AN ECONOMIC ANALYSIS OF PRODUCTION AND MARKETING OF CABBAGE AND CAULIFLOWER IN BELAGAVI DISTRICT OF KARNATAKA

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CERTIFICATE

This is to certify that the thesis entitled "AN ECONOMIC ANALYSIS OF PRODUCTION AND MARKETING OF CABBAGE AND CAULIFLOWER IN BELAGAVI DISTRICT OF KARNATAKA" submitted by Mr. SATISH KUMAR BIRWA for the degree of MASTER OF SCIENCE (AGRICULTURE) in AGRICULTURAL ECONOMICS to the University of Agricultural Sciences, Dharwad is a record of research work carried out by him during the period of his study in this university, under my guidance and supervision, and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

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1. INTRODUCTION

One of the paradoxes of the Indian economy is that the decline in the share of agricultural workers in total workers has been slower as compared to the decline in the share of agriculture in GDP. In India, agriculture contributes around 13.9 per cent to the gross domestic product (Anon., 2013a) and provides employment to around 54.6 per cent of country's work force (Anon., 2011). The net cultivated area in the country is around 141 million hectares. A large area in India is covered by high yielding varieties of cereal crops with monocropping leading to an imbalance in nutrient availability. Improved vegetable production could offer an alternative for correcting this imbalance between food intake and nutrient availability. Vegetables are one of the important aspects of the horticulture sector of India in particular and of the agricultural sector in general. Various factors have led to the rise in the area under production of vegetables in India. The productivity of vegetables has been rising from last many years. All these have been happening because of the factors like increasing income level, urbanization, increasing health consciousness, increasing working women and shifting of farmer's interest towards growing higher value vegetables.

1.1 Vegetable scenario in world and India

Due to the rich and varied climate and geographical diversity, world has been blessed with different varieties of horticultural crops. In the year 2013-14, area under vegetables in the world was 59.16 million ha and the production and yield was 1159.88 million tonnes and 19.6 tonne/ha respectively (Anon., 2014). India is the second largest producer of vegetables in the world, next only to China. India shares about 14 per cent of the world vegetables output from about 2 per cent of the cropped area in the country. During 2014-15, India produced 169.47 million metric tonnes of vegetables on an area of 9.542 million hectares (Anon., 2015b). More than 40 kinds of vegetables are grown in India. Tomato, onion, brinjal, potato, cabbage, cauliflower, okra and peas are among the most important vegetables, grown in India. India ranks second in production of potatoes, onions, cauliflower, brinjal, and cabbage. Potato (25.5 %), onion (11.9 %), tomato (11.5 %), cabbage (5.5 %) and cauliflower (5.3 %) together accounted for about 59.7 per cent of vegetable production (162.89 million tonnes) in 2013-14 in the country (Anon., 2014).

The state-wise vegetable area as a percentage of gross cropped area was highest in the case of West Bengal (14.5 %) followed by UP (12.2 %) and Bihar (8.8 %) in 2014-15. In the same year, Karnataka state occupied 8th place in vegetable cropped area with 485.9 thousand ha which constituted 5 per cent of the total cropped area in India. Production wise West Bengal topped with production of 26.35 million tonnes (15.5 %) followed by UP (15.4 %) and Bihar (8.5 %) in the total production (169.47 million tonnes) of India in 2014-15. Karnataka occupied 7th position in vegetable production of India with 8.82 million tonnes (Anon., 2015b). Karnataka is one of the leading states in Southern India with a great potential for horticultural development. The state is blessed with ten agro-climatic regions suitable for growing variety of fruits and vegetables round the year. The major districts growing horticultural crops in the state are Kolar, Hassan, Belagavi, Kodagu, Bengaluru, Shimoga, Vijayapura and Dharwad.

