulting in reduced income.

16. Are you getting adequate inputs? If not what are the problems? Yes/No

i. Non-availability of quality inputs (seeds, fertilizer, pesticides)

ii. High cost of inputs

iii. Non-availability of credit

iv. Others (specify)

17. Are you getting technical assistance? If yes what are the sources Yes/No

i. Village level workers

ii. Assistant Agriculture Officer

iii. Extension workers

iv. JSYS-officer (worker)

v. Farmer's field school

vi. Others (specify)

i. ii.

18. Where the produce was disposed?

i. In APMC ii. Village market

iii. Wholesale market iv. Retail market

19. Do you have any problem in marketing the farm produce? If yes, what were the problems?

i. Lack of transportation ii. Lack of storage facilities

iii. Lack of marketing information IV. High marketing cost

B. Advantages of farming system approach (Tick mark)

1. Efficient utilization of all the available resources ( )
2. Efficient utilization of all the land available within the farm ( )
3. Provides full employment throughout the year ( )
4. Enables recycling of waste within the farming system ( )
5. Provides balanced food diet ( )
6. Generates income throughout the year and helps in sustainable production ( )
7. Diversification in farm reduces the risk ( )

C. Information regarding impact of demonstration/farmer field schools

1. Are you aware of farmer's field schools/On-farm demonstrations conducted by JSYS in tank commands? Yes/No.
2. Which one is followed in your tank command?
   a. Farmer's field schools
   b. On Farm demonstrations

3. Wheather farmer's participation is there in taking On-farm demonstration/farmer's field schools?
4. Are you beneficiary of On-farm demonstration/FFS? Yes/No

   If yes on which crop demonstration was taken?

   i.

   ii.
5. Which methodology is followed to popularize demonstration information?

   i. Training ii. Field visit

   iii. Group discussion IV. Field days

   v. If other (specify)
6. How many farmers field are involved in taking demonstrations in tank commands?
7. How many farmers are continuing the demonstrated technology after completion of demonstration?
8. Are you continuing the demonstrated technology in your field? Yes/No

   If no give reasons,

   i. Not suitable ii. Expensive

   iii. Labour intensive iv. If other specify
9. Had you communicated the technology demonstrated to you to others? Yes/No

   If yes, for how many people

   i. Inside the village _____ ii. Outside the village _____

   Whether they agree to continue or not? Yes/No

   If no, what is the reason

   i.

   ii.
10. What type of demonstration was taken? Whether on the use of ,

    i. Improved variety ii. Improved practices

11. From demonstration of technology, are there any changes in income level? Yes/No
    If yes, what amount of change *(ha)*

Crop	Before demonstration /FFS from the field		After demonstration/FFS	
	Area	Yield	Area	Yield

12. What type of change do you observe from demonstration/farmer's field school?
    * Yield change
    * Quality change
13. Is there any change in knowledge level of farmers after demonstrations? Yes/No
14. What is your opinion about demonstration/ farmer's field schools?

    Positive/Negative/No

15. What you feel about demonstrations/FFS is there any need to change? Yes/No
    If yes, what type of change.

Cost of cultivation for annual crops (per Crop)

Crop: Variety: Area:

Season: Soil type: Condition: Dry/irrigated

A. Labour used in different operations

Sl. No.	Name of the operation	No. of times	Family			Hired			Machine labour
			M	W	BP	M	W	BP	
1.	Ploughing								
2.	Cloud crushing								
3.	Transportation of FYM								
4.	Spreading of FYM								
5.	Harrowing								
6.	Seed bed preparation								
7.	Sowing/transplanting								
8.	Fertilizer application								
9.	Hand weeding								
10.	Intercultivation/earthing up								
11.	Irrigation								
12.	Plant protection application								
13.	Watch and ward								
14.	Harvesting								
15.	Threshing								
16.	Drying, packing								
17.	Transportation & marketing								
18.	Total (a)								
19.	Wage per day (Rs.)								

