AN ECONOMIC ANALYSIS OF PRODUCTION OF RABI SORGHUM AND ITS COMPETITIVE CROPS IN BELGAUM DISTRICT OF KARNATAKA

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INTRODUCTION

The importance of agriculture sector for initiating and sustaining economic growth in developing countries is a long recognized fact. Agriculture contributes to economic development in the following areas: (a) supplying food to non agricultural labour force and agricultural raw materials to industry; (b) providing surplus labour to industry and other sectors of the economy; (c) providing savings and capital resources for the development of industry and other economic sectors; (d) earning foreign exchange needed for industrialization, infrastructural and other investment projects; and (e) providing market and demand for goods and services produced by non agricultural sectors. Kuznets (1965) argues that a rise in productivity in agriculture is a pre-condition for economic growth and structural change since only then can agriculture generate a surplus and be in a position to fulfill its development tasks. It appears that the growth of agriculture, particularly the nature of technological change in the sector is of crucial importance for overall growth as well as the pattern of structural change and intersectoral resource flows.

In developing countries with limited cultivable land, growing population pressure and diminishing returns in agriculture, exploring the possibilities for achieving significant land-augmenting technical progress offered by the 'Green Revolution' technology is of utmost importance. This no doubt requires an increasing inflow of resources into agriculture in the form of new biochemical inputs, investment on irrigation and infrastructure, *etc.* Whether the final outcome is a net inflow to or outflow from agriculture depends on the efficiency of resource use and genuine technological progress in the sector (Karshenas, 1993).

Indian agriculture witnessed a technological innovation in the mid sixties which is known as 'Green Revolution'. The discovery of high yielding varieties (HYVs), the package of practices for realizing their potential, the mechanization of agriculture involving the development of machinery system for irrigation, tillage, harvesting, threshing *etc.*, are regarded as technological innovations in agriculture. The divisible nature of the new seed-fertilizer technology allows the benefits of technological progress to be spread amongst the small peasant holdings which constitute the core of the agriculture sector of developing countries.

The introduction of high yielding cereal varieties under the High Yielding Varieties Programme launched during 1966-67 in the country ushered new hopes and dimensions in agriculture (Kiresur *et al.,* 1999). Under this programme, the fertilizer-responsive, photoperiod-insensitive and short duration high-yielding varieties (HYVs) of rice, wheat, sorghum, maize and pearl millet were released.

The role of new agricultural technology in the Indian agriculture has been analysed by a number of economists. Narain (1982) observed that relative prices were the effective determinants of the share of non-food grain crops and technological factors (high-yielding seeds and irrigation) have been found to loom in conditioning the relative share of food grain crops. Dantwala (1978) found that HYV technology brought about significant improvement in the productivity of cereal crops, but its overall effect on food grain production, especially in per capita terms was not significant.

Importance of cereals in Indian economy

India is the largest producer and consumer of cereals in the world accounting for 33 per cent of world's area and 22 per cent of world's production of cereals. The total area under cereals was 100.36 (2010-11) million hectares, production was 226.54 million tonnes and productivity was 2257 kg/ha. Karnataka contributes 5.45 million hectares, 12.31 million tonnes and 2260 kg/ha under area, production and productivity respectively in Indian total cereals production scenario. The major contribution to total cereals production is from crops like rice, wheat, Maize, sorghum and pearl millet [Source: Directorate of Economics and Statistics, Bangalore (2010-11)].

Importance of *rabi* sorghum in Indian economy

Sorghum (*Sorghum bicolor* Linn. Moench) occupied an area of 15 million ha in India with the area under *kharif* and *rabi* sorghum showing dynamism during last one decade. The area under *kharif* sorghum has reduced drastically and the area under *rabi* sorghum has changed because of other competitive crops in *rabi* season. *Rabi* sorghum is mainly grown in the states of Maharastra, Karnataka, Tamil Nadu and Gujarat with a total production of 11.85 million tonnes. India has ever been among the major producers of sorghum in the world. The country has been able to maintain its position among the top three producers of the sorghum crop. As already mentioned, sorghum is produced both as a *kharif* and *rabi* crop in the country.

Sorghum is the fifth most important cereal crop in the world after wheat, rice, maize and barley. It is found in the arid and semi arid parts of the world due to its feature of being extremely drought tolerant. The nutritional value of sorghum is same as of that of corn and that is why it is gaining importance as livestock feed. Sorghum is also used for the production of ethanol, grain alcohol, starch, adhesives and paper, apart from being used mainly as food and feed.

Sorghum is popularly known as "Jowar" in India. The crop in the country stands at the third place in context of importance after wheat and rice. The grain has been used for consumption of both humans and livestock and also different genes of the plant serve many other important uses. The crop was introduced in India in the first millennium and since then it has been actively cultivated in the subcontinent.

In many parts of the world, sorghum has traditionally been used in food products and various food items; porridge, unleavened bread, cookies, cakes, couscous and malted beverages are made from this versatile grain. Traditional food preparation of sorghum is quite varied. Boiled sorghums are one of the simplest uses and small corneous grains are normally desired for this type of food product. The whole grain may be ground into flour or decorticated before grinding to produce either a fine particle product or flour, which is then used in various traditional foods. Good-quality sorghums are available with a nutritional feeding value that is equivalent to that of corn. Sorghum can be processed further to improve its feed value and techniques such as grinding, crushing, steaming, steam flaking, popping and extruding have all been used to enhance the grain for feeding. The products are then fed to dairy cattle, poultry, birds and pigs and are used in pet foods.

Karnataka occupies second place with respect to area and production of sorghum in the country during year 2010-11 with 1.24 million hectares of area and 1.34 million tonnes of production and. Bijapur district occupied first place with respect to area, production and productivity of sorghum followed by Gulburga, Raichur, Bagalkot, Belgaum and Dharwad districts. In fact it is an important staple food in Bijapur, Gulburga, Raichur, Bagalkot, Belgaum, Dharwad, Gadag and Haveri districts of Karnataka

Sorghum is a diverse crop which is grown in both *kharif* and *rabi* seasons. *Rabi* sorghum contributes more than 75 per cent share in the production and area in Karnataka over the years (2005-06 to 2010-11). In Karnataka, the districts namely Bagalkot, Belgaum, Bijapur, Gulbarga and Raichur are the major producers of *rabi* sorghum which accounts for nearly 65 per cent of *rabi* area and 70 per cent of *rabi* production. The major varieties grown in this area are CSH series, Maladandi and Muguti, which are suitable for *rabi* cultivation.

Major elements influencing the perspective of *rabi* sorghum are:

1. A productivity limiting growing environment and marginal production Management system.
2. Farmer preference for highly adaptable land races with excellent grain quality.
3. Existing untapped yield potential of major land races.
4. Continuation of low average productivity which is 615 kg/ha despite the release of half a dozen improved cultivars.
5 A low annual growth rate of productivity fluctuating below 1 per cent, inability of high yielding cultivars to gain farmers' acceptability.

Belgaum district in Karnataka is one of the major sorghum producing district. The area under *rabi* sorghum in the district is decreasing. Over the year chickpea and sunflower have emerged as competing crops for *rabi* sorghum.

Competitive crops for *rabi* sorghum in the study region

Chickpea

Chickpea (*Cicer arietinum* L.) is an important grain legume in Asia and being a rich and cheap source of protein can help people improve the nutritional quality of their diets. Chickpea is of relatively minor importance on the world market but it is extremely important for local trade in numerous tropical and subtropical regions. It is grown and consumed in large quantities from South East Asia to India and in the Middle East and Mediterranean countries. It ranks second in area and third in production among the pulses worldwide.

India occupied the first position in the world in terms of chickpea area (9.18 m.ha.) and production (8.22 m.t.) during 2010-11 accounting for nearly 30.9 per cent and 39.9 per cent of total pulses area and production, respectively. The largest chickpea producing state in the country is Madhya Pradesh followed by Uttar Pradesh, Maharastra, Andhra Pradesh, Karnataka, Rajasthan and Haryana.

Sunflower

Sunflower (*Helianthus annuus* L.) is an important oilseed crop in India popularly known as "Surajmukhi." The name "Helianthus" is derived from 'Helios' meaning 'sun' and 'anthos' meaning 'flower'. It is known as sunflower as it follows the sun by day, always turning towards its direct rays. It is one of the fastest growing oilseed crops in India. In early 1970s, only about 0.1 million hectares were under sunflower cultivation, however by 2012-13, it had gone upto 0.9 million hectares. In India, it was used mainly as ornamental crop but in recent past it became an important source of edible oil.

Sunflower is a major source of vegetable oil in the world. It is used for a variety of cooking purposes. Sunflower seed contains about 48 to 53 percent edible oil. The sunflower oil is considered premium compared to other vegetable oils as it is light yellow in colour, possesses good flavour and high smoke point. Sunflower oil is a rich source (64 percent) of linoleic acid which is good for heart patients. Linoleic acid helps in washing out cholesterol deposition in the coronary arteries of the heart. The oil is also used for manufacturing hydrogenated oil.

To compare the *rabi* sorghum crop with its competing crops sunflower and chickpea the present study was carried out with the following specific objectives

Specific objectives

1. To analyse the growth in area, production and productivity of *rabi* sorghum and its competitive crops in Belgaum district.
2. To compare the economics of production of *rabi* sorghum and its competitive crops.
3. To study the price behaviour of *rabi* sorghum and its competitive crops.
4. To study the constraints in production of *rabi* sorghum.

Hypotheses

1. Area, production and productivity of *rabi* sorghum is decreasing, where as that of its competitive crops is increasing over the years in Belgaum district.
2. Cultivation of *rabi* sorghum is less profitable compared to its competitive crops.
3. Price variability is high in sorghum compared to its competitive crops.
4. Farmers face many problems in production of *rabi* sorghum.

Presentation of the study

The entire study has been presented in six chapters. Chapter 1 highlights the introduction to the topic, importance of cereals in Indian economy, importance of *rabi* sorghum in the economy, specific objectives of study and hypotheses of the study. Chapter 2 includes the review of earlier studies connected with present investigation. Description of the study area, nature and sources of data and the tools and techniques of analysis adopted for evaluating the objectives of the study are elaborated in chapter-3. In the Chapter 4, the results obtained in consistence with the objectives of the study are presented and these results have been discussed in detail under Chapter 5, while Chapter 6 summaries the entire study and brings about the major policy implications.

REVIEW OF LITERATURE

A comprehensive review of literature is an essential part of any scientific research. It is useful for developing conceptual framework and formulating appropriate design for the study. The review of literature enables the researcher to plan his research work critically and conclude his findings with reference to past studies. It also enables us to get some support for design of research methodology and techniques of analysis.

A brief review of studies which have a direct or indirect bearing on the objectives of the present study is attempted in this chapter. Commensurate with the objectives of the present study the available literature is briefly reviewed and presented. Some of the research studies which are not directly related to the premise of the study, but methodology used has a great relevance are also presented. Keeping in view the objectives of the study, the reviews are presented under the following sub-headings.

2.1 Growth in area, production and productivity of crops.

2.2 Economics of production of crops.

2.3 Price behavior of agricultural commodities.

2.4 Constraints in production of crops.

2.1 Growth in area, production and productivity of crops.

Nachappa (1993) studied growth and instability in cereals production in Karnataka state. In order to compute growth rate of area and yield of cereals, an exponential growth function was fitted to the data. The variability in cereal production was assessed by decomposition method. The study indicated that the area under cereals in Karnataka decreased during the seventies but increased during the eighties. The rate of growth in yield of cereals was higher during the seventies as compared to that in eighties.

Shankaran (1994) worked out the compound growth rate of area, yield and production of sorghum at All-India level by classifying the study period into pre-green revolution (1950-51 to 1964-65) and post-green revolution (1967-68 to 1992-93) periods. In the first sub-period both area and yield of sorghum have increased at the rate of 0.91 per cent and 2.9 per cent per annum, respectively which led to a 2.2 per cent per annum increase in the production of the crop. The result further revealed that the area of sorghum declined by 0.94 per cent per annum during the post-green revolution period, whereas it grew to the tune of 1.84 per cent, which offset the decline in area and ultimately the rate of growth in production of sorghum was 1.2 per cent per annum. Considering the entire period (1950-51 to 1992-93), the author reported that although the area under sorghum declined by 0.47 per cent per annum the yield and production increased at the rate of 1.51 per cent and 1.27 per cent per annum, respectively.

Sawant (1997) studied the growth performance of India's agriculture sector during different periods. Compound annual growth rates were estimated by fitting a log-liner trend function, for two periods *viz.,* Period-I (1968-69 to 1980-81) and Period - II (1981-82 to 1994- 95). The growth scenario for pulses indicated that from acute stagnation in output in the early part of the green revolution period, the situation improved to a positive significant but low growth in output (1.00% during period - II) The former was the outcome of low pace of expansion in area accompanied by decline in the yield per hectare of pulses, while, in the post 1981 period expansion in pulses output was totally induced by growth in their yield per hectare (growth rate of 1.00%). The dismal performance of the two major pulses, namely, gram and tur, was largely responsible for low level of productivity growth for all pulses after 1981. By and large, however, pulses represented a group of growing crops throughout the green revolution period.

Gyanendra and Chandra (2001) studied the growth trends in area and productivity affecting total food grain production in Madhya Pradesh. The growth rate in area under food grain (1.20 to 1.29%) production (2.3 to 4.27%) and productivity (1.1 to 2.29%) has gone up during pre-green revolution period to green revolution period. And also growth rates of area (1.29 to 0.009%) and production (4.27 to 3.12%) have declined during post green revolution period (1951-52 to 1998-99), the growth rate of area (0.54%), production (2.3%) and productivity (1.73%) were found positive and significant.

Raghuwanshi *et al.* (2001) conducted a study to evaluate the growth performance of chickpea production in Bundelkhand region of Madhya Pradesh during 1970–71 to 1994 95. The findings of the study revealed that all the districts of the region experienced positive growth rates of area, production and productivity of chickpea during the reference period. Tikamgarh district showed higher growth rate under area of chickpea while Datia district ranked first in growth of yield. Coefficient of variation analysis indicated that variability was highest in production and it was due to increased yield variability associated with nominal acreage variability of chickpea crop. Efforts should be made for both increasing and stabilizing yield. Results of the component analysis showed that yield was the major contributor in production than the area in Datia and Tikamgarh districts.

Sharma and Sharma (2003) studied the production and export performance of tea and reported that 'the growth rates were positive for area, production and productivity of tea. The share of Indian tea export in the total export was as high as 72.17 per cent in 1950, which had steadily declined to 23.79 per cent in 1999.

Srivastava *et al.* (2003) worked out compound growth rates of area, production and productivity of pulses in all the districts of eastern Uttar Pradesh during 1975-76 to 1999- 2000. The results revealed that area and production of pulses declined at the rate of 1.8 and 0.67 per cent per annum, but productivity increased at a compound growth rate of 1.18 per cent per year.

Kalamkar (2004) conducted the study on growth of value of crop output in Maharastra. The study revealed that maize crop recorded significant and highest growth rate of 6.31 per cent per annum followed by sugar cane, gram, paddy and cotton.

Karan Singh *et al.* (2004) revealed that rice and wheat have come to contribute around three-fourth of India's food grains production in 2000, up from just one- half in 1950; with the food grains production itself having increased by four times from 50 million tonne in 1950 to 200 million tones 2000. Punjab has been known for wheat production since long. Its productivity increased by more than 5 times in five decades (1950-2000), area by 3 times and production by more than 15 times. Its productivity continues to increase at the growth rate of more than 2 per cent. Its yield variability across districts has declined over time.

Naik (2007) studied growth performance of underutilized millets in Karnataka. The growth in savi area was negative and significant for Dharwad district (-1.934%) and the state (-5.620%) as a whole. Accordingly, the production of savi also showed decling trend for both sample district and state. For state as well as district, the growth rate of foxtail millets area (-8.922%) and production (-8.462%) showed significant declining trend, while growth rate of foxtail millet productivity (0.396%) was found to be positive and statistically significant.

Reddy (2008) analysed the growth rates of area, production and productivity of soybean in India. He concluded that there was a positive trend in area, production and productivity of soybean. The growth rates of area, production and productivity of soybean were 17, 18.29 and 1.48 per cent, respectively.

Dhakre and Sharma (2009) conducted a study on growth and instability of Ginger production in North-eastern region. The study revealed that north-eastern region had showed significant growth in production (26.72%) and productivity (6.77%) of the crops. In the case of area growth, it was positive (11.91%) but not significant. During the period 1992-93 to 2004-05, coefficient of variation of North-Eastern region as a whole recorded instability in area, production and productivity (204.20, 10.46 and 29.43 per cent respectively). Thus area variation had more influence on production fluctuation in the state.

Choudhary (2010) analysed the growth rates of area, production and productivity of mustard in India. He concluded that there was a positive trend in area, production and productivity of mustard. The growth rates of area, production and productivity of mustard were 14.20, 27.85 and 11.71 per cent, respectively.

Preema Borkar *et al.* (2010) examined the growth rates and extent of variability in area, production and productivity of cotton in Vidarbha region of Maharastra state. The Vidarbha region of Maharastra state constituting of two divisions *i.e.*, Amravathi and Nagpur region, were purposefully selected. The study was based on secondary data collected from various government publications and pertained to a period of 26 years from 1980-81 to 2005-06 estimated the growth rate of area, production and productivity of cotton, the period was grouped into, *i.e.*, Period-I (1980-81 to 1992-93) and Period-II (1993-94 to 2005-06). From this study it is concluded that, the Vidarbha agriculture has observed definite change in the cropping pattern. Soyabean attained important position in the

cropping in both divisions. The magnitude of variability in area and production is observed to be small in Nagpur division whereas, productivity has been comparatively small in Amravathi division. The proportion of area under cotton in *Kharif* in total cropped area has reduced in both divisions. The growth rate of area and yield has decreased in period II in both the divisions.

2.2 Economics of production of crops

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

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

Hiremath (1994) analysed the cost and returns of dry chillies in Dharwad district. The total cost of cultivation of chilli per acre was Rs. 5942.64, while cost A was Rs. 3865.90 and cost B was Rs. 5110.39. The value of gross output was Rs. 5531.72. The farm business income was Rs. 1466.08 per acre and family labour income was Rs. 221.33 per acre.