Vegetables occupy a significant place in human diet and provide vitamins and minerals, essential for human health and growth. Due to the short duration, high yield, nutritional richness and economic viability, vegetables become an integral part of the Indian agriculture. Consumption of these items provides taste, palatability, increases appetite and provides fibre for digestion and prevents constipation. Vegetable cultivation is labour-intensive and smallholders have abundant labour. Smallholdings comprising 78 per cent of the total holdings with area share of 33 per cent, contribute more than half of the production of fruits and vegetables (Singh *el al.* 2002). Vegetables play an important role in the household nutritional-security, employment generation and alleviation of hunger. It is hypothesized that the factors like urbanization, shift in dietary patterns, economic and population growth would enhance the vegetable consumption further in the country in future. The present per capita daily consumption of 175 grams of vegetables in the country is far below the recommended level of 285 grams per capita per day. Assuming a population growth rate of 1.7 per cent per annum and country's commitment for export, at least 220 million tonnes of vegetables would be required by 2020 AD. Women could play a major role in production, processing and hybrid seed production of vegetables. Intensive production of vegetables is often associated with the availability of female labour. Growing demand for vegetables is considered to have a favourable economic effect on smallholders who dominate the Indian agriculture scenario. There are vegetables of very short duration that can be grown as rained and intercrop with field crops or vegetable crops and therefore provide returns round the year. There are vegetables which improve soil health and also provide fodder to cattle. Thus farmer has wide choice to select suitable crop to adjust in his cropping pattern in given situation. Since cultivation of vegetable crops involves intensive cultural operations starting from sowing to marketing, it provides more and regular employment opportunities in rural areas. Vegetables are sold at a higher rate than other crops.

Notwithstanding these advantages, smallholders confront a number of constraints in vegetable production. The production risks are high, primarily because of considerable production losses caused by pests and diseases and post-harvest losses. Insect pests and diseases are important biotic constraints in vegetable production in India, causing considerable losses (30 %) in total vegetable output (Alam and Anwar, 2001).

Plant protection plays a vital role in modern agriculture. Inputs like fertilizers, irrigation and improved seeds which are key elements of modern agricultural production technology, unfortunately, also provide a favourable climate for the rapid growth of past as well. In the absence of adequate plant protection measures, the positive contributions of these inputs could be completely nullified and farmers may incur heavy losses due to pest incidence (Yogeshwari, 2002). In addition to that there is a lack of marketing and processing infrastructure. Local markets suffer from infrastructure and trading in distant markets is non-remunerative due to high transportation costs. Also, prices are volatile and often fall drastically with harvesting.

Farmers use a number of pest control methods to mitigate these losses. A pesticide includes chemicals such as insecticides, herbicides, fungicides, acaricides and nematicides. The excessive use of chemical pesticides has destroyed natural enemies of common pests resulting in a resurgence of the pest population. This practice has resulted in a number of side effects that includes increased

cost of production as well as exposure of farmers and consumers to pesticide residues. Indiscriminate use of pesticides has led to several ecological consequences like destruction of natural enemy and effect on non-target organisms, ultimately resistance to pesticide use. Chemical pest control being the preferred strategy in practice, fruits and vegetables are important recipients of chemical pesticides in India. Fruit and vegetables together account for 3.2per cent of the gross cropped area and 7.3 per cent of the total pesticide used in the country. On an average, 1.11 kg of pesticides are applied on one hectare area of fruits and vegetables (Chand and Birthal, 1997).

In view of the above discussions it is important to study various issue of pesticide use in vegetables to have a comprehensive view and formulate appropriate polies. This study examines these issues in two important crops namely cabbage and cauliflower extensively grown in Belagavi area of Karnataka.

1.2 Cabbage

Cabbage is grown all over the world around 129 countries on a total area of 2.24 million ha. China occupied the highest area in the world with 0.958 million ha (39.6 %), followed by India (0.372 million ha) and Russia (0.112 million ha). The highest productivity was recorded in Cyprus (132.6 tonne/ha) followed by Japan (79.3 tonne/ha) and Republic of Korea (70.9 tonne/ha) in 2013-14 (Anon., 2015a).

Cabbage with an area of 386 thousand ha in India, shares about 4.04 per cent of the total vegetable area (9,542 thousand ha) and contributes about 5.06 per cent (8.58 million tonnes) to the total vegetable production (169.47million tonnes) with average productivity of 22.3 tonne/ha during the year 2014-15. In India major cabbage growing states are West Bengal (20.38 %), Odisha (10.5 %) and Bihar (10.1 %). The production of cabbage in India was highest in West Bengal (25.7 %) which followed by Odisha (13.3 %), Bihar (8.1 %). Karnataka ranks 10th place in area and production with total cropped area of 10.4 thousand ha and production of 216.6 thousand tonnes and the average productivity is 20.8 tonne /ha during the year 2014-15(Anon., 2015b).

