AN ECONOMIC ANALYSIS OF PRODUCTION OF MAJOR CROPS IN DHARWAD DISTRICT

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BY

LAXMI N. TIRLAPUR

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

JUNE, 2013

ADVISORY COMMITTEE

DHARWAD
JUNE, 2013

(S. M. MUNDINAMANI)
MAJOR ADVISOR

Approved by :

Chairman : _____
(S. M. MUNDINAMANI)

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2. _____
(B. L. PATIL)

3. _____
(J. S. SONNAD)

4. _____
(S. V. HALAKATTI)

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INTRODUCTION

Agriculture in India is one of the most important sectors of its economy. Agriculture accounts for 17 per cent of India's GDP (2012). Though, the share of Indian agriculture in the GDP has been steadily declining over the years. Yet it is still the single largest contributor to the GDP and plays a vital role in the overall socio-economic development of country. Agriculture is the primary and critical sector of our country giving livelihood and employment opportunities for vast majority of Indian population. About 52 per cent of the total workforce is still employed in the farm sector which makes more than half of the Indian population dependent on agriculture for sustainance (NSS 66th Round).

The agriculture sector in India has undergone significant structural changes in the form of decrease in share of GDP from 30 percent in 1990-91 to 17 percent in 2011-12. This decrease in agriculture's contribution to GDP has not been accompanied by a matching reduction in the share of agriculture in employment is a matter of serious.

India is still the home to the large number of poor and malnourished people in the world, a higher priority to agriculture will achieve the goals of reducing poverty and malnutrition as well as of inclusive growth. Since agriculture forms the resource base for a number of agro-based industries and agro-services, it would be more meaningful to view agriculture not as farming alone but as a holistic value chain, which includes farming, wholesaling, warehousing, processing, and retailing. Further, it may be noted that in the X and XI Five Year Plans, it is clearly mentioned that for the economy to grow at nine per cent, it is important that agriculture should grow at least by four per cent per annum.

The food grain production has increased from 199.44 MT in 1996-97 to 234.47 MT in 2011-12, of the total food grains production, production of cereals was 216.02 MT and pulses 14.77 MT, during 2011-12 highest since independence. The production of oilseeds (nine major oilseeds) has also increased from 29.76 MT to 32.48 MT during 1996-97 to 2011-12. The rapid growth has helped Indian agriculture mark its presence at global level

At present Indian agriculture is at crossroads and one of the major challenges is to reverse deceleration in agricultural growth. Main reason for deceleration in agricultural growth is declining investment particularly, public investment in agriculture research and development and irrigation, combined with inefficiency of institutions providing inputs and services including rural credit and extension, post-harvest losses of food grains at 10 per cent of the total production or about 20 MT. Other factors such as land fragmentation, out-dated tenancy laws, lack of modern market and rural infrastructure, inappropriate input pricing policies, etc. are also responsible for agrarian and ecological crisis in the country. The crux of the problem of increasing agricultural production is to increase the output per unit of input.

The cost of cultivation is an important economic indicator being taken into consideration by the Government of India. Cost of cultivation of a commodity is the total expenditure incurred on various operations and inputs that are used in the production of the commodity. Correct identification of these inputs and their measurement is crucial for realistic assessment of cost incurred in the production of the commodity. Cost of cultivation surveys are an important data source for decision making at the macro as well as micro level. Accuracy of information generated out of these surveys is, therefore, of paramount importance.

In India, the 'Directorate of Economics and Statistics' (DES), Ministry of Agriculture is the main organization responsible for collection of data on cost of production of crops. It was meant to collect representative data on inputs and output in physical and monetary terms, which could then be used for estimation of cost of cultivation per hectare and cost of production per quintal of principal crops. It has immense importance for administrators and policy planners in terms of decision making for fixation of Minimum Support Prices (MSP), selecting production strategies and identifying regional comparative advantages in crop production with a view to enhance the productivity and income of the farmers.

The information on costs and returns of different crops in different agro-climatic and crop-complex conditions can be useful to assess the economic condition of farming community in terms of employment and wage structure to assess the quality of life of agricultural laborers. Farm level input output data is immensely useful to perform production function analysis to assess the technical, allocative and economic efficiency of different category of farmers to frame the future strategies for improving the farming efficiency.

Rice (*Oryza sativa*)

Rice as a cereal grain, is the most widely consumed staple food for a large part of the world's human population, especially in Asia and the West Indies. It is an essential crop for food security, poverty alleviation and improved livelihoods in Asia. It is the grain with the second-highest worldwide production, after Maize (corn). Over two billion people obtain 60-70 per cent of their food energy from rice. About four-fifths of the world's rice is grown by small-scale farmers in low income countries. It is the predominant dietary energy source for 17 countries in Asia and the Pacific, nine countries in North and South America and eight countries in Africa. Rice is the most important grain with regard to human nutrition and caloric intake, providing more than one-fifth of the calories consumed worldwide by the human species.

World production of rice has risen steadily from about 200 MT of Paddy rice in 1960 to over 678 MT in 2010-11. The three largest producers of rice in the world during 2011 were China (197 MT), India (131 MT), Indonesia (66 MT).The rice farm productivity in India is about 45 per cent of the rice farm productivity in China, and about 60 per cent of Indonesia. Because of high domestic consumption of rice in rice-producing countries, the economic importance of rice differs from that of other traditional crop exporter. Worldwide figures are very different to those for production as only 5-6 per cent of rice produced is traded internationally. Developing countries are the main players in the world rice trade, accounting for 83 per cent of exports and 85 per cent of imports. There are numerous importers of rice, while the exporters of rice are limited. Just five countries –namely were India (9.75 MT), Vietnam (7 MT), Thailand (6.5 MT), Pakistan (3.75 MT) and the United States (3.5 MT) (USDA report-2011-12) are the major exporters of rice. The primary variety exported by Thailand and Vietnam were Jasmine rice, while exports from India included aromatic Basmati variety. China, an exporter of rice in early 2000s, was a net importer of rice in 2010.

Rice is one of the chief grains of India. Moreover, India has the biggest area under rice cultivation and leading producers of this crop, as it is one of the principal food crops. It is in-fact the dominant crop of the country. Rice being a tropical plant, it flourishes comfortably in hot and humid climate. Rice is mainly grown in rainfed areas that receive heavy annual rainfall. India is one of the world's largest producers of white rice, accounting for 20per cent of world rice production. The country's rice production declined to 89.13 MT in 2011-12 years from a record 99.18 MT in (2010-11), due to severe drought that affected almost half of the country. Major Rice producing states in India are West Bengal (14.72 MT), Andhra Pradesh (13.33 MT), Uttar Pradesh (11.79 MT) and Punjab (10.49 MT). Karnataka produced 3.72 MT of rice during 2010-11.

A Centrally Sponsored Scheme, "National Food Security Mission started in August 2007, targeted to increase the production of rice by 10 MT by the end of the Eleventh Plan (2011-12). Yield increased at a rate of 1.47 per cent per annum. during 2000-01 to 2010-11 as compared to 1.36 per cent during 1990-91 to 1999-00. There are wide differences in yield levels across states. Punjab, Haryana, Andhra Pradesh and Tamil Nadu have high yields. All the Eastern states except West Bengal have much lower productivity levels. Eastern Region of the country comprising of Bihar, Jharkhand, Eastern UP, Chhattisgarh, Orissa and West Bengal contributes 56 per cent area under rice but only 48 per cent of total rice production. Rice productivity is not only low (1.1 to 2.5 tones/ha) but also fragile.

Maize (*Zea mays*)

Maize is one of the most important cereals in developed and developing countries of the world, and provides more human food than any other cereal. It is of American origin has been domesticated about 7,000 years ago. Maize provides nutrients for humans and animals and serves as a basic raw material for the production of starch, oil and protein, alcoholic beverages, food sweeteners and more recently fuel. Maize is high yielding, easy to process, readily digestable and its price is less than other cereals. It is also a versatile crop, allowing it to grow across a range of agro ecological zones. Every part of the Maize plant has economic value. The Maize cob, used in agriculture includes as a litter for poultry and as a soil conditioner (Maize Outlook Report, 2009), it forms 15 to 18 per cent of the total ear weight and contains 35 per cent cellulose, 40 per cent pentose and 15 per cent lignin.

Maize is an important staple food in many countries of the world and the acreage and production of Maize in the world have been increasing continuously. United States (313.91 MT), China (192.90 MT), Brazil (55.66 MT), Argentina (23.79 MT), Ukraine (22.83 MT), and India (21.72 MT) are the major producer of Maize. Worldwide production was 817 MT in 2011. India is the sixth largest producer of Maize, which accounts for 21.17 per cent of the world production.

According to the FAO (Food and Agriculture Organization) statistics, the area under the Maize crop in the world is showing the increasing trend as it increased from 1446.73 lakh hectares in the year 2005 to 1610.17 lakh hectares in 2010. But the production figures found to be fluctuating like 64.52 and 72.92 MT in the year 2005 and 2006 respectively, then it decreased to 71.39 and 70.63 MT in the year 2007 and 2008 respectively, then it enormously increased to 78.81and 82.27 MT during the years 2009 and 2010. The productivity of the Maize in the world have been increased from 4459.90 kg/ha in the years 2005 to 5109.40 kg/ha during 2010.

The Ministry of Agriculture, Agricultural Statistics at Glance (2010-11), GOI revealed that, the area under the Maize crop in India always has shown an increasing trend. It was 6203 thousand hectares in the year 1998-99 then increased steadily in the next subsequent years and reached to 8553.2 thousand hectares (2010-11). The production of the crop was 0.014 MT in the year 2001-02, it increase 21.72 MT during 2010-11. Among the major producing states, Andhra Pradesh tops the list with the contribution of 17 per cent to the total Indian Maize production. Other producers are Rajasthan (14%), Madhya Pradesh (12%), Bihar (10%), Uttar Pradesh (9%) and Karnataka (8%). But now Karnataka state is gaining the pace because of high demand for the Maize from neighboring states like Maharastra and Tamil-Nadu.

In Indian Agriculture, Maize occupies a prominent position and becoming a commercial crop by replacing rice because it is more profitable (high yields, good prices, reasonable production costs). Maize accounts for major ingradient in the feed ration for broilers. Broiler rations on an average contain 60- 65 per cent Maize, 28-30 per cent Soybean meal and two to three per cent oil.

According to 'International Maize and Wheat Improvement Center' (CIMMYT) Report (2009) approximately seven to eight million tons of Maize is needed each year just for poultry feed, which represents over 50 per cent of India's total annual production of Maize. In many parts of India, the supply of Maize for use in poultry feed is becoming a problem. In most of the developing countries Maize is consumed directly as food. In India, over 26 per cent of the Maize production is used as food. The Directorate of Maize Research (DMR), a ICAR (Indian Council of Agricultural Research) body, promotes and coordinates Maize research. In recent years, the DMR has successfully promoted a number of high-yielding Maize varieties.

Chickpea (*Cicer aritinum*)

Chickpea (Bengal gram) is widely appreciated as health food. It is a protein-rich supplement to cereal-based diets, especially to the poor in developing countries, where people are vegetarians or cannot afford animal protein. The pulse proteins are rich in lysine and have low sulfur containing amino acids. It offers the most practical means of eradicating protein malnutrition among vegetarians. Bengal gram has a very important role in human diet in our country. Sprouted seeds are recommended for curing scurvy. Malic and Oxalic acids collected from green leaves are prescribed for intestinal disorders. Gram seeds contain a higher percentage of oil (4-5%) than other pulses. It has also unique characteristic of maintaining and restoring soil fertility. It is consumed in different forms all over country and thus, forms an important component of Indians' diet.

Two main types of Chickpea are cultivated in India as well as in rest of the world are Desi and Kabuli in the ratio of 3:1. Chickpea is a major and cheap source of protein in comparison with animal protein. Chickpea is the third most important pulse crop (after dry bean and pea) and accounts for 20 per cent of the world pulses production. Major producers of Chickpea include India, Pakistan, and Mexico. Global production is about 7.5 million tons from an area of 10 million hectares with an average productivity 750 kg per hectare. Six countries including India (8.22 MT), Australia (0.52 MT), Myanmar (0.48 MT), Turkey (0.47 MT) and Ethiopia (0.033 MT) were accounts for about 90 per cent of world Chickpea production, while India alone accounts for more than 60 per cent. Major exporters of Chickpea are Australia, India, Mexico, Canada, Turkey and Ethiopia. Major importers of Chickpea are Pakisthan, Bangladesh, United Arb Amirates, Algeria and India. Global area and production of chana has been increasing year after year. The output averaged at 87.9 lakh tons (2008 to 2010) from around 108 lakh hectare areas. In 2011, chana production stood at around 97 lakh tons from the area of around 115 lakh hectares.

In India Bengal gram contributes major share among the pulses which accounts for 40-45 per cent (6.33 MT) of the total pulses produced (14.30 MT) in India. Its area stood at 9185 thousand ha and its production at 8.22 MT in 2010-11. India's production depends upon the monsoon rains and the moisture availability in the soil. Major Chickpea producing states are Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Rajasthan, Karnataka, Haryana and Maharashtra.

Madhya Pradesh was the largest chana producing state contributes about 39 per cent of the total country's chana production followed by Maharashtra (14%), Rajasthan (11%), Andhra Pradesh (11%) and Uttar Pradesh (10%). Though India is the largest producer of chana, India continues to be the net importer, so as to meet out its growing domestic demand. India imports chana mainly from Myanmar, Canada, Australia, Mexico, Turkey and Iran. Normally India imports around 0.15-0.5 MT of chana annually. Despite being the largest importer, normally India manages to export some quantity of pulses mainly to Bangladesh, Sri Lanka, UAE, USA, Nepal, Saudi Arabia and Kuwait.

In India there has been major shift in Chickpea area (about 3.0 million hectares) from Northern India (cooler, long season environment) to Southern India (warmer, short season environment) during the past four decades. The short-duration varieties developed through ICRISAT along with NARS partnership have played a key role in expanding area and productivity of Chickpea in central and Southern India. Among all major pulses of Northern India, Chickpea suffered maximum loosing 63 per cent area from 4.98 million hectare to 1.85 million hectare. It is a serious concern for sustainability of agro ecosystem of Northern India.

Soybean (*Glycine max*)

The Soybean is a species of legume native to East Asia, it is an important global crop widely grown for its edible bean which has numerous uses. Fat-free (defatted) Soybean meal is a significant and cheap source of protein for animal feeds.

Soybean is known as the "Golden bean", "Miracle crop" etc, because of its several uses. It is an excellent source of protein and oil. It contains about 40 per cent of good quality protein. Besides utilization of Soybean as vegetable, it is also used in oil industry where it occupies first place in the world oil production. Soybean based food products are also suitable to diabetic patients as they contain less carbohydrates and low cholesterol. Soybean protein is also good to people who are allergic to animal protein. Therefore, it is one of the most economical protein sources in the world. It is a versatile crop with innumerable possibilities of improving agriculture and supporting industry (Ankita Parekh *et al*., 2012).

Soybean was first introduced to Europe in the early 18th century and to British colonies in North America in 1765. It is a major oilseed crop in the world covering 91.29 million hectare under oilseed crops and contributing around 57 per cent (220.81 MT) of the total oilseed production (390.39 MT) during 2010-11, which makes it as the leading oilseed crop in the world. The phenomenal increase in its area and production together with the expansion in processing units has earned a prominent position for India on the world map of Soybean industry.

Major Soybean producing countries are United States (83.2 MT), Brazil (72 MT), Argentina (48 MT), China (13.5 MT) and India (12.55 MT). These countries contribute more than 90 per cent of global Soybean production. The average worldwide yield for Soybean crops, in 2011, was 2.5 tons per hectare.

India ranked fifth both in area (9.95 million hectare) and production (12.55 MT) in the world during 2010-11 (Ministry of Agriculture, Government of India.). In India Madhya Pradesh is the major producer of Soybean, which accounts for 58 per cent of the countries production (6.67 MT), followed by Maharashtra (4.32 MT), Rajasthan (1.12 MT) and Karnataka (0.15 MT). The area under the crop in the Karnataka state during 2010-11 was 113 thousand hectare, the production was 97 thousand tons and productivity was 852 kg/ha. During same period productivity in Andhra Pradesh was highest (1278 kg/ha) and Madhya Pradesh with 1021 kg per hectare yield was at second position. Average productivity of India was 1235 kilogram per hectare. Madhya Pradesh has emerged as the soy state of the country with over 55 percent share in area as well as in production. To the edible oil pool, Soybean has attained a prominent position in India's agro-economy with 12 per cent contribution. Earnings through Soybean meal export during 2010-11 were ₹ 43,857 million.

It was observed that the ratio of price received of Soybean to each of its competing crops particularly Groundnut and Cotton seen to be more profitable for farmers particularly in Maharashtra and Madhya Pradesh (Ankit and Hugar 2011). However, non-availability of short duration high yielding varieties and good quality seed on adequate scale and low and unbalanced use of chemical fertilizers are the major constraint in achieving higher productivity. As the country is in short supply of edible oil and about 50 per cent of our edible oil consumption is fulfilled by imports of different vegetable oils, there is a direct need to promote the production of oilseeds like Soybean.

There has been a slow but steady growth in the production of Soybean in India, which is attributed to erratic monsoon, poor management, incidence of pests and disease, shattering of pods, Soybean rust and above all low input technology (Rajendra Prasad et all, 2001).

Chilli (*Capsicum annum* L.)

Chilli is one of the most important commercial spice crop of India. Chilli is used in number of activities such as vegetables, spice, condiments, sauce, pickles. Chilli occupies an important place in Indian diet and it is indispensable item in the kitchen as it is consumed daily as condiment in one or the other form. It is rich in vitamins, especially in vitamins A and C. The dried Chilli fruits constitute a major share among the spices consumed per head.

The major Chilli growing countries are India, China, Korea, Nigeria, U.S.S.R and Mexico (Hanamashetti *et al*., 2009). India is the largest producer of Chilli in the world contributing 25 per cent of the total world production. Chilli is a native of Tropical America. It was introduced into India by the Portuguese during the 16th century. India has emerged today as the foremost producer and exporter of Chilli contributing to almost one fourth of the world production. Indian Chilli is exported mainly to Sri lanka, USA, Canada, UK, Saudi Arabia, Singapore, Malaysia and Germany. Till recently, international trade in Chilli was dominated by India. Besides India (0.27 MT), other major producers and exporters of Chilli are China (0.074 MT), Pakistan (0.043 MT), Peru (0.043 MT), Spain (0.032 MT) and Malaysia (0.0390 MT). China has emerged as a principal exporter of Chilli and is serious competitor in international market. Aflatoxin and pesticide residues are the two important problems which act as constraints in increasing our exports to Europe, Japan and USA.

The total export of Chilli from India during 2010-11 was on an average only 4 per cent of total production (1.48 MT). This is mainly because of the high domestic consumption. Chilli is grown as an important spice crop in Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu and Orissa etc on an area of 767.2 hectares and production of 1202.9 tones. State level analysis revealed that Andhra Pradesh is the largest producer followed by Maharashtra and Karnataka.

Cotton (*Gossypium Sp.)*

Cotton is a natural fiber of vegetable origin, like linen, jute or hemp and composed of cellulose. The Cotton is a variety of plants of the genus Gossypium, belonging to the Malvacae family. Out of about 50 species of Cotton plants in the world, only four have been domestically cultivated for fibers viz. *Gossypium arboreum, Gossypium herbaceum, Gossypium hirsutum* and *Gossypium barbadense*. Among them *Gossypium hirsutum* and *Gossypium barbadense* are the most commonly cultivated species of Cotton in the world. Gossypium *hirsutum* variety is the most important agricultural Cotton accounting for more than 90% of world fiber production. The diploid species (*Gossypium arboreum* and *Gossypium herbaceum*,) referred to as the 'Desi' Cotton, having low productivity and low quality Cotton, contributes 25 - 30% of the country production. The tetraploids variety contributes remaining 70% of the Cotton production in India.

Cotton is being cultivated in 70 countries of the world with a total coverage of 32.30 million hectares (mh) (Gaddi et al 1998). During 2009-10, four major Cotton producing countries were China (6.59 MT), India (5.99 MT), USA (3.42 MT), Pakistan (2.32 MT) and Brazil (1673340 MT) which accounted for approximately three-quarters of world's Cotton production.

India was recognized as the cradle of Cotton industry for over 3000 years (1500 BC to 1700 AD). India produces finest and beautiful Cotton fabrics since time immemorial. India, being the earliest country in the world for domesticated Cotton production and manufacture of Cotton fabrics, stood first in Cotton cultivated area (about 33% of the world Cotton area) and second in production among all Cotton producing countries in the world next to China (as per production record in 2009 -10). In India, Cotton was cultivated in an area of 11.16 m ha with a production of 31.20 million bales of seed Cotton during 2010-11 with productivity of Cotton in India is 494 kg lint/ha, which is low when compared to world average of 725 kg lint/ha. The textile industry accounted for 14.4 per cent of the country's export earnings as of 2010. India (1.57 MT) is the second largest exporter of Cotton behind the US (2.97 MT). Major export destinations are Bangladesh, Pakistan, China (Mainland) and other Far-East countries.

The important Cotton growing states in India are Maharashtra, Gujarat, Andhra Pradesh, Madhya Pradesh, Punjab, Haryana, Karnataka, Rajasthan and Tamil Nadu. In 2009-10 the highest Cotton-producing State in India was Gujarat (95 lakh bales), followed by Maharashtra (67 lakh bales).

In India Cotton production over the last 10 years has increased by more than 89 per cent, from 156 bales in 1999-00 to 295 bales in 2009 - 10.

Indian government has been actively participating in the growth of Cotton industry and government agencies like Cotton Corporation of India (CCI) and State Marketing Federations, Committees and Institutions like Genetic Engineering Approval Committee (GEAC) and the Central Institute of Cotton Research (CICR) play an active role in the development of Cotton industry. Technology Mission on Cotton was launched in February, 2000 with the objective to increase Cotton production, productivity and improvement in Cotton quality to increase the income of Cotton growers and ensuring abundant supply of quality Cotton to the textile mills.

The Indian Cotton cultivation sector has not only been increasing its productivity, but also has been undergoing a drastic improvement in terms of quality of Cotton. Cultivation of hybrids, Bt Cotton varieties, latest production technology and plant protection technologies, adoption of scientific and agronomic practices by farmers, increase in area under irrigation, Government policies such as giving greater force to research and development in Cotton, encouraging use of quality seeds and pesticides and price support, are all responsible for the present drastic changes in Indian Cotton scenario. But India still has to go long way to catch up with the world average yield levels.

Keeping in view the importance of above crops in the national and Karnataka's economy, an attempt was made to anlyse the economics of cultivation of these crops. The findings of the study will threw light on the extent of inputs utilized in production these crops, cost incurred on each component of input used, extent of yield realized, the extent of gap in inputs utlisation and yield realisation, the constraints faced in production of these crops. This kind of information is useful to the researchers, policy makers, bankers and farmers to decide profitable cropping pattern, input utilsation pattern, scale of finance for different crops and formulation of appropriate price policis.

Present study

The present study was undertaken to analyse the cost and returns of major crops in Dharwad district, with more focuss on input utilization pattern, resource use efficiency and constraints in production with the following specific objectives.

Specific objectives

1. To analyze growth in area, production and productivity of major crops in Dharwad district.
2. To identify cropping pattern of sample farmers in the study area.
3. To analyse input utilization pattern, cost and returns in production of major crops in study area.
4. To analyze resource use efficiency in production of major crops.
5. To identify constraints in production of major crops and suggest appropriate policy measures to enhance productivity of crops in the study area.

Hypotheses

1. Growth in area and production of major crops is increasing over the years.
2. Diversified cropping pattern is observed in Dharwad district.
3. Returns are higher than cost in the cultivation of major crops.
4. Farmers are not utilizing the resources efficiently in production of major crops.
5. Farmers are facing many constraints in production of crops.

Presentation of the study

The study is presented in seven chapters. Chapter-I introduces the reader to the topic and presents the specific objectives of the study. Chapter II comprehensively presents a review of relevant research work done on the related topics. Chapter III outlines features of the study area, sampling design followed, nature and sources of data collected data and analytical tools used in the study. Chapter IV is devoted to main findings of the study through tables, graphs *etc.* Chapter V concentrates on discussion of results of the study. Chapter VI summarizes findings of the study and brings out policy implications that emerge from the findings of the study and references of the related studies are listed out in the last chapter.

REVIEW OF LITERATURE

A review of past research helps in identifying the conceptual and methodological issues relevant to the present study. This chapter attempts a brief review of the relevant research literature that has accumulated on the areas related to this study. Keeping in view the objectives of the study, the reviews are presented under the following sub-headings.

2.1 Growth Trend in Area, Production and Productivity of Crops

2.2 Cropping Pattern

2.3 Input Utilization Pattern and Resource Use Efficiency in Cultivation of Crops

2.4 Cost and Returns in Cultivation of Crops

2.5 Constrains Faced During Crop Production

2.1 Growth Rate in Area, Production and Productivity of Crops

Bhowmick and Ahemed (1993) conducted a study on Behaviour of trend and growth of area, production, productivity and supply response of major oilseed crops in Assam. The study was based on secondary data. The data on area production and productivity of major oilseed crops for pre and post- Green Revolution period from 1950-51 to 1988-89. Analytical tools like Linear and Compound growth rates were used. Results of the study shown that among the pulses linseed crop showed the highest and positive significant compound growth rate in area (7.31 %), production (7.95 %) and yield (3.58 %).

Kaushik (1993) studied the growth of oilseeds production in India for the period from 1968-69 to 1991-92. The period was divided into two sub-periods, Period I (1968-69 to 1979-80) and Period II (1980-81 to 1991-92) to clearly bring out the trend in the more recent period. The exponential growth model was used. The study revealed that during Period I, most of the growth in oilseeds output was due to growth in area, where as in Period II it was mainly due to improvement in productivity.

Gautam and Verma (1993) carried out time series analysis of area, production and productivity of rapeseed and mustard for Period I (1968-69 to 1978-79) and Period II (1979-80 to 1988-89) for the Gird region of Madhya Pradesh. Resuls of the study revealed that inconsistency of area and productivity during Period II was more than in Period I. The effect of interaction between area and yield on the total production was greater during Period II. The contribution of yield growth was less than area in total production which also showed a lower degree of stability in both periods.

Jain *et al.* (1994) reported growth and instability analysis of oilseed production in five districts of Bundelkhand zone of Madhya Pradesh for a period of 10 years (1980/81-1989/90). An analysis was conducted with data on area, yield and production of Soybean, Sesame and Groundnuts. Increased production of Soybean and Groundnut were attributed more to the area effect. Whereas in case of Sesame, the yield effect was more evident than the area effect.

Hiremath (1994) studied growth rates for dry Chillies in Dharwad district and found that the growth rate with respect to area was higher (5.9%) which was closely followed by production (5.18%) and productivity was very low (0.011%). All these parameters showed positive growth rate with respect to dry Chillies in Dharwad district.

Lal *et al.* (1994) revealed that during pre-green revolution period (1951-52 to 1968- 69), compound growth rates of area, production and productivity were positive and significant for Rice, Wheat and Maize in Bihar. Whereas during post-green revolution period (1969-70 to 1987-88), wheat had shown significant improvement in area, production and productivity in Bihar. In contrast to the significant growth performance of Maize in area, production and productivity during post-green revolution period, there had been non-significant growth in area, production and productivity during pre-green revolution period. Rice had shown continued positive and significant growth performance. For overall period, the growth rate of production was significant for Rice, Wheat and Maize, which resulted due to increase in productivity. Contribution of area was non-significant for Rice production. Singh *et al.* (1994) conducted a study on inter-regional trend analysis of Sugarcane acreage, production and productivity in Uttar Pradesh, based on 20 years secondary data from 1970-71 to 1990-91.

The annual compound growth rates of area, production and productivity of Sugarcane was worked out employing exponential equation of the form $Y=ab^t$. Results of the study revealed that area and production of Sugarcane was increased annually 37.99 per cent and 89.42 per cent. Productivity was increased from 40.6 tonnes to 55.8 tonnes during the study period.

Vani and Vyasulu (1996) analyzed the growth of three major cereal crops on Karnataka for the period 1955-56 to 1989-90. They used six growth models from which the best fit was selected. The results showed that rice forms an important crop in 17 districts: Ragi and Sorghum in nine districts. The average annual growth rate in production of Rice, Ragi and Sorghum were 3.9per cent, 6.08 per cent and 3.22 per cent respectively. Rice productivity was found to be high in the district of Chitradurga, Mysore, Mandya and Raichur. Chitradurga and Shimoga districts showed higher yield per hectare in case of Ragi as compared to other districts. The yield per hectare in the case of Sorghum was found to be high in Chitradurga, Dharwad and Bellary districts.

Sawant (1997) in his study on the performance of Indian agriculture, used time series data for the period from 1967-68 to 1995-96. The data were analyzed using compound growth rate after fitting log linear function. Auther found that, of the two cash crops, namely, Cotton and Sugarcane, the former moved due to high growth rate of its output expanding four per cent during 1981-82 to 1994-95, mainly due to significant advances in its seed technology and resultant high growth in the yield per hectare.

Billore and Joshi (1998) analysed the growth in area, production and productivity of Soybean in India. The study was based on secondary data for the period from 1980-81 to 1993-94 for 16 states in India. Analytical tools like Linear growth equation, Compound growth rate and Coefficient of variation were used. The analysis of the data for the country indicated highest LGR during 1980-85, while it declined in 1986-90 and again it was picked up during 1991-94. CGR showed constant growth during all the three five years blocks. Karnataka showed negative values for LGR and CGR with respect to area, production and productivity during 1986-90.

Gaddi *et al.* (1998) studied growth rates in area, production and productivity of Cotton for the major Cotton producing countries and the state of Karnataka in India for the period from 1982-83 to 1996-97 in the former case and from 1970-71 to 1996-97 in the latter, using exponential function. The results showed that world Cotton area declined by 0.33 per cent per annum even with improvement in productivity. Similar results were reported at all India level, Karnataka state and in some of the traditional Cotton growing districts. Production of Cotton registered significant growth in all the cases mainly due to the substantial growth in productivity. This study considered only one period growth analysis that made it incredible compared to the present study, which was comprehensive in its dimensional objective and the period accounted.

Gaddi *et al.* (1999) analysed growth rates of area, production and yield of nine major oilseeds in India using data for the period 1980/81 to 1992/93. The instability of area, production and yield of oilseeds and the contribution of area and yield towards production were studied. Positive and significant growth was observed in area and production of all the oilseeds except Safflower and Linseed. In the case of Safflower, the growth was negative and non-significant whereas, it was significant in linseed. Growth rate of yield were positive and significant for Castor, Sesame, Linseed and Rapeseed-Mustard. Area and production of Sunflower and Soybean were highly unstable when compared to other oilseeds. Area was found to be the major contributor to the production of Sunflower and Soybean, whereas yield was the major contributor to the production of Castor and Sesame.