Mohandas and Thomas (1997) studied the economics of rice production in Kuttanad area of Kerala. They reported that cost of cultivation of paddy for state was Rs. 13, 108.05 for marginal farmers (Class I), Rs. 13, 309.72 for small farmers (Class II) and Rs. 13, 858.13 for large farmers (Class III). Rental value of own land recorded the highest expenditure in Class I and Class II which accounted for 24.19 per cent (Rs. 3,171.30) and 22.38 per cent (Rs. 3, 112) respectively. However, the item of highest expenditure was fertilizer in Class III which came to 22.39 per cent (Rs. 3,100.75) of the total cost. Gross return was highest for marginal farmers (Rs. 15,857.45) followed by small farmers (Rs. 15,560) and large farmers (Rs. 15,387.50). The net return and input output ratio was also found to be highest in marginal farmers (Rs. 2748.95 and Rs. 1.21) followed by small farmers (Rs. 2250.28 and 1.17) and large farmers (Rs. 1529.37 Rs. 1.11).

Yerriswamy (1999) studied the economics of selected agricultural system in Tungabhadra project area, Karnataka. He reported that the estimated per hectare cost of cultivation for *Kharif* paddy was Rs. 20,475 for Ancient Irrigated Agricultural System (AIAS), Rs. 24,242.04 for Highly Intensive Agricultural System (HIAS) and Rs. 21,381.17 for Semi Intensive Agricultural System (SIAS). Whereas in *rabi /summer* the estimated per hectare cost of cultivation was Rs. 18, 222.97 for AIAS and Rs. 23,143. 35 for HIAS which were lower compared to *kharif* paddy. The gross returns were found to be higher in HIAS for *rabi /summer (*Rs. 44,845.54) and it was Rs. 41,063.75 for AIAS which were higher than *kharif* crop. The benefit-cost ratio in HIAS *rabi /summer* paddy was 2.25 and it was 1.81 for HIAS.

Mundinamani and Kunnal (2000) found that the average total cost of cultivation per hectare of cotton was Rs. 9,460.23 of which the variable cost was Rs. 7,674.89, accounting for 81.12 per cent of the total cost of cultivation. The share of the fixed cost in total cost of cultivation was Rs. 1,176.64 accounting for 18.88 per cent. The gross returns per hectare of cotton cultivation were Rs. 12,844.30 and gross returns per quintal of cotton were Rs. 1,597.55. The net returns obtained over total costs were Rs. 2,442.45 per hectare and Rs. 303.78 per quintal of cotton.

Singh and Singh (2000), estimated the cost and returns 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 (Rs. 12111.04), which was slightly higher than BR farms (Rs. 12104.98) with lowest on DR farms (Rs. 5165.21). When total cost was divided into 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 (Rs. 3615 per ha.) than IHYV farms (Rs. 3329 per ha.) owing mainly to significantly higher yields on BR farms (6.43 t/ha) compared to IHYV (3.9 t/ha). In conclusion, 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 through a sample of 100 farmers for the year 2000-2001. Major portion of the total cost of cultivation was attributed to human labour, which accounted for 61.46 per cent of total cost. Net return per hectare was Rs. 5955.68. The findings further confirmed the trend in changes in cropping pattern. Area under cereals dropped by 34 per cent during 1982-83 to 2001-02 periods mainly due to the reduction in paddy area, which was diverted to other profitable crops.

Rajendraprasad *et al.* (2001) conducted a study on costs and returns in cotton production vis-à-vis its competing crops in Guntur district and reported that per hectare expenditure on PPCs in cotton was Rs. 11,331.37. This was very high compared to Rs. 4,217.92 in soybean-bengal gram cropping system, Rs. 4,379.81 in soybean-red gram and Rs. 1,334.00 in soybean-Jowar cropping systems. The proportion of expenditure on PPCS in total operational cost was the highest in cotton (41.33%) when compared to soybean-bengal gram (22.3%), soybean-red gram (27.04%) and soybean-Jowar (9.83%). The gross return was also the highest in cotton *i.e.*, Rs. 29884.77 compared to soybean-bengal gram (Rs. 27802.84), soybean-red gram (Rs. 29171.42) and soybean-Jowar (Rs. 2,954.78) whereas net returns were very low in cotton compared to other cropping systems.

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

Verma (2002) studied the economics of onion and found that cost A1, cost B1, cost B2, cost C1, cost C2 and cost C3 were worked out to Rs. 21790.24, Rs. 22309.05, Rs. 24499.05, Rs. 24949.28, Rs. 27139.28 and Rs. 29853.20, respectively. The per hectare yield on an average was 263.75 qtl per ha. The average gross return was Rs. 72, 531.25 per ha. It was highest at Rs. 74, 580 on large farms and lowest at Rs. 70, 218.50 on small farms. The average yield and gross return increases with the increase in farm size, because large sized farmers had incurred higher cost per hectare on modern inputs. The average net returns over cost A1, cost B1, cost B2, cost C1, C2 and C3 were calculated at Rs. 50741.01, Rs. 50222.20, Rs. 48032.20, Rs. 47, 581.97, Rs. 45, 391.97 and Rs. 42, 678.05 per hectare of onion respectively. The average cost of production per quintal of onion was worked out be Rs. 102.89 on cost C2 and Rs. 113.18 on cost C3. The average family labour income and farm business income were calculated at Rs. 45, 318.28 and Rs. 46, 459.66 per hectare respectively. The average input-output ratio at cost A1, cost B1, cost B2, cost C1, C2 and cost C3 worked out to be 1:3.32, 1:3.25, 1:2.96, 1:2.90, 1:2.97 and 1:2.42 respectively.

Maharajan *et al.* (2003) carried out a study to measure the profitability of growing crops in the northern dry zone of Karnataka. The breakeven yield was computed to measure the profitability. The decision criteria are if the actual yield is beyond the breakeven yield, the farmer will start earning the profits and if the actual yield is below the breakeven yield the farmer incurs loss. Breakeven yields were relatively quite stable in HYV paddy, sunflower and cotton in *kharif* season, Bengal gram and sunflower in *rabi* season, groundnut in summer season.

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

Sikander and Sandeep (2004) examined the profitability of paddy, maize and wheat crops grown in Himachal Pradesh for the year 2001-2002. In this study, different costs concepts of Costs A1.Cost A2, Cost B and Cost C were calculated. As regard to Cost C, the cost was highest in paddy (Rs 20835) followed by maize (Rs 18709) and wheat (Rs 17102) per hectare. For all the crops, the lion's share of cost was incurred on labour. In respect of gross returns per hectare, it was the highest

on paddy crop followed by wheat and maize. The study further found that the net returns were positive on paddy crop as compared to the wheat and maize crop where net return was negative. The negative return was due to low yield. However, net profit per quintal was negative for all three crops.

Chahal and Katariya (2005) estimated the cost and return of maize in Punjab. The total operation cost of hybrid maize was Rs. 8956 per hectare as compared to Rs. 6427 per hectare for local variety and RS.8009 per hectare for composite varieties. 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 36.26 q/ha. Both gross and net returns in case of hybrid maize amounted to be Rs. 19637.48 and Rs. 10681.65 per hectare, respectively.

Radha and Choudhary *(*2005) conducted a study on costs and returns in cotton seed production vis-à-vis commercial production of cotton in Andhra Pradesh and revealed that per acre total cost of production of cotton seed (Rs. 74,412) was higher than that of commercial cotton production (Rs. 26,461), of which human labour accounted for major share in both cotton seed production (53.86%) as well as commercial cotton production (19.03%). The operational costs of all the items were comparatively higher in seed production (Rs. 68,101/acre) over commercial production (Rs. 16,166/ acre). This was due to the additional operations like gap filling, rouging, emasculation, pollination, *etc*., involved in cotton seed production. Thus, the operational costs took the major share of 91 per cent in seed production as compared to 61 per cent in commercial production. It revealed that seed production gives positive returns with the cost-benefit ratio of 0.29:1.00 when compared to commercial production (1.00:0.35).

Ramasundaram *et al.* (2005) carried out research on cost of cultivation of hybrid cotton under rain fed and irrigated conditions of central India and hybrid under rain fed conditions of south India and varieties under irrigated condition of north India. Study revealed that the per hectare total cost of cultivation of cotton varieties (Rs. 25,358) was relatively higher under irrigated north India followed by rain fed hybrid cotton of south India (Rs. 22,637), irrigated (Rs. 18,958) and rain fed (Rs. 15,640) hybrids of central India. The variable cost accounted for 83 per cent of the total cost of cultivation of the hybrids cultivated in rain fed central zone followed by 81 per cent in the South, irrespective of the ecosystem, while it was only 65 per cent for irrigated cotton variety cultivation under northern conditions. The fixed costs for central and south zones varied between 17-22 per cent, while for north it was 35 per cent. The main reason for higher fixed cost was the exorbitant land rent values in the fertile Indo-Gangetic Plains. Plant protection accounted for the major share (19% and 26%) followed by intercultural operation (15.45%) in southern rain fed farm samples and fertilizers and manures (14%) in the case of others. The cost of cultivation per quintal ranged from Rs. 1,541 in irrigated cotton of north to Rs. 2,148 in rain fed central. Though the cost of cultivation increased with irrigation availability, the associated high yields reduced the cost of production. Returns over total cost were the highest in irrigated hybrid (Rs. 10,810) of central India followed by varieties (Rs. 9,025) irrigated of north, rain fed hybrid (Rs. 8,873) of south India and rain fed hybrid (Rs. 4,448) of central India.

Rohit Singla *et al.* (2006) conducted a study on Economics of Production of Green Peas in Punjab. In this study the data have been analyzed using simple tabular and functional analysis and multi stage random sampling was done in selecting the farmers for the study. In the study it has been noticed that 75.85 per cent of the farmers purchased pea seeds from the dealers. The yield of green peas has been found to be the highest on small farms among all the farm-size categories. The functional analysis revealed that the fertilizers, irrigation and machinery are the impact variables, influencing the productivity of the green peas positively.

Tanveer (2006) made a comparative analysis of paddy based farming systems in Mandya district, Karnataka. He found that, among the four major farming systems identified in the study area, the gross returns in FS-I (crop production and poultry enterprises) was Rs. 940879.80, while total cost was Rs. 768945.99 with a net returns of Rs. 171933.81, which was found to be most profitable, which was due to rearing of poultry birds, followed by FS-III (crop production and sericulture enterprises), FS-IV (only crop production enterprises) and FS-II (crop production and dairy enterprises), with net returns of Rs. 83658.40, Rs. 57739.53 and Rs. 54720.59, respectively.

Sale (2007) studied the Economics of Production and marketing of Jaggery in Kolhapur district. Random sampling was done for the selection of jaggery producers and the data obtained were analysed by simple tabular method. The conclusions of the study were, per ton cost of cultivation of sugarcane was estimated to be Rs. 648.24, the per quintal cost of production of jaggery

including marketing charges worked out to Rs. 982.16 and the net profit per quintal and per hectare from jaggery production was worked out to the tune of Rs. 117.84 and Rs. 11219 respectively.

Karunakaran (2009) studied socio-economic assessment of groundnut production, farmers technology choice and adoption process. In Tamil Nadu Baseline study report revealed that 90 per cent of ruling varieties were Co2, VRI2, TMV7 and POL2 which were released 1984, 1989, 1967 and 1968, respectively.

Sita Devi and Ponnarasi (2009) studied on modern rice technologies and its adoption behaviour in Tamil Nadu. The study revealed that the per hectare cost of cultivation was about 10 per cent lower in SRI than the conventional method. Partial budgeting technique was used to work out the cost and returns incurred in paddy farms. The increment in the profit realized in paddy cultivated through SRI method was Rs. 16968 /ha. It was concluded from the partial budgeting analysis that the adoption of SRI technique would provide additional profit to farmers.

2.3 Price behavior of agricultural commodities

Kunnal *et al.* (1990) analyzed the long-term and short-term variations in prices and arrivals of groundnut in Gadag and Ranebennur markets. Monthly data on arrivals and prices were collected for the period of 1965 to 1981 for Gadag market and for the period 1966 to 1982 for Ranebennur market. The study revealed that, seasonal variability of price was less when compared to variability in arrivals of groundnut in both the markets. Both the markets are subjected to severe fluctuations from year to year. Both the markets have shown an increasing trend for both arrivals and prices. The farm harvest prices were mostly determined by the current year price rather than from the previous year. No prefect relationship between arrivals and price was ascertained as the coefficient of correlation between arrivals and prices was negative and non-significant in both the markets.

Mitrannavar and Gummagolmath (1998) attempted to analyze the seasonal indices of arrivals and prices of potato in regulated markets of north Karnataka. The data on monthly arrivals and prices for the period of 1984-85 to 1994-95 were collected from Belgaum and Hubli markets. The long-run trends in arrivals and prices of potato for the selected markets were analyzed using three years moving average method. The study concluded that arrivals were highest in the month of November in both the markets indicating glut during harvesting season. However, price did not decrease during glut season as majority of the traders purchased potato at that time in Belguam market while there was a negative relationship between arrivals and prices in Hubli market.

Nahatkar *et al.* (1998) worked on price variation of cotton in kukshi regulated market of Dhar district of Madhya Pradesh by considering secondary data for a period of 11 years from 1986-87 to 1996-97. The study revealed that seasonal index of cotton prices was lowest in the second quarter (January to March) and maximum in the third quarter (April to June). The coefficient of price variation shows that price rise was higher during first quarter (October to December), as buyers tend to attract more cotton growers to sell their produce at lower prices. The data on cyclical variations indicated that, after every three years the cycle of cotton prices changes, irrespective of the variations in price in the three quarterly periods, revealing that within a year there is no sudden short fall or boom of cotton arrivals in the market. The variation in arrivals of cotton was found to be higher than that of variations in prices.

Pagire (1998) made analysis on arrivals and prices of grapes in Maharashtra state.The data on arrivals and prices of grapes were collected from the Agricultural Produce Market Committees for a period of 12 years from 1980-81 to 1991-92 and were analyzed to know the seasonal fluctuations in arrivals and prices with the help of indices. The study noticed that the arrivals of grapes in Pune market were observed at its peak in March and lowest in June. The arrivals were observed to drastically increase from December to March. In Nasik market, the arrivals were highest in February. In case of prices, declining trend was noticed from January till March and thereafter began to increase from April onwards in Pune market. In Nasik market, the prices were observed to be stable. Variations were observed in arrivals and prices during the period of twelve years. Definite trends in prices and arrivals were noticed but for a limited periods, during the period of twelve years in both the markets.

Malli *et al.* (1999) analysed the trend in arrivals and prices of vegetables (tomato and lady's finger) in Pune regulated market during the period from 1978-79 to 1996-97. The coefficient of variation of arrivals (56–80%) and prices (40–80%) of tomato were higher than the variation in arrivals (27–60%) and prices (49–75%) of lady's finger. The compound growth rate of arrivals (2.11% per annum) and prices (1.02% per annum) for both the vegetables were significant during the same

period and prices of both vegetables showed increasing trend indicating good integration of Pune regulated vegetable market.

Shiyaini *et al.* (1999) in their study on time series analysis of arrivals and prices of garlic in regulated markets of Saurashtra region of Gujart for a period of 1988 to 1998, revealed that the price of garlic was found relatively higher in mid and lean marketing period than in the peak period.

Mehta and Srivastava (2000) analyzed the seasonality in prices of groundnut and maize. The results showed linear trend in maize prices. The oscillatory movements affecting the prices were found to be regular in period and amplitude. There existed a crop production periodicity of 12 months seasonality. Seasonality index ranged between 5.0-5.9 implying that its supply and consumption were nearly equi- spread throughout the year. Steep price fall after September synchronized with crop attaining maturity in three months after sowing. In case of groundnut, the results showed moderately increasing trend, the periodic variations were of non-uniform cycle and amplitude. The long-term price behaviour was approximately linear and the cyclical trend was less pronounced.

Patel (2000) in his study used time series data on prices for a period of 1975-76 to 1992-93 obtained from six *khet bazaar utpan samitis*, Directorate of Economics and Statistics, Gujart Agricultural Produce Marketing Board and Directorate of Agriculture. The study revealed that all markets have around 40 to 75 per cent of the total market arrivals of rapeseed-mustard in peak marketing season. Whereas prices were lower by Rs. 20 to 60 per quintal over mid and lean marketing season in Mehasana district of Gujarat.

Singh *et al.* (2000) adopted linear equation and moving average methods to examine the trend as well as seasonal variation of arrivals and price of rapeseed-mustard in Haryana from 1985-86 to 1995-96. The findings of the study showed general tendency of rising, while the arrivals indicated greater fluctuations from year to year in all markets.

Birukal (2001) collected data on monthly arrivals and prices of cotton for the period from 1984-85 to 1999-2000 from the Agricultural Produce Marketing Committees and indicated a continuous decreasing trend in both price and arrivals of Laxmi cotton. This may be due to the introduction of DCH-32 around the area and the results showed that the trend values of market arrivals and prices of Varalaxmi cotton in Dharwad market showed an increasing trend.

Ravikumar *et al.* (2001) analysed the data for the study collected for the period from 1981-82 to 1995-96. The study concluded that, in general, arrivals showed mixed trend, whereas, prices showed an increasing trend for the selected commodities in Anakapalle regulated market of Andhra Pradesh. There existed an inverse relationship between seasonal indices of arrivals and prices of selected commodities. Therefore, the policy implication lies in encouraging the farmers to dispose off their produce at the opportune time to get good remunerative prices.

Sanjay Kumar (2003) studied relationship between arrivals and prices of onion in selected markets of India from 1994-2000. The results revealed that the arrivals fluctuated to a great extent and prices had a tendency to rise in all the markets during the study period. The correlation coefficients between yearly arrivals and prices of onion were found to be negative and significant over the years in most of the markets. This indicated inverse relationship between market arrivals and prices.

Wadawani and Bhogal (2003) observed price behaviour of cauliflower and cabbage in Western Uttar Pradesh (1988-1997). The results showed that, the prices of these two vegetables were found to be higher in September and started declining from October onwards. The prices were again found increasing from May. The lowest prices were found to be in March and also that the prices of cauliflower / cabbage responded negatively to the arrivals.