Some of common physiological disorders, diseases and pests very well known for cabbage are browning and whiptail of cabbage, black rot, downy mildew, cabbage borer and diamond back moth which causes high economic loses. Farmers spray a variety of insecticides to control these pests but with little success, as these pests have gradually developed resistance to many synthetic chemicals.

1.3 Cauliflower

Cauliflower is grown all over the world on a total area of 1.25 million ha in 2013-14. China occupied the highest area in the world with0.453 million ha (36.2 %) followed by India (32.1 %) and Ecuador (7.4 %). The highest yield is in Cyprus 75 tonne/ha, followed by Kuwait (53.02 tonne/ha) and Palestine territory (50.5 tonne/ha) (Anon., 2015a). India occupies first position in the production of cauliflower.

Cauliflower with an area of 410.9 thousand ha in India, shares about 4.3 per cent of the total vegetable area (9,542 thousand ha) and contributes about 5.3 per cent (7.92 million tonnes) to the total vegetable production (169.47million tonnes) with average productivity of 19.3tonne/ha during

the year 2014-15. In India major cabbage growing states are West Bengal (18.01 %), Bihar (15.99 %) and Odissa (10.75 %).The production of cabbage in India is highest in West Bengal (23.85 %) followed by Bihar (12.66 %), Madhya Pradesh (9.46 %) during year 2014-15. Karnataka ranks 14th place in area and production with total cropped area of 4.68 thousand ha (1.14 %) and production of 82.3 thousand tonnes (1.04 %) with the average productivity of 17.6 tonne /ha during the year 2014-15 (Anon., 2015b).

Browning, whip tail and buttoning of cauliflower, damping off, black rot, diamond back moth, and aphids are some of common physiological disorders, diseases and pests in cauliflower.

The cabbage and cauliflower are extensively grown in Karnataka. There is always high volatility of market prices leading to uncertainty. The economic performance of a crop is assessed on the basis of cost of cultivation and net returns obtained. The study on cost and returns in cabbage and cauliflower cultivation along with optimum resource use and marketing behaviour is quite essential. This would be extremely useful to farmers and policy makers to augment the productivity and production of these crops. The information on frequency, extent and different types of plant protection chemicals used in cabbage and cauliflower by farmers in the study area would help to know the consumption pattern of various protection chemicals and their pattern of use. Similarly, identification of different problems faced by the farmers with respect to production and marketing of cabbage and cauliflower helps in devising appropriate strategies to support and stabilize producer income. The outcome of the study will be of much use to researchers, development departments and extension workers to understand the potential problems in production and marketing of these crops and design effective research and extension programmes to meet the needs of cabbage and cauliflower crops growers. In view of these a comprehensive study on the economics of cabbage and cauliflower production and marketing with the following objectives was taken up.

1.4 Objectives of the study

1. To study cost and returns in cabbage and cauliflower cultivation in Belagavi district.
2. To estimate the nature and extent of pesticides used in cauliflower and cabbage cultivation.
3. To analyze the resource use efficiency in cabbage and cauliflower production.
4. To study the marketing channels and price spread in marketing of cabbage and cauliflower.
5. To document the constraints in production and marketing of cabbage and cauliflower.

1.5 Hypotheses

1. Cabbage and cauliflower cultivation is profitable.
2. The farmers are using excessive pesticides in cabbage and cauliflower cultivation.
3. All resources in vegetable production are efficiently utilized.
4. Different marketing channels exist for marketing of cabbage and cauliflower with varying costs and margins.
5. Farmers face many problems in production and marketing of cabbage and cauliflower.

1.6 Limitations of study

The study pertains to the agriculture year 2015-16 and is limited to 180 randomly selected farmers, 30 market intermediaries (10 each of wholesaler, commission agent-cum-wholesaler and retailer), due to paucity of time and other resources. Hence conclusions drawn and the explanations of various problems have been based on behavior of the sampled farmers and market intermediaries and availability of data during the reference period. The respondents were not in the habits of maintaining records of their income and expenditure. The entire information was collected by memory recall basis of events by the farmers.