Archana and Srivastava (2003) analysed growth rate and instabilities in sugarcane production in different regions of Uttar Pradesh, using time series data (1980-81 to 1998-99) on area, production and productivity of Sugarcane for Western, Eastern and Central (including Bundelkhand) regions as well as for the state as whole. Semi-log equations were fitted to estimate compound growth rates in area, production and productivity of Sugarcane. Instability in area, production and productivity was measured computing coefficient of variation using de-trended data. The production instability was also decomposed to examine the magnitude of various components of regional Sugarcane production variability. Even though significant and positive growth in the production of sugarcane had emerged as a common feature in all the three regions of the state, its magnitude had not uniform across the regions. The study suggested adequate measures to improve location specific production technology through research, development and also ensured input supply mechanism. Devaraj *et al.* (2003) analysed trends in area, production and productivity of pulses in Bundelkhanda region of Uttar Pradesh. using time series data for the period from 1980-81 to 1999-2000.

The data were analyzed by fitting exponential function. The results revealed that the area under total pulses showed an increasing trend throughout the study period.

The production increased from 578.04 thousand tones in 1980-81 to 1083.65 thousand tones in 1999-2000, whereas productivity of the pulses increased from 748 kg/ha to 968 kg/ha.

Ranjit Kumar *et al.* (2005) found that Bihar was the only state, which performed well and registered high growth rate in Maize yield among the six states considered for the study. Punjab followed next to Bihar with nearly 76 per cent of the Maize area recording higher yield but with slow growth. With respect to stability of Maize yield growth, most of the districts were found to be unstable.

Toor *et al.* (2006) estimated the growth in production of selected commodities during 1990-91 to 1995-96 and 1996-97 to 2003-04. The results indicated declining trend in case of total food grains, cereals, pulses, sugarcane, oilseeds, milk, egg and fisheries. But the growth rates were observed negative in case of oilseeds, Cotton and pulses, which indicated decline in their production after initiation of globalization process.

Saravanadurai and Kalaivani (2010) conducted a study on growth actions of selected cereal crops in Tamil Nadu state, using the data from 1993-94 to 2007-08, the Compound Growth Rate (CGR) of area, production and yield for the selected cereal crops in the Tamil Nadu state were estimated. In Tamil Nadu, Paddy held good performances in absolute terms. But the compound growth rate revealed that the Maize was found to be positive and records a highest growth rate among other cereal corps in terms of area, production and yield in Tamil Nadu over the study period but it could not serve the purpose of livelihood for majority of the population in Tamil Nadu state. Hence, the importance had given to the Paddy cultivation. Besides, the study suggested that the farmers can also cultivate Maize for the money-making purpose in the Tamil Nadu state that suited for the climatic conditions of the state as well.

Sonnad *et al.* (2011) studied growth of oilseeds in India during pre-and post- WTO periods. Results of the study revealed that Soybean had the maximum overall growth rate of 19.48 per cent followed by Sunflower, Castor and Rapeseed and Mustard with 8.72 per cent, 5.88 per cent and 4.60 per cent respectively.

Veerangouda (2011) studied growth scenario of Chilli in North Karnataka, using secondary data on area, production and productivity of Chilli for the period from 1997-98 to 2007-08. The compound growth rate of area in Belgaum (4.85 %), Gulbarga (0.81%) and Raichur (0.40 %) districts were found to be significant at ten per cent, but Haveri (0.65%) district registered significant growth rate at five per cent. Production wise Belgaum (5.49 %), Bijapur (1.11%), Haveri (0.79%) districts significant at ten per cent level of significance, but Gadag (1.09 %) district was significant at five per cent of level of significance and growth rate of other districts were non-significant. Productivity wise Bidar (1.74%) and in Raichur (0.21%) districts were significant at ten per cent of level of significance and in rests of the districts growth rate were non-significant.

2.2 Cropping Pattern

Krishnan *et al.* (1991) studied the growth and instability of agriculture in Kerala and observed a shift in the cropping pattern. The cropping pattern shifted in favour of plantation and commercial crops. They concluded that though the shift in cropping pattern was a welcome sign in terms of the theories of economic development, it was at the cost of making the state deficient in rice, the staple crop of the state. The shift in the cropping pattern was attributed to the exorbitant hike in wage.

Behura and Naik (1994) studied the change in the cropping pattern for the period from 1966-67 to 1990-91 in Orissa. The results revealed that the area under rice, which was the most important crop of the district, declined from 58 per cent of the gross cropped area in 1966-67 to 38 per cent of the gross cropped area in 1990-91. They observed that the reduction in area under rice was mainly due to substitution of this crop by commercial crops like Chilli, Cotton *etc.*

Lal and Singh (1994) studied the structural changes in Haryana agriculture. The study revealed the shift in the cropping pattern and value shares in favour of Paddy and Wheat primarily grown in relatively better resource endowed area. This resulted in an impressive growth in the production of these two superior cereals, where as the coarse cereals were by passed the growth process. They felt that more attention should be given towards yield improvement in non-food grain crops, so that, the balance could be maintained in the food grain basket of the state.

Parmer *et al.* (1995) examined the degree of change in cropping pattern in four districts of South Gujarat during the period 1960-61 to 1989-90. The period of study was divided into three sub-periods as 1960-61 to 1969-70, 1970-71 to 1979-80 and 1980-81 to 1989-90.

The changes in cropping pattern were measured using rank correlation coefficient. The fluctuation in cropping pattern was found to be severe in Bharuch district, moderate in Surat and Valsad and least in Danya district. In the Bharuch district, the acreage under Tur increased tremendously while that of other crops decreased.

Sawant and Achuthan (1995) analyzed the India's agricultural growth across crops and regions from 1967-68 to 1992-93. They found that the food grains output in the 1980's expanded at a low rate of 1.32 per cent in Andhra Pradesh and remained stagnant with non-significant growth in Karnataka. Shift in area from food grains to non-food grains was pronounced and the performance of non-food grains production was better in 1980's which was mainly attributed to area expansion. In Karnataka, the yield per hectare of Cotton increased at the rate of 9.63 per cent during 1980's, while Groundnut output growth was non-significant.

Singh *et al.* (1997) studied the cropping pattern during pre (1959-60 to 1968-69) and post (1969-70 to 1990-91) green revolution periods in plateau region of Bihar. Rice was the most important crop contributing to more than 70 per cent of the total cropped area. There had been a marginal change in the share of Maize in total cropped area in pre-green revolution period, whereas wheat and Maize showed marked changes during the post-green revolution period. The area under pulses declined considerably but after the introduction of high yielding varieties programme, the cropping pattern had shifted in favour of Wheat, Potato and other vegetable crops

Kumar and Singh (1998) made an attempt to analyze the cropping pattern in North Bihar during post-green revolution period (1970-71 to 1993-94). The study revealed that the cropping pattern of North Bihar was still predominated by cereal crops. The predominance of cereal crops in the cropping pattern was attributed to the food grain scarcity in the project area and biochemical and genetic innovations in principal cereal crops during post-green revolution period.

Kebebe *et al.* (2000) studied the diversification of agriculture in Haryana. Study revealed that cereals, commercial crops, vegetables and fruits were found to be relatively more diversified as compared to pulses and oilseeds among the crop groups. Diversification towards high-tech innovative enterprises within the agricultural sector such as vegetables, fruits and towards agro-food processing and rural non-farm sector had been gaining momentum in the State.

Hazra (2001) studied the changes in cropping pattern at the all India level by considering the area share of crops and crop groups at four time points, respectively the triennium ending average of areas at 1966-67, 1976-77, 1986-87 and 1996-97. The study revealed that there was a shift from traditionally grown less remunerative crops to more remunerative crops. The crop shift took place due to government policies and thrust on some crops in a given time. Market infrastructure development and certain other price related support also induced the changes in cropping pattern.

Jayakumar and Velayudhan (2002) studied the agricultural stagnation in Kerala and reported that agriculture, though stagnant for the last many years, was still a major sector of Kerala economy. They observed that the area and production of food crops had been declining over the years, while the area, production and productivity of cash crops had increased. They concluded that the prevalence of obsolete technology in the state and the relative profitability influenced the farmers' decision to allocate land under different crops and resulted in agricultural stagnation.

Goswami and Challa (2004) studied the changes in cropping pattern for the period from 1950-51 to1997-98. The results showed that there was gradual shift in area from food crops to non-food crops indicating more diversification in recent times. The proportion of area under total cereals to total cropped area reduced from 61.1 per cent in 1950-51 to 53.08 per cent in 1997-98. Reverse scenario was noticed in the case of total oilseeds where there was almost three-fold increase in area during the period under study. Rao and Shahid (2005) studied the dynamics of cropping pattern in sorghum growing states of India. They revealed that at the district level, Dharwad had set of competing crops like Groundnut and Cotton to Sorghum, while the Belgaum district had another set of competing crops like Pearl-millet and Maize to Sorghum. The Transition Probability Matrix clearly demonstrated that Karnataka had Sorghum area retention of 31 per cent in 1970-73 Dinesh *et al.* (2007) studied the crop diversification in Chhattisgarh and observed that the pattern of land use and cropping pattern had changed during pre-reform and post-reform periods. The area under forest had increased in Chhattisgarh plains and Northern hills, while it had decreased in Bastar plateau.

Land put to non-agricultural uses and cultivable waste land had increased in Chattisgarh plains while it had decreased in Northern hills. The permanent pasture in plains and plateau were depleting very fast. On the other hand, Paddy area had been continuously increasing in last three decades. The increase was occurred at the expense of coarse cereals and minor millets area. Wheat area was diverted to Gram cultivation.

Munish (2007) studied the growth and changes of Indian agriculture since the eighties. The study revealed that agricultural sector was traditionally regarded as having low price responses. Cropping patterns were different in different areas because of economic reasons or technological reasons but the change was slower.

Subrata (2007) conducted a micro level study on economics of cropping pattern changes in relation to credit in West Bengal. The study concluded that the credit availability from both institutional and non-institutional sources had made a significant contribution on the change in cropping pattern. But the impact of credit availability on cropping pattern change had been more significant in the case of smaller size of land holdings. Again, the profitability was also higher in the case of small and marginal farmers. The profit per acre from non-food grains cultivation was more than that from food grains.

Batla (2008) studied the regional dimensions of inter-crop diversification in India and observed that inter-crop area shifted in favour of high yielding crops like Wheat, Paddy, Oilseeds, Cotton and sugarcane up to eighties and towards Paddy, Sugarcane, fruits vegetables, fibres, plantations, condiments and spices during the nineties and early 2000. The area under Wheat and Paddy had expanded solely at the cost of low yield growth crops like coarse cereals and pulses due to price support and HYV programme. The high value commercial crops had benefited both from area shifts as well as fresh land brought under cultivation.

Tingre *et al.* (2008) made an attempt to study the cropping pattern changes and crop diversification in Akola district of Vidarbha. The study revealed that majority of cereal crops showed negative and low growth in area during the study period. Soybean had attained important position in the cropping pattern. The trend of crop diversification and cropping intensity increased significantly.

Meenakshi and Indumathy (2009) studied the land utilization and cropping pattern in Tamil Nadu. The study revealed that there was a considerable reduction in the cultivated area and hence output was affected to a great extent. The cropping pattern in the state had a high degree for maladjustment for crops. Roughly 53 per cent of the cultivated area was being used for growing unsuitable crops.

2.3 Input Utilization Pattern and Resource Use Efficiency in Cultivation of Crops

Sunandini *et al.* (1993) conducted a study on resource productivity and resource use efficiency on Paddy farms of Andhra Pradesh. Stratified random sampling proportional to stratum size sampling procedure was used for selecting 611 farmers. Cobb Douglas production function was used to analyse the data. Results revealed that none of the resources in the study area were used optimally, since MVP to factor cost ratios was not equal to one.

Velayutham and Zeaudeen (1993) conducted a study on resource use efficiency in sesamum production in South Arcot District of Tamil Nadu. Multistage stratified random sampling procedure was followed to select 100 sample farmers. Data required for the study was collected by personnel interview. Cobb Douglas production function was used to analyse the data. Results of the study revealed that coefficient of multiple determination was 0.8730. It implies that 87 per cent variation in yield of sesamum was explained by five independent variables included in the model. Among the five variables, land and human labour were found to influence the production positively and significantly. Sum of elasticis of production (bi) was 1.235 indicating increasing returns to scale.

Krishna *et al.* (1995) conducted a study on resource use efficiency and returns to scale in production of caster in Andhra Pradesh. Stratified random sampling was followed to select 122 farmers. Data required for the study was collected by personnel interview method. Cobb Douglas production function was employed to analyse resource use efficiency. Results of the study revealed that MVP to factor cost ratio for labour, seed and fertiliser was greater than unity indicating under utilization of resources by of small farmers. In case of medium farmers MVP to factor cost ratio with respect to human labour, cattle labour and seed was more than one.

Koppad *et al.* (1997) studied the resource use efficiency in irrigated wheat in three locations of Malaprabha Command Area in Karnataka. The study revealed that land was under-utilized in head and tail reach and over utilized in mid reach. Human labour was under utilized in head and mid reach and over-utilized in tail reach. Bullock labour was excessively used in all the reaches. Seed was also under-utilized in all the reaches but it had contributed significantly to the growth of income in tail reach. Manure and fertilizer were contributed significantly to the gross income in tail reach and under-utilized in all the reaches. Further, the results of the functional analysis indicated that the variables included in the function explained 94, 99 and 95 per cent variation in the gross income in head, mid and tail reaches, respectively.

Nagaraj *et al.* (1998) employed Cobb-Douglas type of production function to evaluate the resource productivity and resource use efficiency. The results of the production function for various crops revealed statistically non-significant regression coefficients for number of inputs. The non-significant positive regression coefficients of factors indicated that these factors did not significantly contribute to the gross returns. The negative coefficients implied that the respective factors were used in excess of requirements.

Raghuwanshi *et al.* (1999) studied the resource use efficiency in wheat cultivation in Bundelkhand region of Madhya Pradesh. The cost of cultivation of wheat was estimated to be ₹.6496 per hectare at overall level. The yield performance was found deter on small farm when compared to that on medium and large farms. The efficiency of input use in wheat cultivation was analyzed by fitting a Cobb-Douglas type of production function and coefficients were found to be less than unity indicating decreasing return to scale. Among the five independent variables (human labour, bullock labour, seed, fertilizer and irrigation), fertilizer and irrigation were found to influence the production of wheat positively and significantly. Velavan and Balakrishnan *(*2000) examined the resource-use efficiency in groundnut production. Various input for groundnut cultivation 120 farmers selected from irrigated and un-irrigated regions in Salem district of Tamil Nadu. The study indentified large scope for adding more farm inputs in both irrigated and un-irrigated groundnut cultivation.

Reddy *et al.* (2004) conducted a study for two years (2001 and 2002) on farmer's field in Kolar district (Eastern dry zone, Karnataka, India) to study the resource use efficiency of organic manures on growth and yield of Paddy under tank irrigation. Application of poultry manure (9 t/ha) or sewage sludge (9 t/ha) to Paddy, produced grain yield on par with recommended dose of fertilizers + 10 tones farmyard manure (FYM), but both were higher (67% and 69%, respectively) than FYM or urban compost alone. Poultry manure and sewage sludge produced better growth components, *viz.*, plant height and number of tillers per hill, total dry matter per plant and yield components like number of panicles per hill and panicle weight. The highest B:C ratio of 2.73 was obtained with sewage sludge followed by recommended practice (2.61) and poultry manure (2.41).

Senthil Kumar et.al (2005) studied resource use efficiency in Paddy cultivation. Various input factors for Paddy cultivation 90 farmers surveyed from head, mid and tail reach of the Lower Bhavani Basin Project (LBP) Command Area of Tamil Nadu. The study suggested that there was scope for further use of various input factors for enhancing the productivity.

Suresh and Keshavareddy (2006) conducted a study on resource-use efficiency of Paddy cultivation in Peechi Command Area of Thrissur District of Kerala, Using the primary data collected from 71 Rice farmers of the command area by following stratified random sampling technique. The allocative efficiency had indicated that marginal return per rupee increase under these heads would be ₹ 2.83, ₹ 1.57 and ₹ 1.17, respectively. The average technical efficiency of the Paddy farmers in the command area was found to be 66.8 per cent. Education of the farmers and supplementary irrigation provided during the water-stress days had been identified as the major factors which could enhance the technical efficiency.

Taru *et al.* (2008) conducted a study on economic efficiency of resource use in groundnut production in Adamawa State of Nigeria. Primary data were basically used with the aid of structured questionnaires administered on 143 farmers using a simple random technique. The regression analysis indicated that the Cobb- Douglas function gave the best fit. The R^2 (0.78) was highly significant at 1 per cent level. Three out of the eight independent variables were significant at 1per cent level, these were farm size, seed and labour input, they positively affected the groundnut indicating that the more the farm size, quantity of seed and labour used, the more would be the output. Economic efficiency of resource used showed the seed and labour were underutilized, while fertilizer and agrochemicals were over utilized.

Arti and Jyoti (2009) studied resource use efficiency and sustainability of Maize cultivation in Jammu and Kashmir region. Multistage random sampling was adopted for selection of 120 sample farmers. Cobb Douglas production function was employed for analysis. Study revealed that seed, urea, potash, manure, human labour and capital were included in the model which explained 51 per cent variation in the Maize production, and maximum sample farmers were used local seed and only 22 per cent of the farmers used purchased hybrid seeds in the study area.

Hugar *et al.* (2009) conducted a study on productivity difference between Bt and non-Bt farms in Karnataka. selecting 180 farmers consisting of 90 Bt and 90 non-Bt farmers. Cobb-Douglas type of production function was fitted to study the resource use efficiency. Results of the study revealed that, the ratio of MVP to MFC being 0.98 which indicate that plant protection chemicals and other inputs were almost optimally utilized by Bt Cotton farmers.

Udaykumar Hosamani *et al.* (2010) conducted a study on cost, returns and resource use efficiency of pesticides in Paddy production in Koppal district of Karnataka. Multi-stage random sampling procedure was employed for selecting 120 farmers for collecting primary data required for the study. Cobb- Douglas production function was used to assess the resource use efficiency. Results of the study revealed that elasticity coefficients for seed (0.4926) and pesticide (0.0215). Indicate increasing use of seed and pesticides would increase the production and grass income. Elasticity coefficient of fertilizers and manures was (-0.0251) and labour (-0.0370) indicated any further increase in expenditure on manures, fertilizers and labours would result in decrease of grass income.

Kiresur and Ichangi (2011) conducted a study on socio-economic impact of Bt Cotton in Karnataka. Multistage random sampling technique was employed to select 60 sample farmers. Cobb-Douglas production function was fitted to assess the resource use efficiency. Results of the study revealed that average expenditure on seed was higher in Bt Cotton than non-Bt Cotton. Quantity of organic manure used in Bt (6.5/ha) and non Bt (6.7/ha) farmers was almost same. But cost incurred on chemical fertilizers and organic manures was higher in non-Bt than Bt farmers. The use of labour was more on non-Bt than Bt farmers. It was due to more number of sprays for pest management on non-Bt Cotton, adding to the cost on human labour.

2.4 Cost and Returns in Cultivation of Crops

Venkataraman and Gowda (1996) analysed economics of tomato production in Kolar district of Karnataka. The results revealed that the total cost of production, variable cost, fixed cost and marketing costs were ₹ 36611.51, ₹ 15648.26, ₹ 2556.48 and ₹ 18406.77, respectively. Though the net return obtained was high compared to many other costs, the high cost of production along with some other factors discouraged farmers from increasing tomato production.

Kerur *et al.* (1997) studied the economics of sunflower production in Northern Karnataka, per hectare cost of production of sunflower was ₹. 5652.55, ₹. 5693.11 and ₹. 5587.73 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.

Mishra *et al.* (1999) studied the production and marketing cost of Chillis and found that the total cost incurred by the marginal farmers was ₹22782.63 per ha, while it was ₹18488.90 in the case of medium farmers. Of the total cost, expenditure on manure and fertilizer and human labour accounted for 28.19 per cent and 16.56 per cent, respectively. However, there was no substantial difference in the yield between marginal and medium farmers.

Singh and Singh (2000) estimated the cost and return of rice in different ecosystems *viz*., Rain-fed upland (RU), Rain-fed lowland (RL), Irrigated with high yielding varieties (IHYV), Deepwater rice (DR) and Boro - rice (BR) in India. The cost of cultivation (Cost C) per hectare was highest on IHYV farms (₹.12111.04), which was slightly higher than BR farms (₹.12104.98) with lowest on DR farms (₹.5165.21). When total cost was divided among different factors of production, it was found that hired human labour along with imputed value of land jointly contributed to more than 50 per cent of the factor cost under all the rice ecosystems. The study also revealed that net profit was much higher on BR farms (₹. 3615 per ha.) than IHYV farms (₹.3329 per ha.) owing mainly to significantly higher yields on BR farms (6.43 t/ha) compared to IHYV (3.9 t/ha).The study reported that future food needs of the Eastern India could be successfully met by extending the area under boro rice wherever possible.

Krishna (2001) worked out the costs and returns of Paddy cultivation in Kerala based on the data collected through 100 farmers during the year 2000-2001. The total cost of cultivation per hectare was found to be ₹.31043.75. Of this, the lion's share was attributed to human labour, which accounted for 61.46 per cent of total cost. Total returns were ₹.27023.68/ha. The net income was found to be negative with a loss of ₹.4020.08 per hectare and the benefit–cost ratio of 0.87, indicating unprofitable situation. However, rice and prawn cultivation together earned profit with B-C ratio of 1.27. The study concluded that there was an increased trend towards double crop of prawn due to higher profitability of the prawn farming and loss incurred in Rice crop. The study recommended for mechanization of Rice farming operations due to higher wage rate prevailing and scarcity of labour at proper time.

Rajendra Prasad *et al.* (2001) costs and returns in Cotton production vis-a-vis its competing crops in Guntur district and reported that the per hectare expenditure on PPC on Cotton was ₹11331.37. This was very high as compared to ₹ 4217.92 in Soybean-bengalgram cropping system, ₹4379.81 in Soybean-redgram and ₹1334.00 in Soybean- Sorghum cropping systems. The PPC in total operational cost was highest in Cotton (₹. 29884.77/ha) compared to Soybean-bengalgram (₹27802.84/ha), Soybean-redgram (₹29171.42/ha) and Soybean- Sorghum (₹ 2954.78/ha), whereas net returns were very low in Cotton compared to other cropping systems.

Anonymous (2002) a comparison of per hectare cost and returns of moong, gram, Maize, wheat, mustard and Cotton on sample farms revealed that pulse crops were less favourable in terms of net returns. Whereas, wheat followed by Cotton had maximum net returns per hectare. Among pulses, moong yielded significantly higher returns than that of gram.

Mahantesh (2002) analysed costs and returns structure of Cotton in Belgaum district. The total cost of cultivation was found to be ₹. 30058.77 per hectare. The gross and net returns realized were ₹. 33147.75 per ha and ₹. 3088.98 respectively.

Neelappa (2002) studied the costs and returns structure in cultivation of Paddy in Tungabhadra Command Area (TBP) of North Karnataka. The profitability aspect of Paddy cultivation in TBP was analyzed by computing per hectare cost and returns. The per hectare cost incurred in cultivation of Paddy was ₹.26192, ₹.25938 and ₹.23822 by farmers in Bellary, Raichur and prize-winning farmers respectively. The variable cost constituted the major proportion of total cost of cultivation of Paddy, which was about 85 per cent. The expenditure on human labour was found to be major item of variable cost. The gross return per hectare of Paddy cultivation was ₹.42851 (Bellary) and ₹.40735 (Raichur). It was ₹.45350 for prize-winning farmers. The net returns per rupee spent in Paddy were estimated to be ₹.1.64 for farmers in Bellary, ₹.1.57 for farmers in Raichur and ₹.1.90 for farmers.

Sandeep (2002) worked out the economics of existing cropping systems in Bidar district of Karnataka by computing B-C ratio for different cropping systems. The results revealed that sugarcane was the most profitable cropping system under irrigated condition with a net profit of ₹.50616.55 per hectare and a benefit-cost ratio of 3.28. Redgram based cropping system was the next best profitable system under rainfed condition as judged by the benefit–cost ratio of 2.37. The B-C ratio was 1.84 for Paddy-wheat cropping system. The study recommended the need for crop diversification to avoid unforeseen economic losses of mono cropping

Damate *et al.* (2003) conducted a study on changes in costs and returns of major crops in Punjab. The data relating to the study such as cost, input use and returns at different period of time for major crops such as wheat, Paddy and Cotton in Punjab were collected during 1971-72 to 1973-74, 1981-82 to1983-84 and 1992-93 to 1994-95. The results of the study showed that total cost of cultivation per hectare was go on increasing for wheat, Paddy and Cotton crops. Return (per hectare) for a particular crop depended on the productivity and prices of crop products. The study clearly brought out that the raising cost of cultivation and instability in returns were due to variability in yield and price. Variable cost was increasing due to cost of human labour, machine labour, fertilizers, *etc.* This implied that the increase in production and productivity of these crops in the state had been achieved at higher cost and there was urgent need of technology up gradation and farmer friendly farm price policy for sustainable growth of farm sector.

Maharajan *et al.* (2003) carried out a study to measure the profitability of growing various crops in the Northern dry zone of Karnataka. The breakeven yield was computed to measure the profitability.

The decision criteria were, if the actual yield was beyond the breakeven yield, the farmer could start earning the profits and if the actual yield was below the breakeven yield the farmer incured loss. Breakeven yields were relatively quite stable and profitable in HYV of Paddy, sunflower and Cotton in *Kharif* season, Bengal gram and Sunflower in *Rabi* season, groundnut and Sugarcane in *Summer* season.

Wadear (2003) assessed the socio-economic viability of selected different farming systems in North Karnataka. In this study, two farming systems were identified; Farming System–I; crop-dairy animals-drought animals and Farming System-II; crop-drought animals. The study found that farmers in zone one (North Eastern Transition) incurred a total cost of ₹ 15789 per hectare for crop cultivation in Farming System-II and it was higher than Farming System-I (₹12203). However, net returns over variable cost was higher for Faming System-I (₹6197) as compared to Farming System-II (₹4581) while net returns over total cost were very meager in Farming System-II (₹94) and it amounted to ₹3801 for Farming System-I. The B-C ratio for Farming System-I was 1.31 and for Farming System-II it was 1.01. The study suggested combining dairy farming with crops to enhance and sustain farm incomes.

Sikander and Sandeep (2004) examined the profitability of Paddy, Maize and Wheat crops grown in Himachal Pradesh for the year 2001-02, computing different cost concepts such as Cost A1, Cost A2, Cost B and Cost C. As regard to Cost C, the cost was the highest in the Paddy cost is (₹.20835) followed by Maize (₹.18709) and Wheat (₹.17102) per hectare. For all the crops, the lion share of cost was incurred on labour. In respect of gross returns per hectare, it was the highest on Paddy farmers followed by Wheat and Maize. The study further found that net returns were positive on Paddy crop as compared to the Wheat and Maize where the net return was negative. The negative return was due to low yield. However, net profit per quintal was negative for all three crops.

Sreeja (2004) studied the economics of rice, tapioca, coconut and rubber grown in Kollam district of Kerala by analyzing costs and returns during the year 2002-03. In the total production of rice, the variable cost accounted for 82.37 per cent and labour cost alone shared 69 per cent of the total cost. The cost-benefit ratio for rice was 1.09 which was the lowest compared to other crops under study indicating that all crops concerned other than rice had a better income to the farmers. The findings further confirmed the trend in changes in cropping pattern. Area under cereals dropped by 34 per cent from 1982-83 to 2001-02 period mainly due to the reduction in Paddy area, which was shifted for other profitable crops.

Chahal and Katariya (2005) estimated the cost and return in cultivation of Maize in Punjab. The total operational cost of hybrid Maize was ₹.8956/ha as compared to local variety (₹.6427/ha) and for composite varieties ₹.8009/ha. Human and animal labour cost contributed more than one third of the operational cost. Fertilizer accounted for 20 per cent of the operational cost in case of hybrid varieties. The estimated average yield of hybrid varieties was 36.26q/ha. Both gross and net returns in case of hybrid Maize amounted to be ₹.19637.48 and ₹.10681.65 per hectare, respectively.

Rohit Singh *et al.*, (2006) studied economics of production of green peas (Pisum sativum L.) in Punjab using the primary data from pea growers. The data were subjected to simple tabular and functional analyses. The results revealed that 75.85 per cent of the farmers purchase pea seeds from dealers. The yield of green pea was found to be highest on small farms among all the farm-size categories. The total cost incurred was found to be the higher in large than small and medium farmers due to use of excess inputs by the farmer than required. The gross and net returns were found to be higher in the case of small and medium farms due to realization of higher prices by them and exploring of other markets due to their higher marketable surpluses. The results of functional analysis revealed that the fertilizers, irrigation and machinery were the important variables, influencing the productivity of green peas positively. The returns over variable cost of peas were higher by 129 per cent than those in the case of Wheat (main competing crop). Farmers were advised by the agricultural extension experts to adopt green pea cultivation for improving the efficiency of the farms through increased income per unit of land.

Rajur *et al.* (2007) studied economics of Chilli production in Karnataka. The multistage random sampling technique was adopted in designing sampling frame for the study. The primary data were collected from 120 sample farmers by personal interview method using pre-tested structured schedule. The results of the study showed that cost A2 accounted for 30.70 per cent in Bijapur, 44.54 per cent in Raichur and 47.09 per cent in Gulbarga district.

It was obvious from cost C3 that use of family labour was higher in case of Bijapur district than Gulbarga and Raichur district due to non-availability of hired labour during peak period. Returns over cost C3 was higher in Raichur district (₹ 34955.50) followed by Gulbarga (₹ 33870.40) and (₹ 28835.26) in Bijapur districts, which was due to the lower total cost of Chilli production in Raichur district as compared to Bijapur and Gulbarga districts.

Rama rao and Reddy (2007) studied economics of crop production in different agro-climatic zones of Andhra Pradesh. The data were collected from 105 sample farmers and analysed using partial budgeting technique. The results revealed that farmers in Krishna Godavari zone were fallowing rice-rice cropping pattern, jute was the major crop in coastal zone, groundnut and sugarcane were major crops in South zone and cassava was grown in higher altitude and tribal zone. With respect to the economics of crop production cost of cultivation of rice was found to be ₹20,300/ha. In North coastal zone, Southern zone, drought prone Southern Telangana Zone the productivity of rice was found to be 5q/ha, 55q/ha, 50q/ha, respectively. The study concluded that returns to land from irrigated farming were found to be higher in all zones. Cultivation of rainfed crops was marginally profitable. There was a need to relook into the policies for technology generation and transfer and other policies.