Hiremath (2004) collected the data on monthly prices and arrivals of cotton for a period of 1985-86 to 2002-03 in Hubli market (Karnataka). The study revealed that for DCH- 32 cotton kapas, the seasonal indices were the lowest in the month of September and highest in the month of December. The seasonal index was below 100 during the months from April to August.

Pawar and Misal (2004) studied the behaviour of prices and arrivals of pomegranate in Solapur (Maharashtra) market from 1991 to 2000 and found that the arrivals were maximum during July to September and December and the lowest arrivals in the month of April. The correlation coefficient between arrivals and prices exhibited negative relationship. Trends in arrivals showed increase at 9.80 per cent per annum while prices increased at 8.20 per cent, annually during the study period.

Sangeeta (2004) analyzed the arrivals and prices of onion in Lasalgaon and Pune markets (Maharashtra) from 1999-2002. She observed that in Lasalgaon market the arrivals were more in January and February, where as in Pune market the arrivals began increasing in February and March. The prices showed an upward trend from the month of June and continued to rise up to November, after which price decline was observed.

Lavleen *et al.* (2005) analyzed the cyclical variation of arrivals and prices of tomato in Punjab from 1981-2001 by employing Fourier analysis followed by periodogram analysis to estimate the hidden periodicity along with amplitude in the cycles. The periodogram analysis of time series of supply and prices of tomato showed that it followed regular cycles, seasonal within 12 months and cycles of longer duration *viz.,* Kitchin cycles for arrivals with periodicity of 3 years and Jugar cycles for prices with a periodicity of 5 years.

Navadkar *et al.* (2005) in their study on seasonal indices of monthly arrivals and prices of vegetables in Pune (1990-2000) observed lowest coefficient of variation of arrivals for tomato during March and it was more than 50 per cent during remaining months. On the other hand, the price was highest during March and below 50 per cent during April to June. In case of bhendi, the coefficient of variation of arrivals was far below 50 per cent for the period from April to October, while it was more than 50 per cent in all the months except in November and May. It was noticed that the coefficient of variation ranged from 22-79 per cent for arrivals and for prices these were in the range of 31-69 per cent for cabbage. While for cauliflower the same were 31 to 69 per cent and 24 to 54 per cent, respectively. Furthermore, it was indicated that when the arrivals of vegetables were at the higher side, the prices are at the lower side.

Virenderkumar *et al.* (2005) studied the behaviour of market arrivals and prices of major vegetable crops in four metropolitan markets of Delhi, Mumbai, Bangalore and Kolkata from 1990-2001. The results showed that in cabbage, the extent of variability in arrivals was lower in Bangalore and higher in Mumbai. Prices were relatively stable in Mumbai but were volatile in Bangalore. There was broadly a similar pattern in the price across different months in Kolkata and Delhi markets. The authors also found relationship between market arrivals and prices over the years in all the four metropolitan markets. Across different months, there have been several instances of positive relationship between arrivals and prices in all the four markets.

Khunt *et al.* (2006) made a study on the price behaviour of major vegetables in Gujarat state. And the major vegetables considered for the study were onion, brinjal, potato, chillies, tomato and clusterbean. The number of regulated markets ware selected by considering the major vegetable growing areas and data availability about the prices and arrivals of vegetables. The study revealed that there is seasonality in arrivals and price of all the major vegetables produced in the state which indicates the need for storage facilities. The inverse relationship was observed between prices and arrivals of most of the vegetables. Arrivals and prices of major vegetables have increased over the period in most of the regulated markets showing the scope for expansion of vegetable cultivation.

Yogish *et al.* (2007) in their study concluded that, there was a mixed trend in arrivals and prices of potato in all the selected markets. The data pertaining to the study was collected for a period from 1994-95 to 2004-05. The monthly seasonal indices for arrivals of potato, onion, ragi and groundnut were found higher immediately after the harvest in all the markets and the price indices were found to be maximum during lean period and minimum during harvesting period. Hence, the dissemination of information on market arrivals, prices prevailing in the market, crops to be grown to the season, *etc.* will result in maintaining uniformity in supply and demand of the produce.

Manasa (2009) analysed the long term and short term variations in prices and arrivals of pigeonpea in Bidar, Bellary, Gulbarga and Sedam markets in Karnataka. Monthly data on arrivals and prices were collected for the period of 1987-88 to 2007-08. All the markets showed fluctuations from year to year and showed an increasing trend for both arrivals and prices.

Ganganjot Sing *et al.* (2010) conducted a study on behavior of arrivals and prices of green chillies in punjab and colleted the information on the secondary data pertaining to the arrivals and prices for Amritsar and patila districts in Punjab. The data colleted by time series method for the analysis of trend, seasonal variations, cyclical variation and fourier analysis were used for the study. The arrivals and prices of major green chillies have increased over the period in most of the regulated markets showing the scope for expansion of green chillies cultivation.

Govind Pal *et al.* (2010) conducted a study on behavior of arrivals and prices of lac at different levels of market in west Bengal. They collected the secondary data on monthly average

prices from Ranchi for a period of 16 years spanning from 1990-91 to 2005-06. The data collected by time series method for the analysis of trend, seasonal variations, cyclical variation and Fourier analysis were used for the study.

Haradi (2010) conducted a study on Market dynamics and price forecasting of maize in North Karnataka by using Arima model. The pattern of trend in arrivals and prices of maize was similar in all the markets. The results revealed that in the long run, all the markets showed an increasing trend in both the arrivals and prices of maize over the years. A high increase in arrivals and low increase in prices of maize was observed in all selected markets. The extent of increasing trend in arrivals and prices of maize varied from one market to another market. It was observed from the study that the markets have a strong association between the prices of maize, thereby influencing the prices from one market to other market. This helps to transfer the price signals from one market to another and thereby help in stabilization of prices and create a healthy competitive environment. This would also in a long way help to protect the interest of producer- sellers.

Srivastava *et al.* (2010) conducted a study on economic analysis of marketing of soybean in Mandsaur district of MP. He collected the information using multistage stratified random sampling method. Soybean growers of about 120 were selected from six villages of MP. Primary data collected by personal interview method was used for the analysis of marketing costs, producers share in consumers' rupee, marketing efficiency. The producer's share in consumer's rupee varied from 54.1 percentage to 59.6 percentage and marketing efficiency was estimated to be 2.18, 2.47 and 2.44 percentage.

Bandigani (2011) revealed that cyclical fluctuations in market arrivals and prices of sorghum were found to be uneven across the markets. Hence, there is a need to have a constant watch on prices and arrivals of the crop so that the farmers can know the variations occurring in the arrivals and prices during certain period in the market and bring the produce at the right time to avoid the price crash in *rabi* sorghum. The regulated market should take necessary step to see that the dissemination of market information regarding the arrivals and prices reaches the farmer of the remotest places.

Kolur (2011) conducted a study under title Market dynamics of wheat in Karnataka - an econometric approach. The results revealed that in the long run all the markets showed an increasing trend in both the arrivals and prices of wheat over the years. A high increase in arrivals was observed in Bijapur and low increase in prices of wheat in Bagalkot market. The extent of increasing trend in arrivals and prices of wheat varied from one market to another market. The government needs to take initiatives in the dissemination of market information with respect to forecasting of prices so that the farmers realize better returns.

2.4 Constraints in production of crops

Rameshwar *et al.* (1986) studied on the production, processing and marketing of linseed in Bandra district (UP) and suggested for reducing the processing cost of linseed through establishment of cooperative oil crusher plants in the rural area and arrangement may be made for raw material. These activities would help to create an efficient marketing system and employment in rural areas.

Kunnal (1997) while explaining the importance of organic farming to meet twin challenges of producing sufficient foodgrains for growing population and prevention of environmental degradation, opined that combined use of chemical fertilizers with FYM, vermicompost, green manures and biofertilizers will help to attain higher yields as well as improve soil health and to minimize environmental degradation. Research efforts through these angles should be initiated in the country so as to save the country from further disasters.

Narappanavar and Bavur (1998) examined the problems in storage, transportation and dissemination of market information in potato marketing in Dharwad, Karnataka and found that farmers were not facing much problems in transportation because of large number of tractors in the villages. Similarly, farmers were making suitable arrangements for storage of potato on the farm itself. However, about 35 per cent of the farmers complained on illegal deductions while selling the produce at the market in the form of weighment charges. The other problems noticed were lack of grading facilities, arbitrary hamali charges, low prices and variations in output price and high commission charges. Therefore, it is suggested that there is need for ensuring improved storage to cities and purchase of potato at the local market by the Government at the time of heavy arrivals to assure the remunerative returns to the potato growers.

Nagaraj *et al.* (1999) identified the most important constraints in production and marketing of potato in Kolar district of Karnataka by assigning the ranks. In production, high cost of seed material and diseases (Rank-I) were the major constraints followed by frequent power failure (Rank-II), high cost of fertilizers and plant protection chemicals (Rank-III), scarcity and high cost of labourers (Rank-IV) and non-availability of good seed material on time (Rank-V). The frequent fluctuations in price (Rank-I) involvement of too many middlemen (Rank-II), delayed payment (Rank-III), insufficient storage facilities (Rank-IV), low output prices (Rank-V) and high market charges (Rank-VI) were the main constraints in marketing.

Madan (2000) studied the problems faced by seed processing units in Haveri district of Karnataka. He identified that there was a high degree of severity of problems with respect to contract seed production of seed in private sector than public sector. The problem of storage was more intense in public sector due to non-availability of warehousing.

Thyagarajan and Vasanthakumar (2000) conducted a study on constraints to high yields in rice at farm level in South Arcot district of Tamil Nadu. They revealed that lack of reasonable support price was found to be the first important constraint by 36.33 per cent of the respondents followed by high cost of inputs was the second constraint expressed by 34 per cent of respondents.

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

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

Hirala Jana and Verma (2004) conducted a study to know the constraints faced by the paddy growers. The authors identified high cost of chemicals, lack of technical guidance, shortage of labour when needed, high labour charges, non-availability of paddy weeder and non-availability of chemicals as the major constraints.

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

Tanveer (2006) conducted a study to know the constraints faced by the paddy growers in Mandya district of Karnataka. He opined that major constraints as expressed by the farmer-respondents in the study area were high cost of inputs, fluctuation in the prices of the produce, shortage of organic manures/FYM, lack of transportation, marketing facilities and scarcity of funds.

Naik (2007) conducted a study on production and marketing of underutilized millets in northern Karnataka. The study revealed that non- availability of processing units was the very serious impediment in the study area as reported by 93.33 per cent of the farmers. The availability of storage and transportation facilities were inadequate. Further it was revealed that market information was inadequate for 66.67 per cent of the farmers. He concluded that there is need to establish processing and storage facility in the vicinity of the farmers and also there is need to establish the Agricultural Market Extension Service for educating the farmers about how to access, use and take benefit out of the available market information.

Ravikumar (2009) conducted a study on Production and Marketing of Pomegranate in Chitradurga District. Non-availability of labour during peak season, non-availability of credit, water scarcity and fluctuation in market price, high commission charges, lack of transportation facilities and lack of availability of market information were the major problems faced by the pomegranate growers in production and marketing of pomegranate.

Kusuma (2011) conducted research under the title Production and value addition in foxtail millet in Bellary district – an economic analysis. The opinion of sample farmers about the problems in foxtail millet production indicated that the sample farmers were satisfied with the availability of finance and technical guidance for the crop production. About 44.44 per cent of farmers were of the opinion that labour availability was adequate and 55.56 per cent farmers complained about the non availability of labour. This was because of heavy demand for labour during peak seasons of sowing and harvesting. Farmers also opined that availability of high yielding varieties was inadequate (83.33%). About 61.11 per cent of the sample farmers were unaware of the value addition. The state departments of agriculture and agriculture universities have pivotal role in educating the farmers regarding value addition and latest technology. Finally, Non- availability of the quality seeds was one of the major problem in the production of foxtail millet. The state and national seed corporations have to concentrate on the production of quality seeds of these minor millets as the private seed companies are not taking up seed production of these crops.

METHODOLOGY

This chapter deals with the characteristics of the area selected for the study, the methods adopted in the selection of the samples, the nature and sources of data and the various statistical tools and techniques employed in analyzing the data. The methodology is presented under the following headings:

3.1 Description of the study area

3.2 Sampling procedure

3.3 Nature and source of data

3.4 Analytical techniques employed

3.5 Definition of terms and concepts used

3.1 Description of the study area

Belgaum district comes under northern transitional zone of Karnataka and consists of ten taluks namely Athani, Bailhongal, Belgaum, Chikkodi, Gokak, Hukkeri, Khanapur, Raibag, Ramdurg and Savadatti. Belgaum district is located at North–West region of Karnataka state between 15-23° to 16-58° N' latitude and 74.05° to 75.28°E longitude. It is surrounded by Bijapur, Bagalkot, Dharwad and Karwar Districts of Karnataka and Sangli, Kolhapur, Ratnagiri Districts of Maharashtra state. The average rainfall is 820 mm. The total population of the district is 47.78 lakhs with the literacy rate of 64.57 per cent. The population density of Belagum is 355 people per sq. km.

The major rivers flowing in the district are Krishna, Malaprabha and Ghataprabha. The main irrigation sources for the district are canals, followed by wells, bore-wells and lift irrigation. Geographically the district is divided into three regions, *i.e.,* 1.Hilly region, 2.North Semi malnad, 3.North dry zone. The Khanapur taluk lies under Hilly region, Chikkodi, Hukkeri, Bailhongal and Belgaum taluks fall under North semi-malnad region, while Athani, Raibag, Gokak, Ramdurg and Savadatti taluks fall under the north dry region. The major soils of these regions are medium to deep black, reddish sandy and red sandy loam. The climate is generally dry and healthy, except during the monsoon season. The hot season begins by April with the maximum temperature of 36 º C and minimum temperature of 14.5°C during January, which is generally the coldest month.

The total geographical area of the district is 13,44,382 ha of which 7,66,580 ha is net cultivable area, fallow land was 2,33,923 ha and 1,90,424 ha of land was under forest area (Table 3.3). In the district the major crops grown are major cereals and millets (4,29,855 ha) followed by commercial crops (3,08,011 ha), oilseeds (1,39,019 ha) and pulses (84,518 ha) (Table 3.4). The agricultural land holdings and area in Belgaum district is depicted in table 3.2. The total agricultural land holdings in the district is 5,30,935.

Belgaum district is known for cereal cultivation followed by Bijapur and Gulbarga districts with an area of 4,29,855 ha and production of 6,83,327 MT. This is because of congenial climatic conditions and assured supply of water through river and canal and also there is a comparatively assured market. The major cereals grown in this district are sorghum, maize, wheat, paddy, bajra, ragi and minor millets. The total area and production of sorghum in Belgaum district is 1,54,736 hectares and 1,75,882 metric tonnes respectively during 2011-12.

3.2 Sampling procedure

3.2.1 Selection of the study area

Belgaum is the major cereal producing district in the Karnataka, the total area and production of cereals is 4,29,855 ha and 6,83,327 MT. respectively. Cereal cultivation is largely practiced in the district. Hence the Belgaum district was purposively selected for the study. Sorghum is the major cereal widely grown in the district was selected for the study and its competitive crops like sunflower and chickpea were also selected for the study. The total area and production of sorghum, sunflower and chickpea in Belgaum district is 1,54,736 hectares and 1,75,882 metric tonnes, 16,806 hectares and 9,410 metric tonnes and 52,173 hectares and 26,467 metric tonnes respectively.

Table 3.1: Belgaum district at a glance

Sl No.	Important parameters	Value
1	Area(Sq.Km)	13454
2	Taluks (nos.)	10
3	Total population* (nos.)	4778439
	a.Rural population* (nos.)	3567739
	b. Urban population (nos.)	1210700
4	Sex ratio(Females per 1000 males)*	969
5	Population Density*(per sq.km)	355
6	Literacy rate*(percent)	64.57
7	Gross cropped area(ha)	1011264
8	Gross irrigated area(ha)	523,128
9	Cereal production(MTs)	683327
10	Pulse production(MTs)	47090
11	Oilseed production(MTs)	49725
12	Plantation crop production(Ts)	9033
13	Commercial crop production(Ts)	15138864
14	Fruit crop production(MTs)	228376
15	Vegetable crop production(MTs)	626070

Source: District statistical office, Belgaum (2011-12)
*As per 2011 census

Table 3.2: Agricultural land holders and area in Belgaum district (2011-12)

Sl No.	Different categories	Number	Area
1	Small Agril. land holders(Below 1 ha)	215508	123456.5
2	Marginal Agril. land holders(1-2 ha)	156810	222973.7
3	Semi medium Agril. land holders(2-4 ha)	104873	284240.9
4	Medium Agril. land holders(4-10ha)	47736	271488.6
5	Large Agril. land holders(more than 10ha)	5993	90161.7
	Total Agril. land holders	**530935**	**1075228.3**

Source: District statistical office. Belgaum (2011-12)

Table 3.3: Land use pattern in Belgaum district (2011-12)

Sl No.	Particulars	Area (Hectares)	Percentage
1	Area under forest	190424	14.16
2	Land not available for cultivation	114137	8.49
i	Non- agricultural uses	69795	-
ii	Barren	44342	-
3	Other uncultivated land	39318	2.92
i	Cultivable waste	11465	-
ii	Permanent pasture	24807	-
iii	Tree and groves	3046	-
4	Fallow land	233923	17.40
i	Current land	226952	-
ii	Other fallow	6971	-
5	Net sown area	766580	57.02
6	Area sown more than once	244684	18.20
7	Gross cropped area	1011264	75.22
	Total geographical area	**1344382**	**100**

Source: District statistical office. Belgaum (2011-12)

Table 3.4: Area under major crops in Belgaum district (2011-12)

Sl No.	Crops	Area (In Hectares)
I	**Cereals**	
1	Paddy	68307
2	Jowar	154736
3	Bajra	12459
4	Maize	147998
5	Ragi	525
6	Wheat	44014
7	Other minor millets	1816
	Total cereals and minor millets	**429855**
II	**Pulses**	
1	Green gram	17048
2	Bengal gram(Check pea)	52173
3	Other pulses	1696
	Total pulses	**84518**
III	**Oilseeds**	
1	Ground nut	36253
2	Sunflower	16806
3	Others	126719
	Total oilseeds	**139019**
IV	**Commercial crops**	
1	Sugar cane	255253
2	Cotton	38012
3	Tobacco	14746
	Total	**308011**
V	**Horticultural crops**	
1	Fruits	9514
2	Vegetables	23471
	Total	**32985**