1.7 Presentation of the study

The study has been presented in six chapters. In the initial introductory chapter, the objectives of the study have been stated. Chapter II deals with the review of relevant past research efforts related to the present study. Chapter III describes the main features of the study area, sampling design and sources of data, methods of collection of data and statistical tools and techniques adopted. Chapter IV is devoted to the presentation of results through a variety of tables and graphs into which relevant data have been compressed and major findings of the study have been presented. Chapter V concentrates on the discussion. Results of the study have been summarized and presented along with their policy implications in Chapter VI.

2. REVIEW OF LITERATURE

A review of past research helps in identifying the conceptual and methodological issues relevant to the present study and strengthens the research potentiality and quality by adding supportive reasons for discussion. This chapter attempts to review the relevant research literature that has been accumulated on the areas related and relevant to the objectives of the study. Keeping in view of the specific objectives of the study, the various reviews are categorized and presented under the following sub-headings.

2.1 Cost and returns in the production of vegetables

2.2 Nature and extent of pesticide use in cultivation of vegetables

2.3 Resource use efficiency in the production of vegetables

2.4 Marketing costs and margins in different channels in the vegetable marketing

2.5 Problems faced by farmer in production and marketing of vegetables

2.1 Cost and returns in the production of vegetables

Adil *et al*. (2007) studied the economics of three summer vegetables production in different parts of the Punjab in Pakistan. Partial budgeting technique was employed to determine the cost of production and profitability of vegetables. The cost of cultivation per acre was estimated highest in bitter gourd (₹ 13,540) followed by muskmelon (₹ 12,113) and tinda gourd (₹ 5,593). The total production per acre was 2,825 kg, 3,164 kg and 2,485 kg respectively. The net return per acre was highest in bitter gourd (₹ 7,768) followed by tinda gourd (₹ 3,165) and muskmelon (₹ 2,315).

Nandeshwar *et al.* (2013) studied economics of vegetables production in different taluks in Akola district of Maharashtra for the year 2008-09. The total cost of cultivation per hectare for brinjal, cauliflower, cabbage, onion and capsicum were ₹ 82,625, ₹ 68,870, ₹ 64,896, ₹ 83,673 and ₹ 1,37,638 respectively and per hectare net return was ₹ 19,182, ₹28,005, ₹ 28,266, ₹ 51,534 and ₹ 63,240 respectively. Onion was found to be most profitable followed by capsicum, cabbage, cauliflower and brinjal. Per quintal cost of production was found highest for capsicum (₹ 985) followed by brinjal (₹ 625), cauliflower (₹ 572), onion (₹ 544) and cabbage (₹ 515) respectively. Net return per quintal of onion was highest (₹ 335.34) and it was lowest in brinjal (₹ 145.79).

Bala *et al.* (2011) examined the costs and returns structure of tomato, cabbage, cauliflower and peas in Kullu district of Himachal Pradesh for the year 2007-08. The study revealed that average yields of tomato, peas, cabbage and cauliflower were 341 q/ha, 111 q/ha, 295 q/ha and 162 q/ha respectively. The per quintal cost of cultivation was highest for peas (₹ 257) followed by cauliflower (₹ 162), tomato (₹ 160) and cabbage (₹ 116). Costs on plant protection measures was the major item of cultivation cost in all the crops which was in the range of 37-44 per cent, followed by expenditure on fertilizers (21-30 %) and seed (21-27 %). Vegetables being the labour-intensive crops, the labour cost significantly high (₹ 13,200-15,600/ha). The net returns per hectare was highest for tomato (₹ 4,57,200/ha), followed by cauliflower (₹ 1,36,500/ha), cabbage (₹ 1,27,500/ha) and peas (₹ 1,09,900/ha).

Chatterjee *et al.* (2011) estimated cost and returns form brinjal cultivation in West Bengal. A total of 100 farmers from 10 villages from the three blocks were interviewed. The study reported that the total operational cost was ₹ 85,282 per ha. Cost of plant protection chemical used in one hectare of land was ₹9,051.40, gross return obtained was ₹ 2,10,000 per ha giving net return of ₹ 1,24,718 per ha and income per rupee spent was 2.46. The study suggested that the cost of growing brinjal could be reduced by avoiding indiscriminate use of pesticides.