Sushil kaul *et al.* (2009) studied the economic analysis of productivity and profitability of rice production in India, The study was based on secondary data on rice yields collected from 1951 to 2002. Multivariate regression equation was fitted to estimate state wise productivity in rice. Results of the study revealed that overall yields of rice were higher during 1980-81 as compared to 1995-96 to 2000-01. The gross returns had been increased over the years. But the same was not true for the net returns, operating cost and productivity, which were highly correlated to each other and coefficient associated with productivity was positive and highly significant.

Ankit and Hugar (2011) studied on economics of Soybean cultivation vis-à-vis its competating crops in Madhya Pradesh. Multi stage random sampling technique was employed for selection of 90 sample farmers. Results of the study revealed that cost of cultivation of soyabean was ₹ 15946/ha, of which, variable and fixed costs formed about 76.79 per cent and 23.21 per cent respectively. Expenditure on human labour was the major component in variable cost. On the contrary, the total cost of cultivation of Sorghum was worked out to be₹. 8923/ha which was about three fourth of total cost of cultivation of Maize (₹.12516/ha). Human labour required in both cases was similar in both crops. Similarly, benefit cost ratio was higher in the case of Soybean (1.29) than that of Maize (1.16) and Sorghum (1.05).

2.5 Constraints Faced during Crop Production

Ramamoorthy (1995) studied major socio-economic constraints in Cotton production and management. Major constraints identified and ranked were poor quality input supply, inadequate credit supply and high production risk. During marketing price fluctuation, storage problems, under weightment and poor market development were the major constraints identified.

Anonymous (2000) (a) identified constraints in pulse production in three agro-climatic zones in Madhya Pradesh. The study was based on both primary and secondary data. The data so collected were analyzed using regression and coefficient of variation. The results of the study revealed that pulses were cash crops which required lower inputs, increase the productivity of soil but they could not grow without irrigation unlike rice and wheat. There were no high yielding varieties of pulses, so they could not compete with other cereals and were susceptible to pest and diseases. So need to be conduct field level studies for pulses. There was a necessity to supply high yielding varieties in adequate quantity and adopting appropriate IPM measures.

Balaji *et al.* (2003) conducted a study on problems and prospects in production and marketing of groundnut in Tiruvannamali district of Tamil Nadu. 120 samples were selected by multistage sampling technique. The primary data required for the study were collected by personal interview method. Data was analyzed by Garrets ranking technique. The results of the study revealed that farmers were facing environmental constraints, technical constraints and socio-economic constraints which lead to low production of groundnut and low marketable surplus. It was evidenced from the study that pest and disease (57.95), drought (50.51) and non availability of improved seed, fertilizers and plant protection chemicals in time (27.62) were major constraints limit groundnut production. So there was need to adopt integrated control measures, rainfall forecast and market information should be made available to farmers in advance.

Anonymus (2002) (b) conducted a study on economics of pulse production and identification of constraints in Punjab. In Punjab the districts having the highest area and production of Pulse crops were selected for the study. Total sample size was 100. Garret ranking technique was employed to analyse the data. Results of the study revealed that inadequate availability of improved variety seed, lack of adequate irrigation facility, uncertain rainfall were the major constraints faced by sample farmers.

Gaddi *et al.* (2002) studied yield gaps, constraints and potentials in Cotton production in North Karnataka. Multi-stage random sampling technique was employed to select 80 sample farmers. The required data for the study was collected with the help of pre-tested schedule. Principal component analysis was carried out to quantify the influence of constraints. Results of the study revealed that non-availability of labour during weeding and picking season (75 %) was the major problem. The incidence of pest and diseases like bollworm, whitefly (73.75 %) and lack of credit facilities (71.25 %) problems prevented farmers from achieving greater farm productivity in Cotton.

Basavaraja *et al.* (2005) studied economics of *Kharif* sorghum in Karnataka. The Herfindahl index had been computed to find out crop diversification and factors influencing this diversification in the sample districts of Dharwad and Belgaun. The deceleration in the *Kharif* sorghum area in the overall period 1970-71 to 1997-98 and different sub-periods had been found due to the diversion of *Kharif* sorghum area to more remunerative crops like oil seeds (groundnut and sunflower), and pulses. Belgaum district displayed a moderate degree of crop diversification compared to that of Dharwad district. Unfavorable prices, declining yields, inadequate credit and adverse climatic conditions had been identified as the major reasons for the replacement of *Kharif* sorghum crop in the two sample districts. The net returns and benefit-cost ratio had been found low in the cultivation of *Kharif* sorghum compared to those of its competing crops, *viz.* Cotton, Greengram and Groundnut.

Grover and Singh (2007) studied status, problems and constraints in Sesamum cultivation in Punjab. Multistage random sampling technique was employed to select 150 sample farmers. The required information about constraints faced by the sample farmers was collected using pre-tested schedule. Data were analysed using five scale rating. Results of the study revealed that phyllody and blight were the major diseases infecting sesamum crop. The jassid and sesamum leaf webbers were major enemies of sesamum crop. Weed intensity and non availability of labour were also major constraints in Sesamum cultivation.

Hosmath (2011) studied advantages and constraints of Bt Cotton cultivation in Northern Karnataka. Required data for the study were collected from 100 sample farmers and analysed by adopting Garrets ranking technique. Results revealed that 93 per cent farmers faced the problems of leaf reddening irrespective of Bt.hybrids of different firms. More than 92 per cent farmers were expressed that high seed cost limiting its cultivation. About 91 per cent farmers were expressed that they were not at all adopted the recommended control measures with two per cent DAP.

Rama rao (2012) studied efficiency, yield gap and constraints analysis in irrigated and rainfed Sugarcane in North Coastal Zone of Andhra Pradesh. Multistage sampling technique was adopted for selecting 120 (60 for irrigated and 60 for rainfed) sampling units at various levels. Data were collected using pre-tested schedule. Response-Priority index was employed for analyzing the data. Results revealed that, there was labour shortage during the period of important operations. Shortage of irrigation water, non-availability of remunerative price, high cost of machines difficulty in getting good quality seed materials were the constraints faced by sugarcane growers.

METHODOLOGY

This chapter deals with a general description on the study area, the sources and nature of data used for the study, techniques used in selection of the sample, collection of data and analytical tools used, *etc.* For better understanding, this chapter is presented under the following heads.

3.1 Description of the Study Area

3.2 Sampling Procedure

3.3 Nature and Source of Data

3.4 Analytical Tools and Techniques

3.5 Definitions of Terms And Concepts Used

3.1 Description of Study Area

The study on economics of production of major crops was taken up in Dharwad district of Karnataka.

3.1.1 Location of study area

Dharwad district is well known for its varied agro-climatic regions, diversified soil type and cropping pattern. In Dharwad all the crops which are cultivated in different districts of Karnataka are found so it was selected purposively for the present study.

Dharwad district falls in the Northern part of Karnataka between 15^0 15' and $15^0$35'15 N latitude and 75^0 00' and 75^0 20' E longitudes, in the Northern Dry Zone (Zone 3) and Northern Transitional Zone (Zone 8). It is bound on the North by Belgaum district, on the South by Haveri district, on the East by Gadag district and on the West by Uttara-Kannada district. It consists of five taluks viz; Dharwad, Hubli, Kalghatgi, Kundgol and Navalgund. The district has area of 4260 Km^2 constituting about 2.22 per cent of the state area.

3.1.2 Demographic features of the study area

The population of the Dharwad district was 1846993 (2010 census) with per square kilometer population density of 377. Sex ratio of the district was 949 (Number of females per 1000 males). Out of the total population 71.6 per cent was literate. District consisted of 25.8 per cent cultivators, 27.3 agricultural labour, 2.9 per cent household industries and 44.1 other workers.

3.1.3 Climate, rainfall and soil type

The soils of the district are predominantly red loams with patches of black soils. Red soils are well drained and range from red to pace brown in colour. The district generally has a humid and dry climate with the normal rainfall of 786 mm per annum

The agricultural seasons in the district can be broadly classified into *Kharif* and *Rabi* seasons. *Kharif* season commences in May-June and ends in September. *Rabi* season starts in the month of September – October and ends in February. The total net sown area of the district is as much as 3,10,816 ha of which 15,745 was irrigated. The major crops grown, based on their highest area under cultivation are Chickpea, Cotton, Soybean, Chilli, Paddy and Maize, *etc.*

3.1.4 Land utilization pattern

Total geographical area of Dharwad district was 4,27,329 ha out of this 35,235 ha covered by forest, 26,042 ha land was not available for cultivation, 48,279 ha was fallow land and total net sown area was 3,10,816 ha.

3.1.5 Cropping pattern

The cropping pattern in Dharwad district (Table 3.2) during 2010-11, indicated that out of the net cultivated area, Maize occupied major area 1,33,587 ha, followed by sorghum (66,271 ha), Cotton (63,402 ha), oilseeds (43,229 ha), pulse (38,858 ha) and Paddy (37,313 ha) crops.

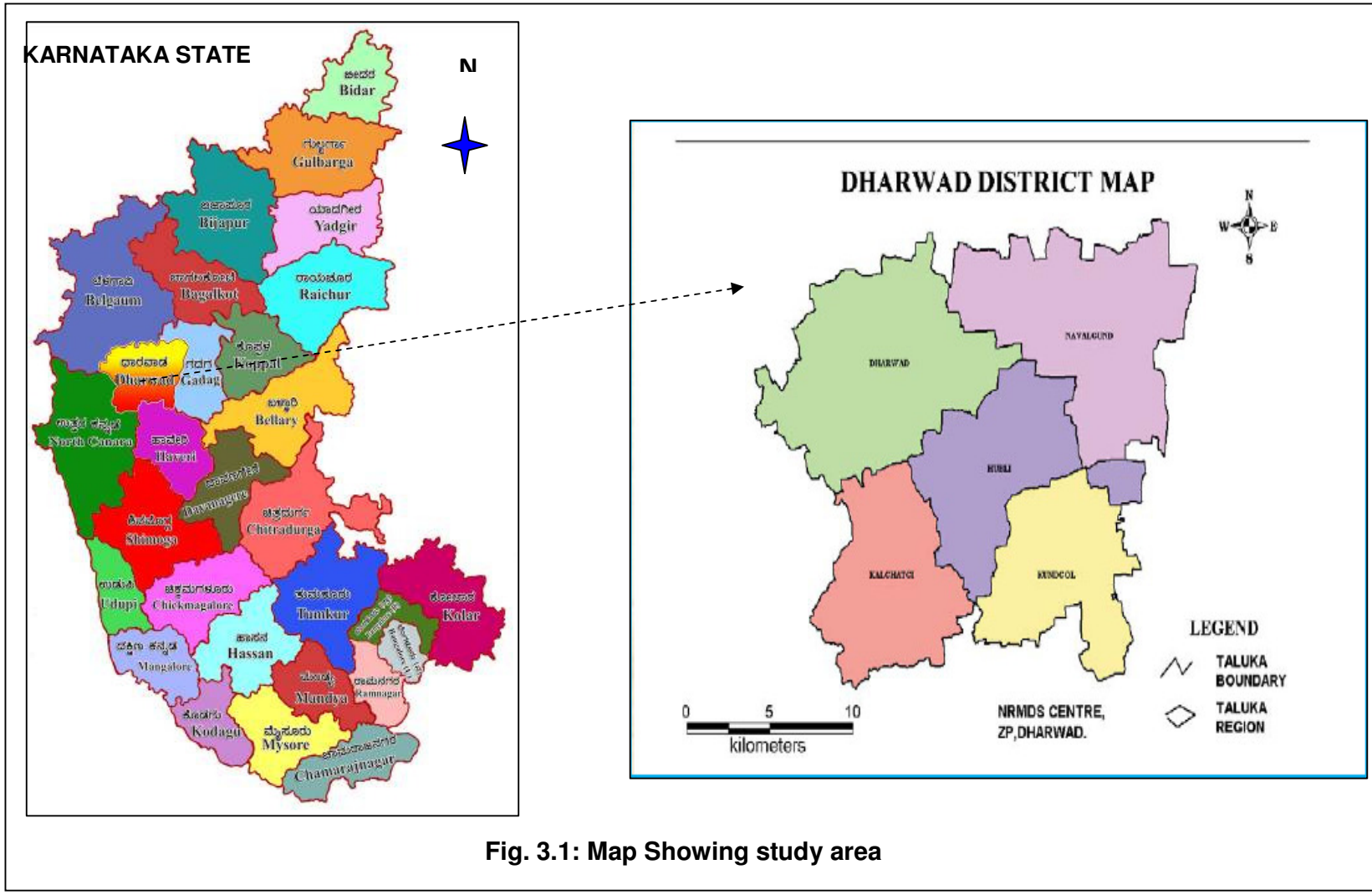

Fig. 3.1: Map Showing study area

Fig. 3.1: Map Showing study area

Table 3.1: General features of the study area

Sl. No.	Particulars	Dharwad Disirict
1	Geographical area (ha)	427329
2	Number of hoblies	14
3	Number of villages inhabited	361
4	Number of villages un-inhabited	18
5	Population (Nos.)	1604253
	Male	823204
	female	781049
	Rural Population	722336
	Male	371275
	Female	351061
	Urban Population	881917
	Male	451929
	Female	429988
6	Density of population (per km^2)	377
7	Literacy rate(%)	71.87
8	Agriculture holdings(lakh)	346823
9	Net area sown (ha)	308067
10	Sources of irrigation(ha)	
	Bore well	15237
	Canals	35362
	Tanks	383
11	Decennial population growth rate(%)(1991-2001)	16.7
12	Actual rainfall (mm)	909
13	Normal rainfall(mm)	786
14	Number of rainy days (average)	63
15	Temperature	
i	Mean Minimum	12.3 to 14 ^oC
ii	Mean Maximum	31.4 to 32.9 ^oC

Source: District at a glance – Dharwad District 2010-11.

Table 3.2: Copping pattern followed in Dharwad district

Crops.	Taluks					District Total
I. Cereals	**Dharwad**	**Hubli**	**Kalagatagi**	**Kundagol**	**Navalgund**	
Paddy	12431 (14.09)	455 (0.66)	13770 (41.07)	302 (0.29)	0 (0.00)	26958 (6.00)
Maize	8281 (9.38)	6619 (9.55)	4064 (12.12)	1283 (1.24)	31615 (20.48)	51862 (11.55)
Jowar	8235 (9.32)	7307 (10.54)	5591 (16.67)	10226 (9.89)	12295 (7.96)	43654 (9.72)
Wheat	6933 (7.85)	5518 (7.96)	41 (0.12)	8741 (8.45)	16855 (10.92)	38088 (8.48)
Sub-total	35880 (40.64)	19899 (28.71)	23466 (69.98)	20552 (19.87)	60765 (39.36)	160562 (35.75)
II. Pulses						
Horsegram	413 (0.47)	318 (0.46)	621 (1.85)	462 (0.44)	0 (0.00)	1814 (0.40)
Green gram	8322 (9.42)	5002 (7.22)	2422 (7.22)	2304 (2.22)	13250 (8.58)	31300 (6.97)
Cowpea	180 (0.20)	266 (0.38)	92 (0.27)	445 (0.43)	8 (0.00)	991 (0.22)
Bengal gram	21565 (24.43)	6453 (9.31)	142 (0.42)	5148 (4.98)	27151 (17.59)	60459 (13.47)
Black gram	1548 (1.75)	588 (0.85)	49 (0.15)	70 (0.06)	125 (0.08)	2380 (0.53)
Sub-total	32028 (36.25)	12627 (18.22)	3326 (9.92)	8429 (8.13)	40534 (26.26)	96944 (21.60)
III. Oilseeds						
Groundnut	7700 (8.72)	8078 (11.65)	488 (1.46)	18074 (17.48)	4767 (3.08)	39107 (18.71)
Sunflower	189 (0.22)	708 (1.02)	51 (0.15)	295 (0.28)	7054 (4.57)	8297 (1.84)
Safflower	2105 (2.39)	1054 (1.52)	102 (0.30)	1472 (1.42)	2488 (1.61)	7221 (1.60)
Sesamum	51 (0.05)	208 (0.30)	0 (0.00)	139 (0.13)	77 (0.04)	475 (0.10)
Sub-total	10045 (11.38)	10048 (14.50)	641 (1.92)	19980 (19.32)	14386 (9.30)	55100 (22.26)
IV. Commercial crops						
Cotton	4291 (4.87)	18971 (27.37)	4878 (14.55)	34140 (33.03)	26060 (16.88)	88340 (19.68)
Chilli	622 (0.70)	7709 (11.12)	141 (0.42)	20238 (19.58)	12520 (8.11)	41230 (9.18)
Sugarcane	5403 (6.12)	60 (0.09)	1079 (3.22)	2 (0.00)	61 (0.03)	6605 (1.47)
Sub-total	10316 (11.69)	26740 (38.58)	6098 (18.19)	34380 (52.61)	38641 (25.02)	136175 (30.33)
Total	**88269**	**69314**	**33531**	**103341**	**154326**	**448781**

(Source: Dharwad district at a glance 2010-11)

3.2 Sampling Procedure

3.2.1 Selection of crops

Secondary data (Triennium ending 2010-11) on area under cultivation of different crops for all taluks were collected. The leading crop in each taluk was selected as the study crop. From Dharwad taluk, Chickpea was a selected crop as it was cultivated on an area of 19456 ha which accounted for 24.48 per cent of the total cultivable area in Dharwad. Similarly Cotton (19166 ha) from Hubli, Soybean and Paddy (14636 ha and 14355 ha) from Kalaghatagi because area under cultivation of these crops is nearly same, from Kundagol and Navalgund, Chilli (30222 ha) and Maize (24691 ha) were selected, respectively. These crops accounts for 21.45 per cent, 23.79 and 23.33 per cent, 25.10 per cent and 16.46 per cent of the total cultivable land of the respective taluks. (Table 3.3)

3.2.2 Sampling design

Multistage sampling technique was used. In the first stage, Dharwad district was selected as it is known for its varied agro-climatic regions and diversified soil types. In the second stage, all the five taluks were covered in order to study the major crops of the district. In the third stage, from each taluk, two villages were selected based on the highest area under cultivation of the selected crops (Table 3.4). From Dharwad taluk, Hebballi and Amminabhavi villages were selected. Similarly, from Hubli taluk- Shiraguppi and Kusugal, from Kalghatgi taluk- Tabakadhonnalli and Hirehonnalli villages, Kundagol and Samshi villages from Kundagol taluk and Annigeri and Shelwadi villages from Navalgund taluk were selected. In the fourth stage, 15 farmers from each village were selected randomly. Total sample size was 150. The Sample farmers were post classified into irrigated and rainfed to compare cost and return structure under both the situations. From the irrigated farmers information about inputs utilization pattern under water scarcity situation was also collected for analyzing resource use efficiency.

3.3 Nature and Sources of Data

The study was based on primary and time series data. Taluk-wise secondary data for the period 2001-02 to 2010-11 on area, production and yield of selected crops were collected from District Statistical Office (DSO), Dharwad. These data were used for analysis of growth of Chickpea, Cotton, Soybean and Paddy, Chilli and Maize crops in Dharwad, Hubli, Kalaghatagi, Kundagol and Navalgund taluks, respectively.

For evaluating the objectives of the study, primary data relating to cropping pattern, land holdings, education, family size, sources of income, and problems faced in production were collected using pre-tested schedule. Details regarding input use and output obtained were also collected for Chickpea, Cotton, Soybean, Paddy, Chilli and Maize. These data were obtained from the selected sample farmers with the help of a pre-tested and well-structured schedule. The farmers were personally interviewed. The primary data regarding input utilization pattern, output realized was collected from the sample farmers were per tained to the period 2010-11. Because of erratic rain during 2011-12 farmers were not able to carry out cultivation practices properly.

3.4 Analytical Techniques Employed

3.4.1 Growth rate analysis

Compound Growth Rate (CGR)

For computing compound growth rate of area, production and productivity of selected crops, the exponential function of the following form was used.

$$Y = a\, b^t\, e^{Ut} \quad \ldots\ldots (1)$$

Where,

Y = Area / Yield / Production

a = Intercept

b = Regression coefficient

'a' and 'b' are the parameters to be estimated

t = time period

U_t= Disturbance term in year't'

Table 3.3: Selection of crops

Crops	Dharwad		Hubli		Kalagatagi		Kundagol		Navalgund		Total	
	Area	**%**	**Area**	**%**	**Area**	**%**	**Area**	**% a**	**Area**	**%**	**Area**	**%**
I. Cereals												
Paddy	13619	17.13	770	0.86	**14355**	**23.33**	305	0.25	0.67	0.00	29049.67	5.80
Jowar	9976	12.55	7427	8.31	5601	9.10	9803	8.14	12336	8.22	45143	9.01
Maize	8863	11.15	6086	6.81	3889	6.32	1268	1.05	**24691**	**16.46**	44797	8.94
Wheat	6450	8.12	5078	5.68	22	0.04	7784	6.46	19258	12.84	38592	7.70
Others	318	0.40	483	0.54	192	0.31	162	0.13	0	0.00	1155	0.23
Total	39227	49.35331	19845	22.21	24341	39.56	19323	16.05	48378	32.24	151114	30.17
II. Pulses												
Chickpea	**19456**	**24.48**	5560	6.22	137	0.22	4193	3.48	16783	11.19	46129	9.21
Redgram	1465	1.84	669	0.75	247	0.40	680	0.56	97	0.06	3158	0.63
Blackgram	1271	1.60	442	0.49	42	0.07	76	0.06	43	0.03	1874	0.37
Greengram	6104	7.68	2835	3.17	2551	4.15	2240	1.86	8471	5.65	22201	4.43
Others	6	0.01	17	0.02	12	0.02	5	0.00	0	0.00	40	0.007
Total	28303	35.61	9525	10.66	2991	4.86	7196	5.98	33303	22.20	81318	16.23
III. Oilseed												
Groundnut	9675	12.17	6978	7.81	411	0.67	15719	13.05	4884	3.26	37667	7.52
Sunflower	328	0.41	1788	2.00	48	0.08	1506	1.25	8083	5.39	11753	2.34
Soybean	8978	11.30	6047	6.77	**14636**	**23.79**	1618	1.34	0	0.00	31279	6.24
others	20361	25.62	17241	19.30	14355	23.33	21935	18.22	15188	10.12	89080	17.78
total	3943	4.96	32055	35.87	28943	47.04	40778	33.87	28155	18.77	133874	26.731
IV. Commercial crops												
Cotton	3245	4.08	**19166**	**21.45**	4354	7.08	22888	19.01	24017	16.01	73670	14.71
Chilli	528	0.66	8688	9.72	88	0.14	**30222**	**25.10**	16119	10.74	55645	11.11
Sugarcane	4235	5.33	72	0.08	807	1.31	0.66	0.00	65	0.04	5179.66	1.034
total	8009	10.08	27927	31.26	5250	8.53	53112	44.11	40202	26.79	134500	26.85
Gross cropped area	79482	100.00	89352	100.00	61525	100.00	120409	100.00	150038	100.00	500806	100

(Source: District Statistics at a glance 2009-10 to 2011-12)

Table 3.4: Selection of villages

Sl.No	Taluk	Crop	Villages	Number of sample farmers
1	Dharwad	Chickpea	Hebballi	15
			Ambinabhavi	15
Sub-total				**30**
2	Hubli	Cotton	Shirguppi	15
			Kusugal	15
Sub-total				**30**
3	Kalaghatgi	Paddy and Soybean	Tabakadahonnalli	15
			Hirehonnalli	15
Sub-total				**30**
4	Kundagol	Chilli	Kundagol	15
			Samshi	15
Sub-total				**30**
5	Navalgund	Maize	Annigeri	15
			Shelwadi	15
Sub-total				**30**
Grand total				**150**

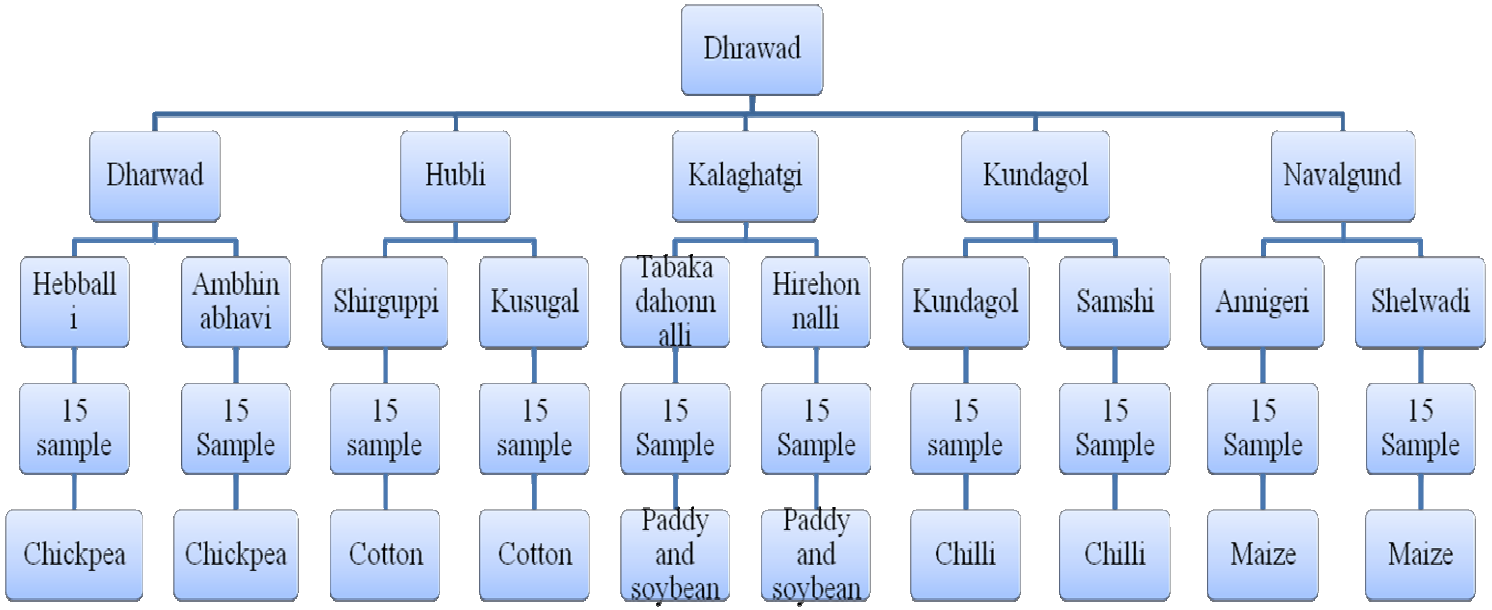

Fig. 3.2: Sampling design

Fig 3.2: Sampling desigh

The equation (1) was transformed into log linear form and written as;

$$\log Y = \log a + t \log b + U_t \quad \text{.....} \quad (2)$$

Equation (2) was estimated using the Ordinary Least Squares (OLS) technique. Then the Compound growth rate (g) of the variable was computed

$$g = (b - 1)\ 100 \quad \text{.....} \quad (3)$$

Where,

g: Compound growth rate in per cent per annum

b: Antilog of log b

The standard error of the growth rate was estimated and tested for its significance with't' statistic.

3.4.2 Tabular analysis / Budgeting technique

Budgeting technique was followed for estimating the cost and return structure and tabular analysis was used to analyse cropping pattern, cropping intensity and to identify most profitable cropping pattern. To achieve meaningful presentation of results, the data were compared and contrasted with the averages, frequencies and percentages.

3.4.3 Analysis of resources use efficiency

The resource-use efficiencies were studied by fitting the Cobb-Douglas type production function (Monetary values) to the farm level data.

$$Y = a\ X_1^{\ b1}\ X_2^{\ b2}\ X_3^{\ b3}\ X4^{\ b4}\ X_5^{\ b5} X_6^{\ b6}\ X_7^{\ b7}\ Eu$$

In logarithmic form, it assumed a log-linear equation as under:

$$\text{Log } Y = \text{Log } a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + u \log e \quad \text{..... (2)}$$

Where,

Y = Gross returns in ₹

X_1 = Expenditure on seeds in ₹

X_2 = Expenditure on FYM in ₹

X_3 = Expenditure on fertilizers in ₹

X_4 = Expenditure on plant protection chemicals in ₹

X_5 = Human labour charges in ₹

X_6 = Bullock labour charges in ₹

X_7= Machine labour charges in ₹

a = Constant/intercept term

u = Random variable

e = 2.718

b_1 to b_7 represented production elasticities of respective inputs.

The regression coefficients (bi) were tested for the significance using't' test.

$$t = \frac{b_i}{\text{Standard error of bi}} \quad \text{.....} \quad (3)$$

The co-efficient of Multiple Determination (R^2) was also worked out to test the goodness of fit of the model.

While calculating resource use efficiency for Chickpea, the variable input FYM was not included because it is *Rabi* crop farmers were not generally applying FYM. Similarly for Maize crop plant protection chemicals were not applied by the sample farmers. Hence these inputs were not included while calculating resource use efficiency in respective crop production.

3.4.5 Garrett Ranking

Garrett Ranking Technique was adopted for studying problems faced by farmers in production of selected crops in the study area.

1. Non-availability of good quality seeds.
2. Erratic behavior of rainfall.
3. Non-availability of labour.
4. Non-availability of required inputs on time.
5. Attack of pest and diseases.
6. Instability in yield.
7. Lack of technical guidance.
8. Non-availability of high yielding and pest resistance varieties.
9. Non-availability of adequate credit for crop production.

In the first stage: ranking given by 30 respondents for each constraint was analyzed.

In the second stage: The ranks assigned by the individual respondents were counted into per cent position value by using the formula.

$$\text{Per cent position} = 100\ (R_{ij} - 0.5)/N_j.$$

Where, R_{ij} stands for rank given for the i^{th} factor by the j^{th} individual.

N_j stands for number of factors ranked by j^{th} individual.

In stage three – For each per cent position scores were obtained with reference to Garrett's Ranking Conversion Table (Appendix V) and each per cent position values were converted into scores by referring to Garret's Table.

In the fourth stage – Summation of these scores for each factor was worked out for the number of respondents who ranked for each factor. Mean scores were calculated by dividing the total score by the number of respondents

In the last stage – Overall ranking was obtained by assigning ranks I, II, III …. IX *etc.* in the descending order of the mean score.

3.5 Definitions of Terms and Concepts Used

Costs

The total cost (TC) was divided into two broad categories *viz.*, 1) Variable costs and 2) Fixed costs

1) Variable costs: The variable costs include cost on seeds, manure, fertilizer, wages of human and bullock labour, plant protection chemicals, irrigation, interest on operational capital and repairs and maintenance charges.

The computations of different variable cost are as follows:

- Seeds: The cost of purchased seeds was based on the actual amount paid by the respondents. The farm-produced seeds were imputed based on the prices, which prevailed at the time of sowing.
- Farmyard manure: The value of FYM generated on their farm was imputed by considering the rates prevailing in the locality for per bullock cart load at the time of its application.