Source: District statistical office. Belgaum (2011-12)]

Table 3.5: Area under sorghum in Belgaum districts (2011-12)

Taluks	Area (ha)	Percentage
Athani	46652	30.15
Bailhongal	19483	12.60
Belgaum	7327	4.74
Chikkodi	10345	6.70
Gokak	8541	5.52
Hukkeri	10491	6.78
Khanapur	31	0.02
Raibag	389	0.25
Ramdurg	29237	18.89
Savadatti	22240	14.37
District total	**154736**	**100**

Source: District statistical office. Belgaum (2011-12)

Table 3.6: Selected farm respondents from the study area

Sl. No.	Taluks	Village	No. of Farmers
1	Ramdurg	Salapur	30
		Chippalkatti	30
2	Savadatti	Hirekumbi	30
		Inamahongal	30
3	Bailhongal	Bailawad	30
		Neginahal	30
Total			**180**

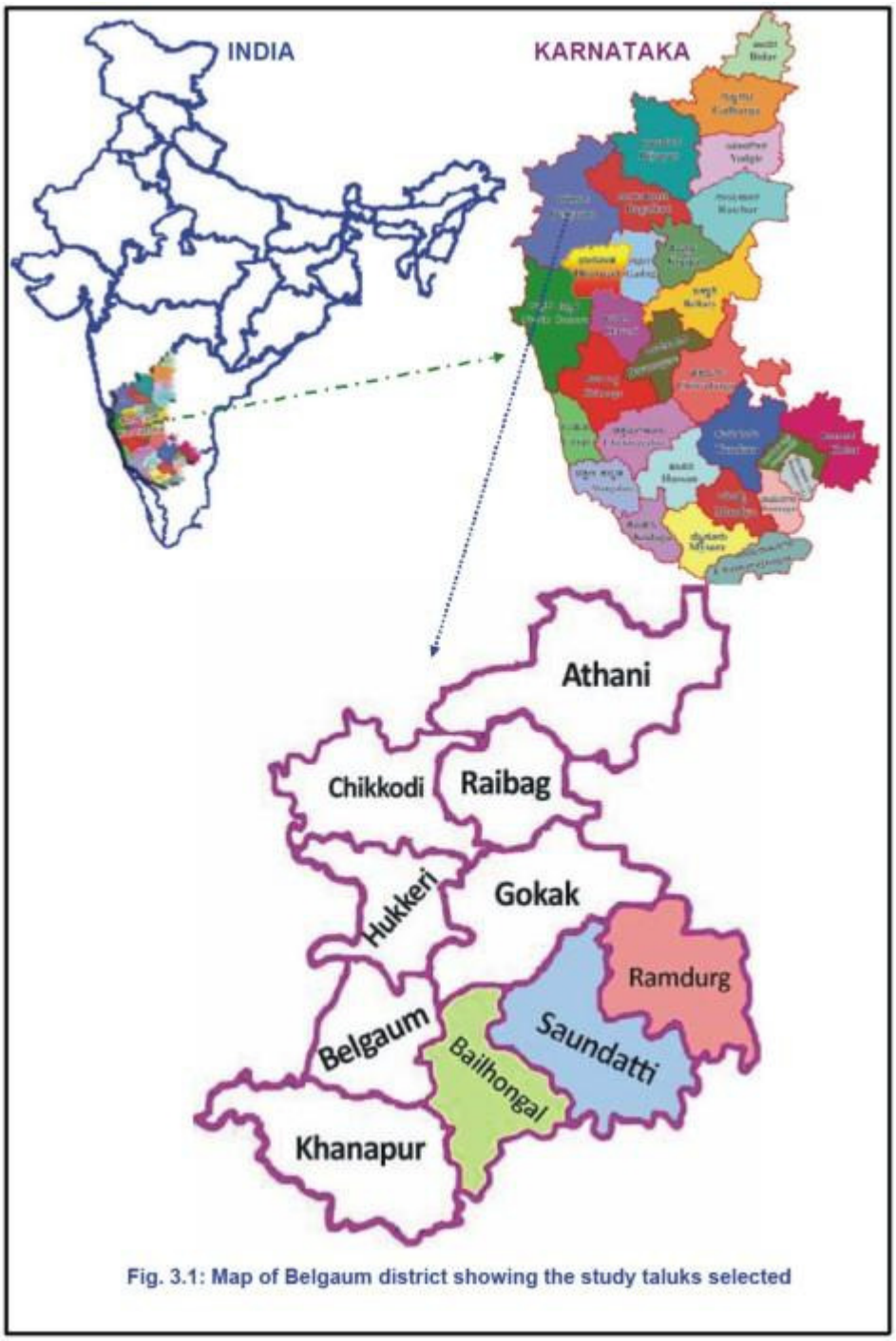

Fig 3.1. Map of Belgaum district showing the study taluks selected

3.2.2 Sampling design and Selection of respondents

Multistage sampling technique was employed in the selection of farmers for the study based on the production of sorghum in the state during *rabi* season. Belgaum district was selected purposively, because it is having major share in the production of *rabi* sorghum in Karnataka. Three taluks of Belgaum district were selected purposively for the study namely Ramdurg, Savadatti and Bailhongal and from each taluk, two villages were selected based on highest area under *rabi* sorghum. From each village 10 farmers growing *rabi* sorghum, 10 farmer growing chickpea and 10 farmers growing sunflower were selected randomly and thus the total sample size for production of *rabi* sorghum was 60 and for its competitive crops like chickpea and sunflower was also 60 each. The total sample size for the study was 180.

3.3 Nature and source of data

To meet the objectives of the study both primary and secondary data were collected.

Secondary data

The secondary data with respect to area, production and productivity of *rabi* sorghum and its competitive crops were collected from the District Statistical Office of Belgaum district for a period of 10 years. The time series data on price of sorghum and its competitive crops were collected from the leading regulated markets in the district for a period of 10 years.

Primary Data

The primary data with respect to input use pattern, economics of production of *rabi* Sorghum and its competitive crops, constraints in production of *rabi* sorghum were collected from the sample farmers by personal interview method with the help of well - structured pre-tested schedule. The data pertained to the year 2012-13.

3.4 Analytical techniques employed

To fulfill the specific objectives of the study based on the nature and extent of data, the following analytical tools and techniques were employed,

1. Tabular presentation,
2. Growth rate analysis,
3. Budgeting technique,
4. Trend analysis,
5. Garret ranking technique.

3.4.1 Tabular presentation

The tabular presentation method was followed to study the general characteristics of sample farmers. The averages and percentages were worked out.

3.4.2 Growth rate analysis

Compound growth rate analysis was carried out in order to analyse the growth in area, production and productivity of *rabi* sorghum and its competitive crops in the Belgaum district of Karnataka. Compound growth rates were computed using the following form of the relationship.

$$Y^t = ab^t u_t \text{……..3.1}$$

Where

Y^t = area, yield or production of crops in year t

t = year which takes values 1, 2 …….n

U_t = random disturbance term

'a' and 'b' are parameters to be estimated. Logarithimic transformation of (3.1) provided the estimating equation

$$\text{Log } Y^t = \log a + t \log b + \log Ut \text{ …….. ……..3.2}$$

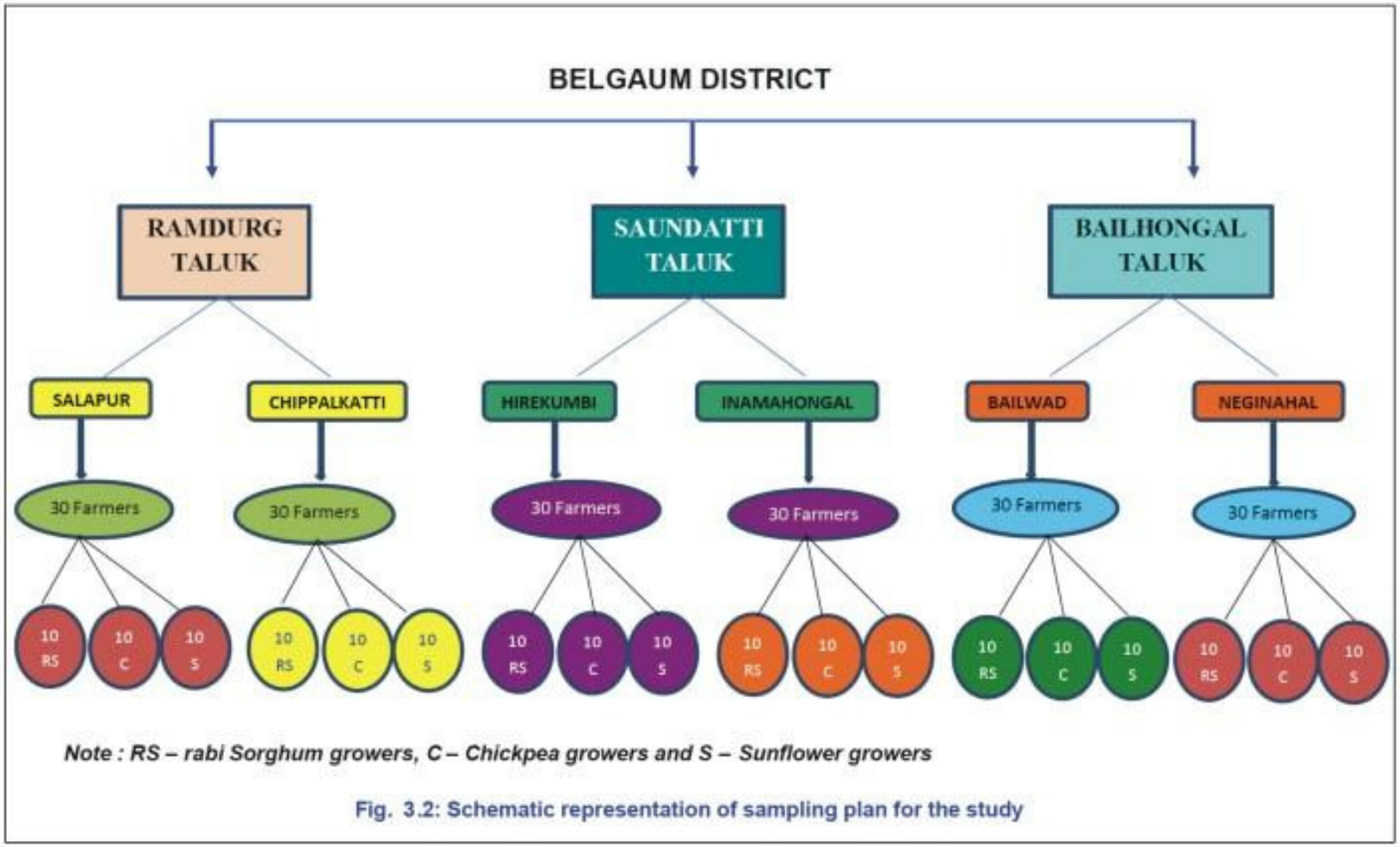

Fig 3.2 Schematic representation of sampling plan for the study

Equation (3.2) was estimated by ordinary least square technique (OLS). Compound growth rate (g) was then estimated by the identity given in equation (3.3)

$$g = (b-1)\ 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 3.3$$

Where,

g = estimated compound growth rate in percent per year and

b = anti log of b

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

Growth rates of area, production and yield of *rabi* sorghum and its competitive crops (chickpea and sunflower) were computed for a period of 10 years (2000-01 to 2009-10).

3.4.3 Budgeting technique

This technique was used to estimate the costs and returns in production of *rabi* sorghum and its competitive crops (chickpea and sunflower).

3.4.4 Time series analysis

3.4.4.1 Estimation of linear trend equation

Linear trend equation of the type Y=a+bT+u was estimated.

Where,

Y=Average annual price

T=Time period in years

a=Intercept

b=Trend coefficient

u=Error term

3.4.4.2 Estimation of seasonal price indices

To measure the seasonal variations in prices, seasonal indices were calculated employing monthly averaging method and expressed in percentages. The usual 12 months moving average method followed by calculating monthly ratios could not be employed, as the data on prices were not available for the whole year. This is mainly because *rabi* sorghum and its competitive crops were not traded in the markets throughout the year.

The seasonal indices were calculated by adopting the following steps:

In the first step, monthly averages for the study period were computed. In the second step, overall average was computed for the whole length of the study period. Then the monthly average values were converted into seasonal indices by computing the ratio of monthly average values by the overall average value and expressed in percentage.

$$SI_i = Average_i \ / \ Overall\ average$$

Where,

SI_i = Seasonal Index for i^{th} month

$Average_i$ = Average value for i^{th} month

3.4.5 Garrett's ranking technique

Garrett's ranking technique was used to identify the constraints in the production of *rabi* sorghum in the study area.

Garrett ranking is applied to rank a set of items or factors as perceived by the sample respondents based on certain criteria. The order of merit assigned by the respondents was converted into scores using the formula given by Garrett and Woodworth (1977).

Per cent position of each rank = $100\ (R_{ij} - 0.5)\ / N_j$

Where,

R_{ij} = the rank of the i th item by j^{th} individual and

N_j = the number of items ranked by the j^{th} individual.

By referring the Garrett's table, per cent position estimated was converted into score. Then, for each factor the scores of various respondents were added and the mean score was calculated. The factor with the highest mean score was considered to be the most important constraint. Thus, mean score for each constraint was ranked by arranging them in the descending order.

3.5 Definition of terms and concepts used

Human labour

Human labour was estimated in terms of eight hours of work per day. The women labour days were converted into man days on the criteria that one woman day is equal to 0.60 man days on the basis of wage rate equivalent, similar, methodology was adopted by Mundinamani and Kunnal (2000).

Bullock labour

It was measured in pair days where, one pair day means eight hours of work by a pair of bullock. Prevailing rate per day paid by farmers was used in the calculation.

Machine labour

The costs of machine labour both for hired and owned on per hour basis was calculated using differential rates for deferent type of operations that prevailed in study area.

Seed cost

The cost of own seeds was calculated at local market price and the actual expenditure incurred in the case of purchased seeds was considered.

Seed treatment

The cost of seeds treatment chemicals was calculated at local market price and the actual expenditure incurred in the case of purchased seed treatment chemical was considered.

Organic manure

The quantity of organic manure used in the cultivation was measured in terms of tonne and the cost was imputed at the market price prevailing in the village.

Fertilizers

Cost of fertilizer was computed considering the actual price paid by the farmers including the transportation cost and other incidental charges if any.

Gross return

The total value of produce [seed and by-product (hay)] for both main and byproduct together is referred to as the gross return.

Net return

Return obtained by subtracting the total cost from gross return.

Interest on working capital

The prevailing bank rate of interest on crop loan @ 8 per cent per annum was used to work out the interest on working capital for the duration of the crop.

Interest on fixed capital

The present value of farm assets, equipments form the fixed capital.

The prevailing bank rate of interest on long term loan @ 11 per cent per annum was used to work out the interest on fixed capital per crop.

Rental value of own land

The actual land rent prevailing per unit of area for a similar land was used in the analysis.

Variable costs

The variable costs included were cost of seed, fertilizer, hired labour, bullock and machine labour *etc.* Actual price paid towards these inputs was included along with the payments made in kind and the impacted value of owned resources.

Fixed costs

Land revenue paid to the government per acre, prevailing land rent paid and apportioned depreciation cost per acre on farm machineries, tools and equipments and farm buildings were included as fixed costs.

Cost of cultivation

It is the sum of variable costs and fixed costs expressed on per hectare basis.

RESULTS

The necessary primary data required for the study collected from the sample farmers spread over Belgaum district of Northern Karnataka and the secondary data collected from various sources were subjected to various statistical tools and techniques to arrive at the results. The major findings of the study are presented in this chapter under the fallowing heads.

4.1 General characteristics of the sample farmers in the study area

4.2 Cropping pattern on the sample farms

4.3 Growth in area, production and productivity of *rabi* sorghum and its competitive crops in Belgaum district

4.4 Input use pattern on the sample farms

4.5 Cost involved in the production of *rabi* sorghum, chickpea and sunflower (rainfed)

4.6 Returns from cultivation of *rabi* sorghum, chickpea and sunflower (rainfed)

4.7 Temporal variations in prices of *rabi* sorghum, chickpea and sunflower

4.8 Production problems of *rabi* sorghum growers

4.9 Marketing problems of *rabi* sorghum growers

4.1 General characteristics of the sample farmers in study area

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 this study to analyze some of the important characteristics of the sample farmers. The general characteristics of the respondents are presented in Table 4.1.

The study comprised of 180 sample respondents spread over three taluks of Belgaum district, in which 60 farmers were *rabi* sorghum growers, 60 farmers were chickpea growers and remaining 60 famers were sunflower growers. From the table, it could be seen that the average age of the *rabi* sorghum growers was 54.12 years, where as that of chickpea and sunflower growers was 48.5 and 50.42 years respectively. With regard to educational status of the farmers revealed that on an average 76.67 per cent, 75.00 per cent and 73.33 per cent of *rabi* sorghum, chickpea and sunflower sample farmers were observed to be literates and remaining 23.33 per cent, 25 per cent and 26.67 per cent respectively as illiterates. Thus it is apparent that the education level of the *rabi* sorghum farmers was little higher as compared to that of chickpea and sunflower farmers. Among the literates 4.34 per cent of *rabi* sorghum farmers were graduates, whereas 2.22 per cent and 9.09 percent of chickpea and sunflower farmers have completed graduation. Most of the literate farmers possessed primary school education *i.e.*, 43.47 per cent of *rabi* sorghum farmers, 33.33 per cent chickpea farmers and 36.37 per cent sunflower farmers. The percentage of farmers who completed college education was 15.22 per cent, 20.00 per cent and 20.45 per cent for *rabi* sorghum, chickpea and sunflower farmers respectively and the percentage of farmers possessing high school education was 36.96, 44.44 and 34.09 per cent for *rabi* sorghum, chickpea and sunflower farmers respectively. In all the cases the main occupation of them was agriculture (96.67 per cent, 98.33 per cent and 93.33 per cent for *rabi* sorghum, chickpea and sunflower farmers respectively).