Sant Kumar (2011) investigated ex-ante benefits of Bt brinjal production over the non-Bt brinjal based on secondary data collected from almost all part of India during year 2008. The study revealed that Bt hybrid would provide yield gain of 37 per cent and reduction in insecticide use by 42 percent over non –Bt hybrid. The increase in net returns at 15 percent adoption level would be ₹ 11,029/ ha. With the increased adoption level of 60 percent of Bt brinjal hybrids would provide, additional production of 119 thousand tonnes and savings on insecticides would be ₹ 187 crore.

Anonymous (2013b) conducted study to map and analyse the vegetable production and marketing potentialities in 7 districts of Chhattisgarh. The estimated total cost of cultivation per acre was ₹ 18,390 and ₹ 9,525 for cauliflower and tomato, having highest share of seed cost of ₹ 12,000 and ₹ 5,625 which accounts 65.3 per cent and 59.10 per cent of the total cost respectively. The cost benefit ratios were1:3, 1:2.7, 1:2.5 and 1:2 for cabbage, bitter gourd, eggplant and tomato respectively.

Lokapur (2013) studied economics of vegetable production in Belagavi district of Karnataka. The study revealed that vegetable production was more labour intensive and per hectare labour utilization was highest in potato (78.77 man days). The total cost incurred by farmers in potato cultivation was highest (₹ 47,299.86/ha) as compared to onion (₹ 31,240.2/ha) followed by tomato (₹ 27,532.42/ha) and green chilli (₹ 25,797/ha). The net returns was highest in onion (₹ 93,278.43/ha) and lowest in green chili (₹ 29,452.63/ha).

Sreedhara *et al.* (2013) studied the economics of capsicum production under protected cultivation in Belagavi and Haveri district of Karnataka during the year 2008-09. The establishment cost for protected conditions was ₹ 2, 51,109 per unit (0.25acre). The cost of cultivation of capsicum production under protected conditions was ₹ 55,080 per units. The total variable cost was ₹ 20,374 per unit. Among the variable costs, the labour cost was highest (₹ 10,291) followed by expenditure on material cost (₹ 8,487). Among the total cost of cultivation, the proportion of total fixed cost was highest (₹ 34,707) compared to total variable cost (₹ 20,373). The total yield of capsicum production under protected conditions was 5.50 tonnes per unit. The total returns and net returns from capsicum production under protected conditions were ₹ l, 54,734 per unit and ₹ 15,279 per unit, respectively. The B: C ratio of capsicum production under protected conditions was 3.92.

Maurya *et al.* (2015) analysed economics of cucumber production in Sultanpur district of Uttar Pradesh. The average cost of cultivation of cucumber was ₹ 5,520.68 /ha, the cost of cultivation was higher on medium farms (₹7,327) followed by marginal, small and large farms. The per hectare gross income was maximum on large farms (₹ 1,21,517) followed by small (₹ 73,304) marginal (₹ 51,513) and medium (₹ 46,482). Per hectare average gross income on overall farms was ₹ 90,016. The income measures like net income, farm business income, family labour income and farm investment income on average farms were ₹ 84,495, ₹ 85,405 and ₹ 85,046 respectively.

Priscilla and Singh (2015) estimated cost and return in major vegetable crop in Thoubal district of Manipur during year 2013-14. The cost of cultivation for pea was highest (₹ 86,940/ ha) followed by cauliflower (₹ 85,218/ha) and cabbage (₹ 84,647 /ha). The highest gross returns was recorded in pea (₹ 1,00,873 /ha) followed by cauliflower (₹ 1,00,490 /ha) and cabbage cultivation (₹ 96,235 /ha). But the net returns was highest in cauliflower (₹ 15,272/ ha) followed by pea (₹ 13,933 /ha) and cabbage (₹ 11,565/ha). Cauliflower gave the highest return per rupee spent (1.18).

Shende and Meshram (2015) while studying cost benefit analysis and marketing of tomato in Bhandara district of Maharashtra during the year 2013-14, computed the cost of cultivation per hectare for tomato over the cost C_2 and it was ₹ 76,417.41 /ha. The total yield was 176.85 quintal whereas the per quintal cost of production was ₹ 432.1. The net return over cost- $C_2$was found to be ₹ 65,139.23 /ha for tomato.