- Fertilizers and plant protection chemicals: The cost of fertilizers and plant protection chemicals was based on the actual prices paid by the sample farmer including the cost of transportation and other incidental charges, if any.
- Labour: The cost of hired labour was calculated at the prevailing wage rates paid per day (Eight hours) in the study area for men, women and bullock pairs during the study period. The same wage rates were imputed for family labour. While expressing labour in mandays, women days were converted into mandays by taking 1.33 women days equal to one manday. Woman labour was converted into male equivalents. The formula used for conversion was Male equivalents of female labour = 0.65 x total number o female labour days Conversion factor 0.65 was taken based on the ratio of wage paid to the men labour Vs women labour.
- Interest on working capital: This was calculated at the rate of 9.5 per cent for the six months on the total value of the seed, manure, fertilizer, plant protection chemicals, human labour, bullock labour, machine labour and materials (based on the interest rates charged by financial institutions).

2) Fixed costs: The fixed cost includes depreciation on farm implements and machinery, interest on fixed capital, land revenue and rental value of land.

- Interest on fixed capital: Interest on fixed capital was calculated at the rate of 8 to 11.5 per cent, as the fixed deposits in commercial banks would fetch this rate of interest. The items considered under fixed capital were implements and machinery. Interest was considered on the value of these assets after deducting the depreciation for the year. No interest was charged on the land value since the rental value of owned land was considered. Then the amount so calculated was apportioned to the crop acreage based on duration of the crop.
- Land revenue: Land revenue was taken at the rates levied by the government.
- Rental value of land: Rental value of land was calculated at the prevailing rate per acre per annum in the study area and was apportioned to the respective crop.

Cost concepts

Cost concepts defined by Commission of Agricultural Costs and Prices (CACP).

- Cost A1 = All actual expenses in cash and kind incurred in production by the producer. The items covered in cost A1 are costs on: i) hired human labour, ii) hired bullock labour., iii) owned bullock labour, iv) home produced/purchased seed, v) plant protection chemicals, vi) home produced/purchased manure, vii) fertilizers, viii) insecticides and pesticides, ix) depreciation on farm machinery, equipment and farm building, x) irrigation, xi) land revenue, land development tax and other taxes, xii) interest on working capital, xiii) interest on crop loan and xiv) miscellaneous expenses.
- Cost A2 = Cost A1 + Rent paid for leased-in land
- Cost B1 = Cost A1 + Interest on value of owned capital assets (excluding land)
- Cost B2 = Cost B1 + Rental value of owned land (net of land revenue) and rent paid for leased-in land
- Cost C1 = Cost B1 + Imputed value of family labour
- Cost C2 = Cost B2 + Imputed value of family labour
- Cost C2* = Cost C2 + estimated by taking into account valuation of human labour at market rate or actual wage rate which ever is higher
- Cost C3 = Cost C2* + Value of marginal input at 10 per cent of total cost (C2*)

Returns

1. Gross returns per rupee of investment =Gross return/Total cost
2. Cost of production (quintal) =Total cost (₹/ha)/ yield (q/ha)
3. Net returns over variable cost= Gross Returns – Total Variable Cost.
4. Net returns over total cost = Gross Returns – Total Cost

5. Cost of production per kg.= Total Variable Cost / yield of main product
6. Gross returns per quintal =Gross returns (₹/ha)/ yield (q/ha)
7. Benefit Cost Ratio = Gross Returns / Total Cost

Cropping pattern

The proportion of the area under various crops at a point of time (*Kharif, Rabi* and biseason) represents the cropping pattern.

Cropping Intensity (CI)

Cropping intensity was computed as the ratio of the gross cropped area to the net sown area and expressed in percentage.

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

RESULTS

Data collected for the study from various sources were analyzed using appropriate techniques and the results of analysis are presented in this chapter under the following headings.

4.1 General characteristics of the sample farmers in Dharwad district

4.2 Compound growth rate in area, production and productivity of major crops

4.3 Taluk wise cropping pattern followed

4.4 Input utilization pattern of selected crops

4.5 Cost and returns in cultivation of selected crops

4.6 Farm business income in cultivation of selected crops

4.7 Resource use efficiency while cultivating selected crops

4.8 Constraints in cultivation of selected crops

4.1 General characteristics of Sample Farmers in Dharwad District

An understanding of general characteristics of the sample farmers is expected to provide a bird's eye view of the general features prevailing in the study area. Therefore, an attempt has been made in the study to analyze some of the important characteristics of sample farmers and the same are presented in Table 4.1.

Average age of the sample farmers was about 40 years and the main occupation was agriculture. It could be further observed that majority of the respondents were literate (87.99%), having their education ranging from primary to college level, while the remaining 12 per cent were illiterates.

Further, it can be observed from the table that the average size of the family was about five and average land holding was 4.19 ha, of which 1.56 ha was irrigated and remaining 2.63 ha was rainfed.

The major crops and their varieties grown in the study area were Annigeri-1 and JG-11 in the case of Chickpea, the Cotton varieties included Double Bt, Bt Banni and Bt Rashi, Paddy varieties such as Udrasali, Untarsali, Dodgya and Jaya, soybean variety such as JSS-335, varieties of Chilli such as Deluxe and Byadgi dabbi and Maize varieties such as Pinacal, Kaveri, Kargil and Kanchana were cultivated.

4.2 Growth Rates in Area, Production and Yield of Selected Crops

4.2.1 Growth rates of area, yield and production of major crops in Dharwad district

Results on compound growth rate of area, production and productivity of major crops in Dharwad district for the period from 2001-02 to 2010-11are presented in the Table 4.2

In Dharwad district Paddy (5.16 % per annum), Maize (22.62 % per annum), Chickpea (4.36 % per annum) and Soybean (17.47 % per annum) showed positive growth in area and yield, resulting in positive growth in production. Chilli showed positive growth rate in area but negative growth rate in yield, resulting in negative growth in production. Cotton (-0.75 % per annum) showed negative growth in area, positive and very higher growth in yield (17.83%), which ultimately influenced the production positively.

4.2.2 Growth rate of area, yield and production of major crops in different taluks

Taluk wise analysis of compound growth rate of area, production and productivity of major crops is presented in the Table 4.3

In Dharwad taluk, Chickpea showed positive growth in area and yield which resulted in positive growth rate of production. In Hubli taluk, yield of cotton showed negative growth and affected the production adversely. In Kalaghatgi taluk, Paddy and Soybean showed positive growth rate in area and yield, resulting in positive growth rate in production. In Kundagol taluk, Chilli showed positive growth in area and yield which resulted in positive growth rate in production. In Navalgund taluk, area under Maize showed positive growth in area and yield resulting in positive growth rate in production.

Table 4.1: Socio-Economic profile of the sample farmers

(n=150)

Sl. No	Particulars	Unit	Sample size	
1	Age	Years	40	
2	Education			
	Illiterate	No.	18 (12.00)	
	Primary	No.	58 (38.67)	
	High school	No.	49 (32.66)	
	College	No.	25 (16.66)	
	Total	**No.**	**150 (100)**	
3.	Occupation			
	Agriculture as Main occupation	No.	121 (80.66)	
	Agriculture as Subsidiary occupation	No.	29 (19.33)	
4	Family size	No	5.00	
5	**Average Land holdings(ha)**	Total	Irrigated	Rainfed
I	Dharwad taluk	3.86	1.08	2.78
ii.	Hubli taluk	4.77	0.97	3.80
iii.	Kalgatagi taluk	3.87	0.25	3.62
iv	Kundagol taluk	3.43	0.47	2.96
v.	Navalgund taluk	5.01	4.65	0.36
	Dharwad District	4.19	1.56	2.63
6	**Soil Type**			
i	Dharwad taluk	Black and Red		
ii	Hubli taluk	Black and red		
iii	Kalgatagi taluk	Red		
iv	Kundagol taluk	Black		
v	Navalgund taluk	Black		
7	Major varieties grown by sample crops	Chickpea	Annigeri-1,JG-11	
		Cotton	Double-Bt, Bt- Banni, Bt-Rashi	
		Paddy	Udrasali, Untarsali,Dodgya, Abhilash, Jaya, Intan	
		Soybean	JSS-335	
		Chilli	Delux, Byadagi dabbi,	
		Maize	Kaveri, Kargil gold,Pioneer, kanchana,	

Table 4.2: Compound Growth Rate in Area, Production and Yield of Selected Crops in Dharwad District (2001-02 to 2010-11)

(% per annum)

Crops	Dharwad District		
	Growth rates		
	Area	Yield	Production
Paddy	5.16	32.65	39.50*
Maize	22.62**	3.45	32.95**
Chickpea	4.36*	16.83**	31.94*
Soybean	17.47**	6.49	20.25**
Chilli	1.05	-3.13	-2.72
Cotton	-0.75	17.83	3.82

Note: ** and * indicate Significance at 1 per cent and 5 per cent probability levels, respectively

Table 4.3: Taluka wise Compound Growth Rate in Area, Production and Yield of Selected Crops (2001-02 to 2010-11)

(% per annum)

Taluks	Selected Crops	Growth rate		
		Area	Yield	Production
Dharwad	Chickpea	5.83	12.24**	18.79
Hubli	Cotton	6.00	-4.04**	1.72**
Kalaghatgi	Paddy	7.72	18.28*	27.42
	Soybean	15.28	3.05	18.81
Kundagol	Chilli	5.70	6.14*	12.20
Navalgund	Maize	34.32	6.86	43.55*

Note: ** and * indicate Significance at 1per cent and 5 per cent probability levels, respectively

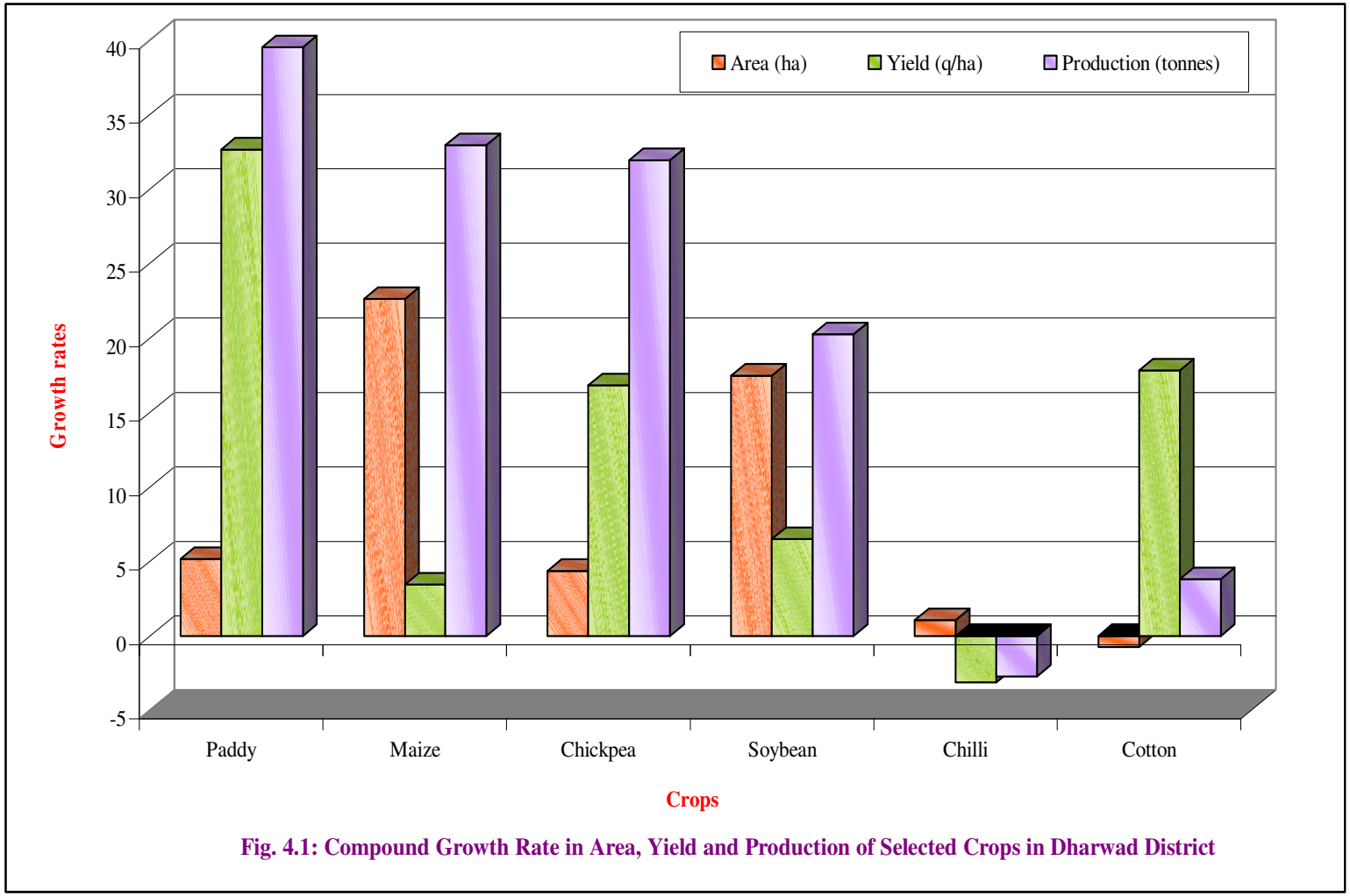

Fig. 4.1: Compound Growth Rate in Area, Yield and Production of Selected Crops in Dharwad District

Fig. 4.1: Compound Growth Rate in Area, Yield and Production of Selected Crops in Dharwad District

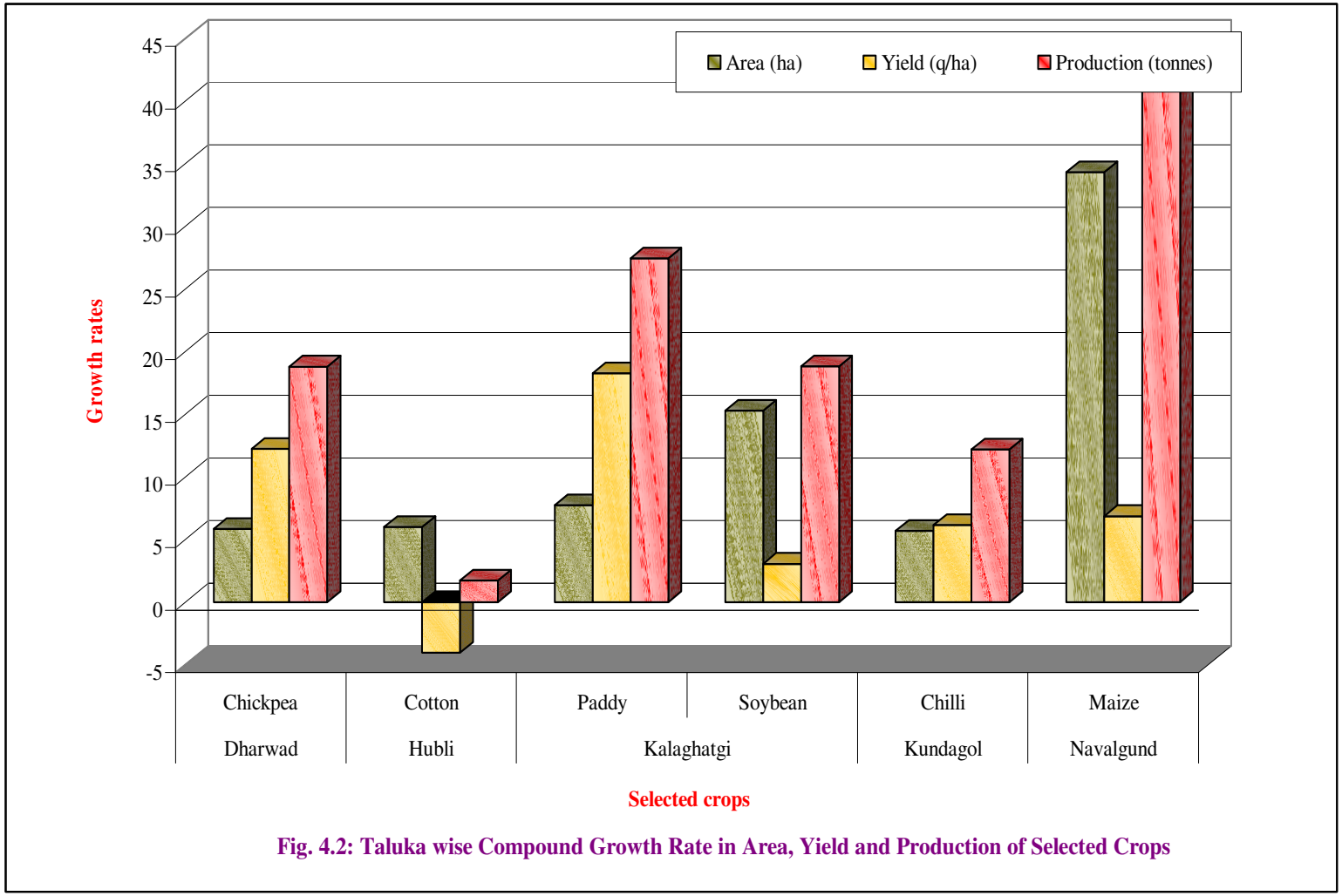

Fig. 4.2: Taluka wise Compound Growth Rate in Area, Yield and Production of Selected Crops

Fig. 4.2: Taluka wise Compound Growth Rate in Area, Yield and Production of Selected Crops

4.3 Cropping Pattern Followed by Sample Farmers in Different Taluks of Dharwad District

4.3.1 Dharwad Taluk

It is evident from the Table 4.4, that in the Dharwad taluk Sorghum, Maize, Wheat were the major cereals grown. Green gram, Red gram and Bengalgram were important pulses, Groundnut and Soybean were major oil seeds, Cotton was the major commercial crop and Onion was seasonal horticultural crop grown in different seasons. Major crops grown during *Kharif* season by sample farmers were Maize, Sorghum, Red gram, Green gram, Groundnut and Cotton. Among these crops the area under Cotton found to be the highest (31.58 ha), followed by Sorghum (23.48 ha), Maize (17.41 ha), Onion (10.73 ha), Groundnut (9.72 ha) and Green gram (7.69 ha). During *Rabi* season Chickpea, Wheat and Wheat+Safflower were the major crops grown. Total area under these crops was 24.70 ha, 12.15 ha and 8.50 ha respectively. During *summer* season Groundnut occupied the highest area of 3.64 ha. It could be noticed that the gross cropped area was 179.92 ha and net cropped area was 115.87 ha with a cropping intensity of 155.57 per cent.

4.3.2 Hubli Taluk

It is evident from the Table 4.5, that the major crops grown during *Kharif* season by sample farmers in Hubli taluk were Cotton, Chilli, Onion, Sorghum and Groundnut. Among these crops the area under Cotton found to be the highest (42.91ha) followed by Chilli (15.38), Sorghum (14.98), Onion (13.77) and Groundnut (10.73). During *Rabi* season, Chickpea, Wheat+ Safflower and Sorghum were the major crops grown. The area under these crops was 16.40 ha, 13.56 ha and 4.45 ha, respectively. During *summer* season Maize occupied an area of 4.86 ha. The grossed cropped area was 195.75 ha and net cropped area was 143.12 ha resulting in cropping intensity of 136.77 per cent.

4.3.3 Kalaghatagi Taluk

The results on cropping pattern presented in the Table 4.6 reveals that, in the Kalaghatgi taluk Paddy, Maize, Wheat were the major food crops grown. Green gram and Cowpea among pulses. Soybean was the major oil seed; Cotton and Sugarcane were the major commercial crops grown in different seasons. The major crops grown during *Kharif* season by sample farmers were Cotton, Sugarcane, Paddy, Maize and Soybean. Among these crops the area under Paddy was found to be the highest (34.01 ha) followed by Cotton (30.77 ha), Soybean (25.10 ha) and Sugarcane (10.12 ha). During *Rabi* season Maize (17 ha), Wheat (10.53 ha) and Sorghum (10.32 ha) were the major crops grown. During *Summer* season Groundnut, Paddy and Maize were the major crops grown. Area under these crops was 8.10 ha, 6.88 ha and 1.62 ha respectively. With grossed cropped area of 170.65 ha and net cropped area of 116.19 ha the cropping intensity of the taluks worked out to be 146.88 per cent.

4.3.4 Kundagol Taluk

Table 4.7 revealed that, in Kundagol taluk major crops grown during *Kharif* season by sample farmers were Chilli, Cotton, Sorghum and Maize. Among these crops the area under Chilli found to be the highest (30.57 ha), Sorghum, Cotton and Maize occupied an average area of 10.12, 9.11 and 9.11 ha respectively. During *Rabi* season Chickpea, Sorghum, Sorghum + Safflower and Chickpea +Safflower were the major crops grown. The area under these crops was 11.54 ha, 8.50 ha, 7.29 ha and 7.29 ha respectively. During *Summer* season, Groundnut was grown on an area of 10.93 ha. It could be noticed that the grossed cropped area and net cropped area were 102.96 ha with a resulting cropping intensity of 157.61 per cent.

4.3.5 Navalgund Taluk

In the Navalgund taluk (Table 4.8) Sorghum, Maize and Wheat were the major food crops grown. Green gram and Redgram were pulses. Groundnut, Sunflower and Safflower were important oil seeds, Cotton and Chilli were the major commercial crops and onion was seasonal horticultural crop grown in different seasons. The major crops grown during *Kharif* season by the sample farmers were Maize, Groundnut, Sunflower, Redgram and Chilli area with respective of 40.28 ha, 14.98 ha, 14.78 ha, 13.68 ha and 12.79 ha. During *Rabi* season Sorghum, Chickpea +Safflower, Wheat, Chickpea and Maize were the major crops grown. The area under these crops was 23.08, 20.24, 19.43, 11.34 and 8.10 ha respectively.

Table 4.4: Cropping Pattern Followed by Sample Farmers in Dharwad Taluk

Crop/season	Area (ha)	Percentage
Kharif		
Sorghum	23.48	13.05
Maize	17.41	9.68
Green gram	7.69	4.28
Black gram	1.62	0.90
Cowpea	1.30	0.72
Red gram	2.83	1.58
Groundnut	9.72	5.40
Soybean	2.43	1.35
Sunflower	3.04	1.69
Onion	10.73	5.96
Cotton	31.58	17.55
Jowar+Green gram	3.24	1.80
Onion+Cotton	0.81	0.45
Sub Total	**115.87**	**64.40**
Rabi		
Sorghum	4.45	2.48
Wheat	12.15	6.75
Chickpea	24.70	13.73
Wheat+Safflower	8.50	4.73
Jowar+Chickpea	5.95	3.31
Sub Total	**55.75**	**30.98**
Summer		
Maize	1.62	0.90
Groundnut	3.64	2.03
Sugarcane	1.21	0.68
Groundnut+Cowpea	1.82	1.01
Sub Total	**8.30**	**4.61**
Gross cropped area	**179.92**	**100**
Net cropped area	115.87	
Cropping intensity (%)	155.27	

Table 4.5: Cropping Pattern Followed by Sample Farmers in Hubli Taluk

Crop/season	Area (ha)	Percentage
Kharif		
Sorghum	14.98	7.65
Green gram	9.92	5.07
Black gram	2.02	1.03
Red gram	2.43	1.24
Cowpea	2.02	1.03
Groundnut	10.73	5.48
Cotton	42.91	21.92
Chilli	15.38	7.86
Onion	13.77	7.03
Cotton+Chilli	13.97	7.14
Jowar+Red gram	9.31	4.76
Groundnut+Green garm	2.83	1.45
Groundnut+Cowpea	0.81	0.41
Groundnut+Coriender	2.02	1.03
Sub Total	**143.12**	**73.11**
Rabi		
Wheat	10.12	5.17
Sorghum	4.45	2.28
Chickpea	16.40	8.38
Safflower	0.40	0.21
Wheat+Safflower	13.56	6.93
Sub Total	**44.94**	**22.96**
Summer		
Maize	4.86	2.48
Chickpea	1.21	0.62
Sunflower	1.62	0.83
Sub Total	**7.69**	3.93
Gross cropped area	**195.75**	**100**
Net cropped area	143.12	
Cropping intensity (%)	136.77	

Table 4.6: Cropping Pattern followed by Sample farmers in Kalaghatagi Taluk

Crop/season	Area (ha)	Percentage
Kharif		
Paddy	34.01	19.93
Maize	10.53	6.17
Cowpea	3.24	1.90
Green gram	2.43	1.42
Soybean	25.10	14.71
Cotton	30.77	18.03
Sugarcane	10.12	5.93
Sub Total	**116.19**	**68.09**
Rabi		
Maize	17.00	9.96
Wheat	10.53	6.17
Sorghum	10.32	6.05
Sub Total	**37.85**	**22.18**
Summer		
Paddy	6.88	4.03
Maize	1.62	0.95
Groundnut	8.10	4.74
Sub-Total	**16.60**	**9.73**
Gross cropped area	**170.65**	**100**
Net cropped area	116.19	
Cropping intensity (%)	146.88	

Table 4.7: Cropping Pattern followed by Sample farmers in Kundagol Taluk

Crop/season	Area (ha)	Percentage
Kharif		
Sorghum	10.12	6.24
Maize	9.11	5.61
Green gram	5.06	3.12
Red gram	3.64	2.25
Cowpea	5.06	3.12
Groundnut	5.51	3.39
Cotton	9.11	5.61
Chilli	30.57	18.84
Jowar+Red gram	6.48	3.99
Maize+ Red gram	8.91	5.49
Chilli+cotton	9.39	5.79
Sub Total	**102.96**	**63.45**
Rabi		
Sorghum	8.50	5.24
Wheat	5.26	3.24
Chickpea	11.54	7.11
Safflower	1.62	1.00
Sorghum + Safflower	7.29	4.49
Chickpea+Safflower	7.29	4.49
Wheat+Safflower	6.88	4.24
Sub Total	**48.38**	**29.81**
Summer		
Groundnut	10.93	6.74
Sub Total	**10.93**	**6.74**
Gross cropped area	**162.27**	**100**
Net cropped area	102.96	
Cropping intensity (%)	157.61	

Table 4.8: Cropping Pattern followed by Sample farmers in Navalgund Taluk

Crop/season	Area (ha)	Percentage
Kharif		
Maize	40.28	15.08
Green gram	8.91	3.33
Red gram	13.68	5.12
Groundnut	14.98	5.61
Sunflower	14.78	5.53
Cotton	10.93	4.09
Chilli	12.79	4.79
Onion	10.12	3.79
Maize+Red gram	9.31	3.49
Cotton+chilli	5.87	2.20
Cotton+Onion	8.91	3.33
Sub Total	**150.57**	**56.36**
Rabi		
Wheat	19.43	7.27
Sorghum	23.08	8.64
Maize	8.10	3.03
Chickpea	11.34	4.24
Safflower	7.49	2.80
Chickpea+Safflower	20.24	7.58
Chickpea+Jowar	2.02	0.76
Sub Total	**91.70**	**34.32**
Summer		
Sugarcane	24.90	9.32
Sub Total	**24.90**	**9.32**
Gross cropped area	**267.17**	**100**
Net cropped area	150.57	
Cropping intensity (%)	177.44	

During *Summer* season Sugarcane (24.90 ha) was the major crop grown. It was noticed that the grossed cropped area was 267.17 ha and net cropped area was 150.57 ha with a cropping intensity of 177.44 per cent.

4.4 Input Utilization Pattern in Cultivation of Selected Crops

4.4.1 Input utilization pattern in Chickpea, Paddy and Soybean cultivation

Input utilization pattern of the Chickpea, Paddy and Soybean were presented in the Table 4.9. All 30 sample farmers growing Chickpea, Paddy and Soybean were rain-fed farmers.

4.4.1.1 Chickpea

In Chickpea production, on an average, farmer used 58.53kg of seed per ha which worked out to be 117.06 per cent of recommended level (Appendix III). Whereas, the nitrogen applied per ha was 17.33 kg and phosphorus 20.32 kg which worked out to be 173.3 per cent and 101.6 per cent of the recommended level. The average quantity of the plant protection chemicals used in the form of liquids was 3.50 ml/liter of water by the Chickpea growers. The per ha labour employed for Chickpea cultivation was around 51 mandays of human labour, 10.39 pair days of bullock labour and 10.05 machine hours. The highest number of a human labour was used for weeding (16.09 mandays) followed by harvesting (12.40 man days) and threshing (6.94 man days) (Table 4.11). Output realized was 9 quintals.

4.4.1.2 Paddy

In Paddy production, on an average, farmer used 89.17 kg of seed per ha which worked out to be 99.07 per cent of recommended level (Appendix III). The quantity of organic manure applied was 2.13 tonnes per ha which is about 35.5 per cent of the recommendation (6 tonnes per ha). Whereas, the per ha nitrogen applied was 72.14 kg, phosphorus 26.29 kg and potassium 18.10 kg which worked out to be 72.14 per cent, 52.58 per cent and 36.20 per cents of recommended level, respectively. The average quantity of the plant protection chemicals used in the form of liquids was 2.20 ml/liters by the Paddy growers. On an average, the labour employed per ha for Paddy cultivation was around 48.30 mandays of human labour, 11.97 pair days of bullock labour and 5 machine hours by sample farmers. Hand weeding operation was utilized the highest number of human labours (16 man days) followed by harvesting (13 man days) (Table 4.11). Output realized was 26.10 quintals.

4.4.1.3 Soybean

In Soybean production, on an average, farmer used 76.57 kg of seed per ha which worked out to be 111.37 per cent of recommended level (Appendix III). The quantity of organic manure used was 4.69 tones per ha which is lower than the recommendation by 6 tones (78.16 %). Whereas, the nitrogen applied per ha was 30.04 kg, phosphorus 33.06 kg and potassium 14.85 kg which worked out to be 75.10 per cent, 41.33 per cent and 59.40 per cents of recommended level. The average quantity of the plant protection chemicals used in the form of liquids was 4.94 ml/liter by the Soybean growers. On an average, the human labour employed per ha for Soybean production was around 45.21 mandays, and farmers used 12.34 pair days of bullock labour and 5.80 machine hours. Weeding operation was consumed the highest number of human labours (13.06 man days) (Table 4.11).The average soybean output realized was 21.24 quintals.

4.4.2 Input utilization pattern in cultivation of Cotton. Chilli and Maize

Sample farmers growing Cotton, Chilli and Maize were post classified into rain-fed and irrigated farmers due to vast difference in input utilization pattern under these two conditions and data were analyzed and depicted in the Table 4.10.

4.4.2.1 Cotton

In irrigated Cotton production on an average, farmer used 3 kg of seed per ha which worked out to be 109 per cent of recommended level (2.75) (Appendix IV). The quantity of organic manure applied per ha was five tones which was lower than the recommendation (10 tones per ha) by 50 per cent. Whereas, the usage of nitrogen per ha was 69.60 kg, phosphorus 36.80 kg and potassium 30 kg which were lower than the recommended level. The average quantity of the plant protection chemicals used in the form of liquid was 7.5 ml/ tank by the Cotton growers. On an average, the per ha labour employed for Cotton production was around 97.61 mandays of human labour, 18.52 pair days of bullock labour and 10.35 machine hours. The highest human labour was employed for harvesting (32.16 man days) (Table 4.11) followed by weeding (23.65 man days).