From the table it could also be seen that the average size of the family of *rabi* sorghum, chickpea and sunflower farmers was six, four and five members respectively and average land holding was 5.73 ha in case of *rabi* sorghum growers where as in case of chickpea and sunflower growers the average land holding was 7.06 ha and 6.20 ha respectively. And average area under irrigation was 1.76 ha, 2.6 ha and 2.13 ha for *rabi* sorghum, chickpea and sunflower farmers respectively. Similarly average area under dry land was 3.17 ha, 4.46 ha and 4.07 ha for *rabi* sorghum, chickpea and sunflower growers respectively. The varieties/hybrids cultivated under *rabi* sorghum were, Maldandi and Muguti, similarly for chickpea Annigeri-1 and local varieties and for sunflower, local varieties were cultivated.

4.2 Cropping pattern on the sample farms

Cropping pattern on the sample farms is presented in Table 4.2.

Table 4.1: General characteristics of sample farmers

Sl. No	Particulars	Unit	Crops		
			Rabi sorghum growers (n=60)	Chickpea growers (n=60)	Sunflower growers (n=60)
1	Age	Years	54.2	48.5	50.42
2	Education				
	a. Illiterate	No.	14 (23.33)	15 (25.00)	16 (26.67)
	b. Literate	No.	46(76.62)	45(75.00)	44(73.33)
	i. Primary	No.	20 (43.47)	15 (33.33)	16 (36.37)
	ii. High school	No.	17 (36.96)	20 (44.44)	15 (34.09)
	iii. College	No.	7 (15.22)	9 (20.00)	9 (20.45)
	iv. Degree	No.	2 (4.34)	1 (2.22)	4 (9.09)
3	Occupation				
	a. Agriculture as main occupation	No.	58 (96.67)	59 (98.33)	56 (93.33)
	b. Agriculture as subsidiary occupation	No.	2 (3.33)	1 (1.67)	4 (6.67)
4	Family size	No.	6	4	5
5	Land holdings(ha)				
	a. Irrigated	Hectares	1.76 (30.71)	2.60 (36.82)	2.13 (34.35)
	b. Dry land	Hectares	3.97 (69.28)	4.46 (63.17)	4.07 (65.65)
	c. Total	Hectares	5.73 (100)	7.06 (100)	6.20 (100)
6	Varieties / Hybrids cultivated	--	Maldandi, Muguti	A-1 and local varieties	Local varieties

Note: Figures in the parentheses indicate percentage to the respective tota

It is evident from the table that all categories of farmers grew a number of crops on their farm. Rabi sorghum, chickpea and sunflower were the major crops grown whereas soybean, green gram, maize, cotton, onion, wheat, vegetables and sugarcane were the other crops grown by the sample farmers.

The major crops grown during *kharif* season by the sorghum growers were green gram, maize, onion, cotton and soybean. Among these crops the area under green gram was found to be highest (4.73 hectare), followed by maize (2.15 hectare), onion (1.80 hectare), cotton (1.43 hectare) and soybean (1.22 hectare).

During *rabi* season sorghum, chickpea, sunflower and wheat were the major crops grown, the average area under sorghum was found to be highest (6.12 hectare) followed by chickpea (1.30 hectare), sunflower (1.30 hectare) and wheat (1.20 hectare). During summer, irrigation was provided for growing of vegetables (0.27 hectare). Sugarcane was the annual crop with an average area of 1.08 acres.

In case of the chickpea growers the major crops grown during *kharif* season were green gram, maize, onion, cotton and soybean. Among these crops the area under green gram was found to be highest (4.47 hectare), followed by maize (2.65 hectare), onion (2.22 hectare), cotton (1.51 hectare) and soybean (1.50 hectare).

During *rabi* season sorghum, sunflower, chickpea and wheat were the major crops grown, the average area under sorghum was found to be highest (6.78 hectare) followed by wheat (1.87 hectare) sunflower (1.50 hectare), chickpea (1.42 hectare). During summer, irrigation was provided for growing of vegetables (0.33 hectare). Sugarcane was the annual crop with an average area of 2.27 hectare.

While in case of the sunflower growers the major crops grown during *kharif* season were green gram, maize, onion, soybean and cotton. Among these crops the area under green gram was found to be highest (4.48 hectare), followed by maize (2.70 hectare), onion (2.18 hectare), soybean (1.67 hectare) and cotton (1.52 hectare).

During *rabi* season sorghum, sunflower, wheat and chickpea were the major crops grown, the average area under sorghum was found to be highest (5.80 hectare) followed by sunflower (2.78 hectare), wheat (1.78 hectare) chickpea (1.20 hectare). During summer vegetables (0.15 hectare) were grown under irrigation. Sugarcane was the annual crop with an average area of 1.40 hectare.

It was noticed that the gross cropped area of sorghum growers was 9.04 hectare, whereas it was 10.60 and 10.32 hectare in case of chickpea growers and sunflower growers respectively. In all the cases the sorghum occupied the major portion of area under cultivation. The cropping intensity was high in case of chickpea growers (214.83%) than the sunflower growers (203.95%) and sorghum growers (199.47%).

4.3 Growth in area, production and productivity of *rabi* sorghum and its competitive crops in Belgaum district

Growth rates of area, production and productivity of *rabi* sorghum (overall), *rabi* sorghum (HYV), chickpea and sunflower in Belgaum district of Karnataka for the period of ten years 2000-01 to 2009-10 have been worked out and are presented in the Table 4.3 and Fig 4.1.

It can be seen from the table that negative growth in area and production but positive growth in productivity was observed in the *rabi* sorghum (overall). The growth rates in area, production and productivity of *rabi* sorghum (overall) were -12.63 per cent, -2.81 per cent and 11.23 per cent respectively.

It can also be seen from the table that positive growth in area, production and productivity was observed in *rabi* sorghum (HYV). *Rabi* sorghum (HYV) registered a growth rate of 24.52 per cent in case of area, 32.62 per cent in production and 6.51 per cent in case of productivity in the Belgaum district.

The table also revealed that positive growth in area, production and productivity was observed in chickpea. Chickpea registered a growth rate of 8.53 per cent in case of area, 12.04 per cent in production and 3.24 per cent in case of productivity.

For sunflower crop also positive growth in area, production and productivity was observed. The growth rates in area, production and productivity of sunflower were 12.99 per cent, 14.46 per cent and 1.29 per cent respectively.

Table 4.2: Cropping pattern on the sample farms

Crops/season	Rabi sorghum growers	Chickpea growers	Sunflower growers
Kharif	**Area (ha)**	**Area (ha)**	**Area (ha)**
Cotton	0.57(6.33)	0.60(5.70)	0.65(6.28)
Soybean	0.49(5.40)	0.60(5.66)	0.67(6.47)
Maize	0.86(9.51)	1.06(10.00)	1.08(10.47)
Onion	0.72(7.96)	0.89(8.37)	0.87(8.45)
Greengram	1.89(20.93)	1.79(16.86)	1.79(17.36)
Total	4.53(50.13)	4.94(46.55)	5.06(49.03)
Rabi			
Sorghum	2.45(27.08)	2.71(25.58)	2.32(22.48)
Chickpea	0.52(5.75)	0.57(5.36)	0.48(4.65)
Sunflower	0.52(5.75)	0.60(5.66)	1.11(10.75)
Wheat	0.48(5.31)	0.75(7.05)	0.71(6.90)
Total	3.97(43.89)	4.63(43.64)	4.64(44.96)
Summer			
Vegetables	0.11(1.19)	0.13(1.24)	0.06(0.58)
Annual Crops			
Sugarcane	0.43(4.78)	0.91(8.56)	0.56(5.43)
Gross cropped area	9.04(100)	10.60(100)	10.32(100)
Net cropped area	4.53	4.94	5.06
Cropping intensity (%)	199.47	214.82	203.95

Note: Figures in the parentheses indicate the percentage to the respective total

Table 4.3: Compound growth rates for area, production and productivity of *rabi* sorghum, chickpea and sunflower in Belgaum district (2000-01 to 2009-10)

	Area	Production	Productivity
Rabi sorghum (overall)	-12.63*	-2.81	11.23
Rabi sorghum (HYV)	24.52*	32.62*	6.51**
Chickpea	8.53*	12.04*	3.24
Sunflower	12.99**	14.46*	1.29

Note: * Significant at the 1 per cent

**Significant at the 5 per cent

HYV- High yielding variety

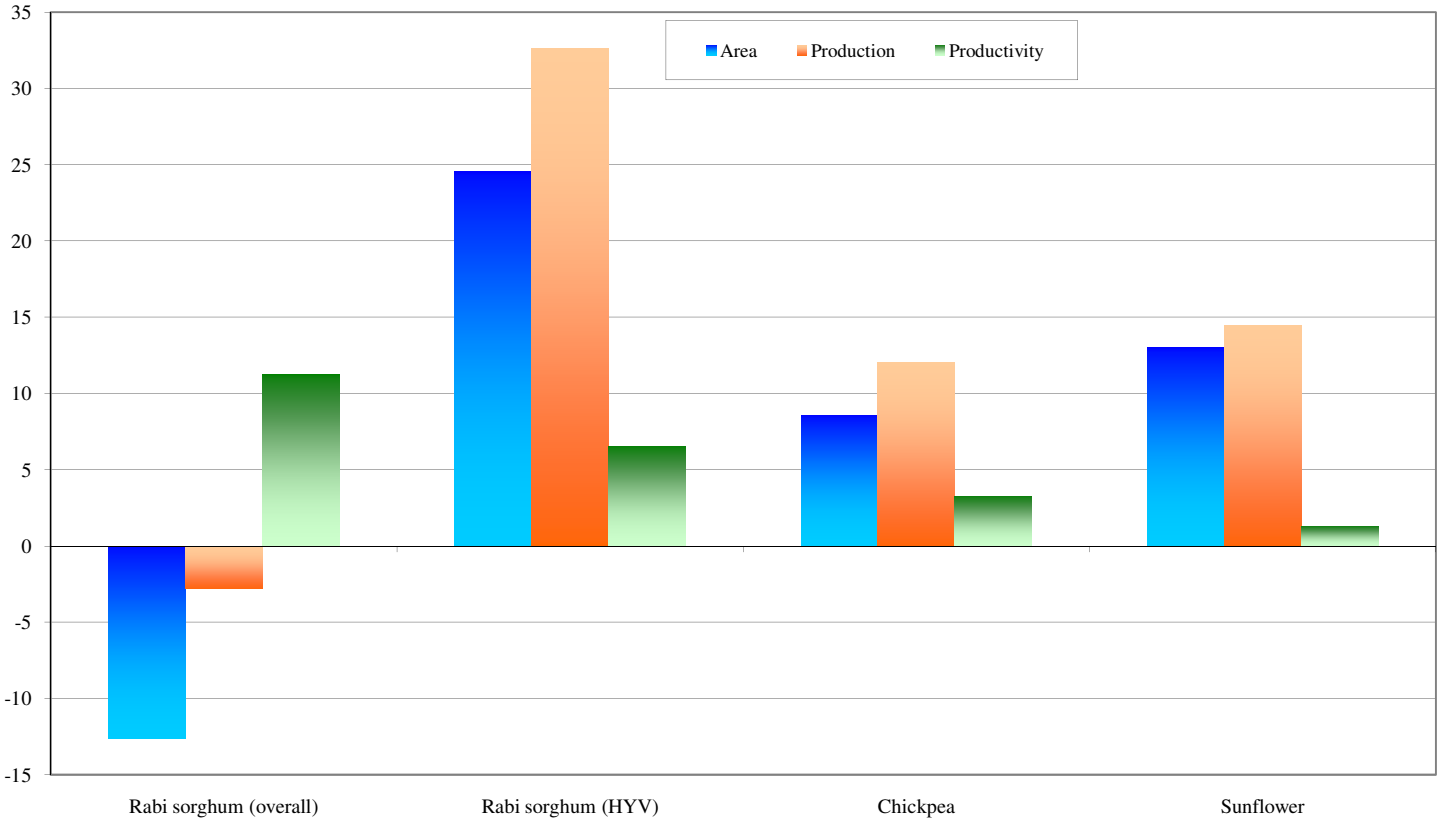

Fig. 4.1: Compound growth rates for area, production and productivity of rabi sorghum, chickpea and sunflower in Belgaum district (2000-01 to 2009-10)

4.4 Input use pattern on the sample farms

Inputs used by the sample farmers for per hectare of *rabi* sorghum, chickpea and sunflower cultivation in the study area are presented in Table 4.4.

4.4.1 Input use pattern in *rabi* sorghum cultivation

The labour utilization in case of cultivation of *rabi* sorghum indicated that the usage of machine labour, bullock labour and human labour were found to 2.31 hrs, 4.34 pair days and 20.75 man days respectively. In case of *rabi* sorghum cultivation, the inputs used were seeds, FYM, urea, DAP and Zinc Sulphate ($ZnSO_4$). The average quantity of seeds used per hectare was 6.9 kgs. The average quantity of farm yard manure (FYM) applied was 2.77 tonnes and 87 kgs, 55 kgs and 15 kgs of urea, DAP and Zinc Sulphate ($ZnSO_4$) respectively were used. No plant protection chemical was used in *rabi* sorghum cultivation.

4.4.2 Input use pattern in chickpea cultivation

The labour utilization in case of cultivation of chickpea indicated that 1.34 hrs of machine labour, 3.8 pair days of bullock labour and 15.38 man days of human days were used. In case of chickpea cultivation, the inputs used were seeds, urea and DAP. The average quantity of seeds used per hectare was 49.61 kgs. The average quantity of chemical fertilizers used was 10 and 54 kgs of urea and DAP respectively. Prophenophos used was one litre as a plant protection chemical in chickpea cultivation.

4.4.3 Input use pattern in sunflower cultivation

In sunflower cultivation also machine labour, bullock labour and human labour were found to be used for 3.4 hrs, 4.39 pair days and 20.4 man days respectively In case of sunflower cultivation, the inputs used were seeds, FYM, urea, DAP and MOP. The average quantity of seeds used per hectare was 6.5 kgs. The average quantity of farm yard manure (FYM) applied was 5.96 tonnes and 35 kgs, 108 kgs and 58 kgs of urea, DAP and MOP respectively were applied. Chloropyriphos used was one litre as a plant protection chemical in sunflower cultivation.

4.5 Cost involved in the production of *rabi* sorghum and its competitive crops (rainfed)

The costs incurred for cultivation of *rabi* sorghum and its competitive crops *viz*., chickpea and sunflower under rainfed conditions were calculated and are presented in Table 4.5.

4.5.1 Cost involved in the production of *rabi* sorghum (rainfed)

The total cost of cultivation of *rabi* sorghum was Rs. 19816.70 per hectare of which 57.17 per cent was the variable cost and remaining 42.83 per cent was fixed cost. The distribution pattern of operational cost on various inputs in *rabi* sorghum cultivation revealed that the chemical fertilizer shared the highest per cent (12.63%) of the total cost followed by human labour that was 11.90 per cent and bullock labour was 11.26 per cent. The share of machine labour, farm yard manure (FYM), interest on working capital, repairs, maintenance and miscellaneous expenses was 6.72 per cent, 6.99 per cent, 4.23 per cent and 2.52 per cent respectively. The seeds shared only 0.91 per cent of total cost of cultivation of *rabi* sorghum.

The share of fixed cost was Rs. 8,488.09 accounting for 42.83 per cent of total cost of cultivation of *rabi* sorghum. The fixed cost included rental value of land, which was Rs. 6,347.32 accounting for 32.03 per cent of total cost of cultivation, land revenue Rs. 8.24 accounting for 0.04 per cent, depreciation Rs. 1,291.37 accounting for 6.52 per cent and interest on working capital Rs. 841.16 accounting for 4.24 per cent.

4.5.2 Cost involved in the production of chickpea (rainfed)

The total cost of cultivation of chickpea was Rs. 18141.60 per hectare of which 54.36 per cent was variable cost and remaining 45.64 per cent was fixed cost. The distribution pattern of operational cost on various inputs revealed that the bullock labour shared the highest per cent (10.39%) of the total cost followed by human labour (9.60%), plant protection chemicals (8.27%), seeds (8.20%), chemical fertilizers (7.85%) and machine labour (4.37%). The interest on working capital and repairs, maintenance and miscellaneous expenses shared 4.03 per cent and 1.65 per cent respectively.

Table 4.4: Input utilization pattern on sample farms

(Per ha)

Sl. No.	Inputs	Units	Rabi sorghum growers	Chickpea growers	Sunflower growers
			Qty	Qty	Qty
I	**Labour utilization**				
a	Machine labour	Hrs.	2.31	1.34	3.4
b	Bullock labour	Pair days	4.34	3.8	4.39
c	Human labour	Man days	20.75	15.38	20.4
II	**Seed**	kgs.	6.9	49.61	6.5
IV	**Organic manures and Chemical fertilizers**				
a	FYM	Tonnes	2.77	0.00	5.96
b	Chemical fertilizers				
	i. Urea	kgs.	87	10	35
	ii. DAP	kgs.	54	54	108
	iii. MOP	kgs.	0.00	0.00	58
	iv. $ZnSo_4$	kgs.	15	0.00	0.00
c	**PPC**				
	i. Prophenophos	lits	0.00	1	0.00
	ii. Chloropyriphos	lits	0.00	0.00	1

Table 4.5 Cost involved in production of *rabi* sorghum, chickpea and sunflower (rainfed)

(Rs/ ha)

Sl. No.	Particulars	Rabi sorghum		Chickpea		Sunflower	
		Value	Per cent to total cost	Value	Per cent to total cost	Value	Per cent to total cost
I	**Variable costs**						
1	Seeds	179.40	0.91	1488.30	8.20	780.00	3.19
2	Chemical fertilizers	2502.60	12.63	1424.80	7.85	3949.00	16.17
3	Plant protection chemicals	0.00	0.00	1500.00	8.27	1500.00	6.14
4	Human labour	2358.86	11.90	1741.63	9.60	2026.97	8.30
5	Bullock labour	2231.49	11.26	1884.15	10.39	2176.60	8.91
6	Machine labour	1332.10	6.72	792.83	4.37	1354.60	5.55
7	Farmyard manure	1385.00	6.99	0.00	0.00	2980.00	12.20
8	Repairs, maintenance & miscellaneous expenses	500.00	2.52	300.00	1.65	425.00	1.74
9	Interest on working capital @ 8 %	839.16	4.23	730.54	4.03	1215.37	4.98
	Total variable costs	**11328.61**	**57.17**	**9862.25**	**54.36**	**16407.54**	**67.19**
II	**Fixed costs**						
1	Land revenue	8.24	0.04	8.32	0.05	8.12	0.03
2	Rental value of the land	6347.32	32.03	6291.57	34.68	5989.54	24.53
3	Depreciation	1291.37	6.52	1158.98	6.39	1220.00	5.00
4	Interest on fixed capital @ 11%	841.16	4.24	820.48	4.52	793.94	3.25
	Total fixed costs	**8488.09**	**42.83**	**8279.35**	**45.64**	**8011.60**	**32.81**
	Total cost of cultivation(I+II)	**19816.70**	**100.00**	**18141.60**	**100.00**	**24419.14**	**100.00**

The share of fixed cost was Rs. 8,279.35 accounting for 45.64 per cent of the total cost of cultivation. The fixed cost included land revenue, which was Rs. 8.32 accounting for 0.05 per cent of total cost of cultivation. Rental value of land, depreciation and interest on working capital were found to be Rs. 6,291.57, Rs. 1,158.98 and Rs. 820.48 accounting for 34.68 per cent, 6.39 per cent and 4.52 per cent respectively.