2.2 Nature and extent of pesticide use in cultivation of vegetables

Ali and Hau (2001) reported the variation of intensity of pesticide use in vegetable production in Bangladesh. They noticed that the level of pesticide use depended on commodity types and agronomical practices followed socioeconomic factors and level of awareness of the farmers making the decision. The study revealed that farmers applied 12-18 times more pesticide on vegetables than on cereals, but adoption of modern vegetable production technologies led to reduction in number of sprays and the actual quantity of pesticides used. The number of pesticide sprays followed by non-adopters of modern vegetable production technology was double than that of adopters of the modern technologies .The reduction in pesticide use was attributed mainly to training of farmers received on the judicious use of pesticides and other agrochemicals in vegetable production.

Shrestha and Neupane (2002) studied the pesticides use in major vegetable crops in Jhiku Khola watershed area in Kabhrepalanchok district of Nepal. They reported that in potato tomato, cucumber bitter gourd, and chilies, the most commonly used insecticides were dichlorvos, dimethoate, fenvalerate and methyl parathion with frequency of application 7-15 times and among fungicides the frequently used one are mancozeb, krilaxyl and carbendazim against late blight with frequency of 4-11 times. Also in case of cabbage and cauliflower the application of dicholorvos and fenvalerate were frequently used chemicals with the application of 2-4 times.

Rahman (2003) examined the factors determining use of pesticides and behavior of vegetables growers in Bangladesh. The study revealed that pesticide cost accounted for about 7.7 per cent of the gross value of output in cotton, 3.6 per cent in vegetables, 2.5 per cent in potato, 1.8 per cent in modern rice, 1.6 per cent in spices and less than 1 per cent in other cereal and non-cereal crops. Cultivation of traditional and modern varieties of potatoes, spices, vegetables and cotton were the prime determinants of pesticide use. Farmers treated pesticides as substitutes for fertilizers. The study concluded that farm size and ownership of land significantly and positively influenced intensity of pesticide use.

Jeyanthi and Kombairaju (2005) examined the pesticide use intensity in four important vegetable crops, viz. chillies, cauliflower, brinjal and okra using farm level cross-sectional data in Dindigul district of Tamil Nadu. Average pesticide usage was estimated at 5.13, 2.77, 4.64 and 3.71 kg active ingredient per hectare on chillies, cauliflower, and brinjal and okra crops, respectively. On an

average, cauliflower and brinjal each were given 15 applications, chilli was given 13 and okra was given 12 applications. The application of fungicides on cauliflower was only 2.22 per cent since all the growers purchased seeds, which were already treated with fungicides. In okra, high-risk pesticides, viz. Monocrotophos and Carbofuran commonly used while in cauliflower, carbofuran and methyl parathion were mostly applied. Pyrithroids like cypermethrin and fenvalerate and organochlorine group of pesticides, Endosulfan were the most frequently used pesticides in brinjal and okra. Organophosphate pesticide profenophos was the most frequently used pesticide in chillies and cauliflower. The study suggested that for reducing pesticide use, farmers need to be educated about different non- chemical control methods and should be encouraged to adopt integrated pest management (IPM) practices.

Dasgupta *et al.* (2007) in a survey conducted on rice, potato, bean, brinjal, cabbage, sugarcane growing farmers in Bangladesh found that over 47 per cent of farmers were overusing pesticides. With only 4 per cent of farmers formally trained in pesticide use or handling. Over 87 per cent openly admitted that little or no protective measures were used while applying pesticides. The variables found to be significantly associated with the probability of a farmers' health impairment from pesticides were, the amount of pesticide applied, nutritional status and income. The overuse of pesticides was primarily determined by misperception, income, ownership, toxicity of pesticides, crop composition and locational dummies.

Ngowi *et al.* (2007) studied farmer's practices, perceptions and related cost and health effects on vegetable pest management using pesticides. The types of pesticides used by the farmers in the study areas were insecticides (59 %), fungicides (29 %) and herbicides (10 %) with the remaining two per cent being rodenticides. Carbofuran, a broad-spectrum pesticide that kills insects, mites and nematodes, zinc phosphide, a rodenticide and methomyl an insecticide were the only WHO Class Ib (highly hazardous) recorded in use. Insecticides used included pyrethroids (such as cypermethrin, deltamethrin, permethrin and lamda-cyhalothrin); organophosphates (such as pirimiphos, profenophos, chlorpyrifos, fenitrothion) and carbamates (carbofuran).The most popular fungicides used were copper based such as copper oxychloride, copper hydrochloride and copper sulphate although mancozeb was also in use. More than 50 per cent of the respondents applied pesticides up to five times or more per cropping season depending on the crop. The highest frequency of application of pesticides was report in onion with more than sixteen times.