Table 4.9: Input Utilization Pattern of the selected crops in Dharwad District

(Per ha)

Sl. No	Particulars	Unit	Chickpea n=30	Paddy n=30	Soybean n=30
I	**Input utilization pattern**				
1	Seeds	Kg	58.53	89.17	76.57
2	FYM	tones	-	2.13	4.69
3	Fertilizers				
i	N	Kg	17.33	72.14	30.04
ii	P	Kg	20.32	26.29	33.06
iii	K	Kg		18.10	14.85
4	PPC	ml/liter	3.50	2.20	4.94
5	**Labour utilization pattern**				
i	Men	Man days	28.76	26.59	23.32
ii	Women	Man days	22.24	21.71	21.89
	Total human labour	Man days	51.00	48.30	45.21
iii	Bullock	Pair days	10.39	11.97	12.34
iv	Machine	Hours	10.05	5.00	5.80
II	**Output realized**				
1	Yield	Qtl	9	26.10	21.24
2	Byproduct	Tones	-	48.17	15.07

Table 4.10: Input Utilization Pattern in Cultivation of Maize, Cotton and Chilli under Irrigated and Non-irrigated condition

(per ha)

Sl. No	Particulars	Unit	Maize		Cotton		Chilli	
			Irrigated n=23	Rainfed n=7	Irrigated n=10	Rainfed n=20	Irrigated n=7	Rainfed n=23
I	**Input utilization pattern**							
1	Seeds	Kg	25	22	3	2.50	1.45	1.35
2	FYM	tones	7	5	5	2	8	6.5
3	Fertilizers							
i	N	Kg	99.00	67.80	69.60	43.5	70.10	44.00
ii	P	Kg	41.40	32.20	36.80	23	32.20	18.40
iii	K	Kg	24.00	18.00	30.00	15	30.00	18
4	PPC	ml/ liter	-	-	7.5	6.5	2.45	2
5	**Labour utilization pattern**							
i	Men	Man days	37.34	32.23	51.78	45.32	51.09	44.51
ii	Women	Man days	25.46	22.53	45.83	39.68	39.20	37.52
	Total human labour	Man days	62.80	54.76	97.61	85	90.29	82.03
iii	Bullock	Pair days	14.16	13.64	18.52	16.91	18.55	17.52
iv	Machine	Hours	9.40	8.30	10.35	9.50	8.78	8.56
II	**Output realised**							
1	Yield	Qtl	55	35	23	17	15	8.5
2	Byproduct	Tones	8	5	-	-	-	-

Table 4.11: Operation Wise Labour Utilization Pattern

Sl. No	Operations	Chickpea(R)	Cotton(R)	Cotton(I)	Paddy(R)	Soybean(R)	Chilli(R)	Chilli(I)	Maize(R)	Maize(I)
1.	Human labours(Man days)									
	a)Transportation of manure (FYM)	-	5.32	5.83	3.02	3.50	5.00	5.20	4.58	4.80
	b)Harrowing and cleaning	6.31	6.50	7.72	4.23	3.20	6.85	6.97	4.94	4.94
	c) Spreading of manure (FYM)	-	4.44	4.47	2.22	2.87	5.37	5.85	4.20	4.22
	d) Sowing	2.35	7.47	7.52	3.02	3.00	12.50	12.50	2.50	2.50
	e)Inter-cultivation	4.91	5.00	5.97	4.06	3.28	6.50	7	4.35	4.65
	f) Hand weeding	16.09	20.48	23.65	16.00	13.06	20.85	22.71	16.20	19.70
	g) Plant protection chemicals	2.00	3.54	3.56	0.75	2.36	4.20	4.50	-	-
	h)Irrigation	-	-	4.21	-	-	-	3	-	2.25
	i) Harvesting	12.40	29.84	32.16	13.00	10.56	20.76	22.56	11.58	12.20
	i) Threshing and packing	6.94	2.41	2.52	2.00	3.38	-	-	6.41	6.82
	Total Human Labour	**51**	**85**	**97.61**	**48.30**	**45.21**	**82.03**	**90.29**	**54.76**	**62.08**
2.	Bullock Labour(Pair days)									
	a)Harrowing	5.48	5.62	6.72	2.87	2.56	6.02	6.35	4.71	4.71
	b) Transportation of manure (FYM)	-	5.32	5.83	3.02	3.50	5.00	5.20	4.58	4.80
	c) Sowing	-	-	-	3.02	3.00	-	-	-	-
	d) Inter-cultivation	4.91	5.00	5.97	4.06	3.28	6.50	7.00	4.35	4.65
	Total Bullock Labour	**10.39**	**16.91**	**18.52**	**11.97**	**12.34**	**17.52**	**18.55**	**13.64**	**14.16**
3.	Machine works (Hours)									
	a) Ploughing	-	3.17	3.86	2.5	2.95	3.27	3.49	1.3	1.4
	b) Clod crushing	-	1.83	1.85	0.5	0.85	1.70	1.70	0.5	0.5
	c) Sowing	2.35	-	-	-	-	-	-	2.50	2.50
	d) Threshing	5.20	-	-	-	-	-	-	3	4
	e)Transportation	2.5	4.50	4.64	2	2	3.59	3.59	1	1
	Total Machine Labour	**10.05**	**9.50**	**10.35**	**5.00**	**5.80**	**8.56**	**8.78**	**8.30**	**9.40**

Note-I-Irrigated and R- Rainfed

In rain-fed Cotton production on an average, farmer used 2.50 kg of seed per ha which worked out to be 90.90 per cent of recommended level (2.75 kg) (Appendix III). The quantity of organic manure applied per ha was 2 tones which was lower than the recommendation (5 tones per ha) by 40 per cent. Whereas, the nitrogen applied was 43.5 kg, phosphorus 23 kg and potassium 15 kg which worked out to be 54.37 per cent, 57.50 per cent and 37.50 per cents of recommended level. The average quantity of the plant protection chemicals used in the form of liquid was 6.5ml/ tank of water by the Cotton growers. Theper ha labour employed for Cotton production was around 85 mandays, 16.91 pair days of bullock labour and 9.50 machine hours by the sample farmers. Highest number of human labour was employed for harvesting (29.84 man days) followed by weeding (20.48 man days) (Table 4.11).

4.4.2.2 Chilli

Farmers used 1.45 kg of seed per ha which worked out to be 116 per cent of recommended level (1.25 kg) for production of chilli under irrigated condition (Appendix IV). The quantity of organic manure applied was 8 tonnes per ha which was 32 per cent of the recommendation (25 tones per ha). Whereas, the nitrogen applied per ha was 70.10 kg, phosphorus 32.20 kg and potassium 30 kg which worked out to be 46.73, 42.93 and 40 per cents of recommended level. The average quantity of the plant protection chemicals used in the form of liquids was 2.45 ml/liter of water by the Chilli growers. On an average, the human labour employed per ha for Chilli production was around 90.29 mandays, 18.55 pair days of bullock labour and 8.78 machine hours utilized by the sample farmers. Weeding (22.71 man days) and harvesting (22.56 man days) operations requires highest number of human labours (Table 4.11)

In the rain-fed Chilli cultivation, The results on per ha imput utilization pattern reveals that on an average, farmer used 1.35 kg of seed which worked out to be 108 per cent of recommended level (1.25 kg) (Appendix III). The quantity of organic manure applied was 6.5 tones which was 26 per cent of the recommendation (25 tones per ha). Whereas, the nitrogen applied was 44 kg, phosphorus 18.40 kg and potassium 18 kg which worked out to be 44 per cent, 36.80 per cent and 36 per cents of recommended level. The average quantity of the plant protection chemicals used in the form of liquids was 2 ml/ liter of water by the Chilli growers. On an average, the human labour employed was around 82 mandays, 17.52 pair days of bullock labour and 8.56 machine hours. Weeding (20.85 man days) and harvesting (20.76 man days) were the major operations utilized higher number of human labours (Table 4.11).

4.4.2.3 Maize

In irrigated Maize production, farmer used 25 kg of seed per ha which was as per the recommendation (27 kg) (Appendix IV). The quantity of organic manure applied per ha was 7 tones which is lower than the recommendation (10 tones per ha) which worked out to be 70 per cent of the recommended level. Whereas, the nitrogen applied per ha was 99 kg, phosphorus 41.40 kg and potassium 24 kg which worked out to be 66.55.20 and 64 per cents of recommended level. On an average, the human labour employed per ha for Maize production was around 62.80 mandays highest man days was employed for weeding (12.20 man days) (Table 4.11), 14.16 pair days of bullock labour and 9.40 machine hours utilized by sample farmers.

In rainfed Maize production on an average, farmer used 22 kg of seed per ha which worked out to be 88 per cent of recommended level (25 kg) (Appendix III). The quantity of organic manure applied per ha was 5 tones which is lower than the recommendation (7.5 tones per ha) which worked out to be 66.66 per cent of the recommended level. Whereas, the nitrogen applied per ha was 67.80 kg, phosphorus 32.20 kg and potassium 18 kg which worked out to be 67.80, 64.40 and 75 per cents of recommended level. On an average, the human labour employed per ha for Maize production was around 54.76 mandays, 13.64 pair days of bullock labour and 8.30 machine hours utilized by sample farmers.Highest number of human labour was employed by weeding (16.20 man days) and harvesting (11.58 man days).

4.5 Cost and Returns in Cultivation of Selected Crops

4.5.1 Cost and returns in cultivation of Chickpea, Paddy and Soybean

Per hectare costs and returns in cultivation of Chickpea, Paddy and Soybean which were grown exclusively under rainfed condition by all the sample farmers is depicted in the Table 4.12.

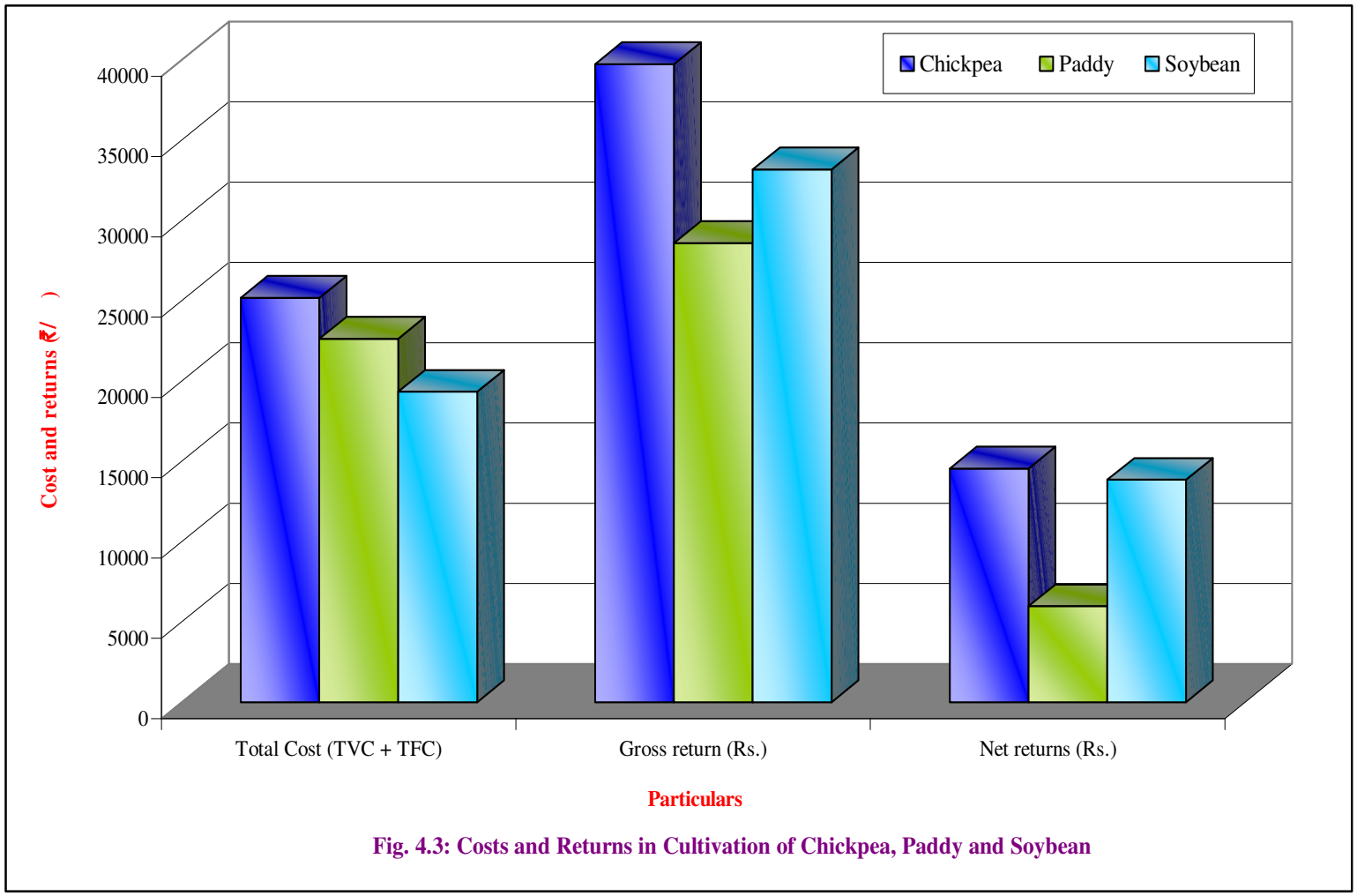

Fig. 4.3: Costs and Returns in Cultivation of Chickpea, Paddy and Soybean

Fig. 4.3: Costs and Returns in Cultivation of Chickpea, Paddy and Soybean

Table 4.12: Costs and Returns in Cultivation of Chickpea, Soybean and Paddy

(per ha)

Sl. No	Particulars	Chickpea n=30	Paddy n=30	Soybean n=30
1	Seed (₹)	2361.23 (9.38)	1210.30 (5.35)	1597.26 (8.27)
2	FYM (₹)	-	1815.45 (8.02)	1503.81 (7.78)
3	Fertilizers (₹)	1170.91 (4.65)	2841.37 (12.56)	2332.19 (12.07)
4	Plant protection chemicals (₹)	342.09 (1.36)	135.85 (0.60)	366.79 (1.90)
5	Human labour (₹)	6750.00 (26.81)	5350.00 (23.64)	4980.00 (25.77)
6	Bullock labour (₹)	917.60 (3.64)	2321.80 (10.26)	621.61 (3.22)
7	Machine labour (₹)	8850.83 (35.15)	4000.28 (17.68)	4184.59 (21.65)
8	Interest on working capital (7%)	1500.15 (5.96)	1663.38 (7.35)	950.34 (4.92)
I	**Total Variable Cost (TVC)**	**21893.81 (86.95)**	**19338.43 (85.46)**	**16536.59 (85.57)**
1	Land revenue (₹)	40.00 (0.16)	40.00 (0.18)	40.00 (0.21)
2	Rental value of land (₹)	2798.10 (11.11)	2898.60 (12.81)	2449.26 (12.67)
3	Interest on fixed capital (12%)	394.48 (1.57)	352.63 (1.56)	298.71 (1.55)
II	**Total Fixed Cost (TFC)**	**3287.35 (13.05)**	**3291.23 (14.54)**	**2787.97 (14.43)**
III	**Total Cost (TVC + TFC)**	**25181.16 (100.00)**	**22629.66 (100.00)**	**19324.56 (100.00)**
IV	**Gross return (₹)**	**39733.24**	**28596.51**	**33170.04**
V	**Net returns (₹)**	**14552.08**	**5966.85**	**13845.48**
	Per quintal cost of cultivation	**2797.90**	**1057.46**	**740.40**
	B:C	**1.58**	**1.26**	**1.72**

Table 4.13: Cost and Returns in cultivation of Cotton

(per ha)

Sl. No	Particulars	Cotton	
		Rainfed n=20	**Irrigated n=10**
1	Seed (₹)	1179.42 (4.19)	2328 (6.68)
2	FYM (₹)	1432.60 (5.08)	1920.60 (5.51)
3	Fertilizers (₹)	2120.00 (7.52)	3552.00 (10.20)
4	Plant protection chemicals (₹)	1265.87 (4.49)	1361.58 (3.91)
5	Irrigation charge (₹)	-	630.00 (1.81)
6	Human labour (₹)	11278.00 (40.02)	12950.00 (37.17)
7	Bullock labour (₹)	623.27 (2.21)	747.17 (2.14)
8	Machine labour (₹)	5434.00 (19.28)	6100.25 (17.51)
9	Interest on working capital (7%)	1374.98 (4.88)	1763.79 (5.06)
I	Total Variable Cost (TVC)	24708.14 (87.69)	31353.39 (90.00)
1	Land revenue (₹)	40.00 (0.14)	40.00 (0.11)
2	Rental value of land (₹)	2967.48 (10.89)	3069.24 (8.81)
3	Interest on fixed capital (12%)	360.89 (1.28)	373.10 (1.07)
II	Total Fixed Cost (TFC)	3470.13 (12.31)	3482.34 (11.34)
III	Total Cost (TVC + TFC)	28178.37 (100)	34835.73 (100)
IV	Gross return (₹)	63344.00	85549.00
V	Net returns (₹)	35165.73	50713.27
	Per quintal cost of cultivation	1657.55	1514.60
	B:C	2.25	2.46

Table 4.14: Cost and Returns in Cultivation of Chilli

(per ha)

Sl. No	Particulars	Chilli	
		Irrigated n=7	**Rainfed n=23**
1	Seed (₹)	376.67 (1.02)	253.65 (0.85)
2	FYM (₹)	3118.37 (8.43)	3137.25 (10.52)
3	Fertilizers (₹)	3360.00 (9.08)	2008.00 (6.73)
4	Plant protection chemicals (₹)	1307.50 (3.54)	1121.53 (3.76)
5	Irrigation charge (₹)	450.00 (1.22)	-
6	Human labour (₹)	11500.00 (31.09)	10465.00 (35.08)
7	Bullock labour (₹)	3828.50 (10.35)	2987.75 (10.02)
8	Machine labour (₹)	7734.68 (20.91)	5850.83 (19.61)
9	Interest on working capital (8%)	1981.20 (5.36)	1609.68 (5.40)
I	Total Variable Cost (TVC)	33656.92 (91.00)	27433.69 (91.97)
1	Land revenue (₹)	40.00 (0.11)	40.00 (0.13)
2	Rental value of land (₹)	2932.86 (7.93)	2100.00 (7.04)
3	Interest on fixed capital (12%)	356.94 (0.97)	256.80 (0.86)
II	Total Fixed Cost (TFC)	3329.80 (9.00)	2396.80 (8.03)
III	Total Cost (TVC + TFC)	36986.72 (100)	29830.00 (100)
IV	Gross return (₹)	89875.00	61715.38
V	Net returns (₹)	52888.28	31884.89
	Per quintal cost of cultivation	2465.78	3509.41
	B:C	2.43	2.07

4.5.1.1 Chickpea Cultivation

The results presented in Table 4.12 revealed that variable costs accounted for major proportion (86.95 %) of the total cost. Among the variable costs, the lion share (35.15 %) was accounted by the machine labour costs (₹8850.83) and the cost of material inputs such as seed, fertilizers and plant protection chemical accounted for 15.39 per cent. Among the material inputs the highest cost incurred was on seed (₹ 2361.23) followed by cost of fertilizers (₹1170.91). Fixed costs like land revenue (₹40), rental value of land (₹ 2798) and interest on fixed capital (₹ 394) together accounted for 13.05 per cent of the total cost.

Per hectare total cost of cultivation of Chickpea worked out to be ₹25181.16 while the per quintal cost of cultivation worked out to be ₹2797.90.

Gross returns realized from one hectare of Chickpea by the sample farmers were ₹. 39733.24. The return per rupee spent in Chickpea cultivation was ₹1.58.

4.5.1.2 Paddy cultivation

It could also be observed from the Table 4.12 that, variable cost in cultivation of Paddy accounted for around 85.46 per cent of the total cost of cultivation, while fixed costs items like land revenue (₹ 40), rental value of land (₹ 2898.60) and interest on fixed capital (₹ 352.63) together accounted for just 14.54 per cent of total cost of cultivation.

Variable cost includes two components *viz*., material input cost and labour cost. The share of material inputs cost (seed, FYM, fertilizers and PPC) was 26.53 per cent of the total cost of cultivation. Among the material input costs, the cost of fertilizer was the highest (₹2841.37) followed by cost of FYM (₹1815.45) seed (₹1210.30). On the other hand among the labour cost, machine labour accounted for the lion share in the total cost of cultivation (17.68 %). Per hectare total cost of cultivation of Paddy worked out to be ₹ 22629.66 and per quintal cost of Paddy cultivation worked out to be ₹ 1057.46. The gross returns realized from Paddy cultivation were ₹ 28596.51 per hectare with a benefit cost ratio of ₹1.26 per rupee spent on Paddy cultivation.

4.5.1.3 Soybean Cultivation

It could be observed from the Table 4.12 that, variable cost in cultivation of Soybean accounted for around 85.57 per cent of the total cost of cultivation, while fixed costs items like land revenue (₹40), rental value of land (₹2449.26) and interest on fixed capital (₹298.71) together accounted for just 14.43 per cent of total cost of cultivation.

Variable cost includes two components *viz*., material input cost and labour cost. The share of material inputs cost (seed, FYM, fertilizers and PPC) was 30.02 per cent of the total cost of cultivation. Among the material input costs, the cost of fertilizer (₹2332.19) followed by cost of seed (₹1597.26) was the highest followed by cost of FYM (₹1503.81) On the other hand among the labour cost, human labour (₹4980) accounted for the lion share in the total cost of cultivation (25.77%)

. Per hectare total cost of cultivation of Soybean worked out to be ₹19324.56 and per quintal cost of Soybean production worked out to be ₹ 740.40. The gross returns realized from Soybean cultivation was ₹33170.04 per hectare with a return of ₹1.72 per rupee spent on Soybean cultivation.

4.5.2 Cost and Returns Structure in Cultivation of Cotton, Chilli and Maize

Cost and Returns structure in cultivation of Cotton ,Chilli and Maize is depicted separately in following sections under tables, because the post classification of the sample farmers revealed that some of the sample farmers were growing these crops under rain-fed condition and some under irrigated condition.

4.5.2.1 Cotton Cultivation

Rainfed Cotton Cultivation

The details on per hectare costs and returns of rainfed Cotton cultivation are given in the Table 4.13. It could be observed from the table that, variable cost accounted for 87.69 per cent of the total cost of cultivation, while fixed costs items like land revenue (0.14%), rental value of land (10.89 %) and interest on fixed capital (1.28 %) together accounted for just 12.31 per cent of total cost of cultivation.

Variable cost includes two components *viz*., material input cost and labour cost. The share of material inputs cost (seed, FYM, fertilizers and PPC) was 21.28 per cent of the total cost of cultivation. Among the material input costs, the cost of fertilizer (₹2120) was the highest followed by cost of FYM (₹1432.6), cost of plant protection chemical (₹1265.87) and seed (₹1179.42). On the other hand, human labour cost (₹11278) accounted for the lion share in the total cost of cultivation (40.02 %).

Per hectare total cost of cultivation of Cotton worked out to be ₹28178.37 and per quintal cost of Cotton cultivation worked out to be ₹1657.55. The gross returns realized from Cotton cultivation was ₹63344 per hectare with a net return of ₹2.25 per rupee spent on Cotton cultivation.

Irrigated Cotton cultivation

The details on per hectare costs and returns for irrigated Cotton are also given in the Table 4.13. It could be observed from the table that, variable cost accounted for around 90 per cent of the total cost of cultivation, while fixed costs items like land revenue (₹40), rental value of land (₹3069.24) and interest on fixed capital (₹373.10) together accounted for just 11.34 per cent of total cost of cultivation.

Variable cost includes two components *viz*., material input cost and labour cost. The share of material inputs cost (seed, FYM, fertilizers and PPC) was 26.3 per cent of the total cost of cultivation. Among the material input costs, the cost of fertilizers (₹3552) followed by cost of seed (₹2328) cost of farmyard manure (₹1920.6) and PPC (₹1361.58). Human labour cost (₹12950) accounted for the lion share (37.17%) in the total cost of cultivation.

. Per hectare total cost of cultivation of Cotton worked out to be ₹34835.73 and per quintal cost of Cotton production worked out to be ₹1514.60. The gross returns realized from Cotton cultivation was ₹85549 per hectare with a return of ₹2.46 per rupee spent on Cotton cultivation.

4.5.2.2 Chilli cultivation

Rainfed Chilli cultivation

It could be observed from the Table 4.14 that, variable cost in cultivation of rainfed Chilli accounted for around 91.97 per cent of the total cost of cultivation, while fixed costs items like land revenue (₹40), rental value of land (₹2100) and interest on fixed capital (₹ 256.80) together accounted for just 8.03 per cent of total cost of cultivation.

Variable cost includes two components *viz*., material input cost and labour cost. The share of material inputs cost (seed, FYM, fertilizers and PPC) was 21.86 per cent of the total cost of cultivation. Among the material input costs, the cost of FYM (₹3137.25) followed by cost of fertilizers (₹2008.62) was the highest followed by cost of plant protection chemical (₹1121.53). On the other hand among the labour cost, human labour (₹10465) accounted for the lion share in the total cost of cultivation (35.08%).

Per hectare total cost of cultivation of Chilli worked out to be ₹29830 and per quintal cost of Chilli production worked out to be ₹ 3509.41. The gross returns realized from Chilli cultivation was ₹61715.38 per hectare with a return of ₹ 2.07 per rupee spent on Chilli cultivation.

Irrigated Chilli cultivation

It could be observed from the Table 4.14 that, variable cost in cultivation of irrigated Chilli accounted for around 91 per cent of the total cost of cultivation, while fixed costs items like land revenue (₹40), rental value of land (₹2932.86) and interest on fixed capital (₹356.94) together accounted for just nine per cent of total cost of cultivation.

Variable cost includes two components *viz*., material input cost and labour cost. The share of material inputs cost (seed, FYM, fertilizers and PPC) was 22.07 per cent of the total cost of cultivation. Among the material input costs, the cost of fertilizers (₹3360) followed by cost of FYM (₹3118.37) was the highest followed by cost of plant protection chemical (₹1307.5). On the other hand among the labour cost, human labour (₹ 11500) accounted for the lion share (31.09%) in the total cost of cultivation.

Per hectare total cost of cultivation of Chilli worked out to be ₹ 36986.72 and to produce a Chilli farmers spent ₹ 2465.78. The gross returns realized from Chilli cultivation was ₹89875 per hectare with a return of ₹2.43 per rupee spent on Chilli cultivation.

Table 4.15: Cost and Returns in Cultivation of Maize

(per ha)

Sl. No	Particulars	Maize	
		Irrigated n=23	**Rainfed n=7**
1	Seed (₹)	1820.26 (6.38)	1268.52 (5.90)
2	FYM (₹)	2679.41 (9.40)	1834.85 (8.53)
3	Fertilizers (₹)	4070.00 (14.28)	3002.00 (13.96)
4	Plant protection chemicals (₹)	-	-
5	Irrigation charge (₹)	400.00 (1.40)	-
6	Human labour (₹)	7575.00 (26.57)	6635.00 (30.85)
7	Bullock labour (₹)	2539.80 (8.91)	1534.92 (7.14)
8	Machine labour (₹)	4278.84 (15.01)	3430.65 (15.95)
9	Interest on working capital (8%)	1501.08 (5.26)	1125.01 (5.23)
I	**Total Variable Cost (TVC)**	**24864.39 (87.21)**	**18830.95 (87.55)**
1	Land revenue (₹)	40.00 (0.14)	40.00 (0.19)
2	Rental value of land (₹)	3215.89 (11.28)	2351.43 (10.93)
3	Interest on fixed capital (12%)	390.76 (1.37)	286.97 (1.33)
II	**Total Fixed Cost (TFC)**	**3646.65 (12.79)**	**2678.40 (12.45)**
III	**Total Cost (TVC + TFC)**	**28511.04 (100)**	**21509.00 (100)**
IV	**Gross return (₹)**	**53573.91**	**38609.29**
V	**Net returns (₹)**	**25062.87**	**17099.94**
	Per quintal cost of cultivation	**518.38**	**614.54**
	B:C	**1.88**	**1.80**

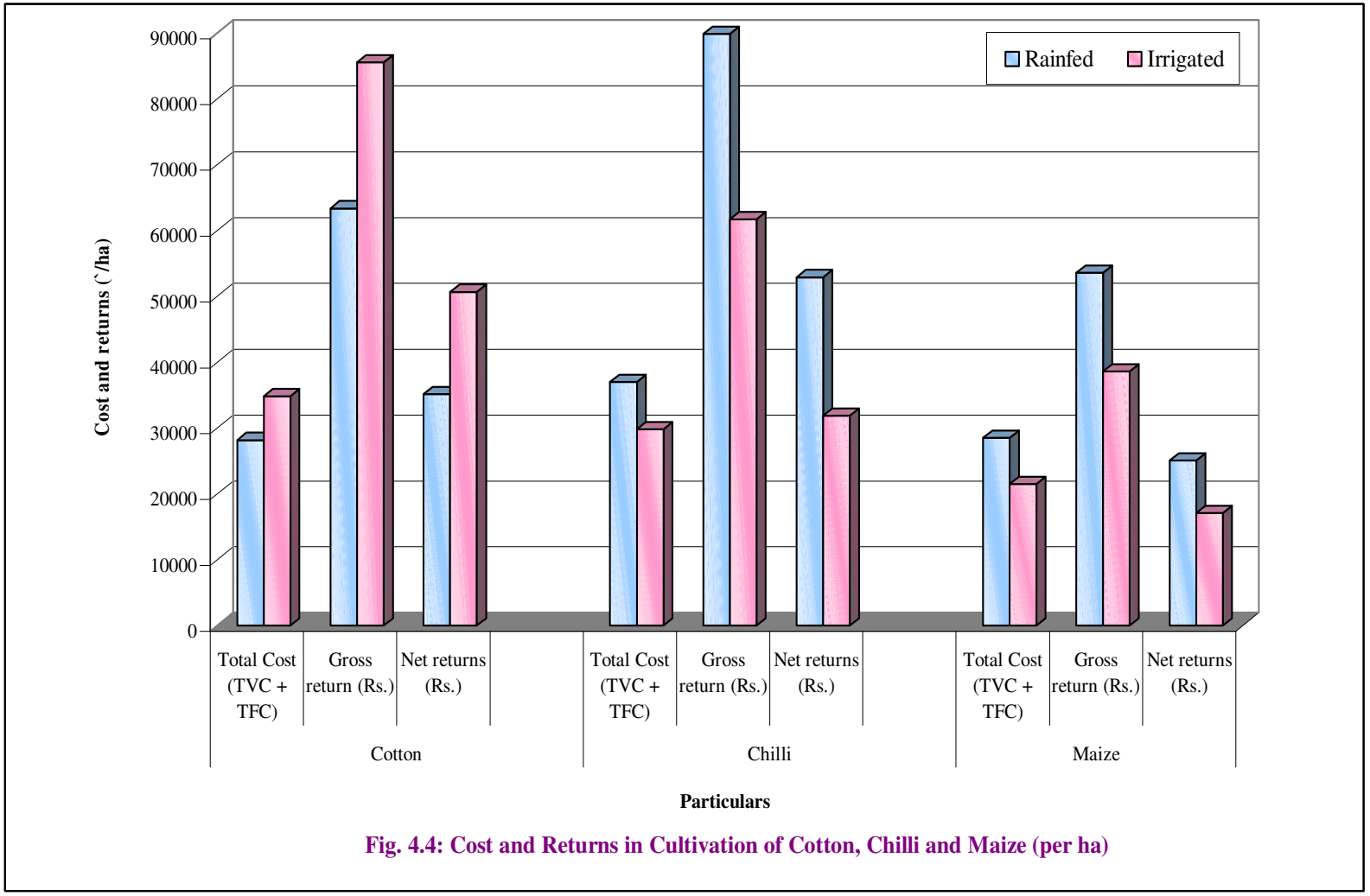

Fig. 4.4: Cost and Returns in Cultivation of Cotton, Chilli and Maize (per ha)

Fig. **4.4: Cost and Returns in Cultivation of Cotton, Chilli and Maize (per ha)**

4.5.2.3 Maize cultivation

Rainfed Maize cultivation

It could be observed from the Table 4.15 that, variable cost in cultivation of Maize accounted for around 87.55 per cent of the total cost of cultivation, while fixed costs items like land revenue (₹ 40), rental value of land (₹ 2351.43) and interest on fixed capital (₹ 286.97) together accounted for just 1.45 per cent of total cost of cultivation.