4.5.3 Cost involved in the production of sunflower (rainfed)

The total cost of cultivation of sunflower was Rs. 24419.14 per hectare of which 67.19 per cent was the variable cost and remaining 32.81 per cent was fixed cost. The distribution pattern of operational cost on various inputs in sunflower cultivation revealed that the chemical fertilizers shared the highest per cent (16.17%) of the total cost of cultivation, followed by farm yard manure (12.20%), bullock labour (8.91%) human labour (8.30%) and plant protection chemicals (6.14%). The share of machine labour, interest on working capital, seeds and repairs, maintenance and miscellaneous expenses were 5.55 per cent, 4.98 per cent, 3.19 per cent and 1.74 per cent respectively.

The share of fixed cost was Rs. 8,011.60 accounting for 32.81 per cent of total cost of cultivation of sunflower. The fixed cost included rental value of land, which was Rs. 5,989.54 accounting for 24.53 per cent of total cost of cultivation, land revenue Rs. 8.12 accounting for 0.03 per cent, depreciation Rs. 1,220.00 accounting for 5.00 per cent and interest on working capital Rs. 793.94 accounting for 3.25 per cent.

4.6 Returns from cultivation of *rabi* sorghum and its competitive crops (rainfed)

The returns obtained from *rabi* sorghum and its competitive crops *viz*., chickpea and sunflower were calculated and are presented in Table 4.6.

4.6.1 Returns from cultivation of *rabi* sorghum (rainfed)

From the table, it was evident that the per hectare average yield obtained from *rabi* sorghum was 11.30 quintals and by product was 3.2 tonnnes. The average market price was Rs. 2,000.00 per quintal for main product and Rs. 1,000.00 per tonne for by product.

The gross returns per hectare were Rs. 25,800.00 and cost of cultivation per hectare was Rs. 198160.70. The net returns realized were Rs. 5983.30 with the benefit cost ratio of 1.30.

4.6.2 Returns from cultivation of chickpea (rainfed)

The returns structure indicated that per hectare average yield obtained from chickpea was 9.38 quintals. The average market price was Rs. 3,000.00 per quintal for main product.

The gross returns per hectare were Rs. 28,140.00 and cost of cultivation per hectare was Rs. 18141.60 respectively. The net returns realized were Rs. 9998.4 with the benefit cost ratio of 1.55.

4.6.3 Returns from cultivation of sunflower (rainfed)

It was evident from the table that per hectare average yield obtained from sunflower was 10.90 quintals. The average market price was Rs. 3,000.00 per quintal for main product.

The returns structure of sunflower revealed that the gross returns per hectare were Rs. 32,700.00 and cost of cultivation per hectare was Rs. 24419.14 respectively. The net returns realized were Rs 8280.86 with the benefit cost ratio of 1.34

4.7 Temporal variations in prices of *rabi* sorghum, chickpea and sunflower

4.7.1 Trends in prices of *rabi* sorghum

To assess the trend in prices of *rabi* sorghum in all the selected markets the trend equations were fitted.

The linear trend equations adopted were specified as follows;

Ramdurg market	Y=325.14+115.75T
Savadatti market	Y=375.41+88.72T
Bailahongal market	Y=276.93+131.83T

Table 4.6: Returns from cultivation of *rabi* sorghum, chickpea and sunflower (rainfed)

Sl. No.	Particulars	Rabi sorghum	Chickpea	Sunflower
1	Yield/ ha:			
	a. Main product (quintals per ha)	11.3	9.38	10.90
	b. By product (tonnes per ha)	3.2	--	--
2	Market price:			
	a. Main product (Rs per quintal)	2000	3000	3000
	b. By product (Rs per tonne)	1000	--	--
3	Gross returns (Rs per ha)	25800.00	28140.00	32700.00
4	Cost of cultivation (Rs per ha)	19816.70	18141.60	24419.14
5	Net returns (Rs per ha)	5983.30	9998.4	8280.86
6	B:C ratio	**1.30**	**1.55**	**1.34**

Where,

Y= Annual price of sorghum in Rs. per quintal

T= Time period in years

The results obtained from the regression analysis are shown in Table 4.7. In Savadatti market the value of the regression coefficient was found to be higher, compared to that in Ramdurg and Bailahongal markets, indicating that of prices of *rabi* sorghum increased over the years in the regulated markets.

The R^2 values for Ramdurg, Savadatti and Bailahongal markets were found to be 0.68, 0.47 and 0.73 respectively.

4.7.2 Trends in prices of chickpea

To assess the trend in prices of chickpea in all the selected markets the trend equations were fitted.

The trend equations adopted were specified as follows;

Ramdurg market Y=1229.80+88.38T

Savadatti market Y=1344.15+87.7T

Bailahongal market Y=1192.16+84.33T

Where,

Y= Annual price of chickpea in Rs. per quintal

T= Time period in years

The results of the regression analysis are presented in Table 4.8. In Savadatti market the value of the regression coefficient was found to be higher, compared to that in Ramdurg and Bailahongal markets, indicating that of price of chickpea increased over the years in the regulated markets.

The R^2 values for Ramdurg, Savadatti and Bailahongal markets were found to be 0.71, 0.75 and 0.64 respectively.

4.7.3 Trends in prices of sunflower

To assess the trend in prices of sunflower in all the selected markets the trend equations were fitted and estimated.

The trend equations adopted were specified as follows;

Ramdurg market Y=910.16+149.67T

Savadatti market Y=962.12+125.69T

Bailahongal market Y=993.55+114.51T

Where,

Y= Annual price of sunflower in Rs. per quintal

T= Time period in years

The results of the regression analysis are presented in Table 4.9. In Bailahongal market the value of the regression coefficient was found to be higher, compared to that in Savadatti and Ramdurg markets, indicating that prices of sunflower increased over the years in the regulated markets.

The R^2 values for Ramdurg, Savadatti and Bailahongal markets were found to be 0.89, 0.78 and 0.80 respectively.

4.7.4 Seasonal indices of prices of *rabi* sorghum in selected markets

In order to analyze the seasonal variations in the prices of *rabi* sorghum in the selected markets, month wise seasonal indices for prices were computed. The seasonal indices of monthly prices of *rabi* sorghum in the selected markets are presented in Table 4.10 and Fig. 4.2.

Table 4.7 Trend in the prices of sorghum in the selected markets (2000-01 to 2009-10)

Market	Equation	R^2	F value
Ramadurg	Y=325.14+115.75T	0.68	25.60*
Savadatti	Y=375.41+88.72T	0.47	9.02**
Bailahongal	Y=276.93+131.83T	0.73	34.00*

* & ** Significant at 1 and 5 per cent respectively

Table 4.8 Trend in the prices of chickpea in the selected markets (2000-01 to 2009-10)

Market	Equation	R^2	F value
Ramadurg	Y=1229.8+88.38T	0.71	23.14*
Savadatti	Y=1344.15+87.7T	0.75	27.81*
Bailahongal	Y=1192.16+84.33T	0.64	16.09*

* Significant at 1 per cent

Table 4.9 Trend in the prices of sunflower in the selected markets (2000-01 to 2009-10)

Market	Equation	R^2	F value
Ramadurg	Y=910.16+149.67T	0.89	101.66*
Savadatti	Y=962.12+125.69T	0.78	33.77*
Bailahongal	Y=993.55+114.51T	0.80	37.35*

* Significant at 1 per cent

Table 4.10: Seasonal indices of prices of sorghum in the selected markets (2000-01 to 2009-10)

Month	Markets		
	Ramadurg	Savadatti	Bailahongal
January	97.45	93.30	99.89
February	93.92	92.69	95.26
March	95.64	91.12	95.94
April	101.97	95.84	105.96
May	100.44	99.96	102.15
June	101.37	98.91	99.21
July	93.92	101.10	97.35
August	93.50	102.84	100.29
September	98.23	98.82	96.62
October	125.42	103.02	100.03
November	98.93	107.22	102.88
December	99.20	115.19	104.41

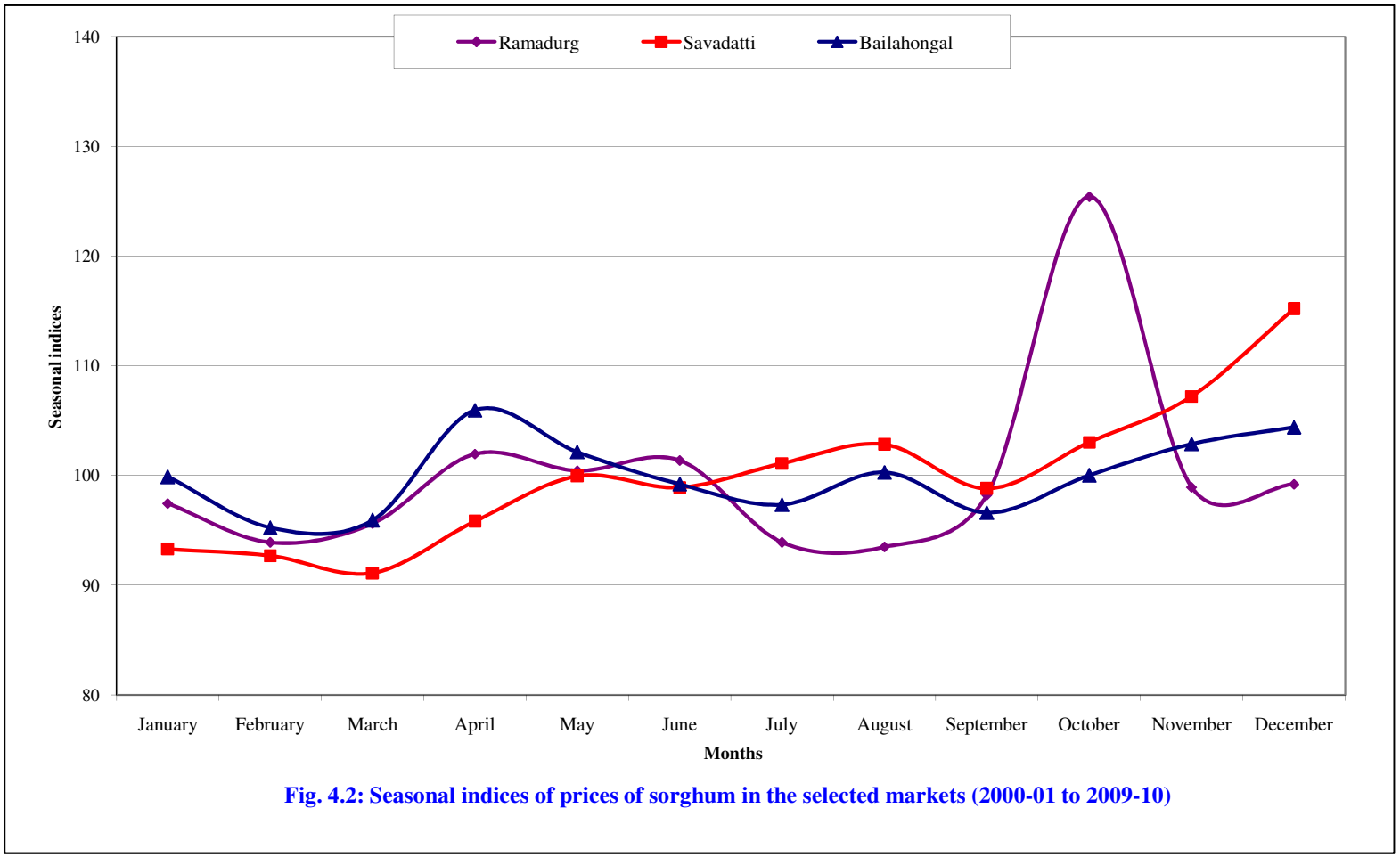

Fig. 4.2: Seasonal indices of prices of sorghum in the selected markets (2000-01 to 2009-10)

The highest seasonal indices for prices were observed in Ramdurg and Savadatti markets, which were of the order 125.42 and 115.19 respectively during the months of October and December respectively and low (93.50 and 92.69, respectively) during the months of August and February respectively. Whereas, in Bailhongal market, seasonal indices for prices was as high as 105.96 during the month of April and was lowest (95.26) during the month of February.

4.7.5 Seasonal indices of prices of chickpea in selected markets

In order to analyze the seasonal variations in the prices of chickpea in the selected markets, month wise seasonal indices for prices were computed. The seasonal indices of monthly prices of chickpea in the selected markets are presented in Table 4.11 and Fig. 4.3.

The highest seasonal indices for prices were observed in Bailohongal and Ramdurg markets, which were of the order 105.67 and 105.57 respectively during the months of October and November respectively and low (95.13 and 93.54, respectively) during the months of April and May respectively. Whereas, in Savadatti market, seasonal indices for prices was as high as 105.19 during the month of September and was lowest (95.68) during the month of January.

4.7.6 Seasonal indices of prices of sunflower in selected markets

In order to analyze the seasonal variations in the prices of sunflower in the selected markets, month wise seasonal indices for prices were computed. The seasonal indices of monthly prices of sunflower in the selected markets are presented in the Table 4.12 and Fig. 4.4

The highest seasonal indices for prices were observed in Bailohongal and Savadatti markets, which were of the order 115.00 and 108.27 respectively during the months of October and September respectively and low (92.62 and 92.07, respectively) during the months of January and May respectively. Whereas, in Ramdurg market, seasonal indices for prices was as high as 107.46 during the month of November and was lowest (92.03) during the month of April.

4.8 Production problems of sample farmers

Production problems faced by the sample farmers are presented in Table 4.13. The problems were ranked using Garrette ranking technique.

From the opinion survey it was observed that the non-availability of labour during peak period was the major problem ranked I which recorded mean score of 73.80, followed by non-availability of quality seed material, incidence of pest and diseases, non-availability of fertilizers and non-availability of PPC which were ranked II, III, IV and V with mean scores of 62.00, 53.60, 52.40 and 44.00 respectively.

4.9 Marketing problems of the sample farmers

Marketing problems faced by the sample farmers are presented in Table 4.14. The problems were ranked using Garrette ranking technique.

From the opinion survey it was observed that the price fluctuation was the major problem ranked I with a mean score of 75.20 followed by low price in the local market, non-availability of market related information, poor storage facilities, poor packing facilities and poor transport facilities which were ranked II, III, IV, V and VI with mean scores of 74.80, 61.10, 59.90, 47.10 and 46.90 respectively.