B. Inputs used in production

Sl.No	Inputs	Quantity	Rate (Rs.)	Amount (Rs.)
1.	Seed			
2.	Manures			
3.	Fertilizer			
a.				
b.				
c.				
4.	Bio-fertilizer			
a.				
b.				
5.	P.P chemicals			
a.				
b.				
c.				
6.	Weedicides			
i.				
ii.				
7.	Irrigation			
8.	Labour used (a)			
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		

D. Net returns= Gross returns - Total variable cost
Rs._____ - Rs._____ = Rs. _____

Economics of Livestock Enterprises

A.LABOUR USED																	
Sl. No	Particulars	Family labour						Hired labour						Wage rate (Rs/mandays)			Contract labour charges (Rs)
		M		W		C		M		W		C		M	W	C	
		H	D	H	D	H	D	H	D	H	D	H	D				
1	Roughage collection transportation.																
2	Watch&ward (during grazing)																
3	Dry & green fodder cutting																
4	Stall feeding																
5	Shed cleaning																
6	Washing animals																
7	Milking																
8	Transportation & milk delivery																
9	Others																
10	Total																

Note: H-Hours per day, D- No. Of such working days in a year, M – Men, W- Women, C-Children

11	FEED AND FODDER COSTS				
	Particulars	Quantity /day	Total Quantity	Price /unit	Total cost (Rs.)
a	Dry fodder (kg)				
b	Green fodder (kg)				
c	Concentrates (kg)				
d	Others				

12	MISCELLANEOUS EXPENSES				
	Particulars	Quantity /day	Total Quantity	Price /unit	Total cost (Rs.)
a	Water (LT)				
b	Electricity (Units)				

MISCELLANEOUS EXPENSES (Contd..)

c	Insemination (times)				
d	Medicines (Rs)				
e	Veterinary services and supervision (Rs)				
h	Others (specify) a b				
13	ESTABLISH MENT COSTS				

	Particulars	No of units	Description	Purchase year	Purchase cost (Rs.)	Present value
a	Equipments					
b	Machinery					
c	Milk cans					
d	Drinking water cans					

14	INCOME EARNED				
	Particulars	Quantity /day	Total quantity/year	Price/unit	Total amount (Rs)
a	Milk production (LT)				
b	Dung production (CL)				
c	Sales of male calves (No)				
d	Sales of female calves (No)				
e	Sales of dried /culled animal (No)				
f	Total				

AN ECONOMIC ANALYSIS OF FARMING SYSTEMS IN TANK COMMANDS OF NORTHERN KARNATAKA

GIREESHAYYA UDAGATTI 2005 Dr. B. K. NAIK
MAJOR ADVISOR

ABSTRACT

The study was conducted in three district of northern Karnataka in selected tank commands rejuvenated by Jala Samvardhana Yojana Sangha, with an objective of identifying and analyzing the cost and returns of major farming systems and to study the impact of on-farm demonstrations (OFD)/farmers field school (FFS) on socio-economic conditions of farmers. Multistage random sampling technique was employed to select 144 sample farmers from 12 selected tank commands primary data was collected by personnel interview method. Tabular and production function analyses were employed to analyze the data. The study identified, two major farming systems each in Bagalkot and Koppal districts and three in Haveri district. In each district dairy enterprise was found to be most common as a complementary enterprise. Farming System-I of Koppal district exhibited by highest net returns (Rs.35,645/ha) followed by Farming System-I of Bagalkot district (Rs.31,238/ha). Production function analysis revealed that, inputs such as labour, seeds, fertilizers + FYM and PPC + veterinary charges were under utilized in Bagalkot district. The resources like labour, feed and concentrates and seeds were under utilized in Koppal and Haveri districts. Hence, there is scope for deployment of these resources. In OFD and FFS plots returns were increased over control plots due to reduced cost of cultivation and increased yield. The OFD/FFS conducted have successfully communicated the information on modern crop production technology to farming community. Constraints like non-availability of quality seeds, lack of awareness of recommended cropping sequences, high cost of inputs, lack of credit facility, scarcity of owned funds, low price for the produce and lack of storage facility were most severe in crop production. Hence, there is need to strengthen institutional support for provision of credit, infrastructure facility and formulate appropriate policies for safe guarding the interest of the farmers.