Variable cost includes two components *viz*., material input cost and labour cost. The share of material inputs cost (seed, FYM and fertilizers) was 28.39 per cent of the total cost of cultivation. None of the farmers were applying any plant protection chemicals. Among the material input costs, the cost of fertilizer (₹3002) followed by cost of FYM (₹1834.85) cost of seed (₹1268.52) On the other hand among the labour cost, human labour cost (₹6635) accounted for the highest share in the total cost of cultivation (30.85 %). Whereas, bullock labour (₹1534.92) and machine labour (₹3430.65) accounted for 7.14 per cent and 15.95 per cent of total cost of production respectively.

Per hectare total cost of cultivation of Maize worked out to be ₹21509 and per quintal cost of Maize cultivation worked out to be ₹614.54. The gross return realized from Maize cultivation was ₹38609.29 per hectare with a return of ₹1.80 per rupee spent on Maize cultivation.

Irrigated Maize cultivation

It could be observed from the Table 4.15 that, variable cost in cultivation of Maize accounted for around 87.21 per cent of the total cost of cultivation, while fixed costs items like land revenue (₹ 40), rental value of land (₹3215.65) and interest on fixed capital (₹390.76) together accounted for just 12.79 per cent of total cost of cultivation.

Variable cost includes two components *viz*., material input cost and labour cost. The share of material inputs cost (seed, FYM and fertilizers) was 30.06 per cent of the total cost of cultivation. Among the material input costs, the cost of fertilizer (₹4070) was the highest followed by cost of FYM (₹2679.41) cost of seed (` 1820.26) On the other hand among the labour cost, human labour cost (₹7575) accounted for the highest share in the total cost of cultivation (26.57 %). Whereas, bullock labour (₹2539.80) and machine labour (₹4278.84) accounted for 8.91 per cent and 15.01 per cent of total cost of production.

Per hectare total cost of cultivation of Maize worked out to be ₹ 28511.04 and per quintal cost of Maize production worked out to be ₹518.38. The gross returns realized from Maize cultivation were ₹53573.91 per hectare with a return of ₹1.88 per rupee spent on Maize cultivation.

4.6 Farm Business Income in Cultivation of Selected Crops

4.6.1 Farm Business Income in cultivation of Chickpea, Paddy and Soybean

Results presented in Table 4.16 provide the details of farm business income in Chickpea, Paddy and Soybean cultivation. It could be observed from the table that Cost-A2 for Chickpea, Paddy and Soybean worked out to be ₹.17822.81, ₹16558.43 and ₹ 14016.25 per hectare, respectively. Cost B2 worked out to be ₹ 20621.91, ₹19457.03 and ₹ 14016.25 per hectare for Chickpea, Paddy and Soybean respectively. Similarly Cost C3 for Chickpea, Paddy and Soybean were ₹ 27425.10, ₹ 24724.73 and ₹ 21148.06 per hectare, respectively.

The Gross returns realized by the respondents for Chickpea worked out to be ₹ 39733.24 per hectare. Whereas returns over Cost-A2, Cost-B2 and Cost-C3 for Chickpea were ₹ 21909.43, ₹ 19111.33 and ₹ 12308.14, respectively.

Gross returns for Paddy worked out to be ₹ 28596.51 per hectare. The returns over Cost-A2, Cost-B2 and Cost-C3 for Paddy were ₹ 12038.08, ₹ 9139.48 and ₹ 3871.78respectively.

Gross returns for Soybean worked out to be ₹ 33170.04 per hectare. The returns over Cost-A2, Cost-B2 and Cost-C3 for Soybean were ₹ 19153.79, ₹ 16704.53 and ₹ 12021.98 respectively.

Table 4.16: Farm business income in cultivation of Chickpea, Paddy and Soybean

(₹ per ha)

Sl. No.	Costs	Chickpea	Paddy	Soybean
I	**Cost concepts**			
1	Cost A1	17822.81 (44.86)	16558.43(57.90)	14016.25(42.26)
2	Cost A2	17822.81 (44.86)	16558.43(57.90)	14016.25(42.26)
3	Cost B1	17822.81 (44.86)	16558.43(57.90)	14016.25(42.26)
4	Cost B2	20621.91 (51.90)	19457.03(68.04)	16465.51(49.64)
5	Cost C1	21933.81 (55.20)	19378.43(67.77)	16576.25(49.97)
6	Cost C2	24731.91 (62.24)	22277.03(77.90)	19025.51(57.36)
7	Cost C2*	24931.91 (62.75)	22477.03(78.60)	19225.51(57.96)
8	Cost C3	27425.10 (69.02)	24724.73(86.46)	21148.06(63.76)
II	**Returns**			
III	**Gross Returns**	39733.24(100)	28596.51(100)	33170.04(100)
1	Returns over A2	21909.43 (55.14)	12038.08(42.10)	19153.79(57.74)
2	Returns over B2	19111.33 (48.10)	9139.48(31.96)	16704.53(50.36)
3	Returns over C3	12308.14 (30.98)	3871.78(13.54)	12021.98(36.24)

Table 4.17: Farm Business Income in Cultivation of Cotton, Chilli and Maize

(₹ per ha)

Sl. No.	Costs	Cotton		Chilli		Maize	
		Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
I	**Cost concepts**						
1	Cost A1	25439.30 (29.74)	20070.05 (31.68)	29546.92 (32.88)	23104.69 (37.44)	21477.39 (40.09)	15903.95 (41.19)
2	Cost A2	25439.30 (29.74)	20070.05 (31.68)	29546.92 (32.88)	23104.69 (37.44)	21477.39 (40.09)	15903.95 (41.19)
3	Cost B1	25439.30 (29.74)	20070.05 (31.68)	29546.92 (32.88)	23104.69 (37.44)	21477.39 (40.09)	15903.95 (41.19)
4	Cost B2	28508.54 (33.32)	23037.53 (36.37)	32479.78 (36.14)	25204.69 (40.84)	24693.28 (46.09)	18255.38 (47.28)
5	Cost C1	31393.3 (36.70)	24748.05 (39.07)	33696.92 (37.49)	27473.69 (44.52)	24904.39 (46.49)	18878.95 (48.90)
6	Cost C2	34462.54 (40.28)	27715.53 (43.75)	36629.78 (40.76)	29573.69 (47.92)	28120.28 (52.49)	21230.38 (54.99)
7	Cost C2*	34662.54 (40.52)	27915.53 (44.07)	36829.78 (40.98)	29773.69 (48.24)	28320.28 (52.86)	21430.38 (55.51)
8	Cost C3	38128.79 (44.57)	30707.08 (48.48)	40512.76 (45.08)	32751.06 (53.07)	31152.31 (58.15)	23573.42 (61.06)
II	**Returns**						
III	**Gross Returns**	85549.00 (100)	63344.00 (100)	89875.00 (100)	61715.38 (100)	53573.91 (100)	38609.29 (100)
1	Returns over A2	60109.70 (70.26)	43273.95 (68.32)	60328.08 (67.12)	38610.31 (62.56)	32096.52 (59.91)	22705.34 (58.81)
2	Returns over B2	57040.46 (66.68)	40360.47 (63.63)	57395.22 (63.86)	36510.31 (59.16)	28880.63 (53.91)	20353.91 (52.72)
3	Returns over C3	47420.21 (55.43)	32636.92 (51.52)	49362.24 (54.92)	28963.94 (46.93)	22421.60 (41.85)	15035.87 (38.94)

Table 4.18: Resource Use Efficiency in the Cultivation of Rainfed Chickpea

Particulars	Parameters	Regression Coefficient	Marginal Value Product (MVP)	MVP/MFC
Intercept	b_0	3.48		
		(1.16)		
Seed	b_1	-0.23**	-3.87	-3.87
		(0.05)		
Fertilizers	b_2	-20.55**	-193.70	-193.70
		(4.62)		
PPC	b_3	-1.64**	-191.95	-191.95
		(0.37)		
Human Labour	b_4	23.44	204.40	204.40
		(4.98)		
Bullock Labour	b_5	0.03	1.33	1.33
		(0.01)		
Machine Labour	b_6	0.06	0.27	0.27
		(0.03)		
Coefficient of determination	R^2	0.976		
F value	F	161.46		
Standard Error	SE	0.009		
Returns to scale	$\sum bi$	1.12		

Note: Figures in parentheses indicate standard error of respective regression coefficients

** and * indicate Significance at 1per cent and 5 per cent probability levels, respectively

MVP= Marginal Value Product; MFC=Marginal Factor Cost

4.6.2 Farm Business Income in cultivation of Cotton, Chilli and Maize

4.6.2.1 Cotton

The per hectare cost of cultivation of irrigated Cotton by cost A2 was ₹ 25439.30, cost B2 was ₹ 28508.30 and cost C3 was ₹ 38128.79. The value of gross returns were ₹ 85549 per hectare. Farm business income (profit at cost A2) was ₹ 60109.70 and family labour income (profit at cost B2) was ₹ 57040.46. Net income (profit at cost C3) per ha was found to be ₹ 47420.21.

The per hectare cost of cultivation of rainfed Cotton by cost A2 was ₹ 20070.05, cost B2 was ₹ 23037.53 and cost C3 was ₹ 30707.08. The value of gross returns realised were ₹ 63344 per hectare, farm business income (profit at cost A2) was ₹ 432273.95 and family labour income (profit at cost B2) was ₹ 40360.47. Net income (profit at cost C3) per ha was found to be ₹ 32636.92.

4.6.2.2 Chilli

The per hectare cost of cultivation of irrigated Chilli by cost A2 was ₹ 29546.92, cost B2 was ₹ 32479.78 and cost C3 was ₹ 40512.76. The value of gross output was ₹ 89875 per hectare. Farm business income (profit at cost A2) was ₹ 60328.08 and family labour income (profit at cost B2) was ₹ 57395.22. Net income (profit at cost C3) per acre was found to be ₹ 49362.24.

The per hectare cost of cultivation of rainfed Chilli by cost A2 was ₹ 23104.69, cost B2 was ₹ 25204.69 and cost C3 was ₹ 32751.00. The value of gross output was ₹ 61715.38 per hectare. Farm business income (profit at cost A2) was ₹ 38610.31 and family labour income (profit at cost B2) was ₹ 36510.31. Net income (profit at cost C3) per ha was found to be ₹ 28963.94.

4.6.2.3 Maize

The per hectare cost of cultivation of irrigated Maize by cost A2 was ₹ 21477.39, cost B2 was ₹ 24693.28 and cost C3 was ₹ 31152.31. The value of gross output was ₹ 53573.91 per hectare. Farm business income (profit at cost A2) was ₹ 32096.52 and family labour income (profit at cost B2) was ₹ 28880.63. Net income (profit at cost C3) per acre was found to be ₹ 22421.60.

The per hectare cost of cultivation of rainfed Maize by cost A2 was ₹ 15903.95, cost B2 was ₹ 18255.38 and cost C3 was ₹ 23573.42. The value of gross output was ₹ 38609.29 per hectare. Farm business income (profit at cost A2) was ₹ 22705.34 and family labour income (profit at cost B2) was ₹ 20353.91. Net income (profit at cost C3) per ha was found to be ₹ 15035.87.

4.7 Resource Use Efficiency in Cultivation of Selected Crops

The resource use efficiency analysis assumes greater importance in ascertaining whether production at farm level and in turn in the region could be increased profitably to an optimum level by making reallocation in the existing resource use pattern.

The Cobb-Douglass type of production function was fitted to the production and input use data in selected crop production. The results of production function estimates, geometric mean levels of inputs and output, marginal factor cost, marginal value product and profitability ratio are presented in Table 4.18.

4.7.1 Chickpea

The estimated coefficients of Cobb-Douglas production function for Chickpea is presented in Table 4.18. The output elasticities of seed (-0.23), fertilizer (-20.55) and plant protection chemical (-1.64) indicated that the production of Chickpea was significantly influenced by these variables. The output elasticities of human labour (23.44), bullock labour (0.03) and machine labour (0.06) were positive but failed to exert any significant influence on chickpea yield.

The coefficient of multiple determination (R^2) for Chickpea production (0.97) indicated that the variables included in the function have explained 97 per cent of the variation in the production of Chickpea. The sum of elasticities (□bi) with 1.12 indicated an increasing returns to scale.

The ratio of marginal value product (MVP) to marginal factor cost (MFC) in the case of seed (-3.87), fertilizers (-193.70), plant protection chemicals (- 191.95) and machine labour (0.27) were less than unity indicated that these inputs were over utilized in the Chickpea production. Whereas human labour (204.40) and bullock labour (1.33) were underutilized.

Table 4.19: Resource Use Efficiency in the Cultivation of Rainfed Cotton

Particulars	Parameters	Regression Coefficient	Marginal Value Product (MVP)	MVP/MFC
Intercept	b_0	12.65		
		(1.86)		
Seed	b_1	-0.01**	-0.36	-0.36
		(0.021)		
FYM	b_2	0.37	13.42	13.42
		(0.108)		
Fertilizers	b_3	0.42	13.78	13.78
		(0.071)		
PPC	b_4	-0.05	-300.96	-300.96
		(0.235)		
Human Labour	b_5	0.06	0.492	0.492
		(0.088)		
Bullock Labour	b_6	-0.50**	-49.86	-49.86
		(0.208)		
Machine Labour	b_7	0.76*	8.38	8.38
		(0.119)		
Coefficient of determination	R^2	0.956		
F value	F	69.06		
Standard Error	SE	0.035		
Returns to scale	$\sum bi$	1.06		

Note: Figures in parentheses indicate standard error of respective regression coefficients

** and * indicate Significance at 1per cent and 5 per cent probability levels, respectively

MVP= Marginal Value Product; MFC=Marginal Factor Cost

Table 4.20: Resource Use Efficiency in the Cultivation of Drill-sown Paddy

Particulars	Parameters	Regression Coefficient	Marginal Value Product (MVP)	MVP/MFC
Intercept	b_0	8.66 (0.560)		
Seed	b_1	0.019 (0.021)	0.453	0.453
FYM	b_2	0.03* (0.012)	0.439	0.439
Fertilizers	b_3	0.04 (0.023)	0.380	0.380
PPC	b_4	0.01 (0.010)	4.243	4.243
Human Labour	b_5	0.41* (0.115)	3.768	3.768
Bullock Labour	b_6	0.05** (0.021)	0.731	0.731
Machine Labour	b_7	-0.26* (0.117)	-1.838	-1.838
Coefficient of determination	R^2	0.9813		
F value	F	165.34		
Standard Error	SE	0.007		
Returns to scale	$\sum bi$	0.324		

Note: Figures in parentheses indicate standard error of respective regression coefficients

** and * indicate Significance at 1per cent and 5 per cent probability levels, respectively

MVP= Marginal Value Product; MFC=Marginal Factor Cost

4.7.2 Cotton

The estimated coefficients of Cobb-Douglas production function for Cotton is presented in Table 4.19, the output elasticity of seed (-0.01), bullock labour (-0.50) and machine labour (0.76) indicated that the production of Cotton was significantly influenced by these variables. The output elasticities of fertilizer (0.42), FYM (0.37) and human labour (0.06) were positive but failed to exert any significant influence on cotton production. Plant protection chemical (-0.05) was negative but non-significant.

The coefficient of multiple determination (R^2) for Cotton production indicated that 95 per cent of the variation in the production of cotton was explained by the variables included in the function. The sum of elasticities (□bi) with 1.06, indicate an increasing return to scale.

The ratio of marginal value product (MVP) to marginal factor cost (MFC) in the case of seed (-0.36), plant protection chemical (-300.96), bullock labour (-49.86) and human labour (0.49) were less than unity indicated that these inputs were over utilized in the Cotton production. Whereas fertilizers (13.78), farm yard manure (13.42) and machine labour (8.38) were underutilized.

4.7.3 Paddy

The estimated coefficients of Cobb-Douglas production function for Paddy is presented in Table 4.20. The output elasticities of FYM (0.03), human labour (0.41), bullock labour (0.05) and machine labour (-0.26) have indicated that the production of Paddy was significantly influenced by these variables. The output elasticities of seed (0.01), fertilizers (0.04) and PPC (0.01) were positive but failed to exert any significant influence on Paddy production.

The coefficient of multiple determination (R^2) for Paddy production indicated that the variables included in the function have explained 98 per cent of the variation in the production of Paddy. The sum of elasticities (□bi) was 0.32 indicated a decreasing return to scale.

The ratio of marginal value product (MVP) to marginal factor cost (MFC) in the case of seed (0.45), FYM (0.44), fertilizer (0.38), bullock labour (0.73) and machine labour (-1.84) were less than unity indicated that these inputs were excessively utilized in the Paddy production. Whereas, PPC (4.24), human labour (3.77) were underutilized.

4.7.4 Soybean

The estimated coefficients of Cobb-Douglas production function for Soybean is presented in Table 4.21.The output elasticities of FYM (0.78) and plant protection chemical (0.40) were indicated that the production of Soybean was significantly influenced by these variables. The output elasticities of seed (0.03), and machine labour (0.08) were non-significant and had positive relationship. Fertilizers (-0.05), bullock labour (-0.006), human labour (-0.08) were non-significant and had negative relationship.

The coefficient of multiple determination (R^2) for Soybean production indicated that the variables included in the function have explained 97 per cent of the variation in the production of Soybean. The sum of elasticities (□bi) was 1.15 indicated an increasing return to scale.

The ratio of marginal value product (MVP) to marginal factor cost (MFC) in the case of seed (0.52), fertilizer (-0.93), human labour (-0.81) and bullock labour (-0.36) and machine labour (0.69) were less than unity indicated that these inputs were over utilized in Soybean production, where as farm yard mannure (8.47) and plant protection chemical (36.94) were underutilized.

4.7.5 Chilli

The estimated coefficients of Cobb-Douglas production function for Chilli are presented in Table 4.22. The output elasticities of bullock labour (-0.32) and Plant protection chemicals (-1.42) have indicated that the production of Chilli was significantly and negatively influenced by these variables. The output elasticities of FYM (0.40), fertilizers (2.77) and machine labour (0.11) had positive relationship but were non-significant. Seed (-0.14) and human labour (-0.20) coefficients were also found to be negative but non-significant negative relationship. The coefficient of multiple determination (R^2) revealed that 93 per cent variation in Chilli production was influenced by the variables included in the model. The sum of elasticities (□bi) with 1.18 indicated an increasing return to scale.

Table 4.21: Resource Use Efficiency in the Cultivation of Rainfed Soybean

Particulars	Parameters	Regression Coefficient	Marginal Value Product (MVP)	MVP/MFC
Intercept	b_0	6.580		
		(1.78)		
Seed	b_1	0.030	0.52	0.52
		(0.11)		
FYM	b_2	0.780**	8.47	8.47
		(0.06)		
Fertilizers	b_3	-0.05	-0.93	-0.93
		(0.04)		
PPC	b_4	0.400**	36.94	36.94
		(0.09)		
Human Labour	b_5	-0.080	-0.81	-0.81
		(0.27)		
Bullock Labour	b_6	-0.006	-0.36	-0.36
		(0.05)		
Machine Labour	b_7	0.086	0.69	0.69
		(0.03)		
Coefficient of determination	R^2	0.966		
F value	F	100.81		
Standard Error	SE	0.01		
Returns to scale	∑bi	1.15		

Note: Figures in parentheses indicate standard error of respective regression coefficients

** and * indicate Significance at 1per cent and 5 per cent probability levels, respectively

MVP= Marginal Value Product; MFC=Marginal Factor Cost

Table 4.22: Resource Use Efficiency in the Cultivation of Rainfed Chilli

Particulars	Parameters	Regression Coefficient	Marginal Value Product (MVP)	MVP/MFC
Intercept	b_0	7.851		
		(2.90)		
Seed	b_1	-0.140	-53.20	-53.20
		(0.13)		
FYM	b_2	0.401	16.74	16.74
		(0.22)		
Fertilizers	b_3	2.770	169.84	169.84
		(0.43)		
PPC	b_4	-1.420**	-120.7	-120.7
		(0.43)		
Human Labour	b_5	-0.200	1.71	1.71
		(0.20)		
Bullock Labour	b_6	-0.322*	-9.99	-9.99
		(0.34)		
Machine Labour	b_7	0.107	-2.65	-2.65
		(0.460)		
Coefficient of determination	R^2	0.932		
F value	F	43.44		
Standard Error	SE	0.077		
Returns to scale	$\sum bi$	1.18		

Note: Figures in parentheses indicate standard error of respective regression coefficients

** and * indicate Significance at 1per cent and 5 per cent probability levels, respectively

MVP= Marginal Value Product; MFC=Marginal Factor Cost

Table 4.23: Resource Use Efficiency in the Cultivation of Rainfed Maize

Particulars	Parameters	Regression Coefficient	Marginal Value Product (MVP)	MVP/MFC
Intercept	b_0	4.23		
		(0.947)		
Seed	b_1	1.23	36.24	36.24
		(0.142)		
FYM	b_2	0.14	2.86	2.86
		(0.090)		
Fertilizers	b_3	0.002	0.03	0.03
		(0.119)		
Human Labour	b_4	-0.17	-1.58	-1.58
		(0.150)		
Bullock Labour	b_5	-0.374**	-8.36	-8.36
		(0.106)		
Machine Labour	b_6	0.091	1.12	1.12
		(0.083)		
Coefficient of determination	R^2	0.96		
F value	F	85.39		
Standard Error	SE	0.03		
Returns to scale	$\sum bi$	0.92		

Note: Figures in parentheses indicate standard error of respective regression coefficients

** and * indicate Significance at 1per cent and 5 per cent probability levels, respectively

MVP= Marginal Value Product; MFC=Marginal Factor Cost

Table 4.24: Problems Faced by the Sample farmers in cultivation of selected crops in Different taluks of Dharwad district

Problems	Dharwad			Hubli			Kalaghatagi			Kundagol			Navalgund			Dharwad district		
	Mean score	%	Rank	Mean score	%	Rank	Mean score	%	Rank	Mean score	%	Rank	Mean score	%	Rank	Mean score	%	Rank
Non –availability of good quality seeds	1344	44.8	VI	1218	40.60	VII	1073	35.76	VII	1959	65.30	III	913	30.43	VIII	6507	43.38	V
Erratic behavior of rainfall	2322	77.8	I	2310	77.00	I	1792	59.73	IV	2217	73.90	I	2198	73.27	I	10835	72.26	I
Non-availability of labour	2098	69.9	II	2053	68.43	II	2213	73.76	I	2196	73.20	II	2184	72.80	II	10744	71.62	II
Non-availability of required inputs	1608	53.6	IV	1055	35.17	VIII	913	30.43	VIII	780	26.00	IX	738	24.60	IX	5094	33.96	IX
Attack of pest & diseases	1898	63.3	III	1923	64.10	III	1397	46.56	V	1488	49.60	V	1470	49.00	VI	8176	54.51	IV
Instability in yield	929	31.00	VIII	1325	44.17	VI	1311	43.70	VI	1037	34.56	VII	1500	50.00	V	6102	40.69	VII
Lack of technical guidance	1023	34.10	VII	1242	41.40	V	2126	70.86	II	1536	51.20	IV	1978	65.93	III	7905	52.7	III
Non-availability of high yielding & pest resistant varieties	1014	47.00	V	1615	53.83	IV	761	25.36	IX	1470	49.00	VI	989	32.97	VII	6245	41.64	VI
Non-availability of adequate credit for crop production	912	30.40	IX	778	25.93	IX	1890	63.00	III	804	26.80	VIII	1530	51.00	IV	5914	39.42	VIII

The ratio of marginal value product (MVP) to marginal factor cost (MFC) in the case of seed (-53.20), plant protection chemicals (- 120.7), bullock labour (-9.99) and machine labour (-2.65) were less than unity indicated that these inputs were over utilized in the Chilli production. Whereas FYM (16.74), fertilizer (169.84) and human labour (1.71) were underutilized.

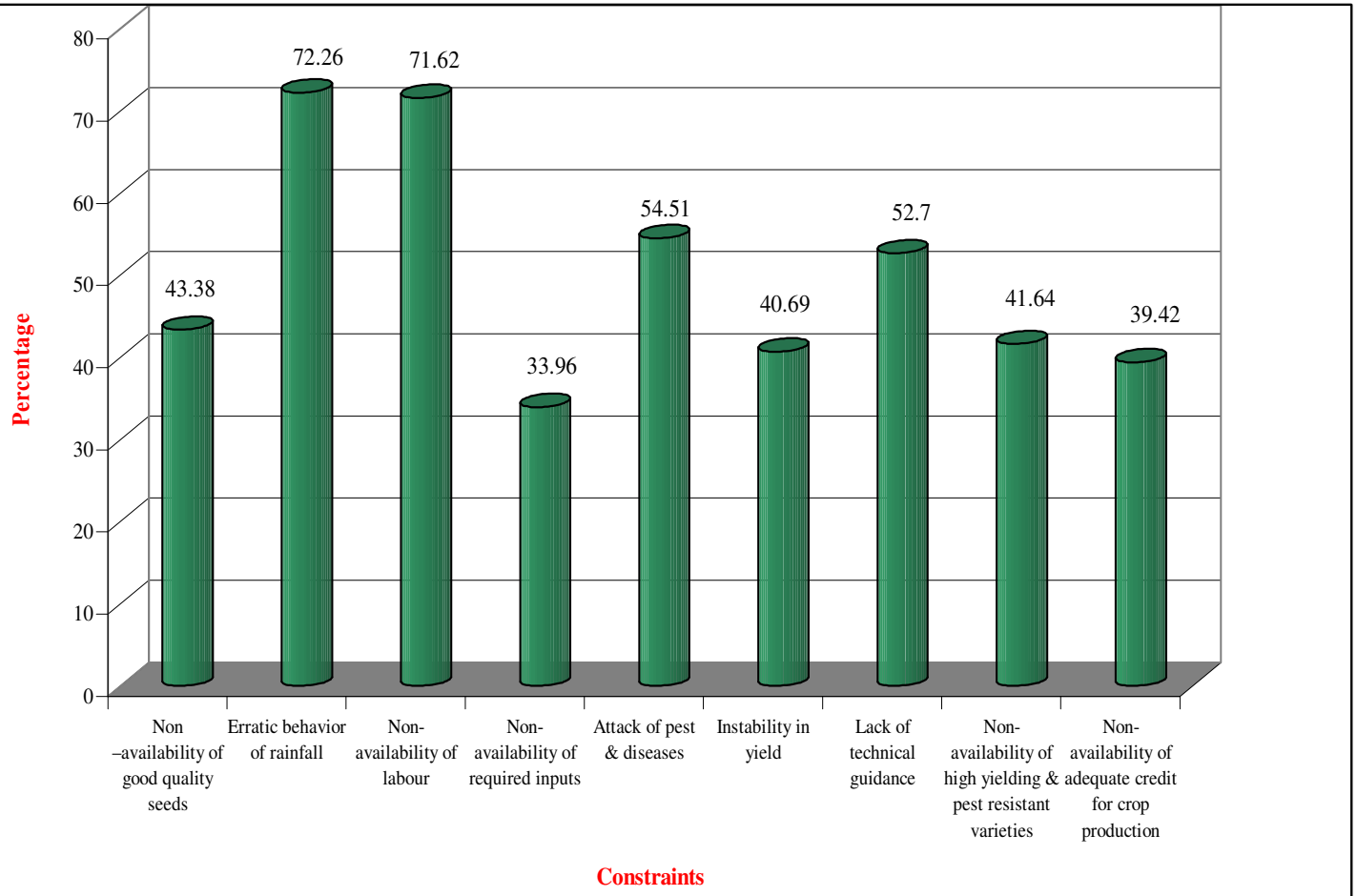

Fig. 4.5: Problems Faced by the Sample Farmers in Cultivation of Crops in Dharwad District

Fig. 4.5: Problems Faced by the Sample Farmers in Cultivation of Crops in Dharwad District

4.7.6 Maize

The estimated coefficients of Cobb-Douglas production function for Maize is presented in Table 4.23 revealed that output elasticity of bullock labour (-0.37) was sugnificant. The output elasticities of seed (1.23), FYM (0.14) fertilizers (0.002) and machine labour (0.09) were positive but failed to exert any significant influence on Maize yield. Human labour (-0.17) were non-significant and had negative relationship.

The coefficient of multiple determination (R^2) for Maize production (0.96) indicated that the variables included in the function have explained 96 per cent of the variation in the production of Maize. The sum of elasticities (□bi) with 0.92 indicated a decreasing return to scale.

The ratio of marginal value product (MVP) to marginal factor cost (MFC) in the case of Fertilizer (0.03), human labour (-1.58) and bullock labour (-8.36) were less than unity indicated that these inputs were over utilized in the production of Maize. Whereas seed (36.24), FYM (2.86) and machine labour (1.12) were underutilized.

4.8 Constraints faced by the farmers in cultivation of crops

Opinion survey was conducted to know the constraints faced by the respondents farmers in sample villages and analyzed using Garrett's Ranking Technique. The factors considered in the analysis were non-availability of good quality seeds, erratic behavior of rainfall, non-availability of labour, non-availability of required inputs, attack of pest and diseases, instability in yield, lack of technical guidance, non-availability of high yielding and pest resistance varieties and non-availability of adequate credit for crop production.