Table 4.11: Seasonal indices of prices of chickpea in the selected markets (2000-01 to 2009-10)

Month	Markets		
	Ramadurg	Savadatti	Bailahongal
January	99.94	95.68	95.29
February	98.60	97.02	96.04
March	96.48	97.73	96.84
April	95.04	94.21	95.13
May	93.54	96.04	96.82
June	93.54	96.52	97.99
July	100.31	102.65	101.44
August	101.29	101.40	103.05
September	105.11	105.19	103.10
October	105.32	104.12	105.67
November	105.57	105.10	105.30
December	105.26	104.34	103.32

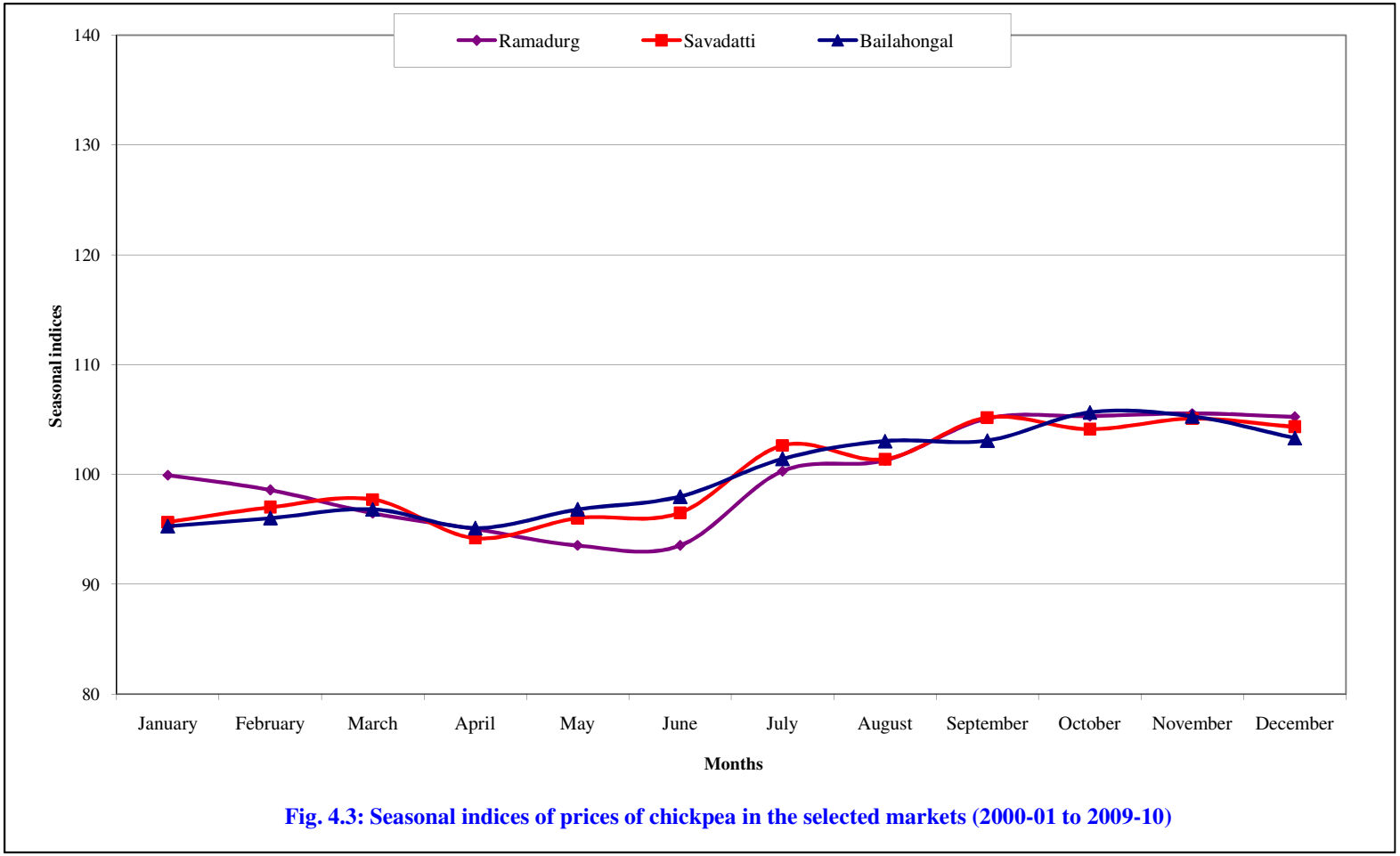

Fig. 4.3: Seasonal indices of prices of chickpea in the selected markets (2000-01 to 2009-10)

Table 4.12: Seasonal indices of prices of sunflower in the selected markets (2000-01 to 2009-10)

Month	Markets		
	Ramadurg	Savadatti	Bailahongal
January	95.33	97.06	92.62
February	97.44	93.23	93.90
March	96.11	99.92	95.50
April	92.03	95.45	95.63
May	95.67	92.07	94.01
June	100.80	98.28	100.74
July	102.42	101.21	102.36
August	105.08	103.69	98.05
September	104.17	108.27	104.25
October	101.68	102.76	115.00
November	107.46	101.43	104.25
December	101.82	106.62	103.71

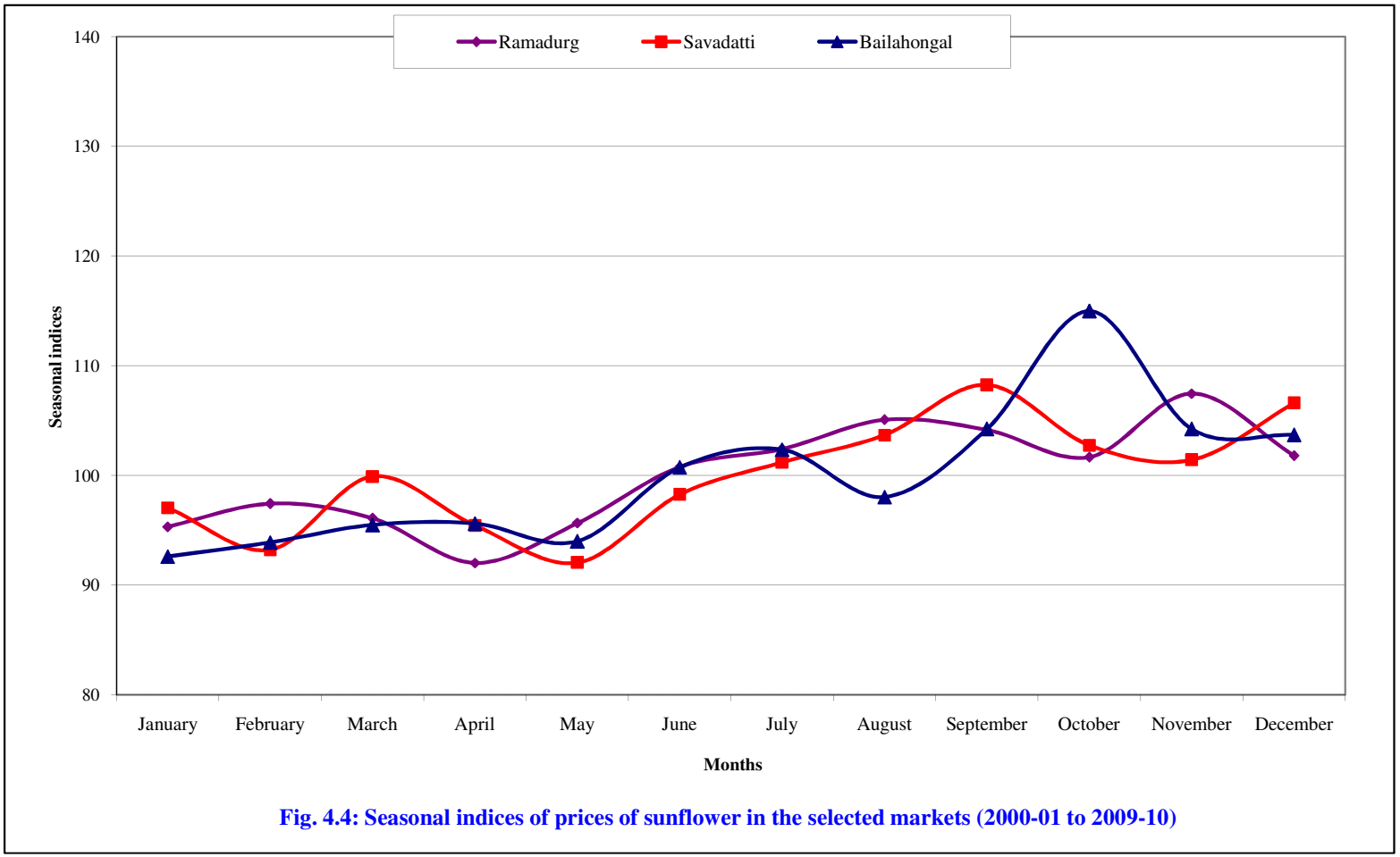

Fig. 4.4: Seasonal indices of prices of sunflower in the selected markets (2000-01 to 2009-10)

Table 4.13: Production problems of *rabi* sorghum growers (opinion survey)

n=60

Sl. No.	Particulars	Garette score	Rank
1	Non -availability of quality seed material	62	II
2	Non -availability of labour during peak period	73.80	I
3	Non -availability of fertilizers	52.40	IV
4	Non- availability of PPCs	44	V
5	Incidence of pest and diseases	53.60	III

Table 4.14: Marketing problems of *rabi* sorghum growers (opinion survey)

n=60

Sl. No.	Particulars	Garette score	Rank
1	Poor transport facilities	46.90	VI
2	Poor packing facilities	47.10	V
3	Poor storage facilities	59.90	IV
4	Non- availability of market related information	61.10	III
5	Price fluctuation	75.20	I
6	Low price in local market	74.80	II

DISCUSSION

The results of the study presented in the previous chapter are discussed in this chapter under the following subheads.

5.1 General characteristics of the sample farmers in the study area

5.2 Cropping pattern on the sample farms

5.3 Growth in area, production and productivity of *rabi* sorghum and its competitive crops in Belgaum district

5.4 Input use pattern on the sample farms

5.5 Cost involved in the production of *rabi* sorghum, chickpea and sunflower (rainfed)

5.6 Returns from cultivation of *rabi* sorghum, chickpea and sunflower (rainfed)

5.7 Temporal variations in prices of *rabi* sorghum, chickpea and sunflower

5.8 Production problems of *rabi* sorghum growers

5.9 Marketing problems of *rabi* sorghum growers

5.1 General characteristics of the sample farmers in the study area

The general characteristics of the respondents (Table 4.1) showed that mean age of the respondents across study area proved to be of productive age. Their age ranged between 48.5 to 54.2 years across *rabi* sorghum, chickpea and sunflower growers and their ability to with stand risks in farming enterprises would be always high when at productive age.

Educational achievements among the farmers showed that a large proportion (about 75.00%) of them were literate. Among the literates the primary and high school lavel education was high among respondents (37.33% to 38.49%). About 25 per cent farmers had no formal education. Thus, it could be ascertained from the results that while adopting strategies for promoting technology adoption there is need to focus on extension strategies involving demonstrations, trainings to appraise about the modern technologies. High literacy rate among the farmers in the study area was the resultant of their sound economic strength.

Agriculture has been the main occupation for about 96.11 per cent of the farm families in the selected taluks. Agriculture as a subsidiary occupation was practiced by 3.90 per cent of the sample farmer only. It showed the importance of farming in study area. The average family size ranged between 4 to 6 members t across study area. This indicated availability of substantial work force in agriculture.

In the case of land holding in study area in *rabi* season dry land covers maximum area (66%) compared to irrigated area (34%). The predominant varieties/hybrids cultivated by the respondents under sorghum were, Maldandi and Muguti, similarly for chickpea Annigeri-1 and local varieties and for sunflower, local varieties were cultivated.

5.2 Cropping pattern on the sample farms.

It is clear that sample farmers have grown variety of crops. The proportion of area accounted by each crop in sorghum sample growers' farm varied from 5.40 per cent to 21 per cent in *kharif* season and 5.31 per cent to 27 per cent in *rabi* season. The corresponding figures for chickpea growers varied from 5.66 per cent to 16.86 per cent in *kharif* and 5.36 per cent to 25.58 per cent in *rabi* season. Similarly on sunflower growers farm it varied from 6.28 per cent to 17.36 per cent in *kharif* season where as it varied from 4.65 per cent to 22.48 per cent in *rabi* season. There is no much variation in the type of crops grown. But it is clear that if the farmers had the facility of irrigation then their tendency was to grow commercial annual crop like sugarcane in the irrigated condition and had grown vegetables in summer season (Table-4.2) under irrigation.

Cropping intensity is one of the indices of measuring land use efficiency. The cropping intensity depends on many factors *viz.,* natural conditions (like rainfall and climate) and also socio-economic factors. However, given the situation, sorghum (199.47%), chickpea (214.82%) and sunflower (203.95%) growers had a cropping intensity of more than 100 per cent indicating efficient

utilization of land. Among the growers there was a magnitudinal variation in the cropping intensity which reiterated the inter-regional and intra-regional variation in natural, social and economic factors.

5.3 Growth in area, production and productivity of *rabi* sorghum and its competitive crops in Belgaum district

Compound growth rate is a useful tool in assessing the growth performance of any crop, industry or firm under consideration. Many of the earlier studies, for instance, Srivastava *et al.* (2003), Kalamkar (2004), Naik (2007), Reddy (2008), Choudhary (2010) *etc.*, used the compound growth rates to assess the growth performance of agriculture and different crops under considerations.

Accordingly, in the present study compound growth rates were used to study the growth pattern of *rabi* sorghum and its competitive crops cultivation for the sample district for the period of ten years 2000-01 to 2009-10.

It can be seen from the table (4.3) that negative growth in area (-12.63%) and production (-2.81%) but positive growth in productivity was observed in the *rabi* sorghum (overall). But in case of *rabi* sorghum (HYV) positive growth rates were seen in area, production and productivity. Similarly in case of chickpea and sunflower positive growth in area, production and productivity was observed.

The reason for decline in growth of area under overall *rabi* sorghum is that farmers are shifting to more remunerative crops like chickpea and sunflower.

Hence, the hypothesis area and production of *rabi* Sorghum is decreasing, where as that of its competitive crops is increasing over the years in Belgaum district has been accepted.

5.4 Input use pattern on the sample farms

Inputs used by the sample farmers for per hectare of *rabi* sorghum, chickpea and sunflower cultivation in the study area are presented in Table 4.4 and are discussed as under.

Different types of inputs were used in the cultivation of *rabi* sorghum namely seeds, FYM, urea, DAP and Zinc Sulphate ($ZnSO_4$). The quantities of various inputs used by the sample farmers are in line with the recommendations made in package of practices. No plant protection chemicals were used in *rabi* sorghum cultivation since there was no prevalence of any pest or diseases recorded in the study area

In case of chickpea cultivation, the inputs used were seeds, urea and DAP. Since prevalence of pest and diseases is more in case of chickpea, Prophenophos was used as a plant protection chemical. The usage of chemical fertilizer was found to be lesser than that of the recommendations made in package of practice.

While in case of sunflower cultivation, the inputs used were seeds, FYM, urea, DAP and MOP. Chloropyriphos was used as a plant protection chemical in sunflower cultivation. The use of fertilizers was more in case of sunflower as the crops requires more fertilizers than sorghum and chickpea. The usage of FYM and chemical fertilizer was found to be lesser than that of the recommendations made in package of practice.

5.5 Cost involved in the production of *rabi* sorghum, chickpea and sunflower (rainfed)

It was evident from the Table 4.5 that the cost of cultivation involved in case of *rabi* sorghum, chickpea and sunflower was Rs. 20,985.31, Rs. 19,771.82 and Rs. 25,735.48 per hectare respectively of which 59.55 per cent, 58.13 per cent and 68.87 per cent was the variable cost respectively.

The cost of human labour was more in case of *rabi* sorghum followed by chickpea and sunflower. Because *rabi* sorghum requires more number of human labourers for operations like loading and unloading of FYM, harvesting and threshing. Similarly use of bullock labour and machine labour was also more in case of *rabi* sorghum than sunflower and chickpea.

The per cent share of fixed cost to the total cost of cultivation was found to be more in case of chickpea (41.87%), compared to *rabi* sorghum (40.45%) and sunflower (31.13%). The major items of fixed cost were land revenue, land rent and depreciation charges. Land revenue was almost similar for all the crops but there is a variation in case of rental value of land. The depreciation charge was

slightly high on *rabi* sorghum farms and low on chickpea farms because *rabi* sorghum farmer's asset position was high. Similar results were observed by Mundinamani and Kunnal (2000), Krishna (2001), Maharajan *et al.* (2003), Chahal and Katariya (2005).

5.6 Returns from cultivation of *rabi* sorghum, chickpea and sunflower (rainfed)

The returns obtained from *rabi* sorghum and its competitive crops *viz.*, chickpea and sunflower were calculated and presented in Table 4.6.

The output obtained from the cultivation of *rabi* sorghum, chickpea and sunflower was 11.3 quintals, 9.38 quintals and 10.90 quintals respectively and 3.2 tonnes of by product was obtained in case of *rabi* sorghum. The average per quintal market price of *rabi* sorghum, chickpea and sunflower were Rs. 2,000.00, Rs. 3,000.00 and Rs. 3,000.00 respectively. Though yields were less in case of chickpea and sunflower, they fetched high market price than *rabi* sorghum.

Gross returns obtained in case of sunflower were more (Rs. 32,700.00) than that of chickpea (Rs. 28,140.00) and *rabi* sorghum (Rs. 25,800.00). This was mainly because of the good market price received by sunflower than other two crops. But net returns were found to be more in case of chickpea cultivation (Rs. 9998.40) followed by sunflower (Rs. 8280.86) and sorghum (Rs. 5983.30). This was mainly due to the lower cost of cultivation in chickpea compared to *rabi* sorghum and sunflower.

The benefit cost ratio was found to be high in case of chickpea cultivation (1.55) as against sunflower (1.34) and *rabi* sorghum (1.30). Similar results were observed by Mundinamani and Kunnal (2000), Krishna (2001), Maharajan *et al.* (2003), Chahal and Katariya (2005).

5.7 Temporal variations in prices of *rabi* sorghum, chickpea and sunflower

Trends in prices of *rabi* sorghum

Table 4.7 depicts that prices in all the selected markets showed an increasing trend. Bailhongal market registered the highest increasing trend in prices of *rabi* sorghum. Over the years the annual increment in prices was at the rate of Rs. 88.72 to 131.33 per quintal, the annual increment in prices was the lowest in Savadatti market (Rs. 88.72/qtl) as compared to the other markets under study.

The increasing trend in the price of the *rabi* sorghum could be due to decrease in the production of *rabi* sorghum over the years in the study area.

Trends in prices of chickpea

Table 4.8 depicts that prices in all the selected markets showed an increasing trend. Savadatti market registered the highest increasing trend in prices of chickpea. Over the years where the annual increment in prices was at the rate of Rs. 84.33 to 88.38 per quintal, the annual increment in prices was the lowest in Bailhongal market (Rs. 84.33/qtl) as compared to the other markets under study.

By and large it was observed that the prices of chickpea increased over the year in the study period as a result of increase in demand for the chick pea.

Trends in prices of sunflower

Table 4.9 depicts that the prices in all the selected markets showed an increasing trend. Ramdurg market registered the highest increasing trend in prices of sunflower. Over the years where the annual increment in prices was at the rate of Rs. 114.51 to 149.67 per quintal, the annual increment in prices was the lowest in Bailhongal market (Rs. 114.51/qtl) as compared to the other markets under study.

It could be concluded that the increase in the prices of the sunflower in the study area is attributed to decrease in the arrivals of the sunflower to the selected markets over the years. Similar results were observed by, Patil (1983), Hiremath (2004), Haradi (2010) and Bandigani (2011).

Seasonal indices of the market prices of *rabi* sorghum in selected markets

To ascertain the pattern of price variations in *rabi* sorghum during different months of the year, seasonal indices were computed and the results of seasonal indices of prices are presented in table 4.10.

It was observed that the seasonal indices of prices of *rabi* sorghum (range 92.69 to 125.42) were quite fluctuating. This may be attributed to the nature of availability of produce in the market. The lower seasonal indices of prices were observed during December to March in the selected markets indicating that prices of the *rabi* sorghum were less in these months as compared to other months attributed to increase in arrivals in these months.