Table 4.24 presents the results of Garrett's Ranking Analysis of problems associated with crop production in Dharwad district. Here, the erratic behavior of rainfall was the major problem expressed by the most of the farmers so this problem got assigned first rank followed by non-availability of labour (II), lack of technical guidance (III), attack of pest and diseases (IV), non-availability of good quality seeds (V), non-availability of high yielding and pest resistance varieties (VI), instability in yield (VII), non-availability of adequate credit for crop production (VIII) and non-availability of required inputs (IX).

DISCUSSION

The results of the investigation are discussed in the present chapter. The main focus is to throw light on causes responsible for the results arrived in the previous chapter and are presented under the following headings.

5.1 Compound growth rate in area, yield and production of selected crops

5.2 Taluk wise cropping pattern followed

5.3 Input utilization pattern of selected crops

5.4 Economics of selected crops cultivation and farm business income

5.5 Resource use efficiency while cultivating selected crops

5.6 Constraints in cultivation of selected crops

5.1 Growth Rate in Area, Yield and Production of Selected Crops of Dharwad District

5.1.1 Chickpea

It follows from the results that the incline in growth of area, production and productivity of Chickpea in Dharwad district. Similarly positive and significant growth was observed in case of yield in Dharwad taluk. This mainly attributable to the availability of good technical guidance for the sample farmers in the study area and stability in the yield levels of Chickpea due to availability of high yielding pest resistance varieties of Chickpea such as Annigeri-I, JG-11 which are agro-ecologically suitable. The findings of the study are in line with the results obtained by Devraj *et al.* (2003)

5.1.2 Cotton

The results on growth rate of cotton revealed that, in Hubli taluk Cotton showed positive growth rate in area and production, where as yield showed negative and significant growth rate. This reduction in the yield levels is mainly due to the erratic behavior of the rainfall in the study area. Cotton crop requires adequate quantity of water before and after flowering, due to scarcity of water supply it will reduce yield levels considerably. The findings of the study are in line with the results obtained by Gaddi (1998).

Similarly in Dharwad district results revealed that, Cotton showed positive and significant growth in production and yield. Yield showed the highest positive growth rate than in production. This increased growth rate of yield levels was mainly due to significant advances in its seed technology and resultant high growth in the yield per hectare. The findings of the study are in line with the results obtained by Sawant (1997).

5.1.3 Paddy

In Kalghatgi taluk Paddy showed positive growth rate in area, production and yield. Since it is the traditional crop of the study area it is cultivated by all the farmers as a source of subsistence even if the returns are low. The findings of the study are in line with the results obtained by Lal *et al.* (1994)

In Dharwad district as whole Paddy showed positive growth rate in area, yield and production. This is due to availability of high yielding pest resistance varieties of Paddy.

5.1.4 Soybean

Results revealed that in Kalghatgi taluk, Soybean showed positive growth rate in area, production and yield. The increase in area was due to replacement of non-remunerative crops like Paddy and minor millets in the study area. Because Soybean is emerging as commercial crop in the study area, For the Dharwad district as a whole for Soybean showed positive growth in area, production and yield. This fast pace of adoption of crop could be accounted for low input and water requirement, apt fitting in existing cropping pattern and remmunerative. The findings of the study are in line with the results obtained by Billore and Joshi (1998) and Sonnad *et al*. (2011)

5.1.5 Chilli

In Kundagol taluk Chilli showed positive growth in area, production and yield during the study period. Improved varieties and production technology, better prices with higher income and export opportunities along with low interest rate credit facilities in recent years might have encouraged Chilli performance. The findings of the study are in line with the results obtained by Rajur et.al (2007).

For Dharwad district as whole Chilli showed positive growth in area, but due to negative growth in chilli production was decreased during the study period. This decline in production was due to erratic rainfall from the last three years. The findings of the study are in line with the results obtained by Hiremath (1994).

5.1.6 Maize

In Navalgund taluk Maize showed positive growth in area and yield. Production showed positive and significant growth during the study period. The growth in area was due to availability of canal irrigation facility and high yielding varieties which ultimately increased the productivity, as Maize threw well under irrigated condition. The findings of the study are in line with the results obtained by Lal *et al.* (1994).

For the Dharwad district as a whole Maize showed positive growth in area, yield and production. The remarkable performance of Maize in terms of area, yield and production was due to higher profitability, due to less labour requirement, availability of pest resistant hybrids and lower cost of production. This crop is gaining more importance in industries for starch production so farmers were getting good returns from this crop.

5.2 Cropping Pattern of Sample Farmers

5.2.1 Dharwad Taluk

It is clear from the results presented in the previous chapter that cropping pattern in Dharwad taluk (Table 4.4) showed variety of crops in both the seasons. The proportion of area accounted by each crop varied from 17.55 per cent up to 0.45 per cent in *Kharif* season. Similarly in *Rabi* season Chickpea occupied highest per cent of area under cultivation. Their tendency might be towards more remunerative returns like Cotton and Maize. This concluded that though the shift in cropping pattern was a welcome sign in terms of the theories of economic development. Cropping intensity is one of the indices of measuring land use efficiency. The cropping intensity depends on many factors *viz*., natural conditions and also socio economic factors. However, in Dharwad taluk cropping intensity was 155 per cent indicating efficient utilization of land. The findings of the study are in line with the results obtained by Hazare (2001).

5.2.2 Hubli taluk

In Hubli taluk also dicersified cropping pattern was noticed (Table 4.5). During *Kharif* the proportion of area occupied by each crop varied from 21.92 to 0.41 per cent. The highest area was occupied by Cotton. Similarly during *Rabi* and *Summer* higher proportion of area was occupied by Chickpea and Maize, respectively. These results are in line with results obtained by Jayakumar and Velayudhan (2002). The area under food crops had been declining over the years, while the area under cash crops increased. The relative profitability of commercial crops influenced the farmer's decision to allocate land under different cash crops. Cropping intensity was 136.77 per cent, which indicate that land is not efficiently utilized compare to other taluk, due to erratic monsoon during the study period.

5.2.3 Kalghatgi taluk

In Kalaghatgi taluk major proportion of the area during *Kharif* was accounted by Cotton (18.03 %), Soybean (14.71 %), Paddy (19.93 %) and Maize (6.17 %). In *Rabi* and *Summer* season major proportion of the area was occupied by Sugarcane and Groundnut respectively (Table 4.6). Credit availability from both institutional and non-institutional sources had made a significant contribution on the change in cropping pattern. In the study area availability of the credit is one of the constraints faced by the sample farmers. So small and marginal farmers in the study area were undertaking Paddy cultivation whereas, large farmers who had strong financial support were undertaking cash crop cultivation like Cotton which needs high cost for production. The findings of this study are in line with results obtained from Subrata (2007) and Behur and Naik (1994).

The cropping intensity in the study area was 146.88 per cent, which indicate that land is efficiently utilized due to good monsoon in Kalghatgi taluk compare to other taluks of Dharwad district.

5.2.4 Kundagol taluk

In Kundagol taluk, respondents were cultivating variety of crops in both the seasons (Table 4.7). Major proportion of the area was occupied by Chilli (18.84 %), Sorghum (6.24 %), Cotton (5.61 %), and very less proportion by Red gram (2.25 %) during *Kharif*. Farmers in the study area were diverted towards commercial crops because of availability of institutional credit and required inputs for production, market infrastructure development and certain other price related support induced the farmers to take up this cropping pattern. These results were in line with findings of Hazare (2001).

During *Rabi* and *Summer*, major proportion of the area was occupied by Chickpea and Groundnut. It is due to attention given by the sample farmers towards yield improvement of food grain crops so that balance could be maintained in the food grain basket. These results were in line with findings of Lal and Singh (1994). Cropping intensity in the study area was 157.61 per cent, indicates efficient utilization of land in the study area due to assured rainfall.

5.2.5 Navalgund taluk

Variety of crops were grown in Navalgund taluk by the sample farmers (Table 4.8). Major proportion of area was accounted by Maize (15.08 %), followed by Groundnut (5.61 %) and Sunflower (5.53%) during *Kharif* and again Maize in *Rabi* season, Sugarcane in *Summer* season. These results were in line with findings of Goswami *et al.* (2003). Because of availability of high yielding varieties and irrigation facility, sample farmers were practicing this cropping pattern in the study area, where most of these crops demand more water. Maize and Sugarcane crops required many irrigations and yield levels will be much higher than the rain-fed condition. Cropping intensity in the study area was 177.44 per cent, indicates that efficient utilization of land in Navalgund taluk compared to other taluks of the Dharwad district due to canal irrigation facility from malaprabha.

5.3 Input Utilization Pattern of Selected Crops

Input utilization pattern in cultivation of Chickpea, Paddy and Soybean under rainfed situation are presented in the Table 4.9.

5.3.1 Chickpea

It could be seen from the Table that, the inputs like seed, fertilizers were used not according to recommended package of practices due to the usage of tractor drawn seed drill without following recommended spacing which consumed more seeds. However, there was a lesser quantity of fertilizers than the recommended. Farmers were unaware of the recommended doze of fertilizers and their calcution (Appendix III). A moderate extent of about 3.50 liters per ha of plant protection chemicals were used to control pests like pod borer. Total labour used was 51 mandays, in that men labour used was 28.76 mandays and women labour was 22.24 mandays, among the different operations in Chickpea production weeding required the highest man days. Machine labour was extensively used for threshing and transporation purpose.

5.3.2 Cotton

Under irrigated situation farmers were using seed rate more than the rainfed situation (Table 4.10). This is because of the reason that to avoid moisture loss from the soil under rainfed situation, respondents were following lesser spacing while sowing. In both the situations seed rate utilization was nearly same as per the recommendation because of higher cost for hybrid seeds. FYM application under both the situation was less than the recommended because farmers were not specific about quantity of application instead they were applying whatever quantity available some time they will be applying more and some time less based on the quantity available. Farmers will be applying lesser quantity of chemical fertilizers than the recommended; it is mainly due to non availability of these fertilizers at required quantity. Irrigated farmers were using higher plant protection chemicals than the rainfed farmers; it is due to more pest incidence in irrigated situations.

Human labour employed in irrigated situation was more than the rainfed situation. It is due to more weed problem, more number of inter-cultivations, higher yield demanding more number of harvests. Bullock and machine labour employed was also more in irrigated area than in rainfed situation.

5.3.3 Paddy

It could be seen from the results presented in previous chapter that fertilizers was used lesser than the recommended lelel. Paddy was growing under drill sown situation, the seed rate used was as per the recommendation, where Farm y+ard manure (FYM) application was slightly lower than the recommended level because of non-availability of required quantity of FYM. Because of less severity in pest incidence, only some of the farmers were using an average quantity of plant protection chemicals. Total labour used was 48.30 mandays, in that 26.59 mandays of men labour and 21.71 mandays of women labour. Women labour was extensively used for weeding while cultivating Paddy. Output realized was also because of lower nutrient status in soil.

5.3.4 Soybean

During cultivation of Soybean farmers were using higher seed rate than the recommended. It is due to the fact that most of the farmers were using their own seeds for sowing. Farm yard manure was used lower than the recommended quantity due to non availability of required quantity of FYM in the study area. Fertilizers were used lesser than the recommended rate in cultivation of Soybean because farmers were of the opinion that it is the hardy crop which not demand more fertilizers, it can be grown under wide variety of soil. The farmers were using 4.94 ml of plant protection chemicals per liter of water to control pest like spodoptera (Cater piller) and pod borer. Average men labour used was 23.32 mandays which was mostly used for harvesting to bagging and 21.89 mandays of women labour was employed mainly for weeding. Bullock labour utility was more because it was used to carry out sowing, inter-cultivation and mechanical threshing. Machine labour was extensively used for ploughing. Output realized was also less than the average yield of the locality.

5.3.5 Chilli

Chilli was cultivated under borewell irrigation by some of the farmers and others were growing under rainfed situation. Under both the situation farmers were using more seed rate than the recommended (Table 4.10) because in the case of Chilli quick wilting will takes place due to lack of moisture in the soil, so to overcome this respondents were preparing more seedlings using higher amount of seed rate. In both the situations farmers were using lesser amount of FYM than the recommended due to non-availability of required amount of FYM. Non-availability of FYM was due to the reason that most of the farmers were selling their livestock as they are not able to provide required feed to animals due to erratic rainfall there was no fodder availability. Farmers were using lesser amount of chemical fertilizers than the recommended. Respondents were of the opinion that, they were getting good returns even at following rate of chemical fertilizer application.

In both the situations women labour was utilized exclusively for weeding and harvesting. Output realized appeared to be less than the recommendation due to moisture stress and disease incidence.

5.3.6 Maize

Maize was cultivated under canal irrigation system by most of the farmers and some were cultivating under rainfed situation. Under both the situations farmers were using hybrid seed for production as per the recommendation because they were available in 25 kg packets and higher price for hybrid Maize seeds, so farmers were utilizing seeds very judiciously. Irrigated farmers were using seed rate more than the rainfed farmers because irrigated farmers were following lesser spacing for sowing. FYM applied in both the situation was less than the recommended rate due to non-availability of required quantity of manure and were dependent more on inorganic fertilizers. None of the farmers used plant protection chemicals in the study area due to availability of pest resistant varieties of Maize like Kargil and Kaveri. Average human labour used under irrigated situation was higher than the rainfed situation. It was due to the reason that more weed problem under irrigated situation. Bullock labour used was higher in irrigated situation due to more number of inter-cultivations. Due to higher yield level under irrigated situation more machine labour was used for threshing.

5.4 Costs and Returns in Cultivation of Selected Crops

5.4.1 Chickpea

It could be observed from the results presented in Table 4.12 that the total cost of Chickpea cultivation per ha was found to be ₹ 25181.16. The average total variable cost incurred in Chickpea production formed major component (₹ 21893.81/ha) (86.95%) of the total cost.

The expenditure on machine labour (35.15%) was major item of variable cost in Chickpea production. As stated earlier, the number of machine labour used was higher in Chickpea production since farmers were using machine labour for land preparation and Chickpea was sown using tractor drawn seed drill. There exists more cost per hour of machine labour. Hence, the cost on this item was found to be higher.

The cost of material inputs included seeds, fertilizer and plant protection chemicals. None of the farmers incurred the expenditure on farm yard manure since it is *Rabi* crop. The cost of material input worked out to be less. The major reasons for this phenomenon are most of the farmers have used their own seeds, and very less application of fertilizer.

Accordingly, the cost of cultivation worked out to be ₹ 2797.90 per quintal. The gross return worked out to be higher than total cost of cultivation. The benefit- cost ratio of 1.58 indicated the profitability of cultivation of Chickpea in the study area especially under rainfed condition.

From the Table 4.16, it could be observed that cost A2 accounted for 44.86 per cent. Cost B2 that includes cumulative effect of cost A2 which could be attributed to the effective management of various factors of production at various level of crop production. It is obvious from the cost C2 that use of family labour was more in case of chickpea cultivation.

5.4.2 Cotton

The total cost of cultivation of Cotton under irrigated and rainfed condition worked out to be ₹34835.73 and ₹28178.37 per hectare, respectively of which the fixed cost accounted for the lesser proportion in both the cases. The variable cost which accounted chunk proportion of total cost. Variable cost includes cost of human labour, machine labour, fertilizers *etc.* Of the variable cost, major proportion was accounted for the labour cost due to various labour intensive operations like weeding, inter-culturing, harvesting and post-harvesting operations and in irrigated condition labour cost is still higher than the rainfed situation due to more weed problem and higher yield in rainfed situation. These results were in line with results obtained by Damate *et al.* (2003). Material inputs included farm yard manure, fertilizer and seeds and together accounted for 21.28 per cent and 26.30 per cent of the total cost of cultivation under rainfed and irrigated conditions respectively. Material cost was slightly more in case of irrigated condition. Among material cost fertilizer costs was more in both the situations. Farmers were of the opinion that, when a crop is growing under irrigated condition, application of more fertilizers and FYM will give complimentary returns. Now-a-days, due to increase in irrigated area and introduction of high yielding varieties of commercial crops, most of the farmer in the study area has been using FYM on larger scale. This higher rate of FYM has further created demand for it, resulting in an increase in its price, rising material cost upwards. Similarly in irrigated situation pest incidence was comparatively more so farmers were using more plant protection chemicals.

Gross returns from Cotton cultivation worked out to be ₹63344 and ₹ 85549 per hectare under rainfed and irrigated situations respectively. This was more enough to cover the total cost of cultivation. The benefit- cost ratio of 2.25 and 2.46 in rainfed and irrigated situations respectively indicated its feasibility of cultivation under both the situations.

From the Table 4.17, it could be observed that paid out cost worked out to be ₹ 25439.30 and ₹ 20070.05 per hectare with the marginal addition of fixed cost under irrigated and rainfed situations, respectively, Cost-B2 worked out to be ₹28508.54 and ₹23037.53 per hectare, respectively under irrigated and rainfed situations. The Cost-C2 was the highest under both the situations, which was due to involvement of family labour for weeding and harvesting operations. Gross returns under irrigated and rainfed situations worked out to be ₹ 85549 and ₹ 63344 per hectare, respectively. Returns over Cost-A2, Cost-B2 and Cost-C3 were found to be positive and indicated the economic feasibility of Cotton cultivation. As expected it is more economical to grow Cotton under irrigated situation than rainfed conditions if irrigation facility is available.

5.4.3 Paddy

Per hectare cost of cultivation of Paddy worked out to be ₹22629.66 which included fixed cost and variable costs. Among the variable costs, human labour cost accounted for lion share followed by machine labour cost. Because of more weed problem more number of human labour was utilized and as it included machine intensive operations like land preparation and operational cost of machine labour was more in the study area so machine cost was found to be more.

The cost of material inputs included only seeds, fertilizer, farm yard manure and plant protection chemicals. Cost of fertilizers was more because farmers were using more fertilizers. However the cost of material input worked out to be less as most of the farmers have used their own seeds and farm yard manure.

Accordingly, the cost of production worked out to be modest of ₹ 1057.46 per quintal. The gross returns were just sufficient to cover the total cost of cultivation. The benefit- cost ratio of 1.26 indicated the cultivation of Paddy as rainfed crops was marginally profitable. These results were in line with results obtained by Rama Rao and Reddy (2007).

From the Table 4.16, it could be observed that the per ha paid out cost worked out to be ₹16558.43 and Cost-B2 worked out to be ₹ 19457.03. The Cost-C2 (₹ 22277.03/ha) was slightly higher but not too much, which was due to the reason that cost of labour was low in the study area. Gross returns worked out to be ₹28596.51 per hectare. Returns over Cost-A2, Cost-B2 and Cost-C3 were found to be positive and indicated the economic feasibility of Paddy cultivation.

5.4.4 Soybean

Per hectare total cost of cultivation of Soybean worked out to be ₹ 19324.56. Among the variable costs, human labour cost accounted for lion share followed by machine cost, as farmers used machine for land preparation and post harvesting operations and operational cost of machine labour was more in the study area.

The major items under material inputs included only seeds, fertilizer, farm yard manure and plant protection chemicals. Cost of fertilizers was more because of lateritic soil in the study area which is having low inherent fertility so farmers were using more amount of fertilizers. The cost of material input worked out to be less. As farmers used their own farm produced seeds and farm yard manure.

Accordingly the cost of production worked out to be modest of ₹ 740.40 per quintal. The gross return worked out to be more over the total cost of cultivation. The benefit- cost ratio of 1.72 indicated the profitability of cultivation of Soybean in the study area under rainfed condition.

From the Table 4.16 it could be observed thatper ha paid out cost worked out to be ₹14016.25 per hectare, Cost-B2 worked out to be ₹ 16465.51 per hectare. The Cost-C3 which includes cost-B2 plus imputed value of family labour (₹19025.51/ha) was the slightly higher due to the reason that cost of labour was low in the study area so farmers were utilizing hired labours. Gross returns worked out to be ₹33170.04 per hectare. Returns over Cost-A2, Cost-B2 and Cost-C3 were found to be positive and indicated the economic feasibility of Soybean cultivation.

5.4.5 Chilli

Per hectare cost of cultivation of Chilli worked out to be ₹ 36986.72 and 29830 in irrigated and rainfed situations, respectively. Among the material cost incurred, cost of farm yard manure (8.43% in irrigated and 10.52% in rainfed) and fertilizer (9.08 % and 6.73 % in irrigated and rainfed situations respectively) were the major items of the total cost followed by that of PPC, it is due to considerable increase in the prices, mainly of fertilizer, seeds and plant protection chemicals (PPC). Most of the farmers felt that due to the reduction in the subsidies on fertilizer was the reason for rise in fertilizer prices. Added to this, due to the entry of many seed companies, labour charges in the seed production has become a costly affair leading to rise in the prices of seeds. Now, unlike during previous decades, most of the farmers have been taking up plant protection measures, which in turn due to improper use of chemicals, many of the crop pests have developed resistance, necessitating the application of more and more chemicals. This ultimately has led to rise in the material cost. Among the labour cost, human labour cost accounted for major share under both the situations. Due to many other socio-economic factors, the cost of living even in rural areas was also been rising steadily. All these factors have resulted in considerable rise in the labour wage rates. These results were in line with results obtained by Rajur *et al*. (2007).

Accordingly, The cost of cultivation worked out to be modest of ₹ 2465.78 and 3509.41 per quintal in irrigated and rainfed situations respectively. The gross return worked out to be more over the total cost of cultivation. The benefit-cost ratio of irrigated (2.43) and rainfed (2.07) Chilli production indicated the profitability of cultivation of Chilli in the study area under both the situations.

From the Table 4.17, it could be observed that paid out cost worked out to be ₹ 29546.92 and ₹ 23104.69 per hectare in irrigated and rainfed situations, respectively and with the marginal addition of fixed cost, Cost-B2 worked out to be ₹ 32479.78 and 25204.69 per hectare in irrigated and rainfed situations. The Cost-C2 was higher in both the situation which was due to involvement of higher family labour. Gross returns worked out to be ₹ 89875 and ₹ 61715.38 per hectare under irrigated and rainfed situation, respectively. Returns over Cost-A2, Cost-B2 and Cost-C3 were found to be positive and indicated the economic feasibility of Chilli cultivation under both the situations.

5.4.6 Maize

Per hectare cost of cultivation of Maize worked out to be ₹28511.04 and ₹21509 in irrigated and rainfed situations respectively, which included fixed cost and variable costs. Fixed cost worked out to be very meager as this doesn't require much of the investment. Among the variable costs, labour cost accounted for lion share under both the situations, as it included number of labour intensive operations like dibling, inter-culturing, weeding, harvesting and post harvesting operations. Under irrigated situations more labour were employed than the irrigated situation because of more weed problem and handling ofs higher yield level.

The cost of material inputs included seeds, fertilizer and farm yard manure. None of the farmers incurred the expenditure on plant protection chemicals because of availability of pest resistant varieties as pest incidence was low.

Accordingly the cost of cultivation worked out to be modest of ₹ 518.38 and 614.54 per quintal under irrigated and rainfed situations, respectively it was due to higher yield level under irrigated condition. The gross return worked out to be almost double the total cost of cultivation. The benefit- cost ratio of 1.88 and 1.80 under irrigated and rainfed conditions, indicated the profitability of cultivation of Maize in the study area especially under irrigated condition.

From the Table 4.17 it could be observed that the paid out cost worked out to be ₹ 21477.39 and ₹ 15903.95 per hectare under irrigated and rainfed situations, respectively and with the marginal addition of fixed cost, Cost-B2 under irrigated and rainfed situations worked out to be ₹ 24693.28 and ₹ 18255.38 per hectare, respectively. The Cost-C2 under irrigated situation was the highest compared to rainfed situation, which was due to involvement of higher family labour for weeding and harvesting, where more weed problem and higher yield level were realized under irrigated situation. This is quite obvious under Indian conditions that participation of family labour is high on farm due to its abundant availability and lack of opportunities and participation in the other sectors and subsidiary activities. Gross returns worked out to be ₹ 53573.91 and ₹ 38609.29 per hectare under irrigated and rainfed situations, respectively. Returns over Cost-A2, Cost-B2 and Cost-C3 were found to be positive under both the situations and higher under irrigated situation indicated the economic feasibility of Maize cultivation.

5.5 Resource Use Efficiency in Cultivation of Selected Crops

Regression equations under rainfed situation were estimated separately using total gross returns as the dependent variable and the expenditure on seeds, organic manure, chemical fertilizers, human labour, bullock and machine labour, plant protection chemicals as independent variables in Chickpea, Paddy, Soybean, Cotton, Chilli and Maize production. The regression equation was estimated in order to capture the nature and magnitude of the effects of the independent variables on the productivity of selected crops. The coefficients were estimated by employing the Cobb-Douglas production function as detailed in methodology chapter.

The efficiency in resource utilization in respect of selected inputs in selected crop production has been explained based on the ratios of the Marginal Value Product (MVP) to Marginal Factor Cost (MFC).

5.5.1 Chickpea

The output elasticity coefficients for seed, fertilizers and plant protection chemicals were negative and found to be significant (Table 4.18). This showed that there is need to reduce the expenditure on these inputs and that would contribute significantly towards gross returns. Elasticity coefficients for human labour, bullock labour and machine labour were positive but non-significant. Hence, it would not be profitable to further increase in the expenses on these resources.The summation of elasticity coefficients was 1.12 and that showed increasing returns to scale. The

increasing returns to scale indicated that a one per cent increase in all the factors of production simultaneously would result on an average increase of gross returns by 1.12 per cent.

Coefficient of multiple determination showed that 97 per cent of total variation in gross returns was explained by the variables included in the model.

The results on MVP to MFC ratios for human labour and bullock labour was more than one indicating that still there is scope to use more of these inputs and increase the gross returns of Chickpea production. On the other hand, the MVP to MFC ratios seed, fertilizers, plant protection chemicals and machine labour were less than one, indicating the expenditure on this input was more than the optimum level. Hence, withdrawal of some units of these resources which were overused is profitable in the short run.

5.5.2 Cotton

The results on production function analysis in cotton cultivation showed that, the output elasticity coefficients for seed and bullock labour were negative and found to be significant (Table 4.19). This showed that decrease in the use of these inputs would result in increase in profitability of Cotton production. Coefficient for Machine labour was positive and significant so increasing use of these inputs results increasing efficiency of Cotton production. FYM, fertilizer and human labour were positive but non-significant. The elasticity coefficient for plant protection chemical was negative and found to be non-significant indicating that the PPC was over used.

It could be observed from the results in table that the marginal productivity of the fertilizer (13.78) was the highest followed by FYM (13.42) and human labour (0.49). Profitability ratio analysis showed that MVP:MFC ratio was less than unity for all the inputs except seed, PPC and bullock labour indicating they are over utilized thus there is a need to reduce expenditure on these inputs.

5.5.3 Paddy

The output elasticity coefficients for FYM, human labour and bullock labour were positive and found to be significant (Table 4.20). This showed that increase in the use of these inputs would result in increase in efficiency of Paddy production, which contributed significantly towards gross returnsin paddy cultivation. Elasticity coefficient of machine labour was negative and significant warned to decreas the use of this input to increase efficiency in Paddy production. Elasticity coefficients for seeds, fertilizers and plant protection chemicals were positive but non-significant. Hence, it would not be profitable to further increase in the expenses on these resources.

The sum of elasticity coefficients with 0.34 showed decreasing returns to scale. The value of coefficient of multiple determination (R^2) showed that 98 per cent of total variation in gross returns was explained by the variables included in the model.

The analysis of marginal value products of various inputs indicated that it was negative for machine labour (-1.84) which was due to over use of this inputs. Plant protection chemical (4.24) showed the highest marginal value product followed by human labour (3.76), bullock labour (0.73), seeds (0.45), FYM (0.44) and fertilizers (0.38). Thus, there is scope to increase area under Paddy production by reorganizing expenditure on different inputs.

5.5.4 Soybean

The output elasticity coefficients for FYM and plant protection chemicals were positive and found to be significant (Table 4.21). This showed that these inputs were contributing significantly towards gross returns. Elasticity coefficients of seed and machine labour were positive but non-significant. Fertilizer, human labour and bullock labour were negative and non-significant indicating that they are over-used and need to reduce expenditure on them.

The sum of elasticity coefficients (1.15) showed increasing returns to scale. The increasing returns to scale indicated that a one per cent increase in all the factors of production simultaneously would result in an average increase of gross returns by 1.15 per cent. Coefficient of multiple determination (R^2) implied that 97 per cent of total variation in gross returns was explained by the variables included in the model.

The analysis of marginal value products of various inputs indicated negative rate for human labour (-0.81), bullock labour (-0.36) and fertilizer (-0.93), were over used. Plant protection chemical showed the highest marginal value product followed by farm yard manure (8.47), machine labour (0.69) and seeds (0.52). By optimum utilization of these resources, the profits can be increased.

5.5.5 Chilli

The output elasticity coefficients for plant protection chemicals and bullock labour were negative and found to be significant (Table 4.22). This showed, these inputs contributed significantly towards gross returns. Seed and human labour were negative indicating that they were over utilized. Elasticity coefficients of FYM, fertilizers and machine labour were positive and non-significant. Hence, it would not be profitable to reallocate expenditure on these resources.

The sum of elasticity coefficients (1.18) showed increasing returns to scale. Coefficient of multiple determination (R^2) implied 93 per cent of total variation in gross returns was explained by inputs included in the model.

Seeds, plant protection chemicals, machine labour and bullock labour were over utilized in the production of Chilli where as FYM, fertilizer and human labour were underutilized. So there is a scope for reallocation of expenditure among different inputs.

5.5.6 Maize

Elasticity coefficient of bullock labour was not only negative but significant (Table 4.23). This showed that any increase in the use of this inputs would result in decreased Maize production. Elasticity coefficient of seed, FYM, fertilizer and machine labour were positive but non-significant.

The sum of elasticity coefficients (0.91) showed slightly decreasing returns to scale. The value of coefficient of multiple determination (R^2) was 0.95 which implied that 95 per cent of total variation in gross returns was explained by the variables included in the model.

The results on MVP to MFC ratios showed that seeds, FYM and machine labour were more than one indicating that still there is scope to use these inputs and increase the gross returns from Maize cultivation. On the other hand, the MVP to MFC ratios for human labour and bullock labour were less than one and negative, indicating the expenditure on this input was more than the optimum level.

5.6 Constraints faced by the farmers during crop production

An informal discussion with the sample farmers revealed that they are facing lot of problems in crop production. Opinion survey was conducted to know the major constraints faced by the farmers in crop production and results of opinion survey are presented in the Table 4.24. Garrett's test was applied by giving ranks for constraints

Erratic behavior of rainfall was the major problem expressed by the most of the farmers. Because it is difficult to get good returns from high yielding seeds and higher doses of fertilizers. Water will remain a critical input for agriculture. So sample farmers need technical guidance regarding water harvesting techniques and farmers should use water efficiently by giving only life saving irrigations. Non-availability of labour in the study area has got II rank; labour is one of the basic factor without which production is not at all possible. So agriculture labours, small and marginal farmer's migration to the nearby city for other works like carpentry, factory etc to meet their basic requirements, educated youths have negative attitude towards agriculture and presumption of agriculture as low esteem job. The farmers expressed that, lack of technical guidance for crop production III rank. Attack of pest and diseases was the IV constraint faced by the sample farmers. Even after releasing so many high yielding and pest resistance varieties, farmers were unaware of these things because of lack of technical guidance to the sample farmers. These problems prevented farmers from achieving greater farm productivity. These results were in line with findings of Ramarao (2012).

Non-availability of good quality seeds, non availability of high yielding and pest resistance varieties, instability in yield, non-availability of credit and non-availability of required inputs has got rank V,VI,VII, VIII and IX ranks, respectively. These findings were in line with results of Gaddi *et al.* (2002) and Ramamoorthy (1995).

SUMMARY AND POLICY IMPLICATIONS

This chapter summarises the findings of the investigation and suggests appropriate policies to achieve efficient method of cultivation by reducing the cost.

6.1 Introduction

Dharwad is known for its varied agro-climatic regions and soil types. To attain sustainability and self sufficiency in food grain production, various technological interventions have been introduced in agricultural sector which demanded externally produced inputs purchased by the farmers in order to exploit the potentiality of resources used in the production of crops. As a result, cost of production of various crops has been rising over the years. In view of poor economic status, majority of the farmers in general and small and marginal farmers in particular are unable to invest on their own for the externally purchased inputs revealing a demand for higher scale of finance for various crops grown by the farmers. Hence, the scale of finance for different crops is necessarily to be revised every year by taking into account the various components of cost of cultivation of major crops in the district. To estimate the costs involved in production of crops, it is essential to work out the costs incurred in production of different agricultural commodities. The information on cost of cultivation will be of immense use to the policy makers and scientists to frame effective policy relating to agriculture development in the district in particular and Karnataka state as a whole in general.

Keeping in view the importance of cost of cultivation of different crops an attempt was made in this study to analyzed the economics of production of major crops in Dharwad district.

6.2 Objectives

1. To analyze growth in area, production and productivity of major crops in Dharwad district.
2. To identify cropping pattern of sample farmers in the study area.
3. To analyse input utilization pattern, cost and returns in production of major crops in study area.
4. To analyze resource use efficiency in production of major crops.
5. To identify constraints in production of major crops and suggest appropriate policy measures to enhance productivity of the crops in the study area.

6.3 Methodology

6.3.1 Data base

The study was based on both the primary and secondary data. To study the growth rates of selected crops, time series data on area, yield and production of major crops was obtained from the Dharwad District at a glance. The data on these variables were collected for 10 years from 2001-02 to 2011-2012. The sample farmers were interviewed personally by using pretested schedule. Information on socio-economic profile of the farmers, land holdings, cropping pattern, quantity and value of various inputs used and the yield obtained in case of selected crops were collected. The opinions of the farmers with respect to the problems in the production were documented.

6.3.2 Sampling technique

Multistage sampling technique was used. In the first stage, Dharwad district was purposively selected. In the second stage, all the five taluks were covered in order to study the major crops of the district. In the third stage, from each selected taluk, two villages were selected based on the highest area under cultivation of the selected crops. At the final stage, 15 farmers from each village were selected randomly. Total sample size was 150. Sample farmers were post classified into rainfed and irrigated famers to compare cost and returns structure under both the situations. From the irrigated farmers information regarding input utilization pattern under rainfed condition was also collected since they might have come across water scarcity during certain situations. Based on this information resource use efficiency under rainfed situation was calculated.

6.4 Analytical tools and techniques used

Keeping in view the objectives of the study, the following analytical techniques were employed.

Budgeting technique was used to work out the cost and returns in cultivation of major crops. In order to analyze the growth in area, yield and production of selected six crops, exponential function form was used. The resource use efficiency in production of major crops selected for the study was analyzed by fitting the Cobb-Douglas type of production function to the farm level data.

6.5 Findings of the study

6.5.1 Growth performance of major crops in Dharwad district

Among the major crops selected for the study, Maize (22.62 %) the highest per annum growth rate in area followed by Soybean (17.47 %), Paddy (5.16 %), Chickpea (4.36 %) and Chilli (1.05 %). Cotton was showed negative growth trend (-0.75 %). But yield level of Paddy (32.65 %) showed highest growth rate followed by Cotton (17.83 %), Chickpea (16.83 %), Soybean (6.49 %), Maize (3.45 %) and the least growth was observed in case of Chiilli. This resulted in direct impact on production of these crops.

6.5.2 Growth performance of major crops in sample taluks

Taluk wise analysis of CGR revealed that, in Dharwad taluk Chickpea showed positive growth rate in area, production and yield. In Hubli taluk, Cotton was showing positive growth rate in area but yield showed negative growth. In Kalaghatgi taluk both Paddy and Soybean were showing positive growth in area, production and yield. In Kundagol taluk Chilli was showing positive growth rate in area, production and yield. In Navalgund, Maize was showing positive growth in area, yield and production.

6.5.3 Cropping pattern of sample farmers

In Dharwad district sample farmers cultivated of Cotton, Maize, Chilli, Sorghum and Groundnut during *Kharif*, Chickpea, Wheat and Sorghum during *Rabi* and Sugarcane and Groundnut during *Summer*. Cropping intensity was found to be the highest in Navalgund taluk followed by Kundagol, Kalaghatgi, Dharwad and Hubli taluks.

6.5.4 Input utilization pattern and Cost and return structure in cultivation of major crops

6.5.4.1 Chickpea

Chickpea growers used about 28.76 man days of male labour and 22.24 man days of female labour, 58.53 kg seed, 37.65 kg of inorganic fertilizers and 3.50 ml/liter of PPC.

The analysis of cost and returns showed that per hectare cost of cultivation of Chickpea was ₹25181.16/ha. Operational cost constituted the major portion (86.95%) of the total cost of cultivation. Machine labour (₹ 8850.83/ha) found to be major item of variable cost. Machine labour had a share of 33.55 per cent in the total cost of cultivation. Cost of human labour, fertilizer and seed were the other major items of operational cost.

Gross and net returns per acre of Chickpea were estimated to be ₹ 39733.24 and ₹ 14552.08, respectively with a benefit cost ratio of 1.58.

6.5.4.2 Cotton

In cultivation of Cotton under irrigated condition, the sample farmers used 3 kg of seed, 5 tones of FYM, 136.40 kg of inorganic fertilizers, 7.5 ml/liter of PPC, 97.61 man days of human labour, 18.52 pair days of bullock labour and 10.35 hours of machine labour. Where as in case of rainfed condition farmers were employing 2.50 kg of seed, 2 tones of FYM, 81.50 kg of inorganic fertilizers, 6.5 ml of PPC per liter of water, 85 man days of human labour, 16.91 pair days of bullock labour and 9.50 hours of machine labour.

The analysis of cost and returns showed that, per hectare cost of cultivation of irrigated Cotton was ₹ 34835.73 and that of rainfed Cotton was ₹ 28178.37. Operational cost constituted the major portion of the total cost of cultivation under irrigated (90%) and rainfed (87.69%) situations. Human labour cost was found to be the major item of variable cost under both the situations which accounted for 40.02 per cent and 37.17 per cent under irrigated and rainfed situation, respectively. Cost of machine labour, seed and fertilizers were the other items of operational cost. Gross and net returns per hectare of Cotton cultivation was estimated to be ₹ 85549 and ₹ 50713.27, respectively under irrigated situation which was higher compare to rainfed situation where in the gross and net return computed as ₹ 63344 and ₹ 35165.73, respectively. The benefit cost ratio was 2.46 and 2.25 in case of irrigated and rainfed situations, respectively.

6.5.4.3 Paddy

It could be revealed from the results that the Paddy growers employed about 26.59 man days of male and 21.71 man days of female labour, 89.17 kg seed, 116.53 kg of inorganic fertilizers, 2.13 tones of organic manure and 2.20 ml/liter of PPC per hectare.

The analysis of cost and returns showed that per hectare cost of cultivation of Paddy was ₹ 22629.66/ha. Operational cost constituted the major portion (85.46%) of the total cost of cultivation. Human labour cost (₹ 5350/ha) was found to be major item of variable cost. Machine labour had a share of 17.68 per cent of the total cost of cultivation. Cost of fertilizer, human labour and bullock labour were the other major items of operational cost.

Gross returns, net return per acre and B:C ratio for Paddy was estimated to be ₹ 28596.51 and 1.26 respectively.

6.5.4.4 Soybean

In the case of Soybean, farmers were using 76.57 kg of seed, 4.69 tones of FYM, 77.95 kg of inorganic fertilizers and 4.94 ml/liter of PPC per hectare. Among the labour 23.32 man days of men labour 21.89 man days of women labour, 12.34 pair days of bullock labour and 5.80 hours of machine labour was employed.

The analysis of cost and returns showed that per hectare cost of cultivation of Soybean was ₹ 19324.56/ha. Operational cost constituted for the major portion (85.57%) of the total cost of cultivation. Human labour (₹ 4980/ha) was found to be major item of variable cost. Machine labour had a share of 21.65 per cent of the total cost of cultivation. Cost of human labour, fertilizers and seed the other major items of operational cost.

Gross and net return per ha of Paddy was estimated to be ₹ 33170.04 and ₹ 13845.48, respectively with a benefit cost ratio of 1.72.

6.5.4.5 Chilli

Under irrigated condition for per hectare Chilli cultivation farmers were using 1.45 kg of seed, 8 tones of FYM, 132.30 kg of inorganic fertilizers, 2.45 ml of PPC per liter of water, 90.29 man days of human labour, 18.55 pair days of bullock labour and 8.78 hours of machine labour. Where as in case of rainfed condition farmers were using 1.35 kg of seed, 6.5 tones of FYM, 80.40 kg of inorganic fertilizers, 2 ml of PPC, 82.03 man days of human labour, 17.52 pair days of bullock labour and 8.56 hours of machine labour were utilized.

The analysis of cost and returns showed that, the per hectare cost of cultivation of irrigated Chilli was ₹ 36986.72 and rainfed Chilli was ₹ 29830.

Operational cost constituted the major portion of the total cost of cultivation under irrigated (91%) and rainfed (91.97%) situations. Human labour cost was found to be the major item of variable cost under irrigated and rainfed method of cultivation. Human labour had a share of 31.09 per cent and 35.08 per cent under irrigated and rainfed situation respectively. Cost of machine labour, bullock labour and FYM were the other items of operational cost.

Gross and net returns per hectare of Chilli cultivation was estimated to be ₹ 89875 and ₹ 52888.28 respectively under both irrigated situation which was higher compared to rainfed situation ₹ 61715.38 and ₹ 31884.89. The benefit cost ratio was 2.43 and 2.07 in case of irrigated and rainfed situations respectively.

6.5.4.6 Maize

In Maize cultivation, under irrigated condition farmers were using 25 kg of seed, 7 tones of FYM 164.40 kg of inorganic fertilizers, 62.80 man days of human labour, 14.16 pair days of bullock labour and 9.40 hours of machine labour were utilized per hectare. Where as in case of rainfed condition farmers were employing 22 kg of seed, 5 tones of FYM, 110 kg of inorganic fertilizers, 54.76 man days of human labour, 13.64 pair days of bullock labour and 8.30 hours of machine labour were employed. It revealed that inputs utilized under irrigated condition were more than the rainfed situation. Per hectare cost of cultivation of irrigated Maize was ₹ 28511.04 and rainfed Maize was ₹ 21509. Operational cost constituted the major portion of the total cost of cultivation under irrigated (87.21%) and rainfed (87.55%) situations. Human labour cost was found to be the major item of variable cost under irrigated (26.57 %) and rainfed (30.85%)method of cultivation.

Cost of fertilizer, machine labour and FYM were the other items of operational cost in irrigated and rainfed Maize cultivation.

Gross and net returns per hectare of Maize cultivation were estimated to be ₹ 53575.91 and ₹ 25062.87, respectively under irrigated situation which was higher compare to rainfed situation figures as ₹ 38609.29 and ₹ 17099.94, respectively. The benefit cost ratio was 1.88 and 1.80 in case of irrigated and rainfed situations respectively.

6.5.5 Resource use efficiency in cultivation of major crops

6.5.5.1 Chickpea

Seed, fertilizers, PPC and machine labour were over utilized and human labour and bullock labour were underutilized by the Chickpea farmers. 97 per cent of the variation in Chickpea output was explained by the inputs included in the model.

6.5.5.2 Cotton

Results of the Cobb-Douglas production function for Cotton under rainfed condition revealed that seed, PPC, human labour and bullock labour were over utilized and FYM, fertilizer and machine labour were underutilized. The independent variables included in the model were able to explain 96 per cent of the variation in Cotton production of sample growers.

6.5.5.3 Paddy

In production of paddy seed, fertilizers, FYM, bullock labour and machine labour were over utilized and human labour and PPC were underutilized by the farmers. The coefficient of multiple determination (R^2) value of 0.981 indicated that inputs included in the model were able to explain 98 per cent of the variation in Paddy production of sample growers.

6.5.5.4 Soybean

Production function analysis indicated that FYM and PPC were under utilized by the soybean farmers. Seed, fertilizers, human labour, bullock labour and machine labour were overutilized. The results of the coefficient of multiple determination (R^2) value of 0.967 indicating that inputs included in the model were able to explain 97 per cent of the variation in Soybean production.

6.5.5.5 Chilli

The results of production function analysis indicated resource use efficiency under rainfed Chilli production revealed that seed, PPC, bullock labour and machine labour were over utilized where as FYM, fertilizer and human labour were under utilized by the farmers. Seed, PPC and bullock labour were influencing the output significantly. that with the coefficient of multiple determination (R^2) value of 0.932 indicating that inputs included in the model explained 93 per cent of the variation in Chilli production of sample growers.

6.5.5.6 Maize

The analysis of resource use efficiency for maize under rainfed condition was revealed that seed, FYM and machine labour was underutilized and fertilizer, human labour and bullock labour were over utilized by the sample farmers. The results of production function analysis indicated 96 per cent of the variation in Maize production was influenced by the variables included in the model.

6.5.6 Constraints during crop production

In Dharwad district sample farmers were facing many constraints during crop production. Erratic behaviour of rainfall was the major problem expressed by the most of the farmers and this problem got first rank followed by non-availability of labour (II), lack of technical guidance (III), attack of pest and diseases (IV), non availability of good quality seeds (V), non availability of high yielding and pest resistance varieties (VI), instability in yield (VII), non availability of adequate credit for crop production (VIII) and non availability of required inputs (IX).

Policy implications

Based on the findings of the study the following policies were suggested to reduce the cost and increase the returns in production of selected crops in the study area.

1. The results of compound growth rate analysis revealed that of the six crops selected for the study, except in chilli and cotton, increased growth in area, production and yield was observed. However, in case of chilli, though the area showed positive insignificant growth but yield and production showed substantial decline in growth. This was mainly due to non availability of suitable variety for control of murada disease in the study area. On the contrary, in case of cotton, though insignificant growth was observed in area but a substantial growth was seen both in production and yield of this crop. This was mainly due to availability of good quality, pest resistant Bt-hybrids introduced by many seed companies accompanied by remunerative price. To attain sustainable growth in production of these crops, efforts should be made to supply location specific, pest resistant improved varieties/hybrids in chilli and cotton in the study area.

2. The analysis of cropping pattern in the study area showed that majority of the farmers inclined towards growing commercial crops such as Cotton, Chilli and Maize, which were found to be more profitable as compared to cultivation of other food grains. This kind of shift in cropping pattern may threaten the food security of farm households and also degrade soil fertility in the long run. Hence collaborative efforts are to be made by the research institutions and extension agencies for exploiting the existing potential of improved and short duration varieties of food grains along with commercial crops, which permit double cropping, so that productivity of these crops can be enhanced.

3. Farmers in the study area were using local vareties of food grains for cultivation. They are unaware of the peast resistant and high yielding improved varieties/hybrids. So extension efforts should be made towards indroduction of these varieties/hybrids to the farming society.

4. The analysis of input utilization pattern in different crops in the study area revealed that majority of the farmers have used seeds more than the required/ recommended quantity, which unnecessarily adds to the total cost of production. Similarly, the sample farmers have used fertilizers and FYM less than the recommended quantity. This leads to low nutrients availability to the crops. In this direction, efforts are to be made to create awareness among the farmers to use inputs as per the recommendations, which leads to decrease in cost of cultivation and increase in output levels and farm profitability.

5. A comparative analysis of cultivation of crops under rainfed and irrigated conditions in the study area revealed that yield realized in rainfed situation in all three crops was less as compared to irrigated condition. To narrow down the yield gaps in these two situations, the efforts should be made to create awareness among the farmers regarding various dry land cultivation techniques such as seed hardening, seed treatment, mulching and growing drought resistant verities.

6. Among the nine constraints identified in production of major crops in the study area, majority of the farmers expressed erratic behavior of rainfall and non availability of labour were the major ones followed by lack of technical guidance, attack of pest and diseases *etc.* To overcome these problems in the study area, the farmers are to be advised to grow drought resistant varieties/hybrids, adoption of water harvesting and water conservation techniques, partial mechanization and adoption of labour saving techniques.

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Appendix I: State wise Area. Production and Yield of different crops-2011-12

States	Area('000 hect.)						Production('000 tons)						Yield(Kg/ha)					
	Rice	Maize	Gram's	Soybean	Cotton	chilli	Rice	Maize	Grams	Soybean	Cotton	chilli	Rice	Maize	Grams	Soybean	Cotton	Chilli
A.P	3984	786	1233	88	1134.0	223	13324	3621	720	173	3491	772	3344	4607	1233	1966	523	3462
Arunachal Pradesh	124	42	-	3.6	-	2.40	158	57	-	4.2	-	3.60	1275	1344		1167		1500
Assam	2324	18	500	-	1	16.00	3319	13	0.9	-	0.6	10	1428	722	500		102	625
Bihar	3572	639	1187	-	-	2.90	4418	1455	60.3	-		3.90	1237	2274	1187			1345
Chattisgharh	3752	105	959	69.2	0.1	5.60	5426	165	241.5	79	0.1	2.60	1446	1567	959	1149	170	464
Goa	46.6	0.1	-	-	-	-	121	0.5		-			2330	5000				
Gujrat	808	424	1136	68	2422	8.00	1474	583	200	26	8276	8.00	1942	1375	1136	382	581	1000
Haryana	1245	14	982	-	483	0.70	3613	37	110	-	1885	0.70	3361	2643	982		663	1000
Himachal Pradesh	77	300	1000	0.6	0.1	0.70	121	862	0.6	1.1	0.2	0.30	1546	2873	1000	1833	340	429
J &K	263	302	545	-	-	0.70	561	474	0.1	-		0.70	2133	1569	545			1000
Jharkhand	720	237	1052	0.3	-	-	3336	358	73.5	0.1			2018	1509	1052			
Karnataka	1540	1113	658	113	403	136.0	3717	3254	631	97	778	155.00	2625	2924	658	858	328	1140
Kerala	228	-	-	-	1.3	1.40	528	-		-	1.7	1.30	2310				222	929
MP	1602	879	863	5024	630.4	43.01	1461	1133	2686	5480	864	44.75	938	1288	863	1091	233	1040
Maharashtra	1518	672	904	2664	3195	100	2996	1790	1300	3976	7015	44.00	1903	2664	904	1492	373	440
Manipur	212	3		-	-	7.90	406	8.4		-		4.30	2446	2800				540
Meghalaya	106	17	500	1.1	7.2	1.90	200	25	0.3	1	6.5	1.40	1880	1468	500	909	153	737
Mizoram	54	7		1.7	0.1	1.30	15	0.7		0.4	0.6	0.80	288	95		235	1020	615
Nagaland	172	67	714	28.3	0.2	0.80	290	119	0.5	32.5	0.3	1.00	1685	1788	714	1148	255	1250
Orissa	4451	74	780	-	50.1	76.10	7540	147	32.7	-	124	63.90	1694	1987	780		423	840
Punjab	2610	153	1286	-	604	2.60	10489	521	2.7	-	2355	4.20	4019	3405	1286		663	1615
Rajasthan	127	1051	898	797.6	369.2	20.60	259	1955	1600.7	1071	562	27.40	2031	1860	898	1343	397	1330
Sikkim	14	39		3.6	-		22.9	62		3.2	-		1636	1601		889		
Tamil Nadu	1789	223	671	-	99.3	67.40	5040	810	4.9	-	200	34.00	2817	3627	671		344	506
Tripura	237	2.1	667	-	1.1	2.00	624	2.1	0.2	-	1.5	2.50	2633	1000	667		232	1250
UP	5709	838	930	4.8	4.3	16.00	11780	1209	530	3.2	6.8	15.00	2063	1443	930	667	269	938
Uttarkhand	289	29	785	-	-	6.00	593	-	0.4	-		2.00	2052		785			
West Bengal	5719	77.2	1072	0.5	8.2	62.40	14719	244	23.7	0.3	13	93.70	2573	3166	1072	600	274	
All India	43914	8117	895	8881.7	9413.7	805.8	96692	18955	8221	10968	25884	1297.8	2202	2335	895	1235	467	1611

Source: Directorate of Economics and Statistics-2011-12

Appendix II: District wise area, production and yield under different crops 2011-12

District	Area(Ha)						Production(Tonnes)						Yield(Tonnes/ha)					
	Rice	Maize	Grams	Soybean	Cotton	chilli	Rice	Maize	Gram	Soybean	Cotton	Chilli	Rice	Maize	Gram	Soybean	Cotton	Chilli
Bagalkot	133	82030	2054	3524	2824	1318	381	197519	702	2035	4402	1836	2.86	2.41	0.34	0.58	1.56	1.39
Bangalore(Rural)	1667	10935	3231	-	--	320	7189	50412	2003	15	-	351	4.31	4.61	0.62	1.07		1.10
Bangalore(Urban)	2041	655	913	-	-	151	6016	1627	468	-	-	211	2.95	2.48	0.51			1.40
Belgum	7188	162344	5014	97400	30046	4937	84042	343578	1613	49318	63454	3051	1.17	2.12	0.32	0.51	2.11	0.62
Bellary		100517	7298		25269	13274	120414	198142	2820	-	47008	15189	3.16	1.97	0.39		1.86	1014
Bidar	5039	1685	38454	33508	1165	629	3857	1406	21799	7894	1115	740	0.77	0.83	0.57	0.24	0.96	1.18
Bijapur	27	64558	9105	4	3669	1305	77	96242	1610	2	7636	2227	2.85	1.49	0.18	0.50	2.08	1.71
Chamarajannagar	17114	37899	19741	-	754	746	45717	82932	11356	1	683	806	2.67	2.19	0.58	1.00	0.91	1.08
Chikballapur	3359	39139	8134	-		406	8503	118641	3230	-		386	2.53	3.03	0.36			0.95
Chikmagalur	43642	10697		-	1028	2468	108173	29449	5671	132	1425	1002	2.48	2.75	0.70	1.04	1.30	0.41
Chitradurga	11075	84438	8295	-	10513	1802	11075	141928	3601	20	14749	2026	2.31	1.68	0.43	0.91	1.40	1.12
Dakshinakannada	54899	10	1611	-	-	128	54899	12	1147	-		170	2.26	1.20	0.47			1.33
Davangere	137449	174172		-	16843	2349	137449	518239	965	2	28211	3615	3.41	2.98	0.71	0.50	1.67	1.54
Dharwad	26958	51862	49498	36033	83461	51070	26958	118104	1027	19204	130437	38030	1.17	2.28	0.73	0.53	1.56	0.74
Gadag	2012	48292	2092	4	62015	8610	3722	91242	394	2	82054	4987	1.85	1.89	0.49	0.50	1.32	0.58
Gulbarga	79472	6352	803	1650	23502	2794	180692	7141	5094	192	55471	5291	2.27	1.12	0.63	0.10	2.36	1.89
Hassan	47659	62825	10712		297	2375	127886	222250	387	3	453	8864	2.68	3.54	0.48	0.75	1.53	3.73
Haveri	49995	125965	4516	11342	109231	13763	60166	262420	2404	3739	143134	29606	1.20	2.08	0.57	0.33	1.31	2.15
Kodagu(coorg)	34844	3576	120			431	85137	16736	56		3	1329	2.44	4.68	0.47		1.50	3.08
Kolar	7096	845	6017			1773	12830	2122	1832		53	2494	1.81	2.51	0.30		1.77	1.41
Koppal	73955	41056	11094		17514	1634	245406	61771	2162		7430	2474	3.32	1.50	0.20		0.42	1.51
Mandya	79961	4073	26375	6		550	263413	5261	12306	5	15	669	3.29	1.29	0.47	0.83	3.00	1.22
Mysore	123650	29391	49403	17	41255	1217	381919	92500	34012	12	54175	2302	3.09	3.15	0.69	0.71	1.31	1.89
Raichur	176440	915	1380		22101	330	492337	1855	389	3	53381	2523	2.79	2.03	0.28	1.00	2.42	0.76
Ramanagar	8314	1993	7603		1680	561	24015	7786	3579			556	2.89	3.91	0.47			0.99
Shimoga	133259	69481	509			628	319806	199932	247	3	2460	1248	2.40	2.88	0.49	0.60	1.46	1.99
Tumkur	36335	26306	30307	5	852	3460	92959	39348	13935	2	2114	2598	2.56	1.94	0.46	0.40	2.48	0.75
Udapi	57509	40	391			310	138204	40	395			456	2.40	2.67				1.47
Uttarkannada	80272	4451	230	18	2783	4	155245	16361	109	8	5287	7	1.93	3.68	0.53	0.40	1.90	1.75

Source: Directorate of Economics and Statistics-2011-12

Appendix III: Recommended quantity of inputs and estimated output levels of selected crops in Dharwad district under rainfed condition

Sl. No	Particulars		Paddy	Maize	Chickpea	Soybean	Cotton(Hybrids)	Chilli
1	Varieties		Jaya, Rashi, Abhilash, intan, Avinash, Hemawati	Deccon-103	Annigeri-1, ICCV-10, ICCV-2, JG-11, BGD-103	JS-335, KHSB-2	DHB-105, DCH-32, Varalaxmi	Byadagi, Pusa jwala
2	Seed rate	Kg	80-100(drill sown)	22.5-27.5	50	62.5-75	2.5-3	1.25
3	Spacing	cm		60*20*5	30 cm line spacing	30*8-10	90*60	90*90
4	FYM	tones	1	7.5	_	6	5	25
5	Fertilizers							
i	N	Kg	100	100	10	40	80	100
ii	P	Kg	50	50	25	80	40	50
iii	K	Kg	50	25	_	25	40	50
6	Output	q/ha	30-40	35-40	8-10	18-20	12-18	9
7	By product	q/ha	55-70	5-6	_	10-15	_	

Source- Package of practice-2010, UAS, Dharwad

Appendix IV: Recommended quantity of inputs and estimated output levels of selected crops in Dharwad district under irrigated condition

Sl. No	Particulars		Paddy	Maize	Chickpea	Soybean	Cotton(Hybrids)	Chilli
1	Varieties		Jaya, Jyoti, Avinash,	Deccon-103, Ganga-11	-	-	Banni,Ganesh, Gowri,	
2	Seed rate	Kg	62	22.5-27.5	-	-	2.5-3	1.25
3	Spacing	cm		60*20*5	-	-	90*60	75*45
4	FYM	tones	5-7	10	-	-	10	25
5	Fertilizers							
i	N	Kg	100	150	-	-	150	150
ii	P	Kg	50	75	-	-	75	75
iii	K	Kg	50	37.5	-	-	75	75
6	Output	q/ha	50-55	48-65	-	-	20-25	15-18
7	By product	q/ha	60-75	6-9	-	-	15-18	

Source- Package of practice, UAS, Dharwad

Appendix V: Garret ranking conversion table

The conversion of orders of merits into units of amount of "socres"

Percent	Score	Percent	Score	Percent	Score
0.09	99	22.32	65	83.31	31
0.20	98	23.88	64	84.56	30
0.32	97	25.48	63	85.75	29
0.45	96	27.15	62	86.89	28
0.61	95	28.86	61	87.96	27
0.78	94	30.61	60	88.97	26
0.97	93	32.42	59	89.94	25
1.18	92	34.25	58	90.83	24
1.42	91	36.15	57	91.67	23
1.68	90	38.06	56	92.45	22
1.96	89	40.01	55	93.19	21
2.28	88	41.97	54	93.86	20
2.69	87	43.97	53	94.49	19
3.01	86	45.97	52	95.08	18
3.43	85	47.98	51	95.62	17
3.89	84	50.00	50	96.11	16
4.38	83	52.02	49	96.57	15
4.92	82	54.03	48	96.99	14
5.51	81	56.03	47	97.37	13
6.14	80	58.03	46	97.72	12
6.81	79	59.99	45	98.04	11
7.55	78	61.94	44	98.32	10
8.33	77	63.85	43	98.58	9
9.17	76	65.75	42	98.82	8
10.06	75	67.48	41	99.03	7
11.03	74	69.39	40	99.22	6
12.04	73	71.14	39	99.39	5
13.11	72	72.85	38	99.55	4
14.25	71	74.52	37	99.68	3
15.44	70	76.12	36	99.80	2
16.69	69	77.68	35	99.91	1
18.01	68	79.17	34	100.00	0
19.39	67	80.61	33		
20.93	66	81.99	32		

AN ECONOMIC ANALYSIS OF PRODUCTION OF MAJOR CROPS IN DHARWAD DISTRICT

LAXMI N. TIRLAPUR **2013** **Dr. S. M. MUNDINAMANI**
Major Advisor

ABSTRACT

The cost of cultivation is an important economic indicator being taken into consideration by Government of India. Early 1970 farmers were using farm produced inputs for cultivation. It was after 1970, that is after the advent of green revolution, agriculture practices became more capital intensive and costlier. Therefore reliable and representative estimates about cost of cultivation of agricultural crops is obvious for formulating an appropriate strategy for planned agricultural development. The present study was under taken in Dharwad district. Random sampling technique was employed for selection of the sample farmers. Total sample size was 150. Chickpea, Cotton, Paddy, Soybean, Chilli and Maize were selected as a major crops. Analytical tools such as mean and averages, cobb-douglas production function, budgeting technique and garret ranking technique were used. It was revealed from the study that farmers in the study area were inclining towards cultivation of commercial crops which gives more remunerative returns compare to food-grains. Farmers were not utilizing the inputs efficiently in cultivation of crops. Cost of cultivation of selected crops under rainfed situation was found to be ₹25181.16, ₹22629.66, ₹19324.56, ₹28178.37, ₹36986.72 and ₹21509.00 for chickpea, paddy, soybean, cotton, chilli and maize, respectively. Cultivation of cotton, chilli and maize under irrigated condition were found to be ₹34835.73, ₹36986.72 and ₹28511.04, respectively. It is more profitable to grow cotton under both irrigated (2.46) and rainfed (2.25) situations compare to chickpea (1.58), paddy (1.26), soybean (1.72), irrigated chilli (2.43), rainfed chilli (2.07), irrigated maize (1.88) and rainfed maize (1.80).