Seasonal indices of the market prices of chickpea in selected markets

Seasonal indices were computed to ascertain the pattern of price variations in chickpea during different months of the year and the results of seasonal indices of prices are presented in table 4.11.

The table revealed that the seasonal indices of prices of chickpea in all the selected markets increased marginally. It was observed that the indices of prices of chickpea (range 95.13 to 105.67) were not fluctuated much. This may be attributed to the nature of arrivals to the market.

Seasonal indices of the market prices of sunflower in selected markets

Seasonal indices were computed to ascertain the pattern of price variations in sunflower during different months of the year and the results of seasonal indices of prices are presented in table 4.12.

It was observed that the seasonal indices of prices of sunflower (range 92.07 to 115.00) were fluctuating. This may be attributed to the fluctuation in movement of arrivals to the markets. Similar results were observed by Patil S.S (1983), Hiremath (2004), Haradi (2010) and Bandigani (2011).

5.8 Production problems of the *rabi* sorghum farmers

The analysis of problems faced by sample respondents in production revealed that non-availability of labour during peak period was the major problem as opined by all the sample farmers followed by non-availability of quality seed material, incidence of pest and diseases, non-availability of fertilizers and non-availability of PPC.

5.9 Marketing problems of the *rabi* sorghum farmers

In case of marketing price fluctuation was the major problem followed by low price in the local market, non-availability of market related information, poor storage facilities, poor packing facilities and poor transport facilities.

SUMMARY AND POLICY IMPLICATIONS

Sorghum (*Sorghum bicolor* Linn. *Moench*) occupied an area of 15 million hectares in India with the area under *kharif* and *rabi* sorghum showing dynamism during last one decade. The area under *kharif* sorghum has reduced drastically and the area under *rabi* sorghum has changed because of other competitive crops in *rabi* season. *Rabi* sorghum is mainly grown in the states of Maharashtra, Karnataka, Tamil Nadu and Gujarat with a total production of 11.85 million tonnes. India has ever been among the major producers of sorghum in the world. The country has been able to maintain its position among the top three producers of the crop. As already mentioned, sorghum is produced both as a *kharif* and *rabi* crop in the country.

Karnataka occupies second place with respect to area and production of sorghum in the country with 1.24 million hectares of area and 1.34 million tonnes of production (2010-11). Bijapur district occupied first place with respect to area, production and productivity of sorghum followed by Gulburga, Raichur, Bagalkot, Belgaum and Dharwad districts. In fact it is an important staple food in Bijapur, Gulburga, Raichur, Bagalkot, Belgaum, Dharwad, Gadag and Haveri districts of Karnataka

Sorghum is a diverse crop which is grown in both *kharif* and *rabi* seasons. *Rabi* sorghum contributes more than 75 per cent share in the production and area in Karnataka over the years (2005-06 to 2010-11). In Karnataka, the districts namely Bagalkot, Belgaum, Bijapur, Gulbarga and Raichur are the major producers of *rabi* sorghum which account for nearly 65 per cent of *rabi* area and 70 per cent of *rabi* production. The major varieties grown in this area are CSH series, Maldandi and Muguti, which are suitable for *rabi* cultivation. In *rabi* season competitive crops for *rabi* sorghum in the study region are chickpea and sunflower.

To compare the economics of *rabi* sorghum and its competitive crops chickpea and sunflower in Belgaum district of Karnataka the present study was carried out with the following specific objectives

Specific objectives

1. To analyze the growth in area, production and productivity of *rabi* sorghum and its competitive crops in Belgaum district.
2. To compare the economics of production of *rabi* sorghum and its competitive crops.
3. To study the price behavior of *rabi* sorghum and its competitive crops.
4. To study the constraints in production of *rabi* sorghum.

Hypotheses

1. Area, production and productivity of *rabi* sorghum is decreasing, where as that of its competitive crops is increasing over the years in Belgaum district.
2. Cultivation of *rabi* sorghum is less profitable compared to its competitive crops.
3. Price variability is high in *rabi* sorghum compared to its competitive crops.
4. Farmers face many problems in production of *rabi* sorghum.

6.1 Methodology

Multistage sampling technique was employed in the selection of farmers for the study based on the production of sorghum in the state during *rabi* season Belgaum district where *rabi* sorghum was largely cultivated was selected for the study. Three taluks of Belgaum district were selected purposively namely Ramdurg, Savadatti and Bailhongal and from each taluk, two villages were selected based on highest area under the *rabi* sorghum. From each village 10 farmers growing *rabi* sorghum, 10 farmers growing chickpea and 10 farmers growing sunflower were selected randomly. Consisting of 60 *rabi* sorghum growers, 60 chickpea growers and 60 sunflower growers. Thus total sample size for the study was 180.

The primary data with respect to input use pattern, labour use pattern, cost yield and return in production of *rabi* sorghum and its competitive crops, constraints in production of *rabi* sorghum were collected from the sample farmers by personal interview method with the help of well - structured pre-tested schedule.

The secondary data with respect to area, production and productivity of *rabi* sorghum and its competitive crops were collected from the District Statistical Office of Belgaum district for a period of 10 years. The time series data on price of sorghum and its competitive crops were collected from the leading regulated markets in the district for a period of 10 years

The tabular presentation method was followed to study the general characteristics of sample farmers. The averages and percentages were worked out. Compound growth rate analysis was carried out in order to analyze the growth in area, production and productivity of *rabi* sorghum and its competitive crops in the Belgaum district of Karnataka. Budgeting technique was used to estimate the costs and returns in production of *rabi* sorghum and its competitive crops (chickpea and sunflower). Linear trend analysis and seasonal indices were carried out to study the variations in monthly prices of *rabi* sorghum and its competitive crops *i.e.* sunflower and chickpea for the period of 10 years. Garrett's ranking technique was used to identify the constraints in the production of *rabi* sorghum in the study area.

6.2 Findings of the study

1. Growth in area, production and productivity of *rabi* sorghum and its competitive crops in Belgaum district

The growth rates in area, production and productivity of *rabi* sorghum (overall) were -12.63 per cent, -2.81 per cent and 11.23 per cent respectively. *Rabi* sorghum (HYV) registered a growth rate of 24.52 per cent in case of area, 32.62 per cent in production and 6.51 per cent in case of productivity in the Belgaum district. Chickpea registered a growth rate of 8.53 per cent in case of area, 12.04 per cent in production and 3.24 per cent in case of productivity. The growth rates in area, production and productivity of sunflower were 12.99 per cent, 14.46 per cent and 1.29 per cent respectively.

2) Input use pattern on the sample farms

The labour utilization in case of cultivation of *rabi* sorghum indicated that the usage of machine labour, bullock labour and human labour were found to 2.31 hrs, 4.34 pair days and 20.75 man days respectively. In case of *rabi* sorghum cultivation, the inputs used were seeds, FYM, urea, DAP and Zinc Sulphate ($ZnSO_4$). The average quantity of seeds used per hectare was 6.9 kgs. The average quantity of farm yard manure (FYM) applied was 2.77 tonnes and 87 kgs, 55 kgs and 15 kgs of urea, DAP and Zinc Sulphate ($ZnSO_4$) respectively were used. No plant protection chemical was used in *rabi* sorghum cultivation.

The labour utilization in case of cultivation of chickpea indicated that 1.34 hrs of machine labour, 3.8 pair days of bullock labour and 15.38 man days of human days were used. In case of chickpea cultivation, the inputs used were seeds, urea and DAP. The average quantity of seeds used per hectare was 49.61kgs. The average quantity of chemical fertilizers used was 10 and 54 kgs of urea and DAP respectively. Prophenophos used was one litre as a plant protection chemical in chickpea cultivation.

In sunflower cultivation also machine labour, bullock labour and human labour were found to be used for 2.31 hrs, 4.34 pair days and 20.75 man days respectively In case of sunflower cultivation, the inputs used were seeds, FYM, urea, DAP and MOP. The average quantity of seeds used per hectare was 6.5 kgs. The average quantity of farm yard manure (FYM) applied was 5.96 tonnes and 35 kgs, 108 kgs and 58 kgs of urea, DAP and MOP respectively were applied. Chloropyriphos used was one litre as a plant protection chemical in sunflower cultivation.

3) Cost involved in the production of *rabi* sorghum and its competitive crops (rainfed)

The total cost of cultivation of *rabi* sorghum was Rs. 19816.70 per hectare of which 57.17 per cent was the variable cost. The share of fixed cost was Rs. 8,488.09 accounting for 42.83 per cent of total cost of cultivation of *rabi* sorghum.

The total cost of cultivation of chickpea was Rs. 18141.60 per hectare of which 54.36 per cent was variable cost. The share of fixed cost was Rs. 8,279.35 accounting for 45.64 per cent of the total cost of cultivation.

The total cost of cultivation of sunflower was Rs. 24419.14 per hectare of which 67.19 per cent was the variable cost. The share of fixed cost was Rs. 8,011.60 accounting for 32.81 per cent of total cost of cultivation of sunflower.

4) Returns from cultivation of *rabi* sorghum and its competitive crops (rainfed)

The returns structure of *rabi* sorghum revealed that the gross returns per hectare and cost of cultivation per hectare were Rs. 25,800.00 and Rs. 198160.70 respectively. The net returns were found to be positive and it was Rs. 5983.30 with the benefit cost ratio of 1.30.

The returns structure of chickpea revealed that the gross returns per hectare and cost of cultivation per hectare were Rs. 28,140.00 and Rs. 18141.60 respectively. The net returns were found to be positive and it was Rs. 9998.4 with the benefit cost ratio of 1.55.

The returns structure of sunflower revealed that the gross returns per hectare and cost of cultivation per hectare were Rs. 32,700.00 and Rs. 24419.14 respectively. The net returns were found to be positive and it was Rs 8280.86 with the benefit cost ratio of 1.34.

5) Trend in prices of *rabi* sorghum, chickpea and sunflower.

The pattern of trend in prices of *rabi* sorghum and its competitive crops was similar in all the markets. The results revealed that in the long run all the markets showed an increasing trend in prices of *rabi* sorghum and its competitive crops over the years. Increasing trend in prices of *rabi* sorghum was less as compared to sunflower but more in comparison with chickpea and findings hold good for all the selected markets. The extent of increasing trend prices of *rabi* sorghum and its competing crops varied from one market to another market.

6) Seasonal indices of prices of *rabi* sorghum and its competitive crops in selected markets

With respect to prices of *rabi* sorghum in all the selected markets, lower seasonal indices of price were observed during the months of December and march when the arrivals were high. The seasonal indices of chickpea were not changed much in all the months. But seasonal indices of prices of sunflower were higher in June to December attributed to lesser arrivals in these months.

7) Production problems of *rabi* sorghum farmers

From the opinion survey it was observed that the non-availability of labour during peak period was the major problem ranked I which recorded mean score of 73.80, followed by non-availability of quality seed material, incidence of pest and diseases, non-availability of fertilizers and non-availability of PPC which were ranked II, III, IV and V with mean scores of 62.00, 53.60, 52.40 and 44.00 respectively.

8) Marketing problems of the *rabi* sorghum farmers

From the opinion survey it was observed that the price fluctuation was the major problem ranked I with a mean score of 75.20 followed by low price in the local market, non-availability of market related information, poor storage facilities, poor packing facilities and poor transport facilities which were ranked II, III, IV, V and VI with mean scores of 74.80, 61.10, 59.90, 47.10 and 46.90 respectively.

Policy implications

1. The area and production of *rabi* sorghum in the study district is declining over the years. There is need to stabilize the production of *rabi* sorghum by increasing area under it as it is the staple food crop of the region.
2. To retain the area under *rabi* sorghum it is necessary to increase the returns of *rabi* sorghum. It may be done by reducing the cost of cultivation, by stabilizing the price and by increasing the demand for *rabi* sorghum.
3. Seasonal indices of prices indicated that prices o*f rabi* sorghum and its competitive crops were higher in the off season. Hence, the producers need to be educated to plan their sales of *rabi* sorghum.
4. Non availability of labour during peak period was the major problem in the production of *rabi* sorghum. To overcome the problem partial mechanization need to be followed specially for sowing and harvesting operations.

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Appendix I: Interview schedule

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

Research Topic: An economic analysis of production of rabi sorghum and its competitive crops in Belgaum district of Karnataka

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No**:** Date: **I.**

General Information:

1.	Name of the Farmer :	
2.	Age:	
3.	Village :	3. Taluk: 4. Dist:
4.	Education level of the respondent:	Illiterate/Primary/High School/PUC/Degree
5.	Occupation	a. Agriculture as main occupation: b. . Agriculture as subsidery occupation:
6.	Land Holding(in ha)	
	Irrigated:	
	Rainfed :	
	Total	
7.	Source of Irrigation	a. Canal b. tube well c. river d. tank e. Others

8. Family composition:

Male: Female: Children: Total:

Sl. No.	Name	Education	Age	Occupation
	Head of the family: Wife: Children: 1 2 3 4			

II. Farm inventory position

Sl. No.	Items	Number	Year of purchase	Purchase value (Rs.)	Current value (Rs.)
1.	Tractor				
2.	Power tiller				
3.	Bullock cart				
4.	Pump set (diesel/electric)				
5.	Ploughs				
	i. Wooden plough				
	ii. Iron plough				
	iii. MB Plough				
6.	Cultivator				
7.	Seed drill				
	i. Tractor drawn				
	ii. Bullock drawn				
8.	Intercultural implements				
9.	Thresher				
10.	Sprayer/duster/power sprayer				
11.	Harrow				
12.	Leveler				
13	Puddler				
14	Rotovator				
15	Bund former				
16.	Others, if any (specify)				
	i.				
	ii.				

a. Farm machinery and equipments

b. Livestock/animal husbandry

Sl. No	Animals	Number	Year of Purchase	Purchase value (Rs.)	Current value (Rs.)
1	Dairy cows				
	i. Local				
	ii. Crossbred				
2	Buffaloes				
	i. Local				
	ii. Crossbred				
3	Bullock pair				
4	Calves				
5	Poultry				
	i.				
	ii.				
6	Sheep				
7	Goat				
8	Piggery				
9	Fisheries				
	i. Tank				
	ii. Farm pond				
10	Others (specify)				

III. Cropping pattern

Season	Sl No	Crop	Irrigated (Ac)	Rainfed (Ac)	Total (Ac)
Kharif	1				
	2				
	3				
	4				
Rabi	1				
	2				
	3				
	4				
Summer	1				
	2				
	3				
	4				
Annual crops	1				
	2				
	3				
	4				

IV. Cost of cultivation of crop:

Variety: Area (Acre):

Season: Irrigated/Rainfed:

Wage Rate:

Cost of hiring labour:

1. Men (Rs / day) :
2. Women (Rs / day) :
3. Bullock Pair (Rs / day) :
4. Machine labour (Rs / hr) :

A. Labour used in different operations

Sl. No.	Name of the operation	No. of times	Family				Hired			
			M	W	BP	ML	M	W	BP	ML
1.	Ploughing									
2.	Harrowing									
3.	Transportation of FYM									
4.	Spreading of FYM									
5.	Seed bed preparation									
6.	Sowing									
7.	Fertilizer application									
8.	Hand weeding									
9.	Inter cultivation									
10.	Irrigation									
11.	Plant protection application									
12.	Watch and ward									
13.	Harvesting									
14.	Threshing									
15.	Drying, packing									
16.	Transportation & marketing									
17.	**Total :**									

B. Inputs used in production

Sl. No	Inputs	Quantity	Rate (Rs.)	Amount (Rs.)
1.	Seeds			
2.	FYM			
3.	**Fertilizer**			
a.	DAP			
b.	Urea			
c.	MOP			
d.				
e.				
4.	**Bio-fertilizer**			
a.				
b.				
c.				
d.				
5.	**PPC**			
a.				
b.				
c.				
6.	**Herbicides**			
i.				
ii.				
7.	Irrigation			
8.	Electricity charges			
9.	Land revenue			
10.	Land rent			
11.	Others (specify)			

C. Gross returns

Total production (qtl)		**Main product Rs/qtl**	**By product Rs/qtl**	**Total Amount (Rs.)**
Main product	**By product**			

VII Constraints faced by the respondents:

A. Production problems

1. Non-availability of quality seed material
2. Non-availability of labour during peak period
3. Non-availability of fertilizers
4. Non-availability of PPCs
5. Incidence of pest and diseases

B. Marketing problems

1. Poor transport facilities
2. Poor packing facility
3. Poor storage facility
4. Non-availability of market related information
5. Price Fluctuation
6. Low price in the local market

AN ECONOMIC ANALYSIS OF PRODUCTION OF RABI SORGHUM AND ITS COMPETITIVE CROPS IN BELGAUM DISTRICT OF KARNATAKA

VITTAL SATTIGERI **2014** **Dr. L. B. KUNNAL**
Major Advisor

ABSTRACT

Sorghum (*Sorghum bicolor* Linn. Moench) occupied an area of 15 million ha. in India with the area under *kharif* and *rabi* sorghum showing dynamism during last one decade. Karnataka occupies second place with respect to area and production of sorghum (2010-11) and *Rabi* sorghum contributes more than 75 per cent share in production and area of sorghum in Karnataka over the years (2005-06 to 2010-11). The area under *kharif* sorghum has reduced drastically and area under *rabi* sorghum has changed because of other competitive crops in *rabi* season. The present study was conducted in Belgaum district of Karnataka to analyse the growth in area, production and productivity, economics of production, price behaviour and constraints in production of *rabi* sorghum in comparison with its competitive crops (chickpea and sunflower) by using both primary and secondary data. Statistical tools like Tabular analysis, Growth rate analysis, Budgeting technique, Trend analysis and Garret ranking technique were utilized to arrive at meaningful results.

The results revealed that area and production of *rabi* sorghum in the study district is declining over the years while the same under competitive crops was increasing. There is need to stabilize the production of *rabi* sorghum by increasing area under it as it is the staple food crop of the region. To retain the area under *rabi* sorghum it is necessary to increase the returns of *rabi* sorghum by reducing the cost of cultivation, stabilizing the price and increasing the demand for *rabi* sorghum. Seasonal indices of prices indicated that prices o*f rabi* sorghum and its competitive crops were higher in off season. Hence, the producers need to be educated to plan their sales of *rabi* sorghum. Non-availability of labour during peak period was the major problem in production of *rabi* sorghum.