Selvarajah and Thinichelvani (2007) in Sri Lanka noticed that the estimated average amounts of active ingredients applied for rice and chili were 1.9 kg/ha/year and 11.5 kg/ha/year respectively. Thus, farmers applied 6 times more pesticides on chili than on rice. About 60 per cent farmers had applied 30-40 per cent higher concentrations than the recommended level. Econometric analysis revealed that high price of chemical minimized pesticides use and use of family labour in spraying tends to increase with increased use of pesticides. There was no significant relationship between the strength of spray mixture used with farmers education, experience and crop extent.

Mariyono and Bhattarai (2009) analysed the factors affecting chili farmer decision to use pesticides in Mageland, Brebes and Rembang districts of Indonesia during the year 2008. The noticed that the quantity of pesticide applied on chili largely varied across the locations. It was reported that

recommended pesticides often were ineffective in controlling many diseases and pests, and traditional cultural practices favoured the growth of some diseases Thus on average farmers applied approximately 12 kg/ha of pesticide on chili in a three- to four-months period, and the frequency of spray was about 23 times over each growing season. It was highest in Brebes (22 kg/ha/crop season), 7.2 kg/ha/crop season in Magelang, and 5.3 kg/ha/crop seasons in Renibang. It indicated that pesticide quantities applied were highest for local varieties and lowest was for hybrid varieties as mostly local varieties of chili were grown in Brebes, where higher quantities of pesticides were applied.

Nagendra *et al.* (2009) examined the frequency of pesticide application by farmers in Belagavi district. It was reported that the number of spraying applied by farmers ranged from 5 to 12 with an average number of 8.5 sprays per farm. About 24.17 per cent of farmers applied on the average 8 sprayings, followed by 19.17 per cent of farmers applied 7 sprayings. The optimum quantity of pesticide required for cabbage was estimated to be 0.495 kg a.i. per ha as against (0.563 kg a.i.per ha) of actual quantity used.

Karmacharya and Shrawasti (2012) examined the amount and frequency of pesticides used in Kavre district of Nepal. About, 68.75 per cent of the farmers applied pesticides regularly, only 25 per cent applied occasionally and 6.25 per cent did not apply any pesticides. The reasons for high use of pesticides were their cheapness and very low share in the total cost of production of the crops. Almost all the respondents reported that the use of pesticides and chemical fertilizer in the crops had increased the output production. The farmers had very low knowledge on pesticides and the pesticide regulations had not been enforced properly.

Abang *et al.* (2013) studied vegetable grower's perception of pesticide use practices in the tropical region of Cameroon. Study revealed that many vegetable farmers (83 %) did not follow timeliness of operations, choice of growing season and planting date as pest management strategies. It was found that weekly spray of pesticides was the most common practice. However, 45 and 59 per cent could not identify the insect pests and diseases respectively they were attempting to control. Farmers applied 0.5-9 liters of pesticide per year, 10-49 kg/ha of various chemical depending on farm size. The period of pesticide spraying varied with crops growth stages but 39 per cent could not identify correct time of plant growth for most effective for control of pests. Based on farmers' recollections of pesticide type and application frequency, weekly pesticide spraying was the most common, with 40 per cent and 28 per cent of farmers spraying insecticide and fungicides respectively. Many vegetable farmers (40 % for insecticides and 28 % for fungicides) did not take note of the number of times they applied chemicals on their crops.

Sutharsan *et al.* (2014) studied pesticide usage pattern for vegetable cultivation in Manmunai South and Eruvilpattu divisional secretariat of Division of Batticaloa district of Sri Lanka. It was observed that, the usage of pesticides was higher in the study area. The vegetable farmers used more than 14 types of pesticides to control pest. Farmers in the study area apply pesticides more frequently. Highly pesticide sprayed crop was brinjal. About 66 per cent of the chilli producing farmers and 84 per cent of the brinjal producing farmers applied pesticide more than 22 times per cropping season. Also around 90 per cent of the farmers applied more than the recommended dosage and frequency of the pesticides

Sharaniya and Loganathan (2015) investigated the current pesticide use pattern and practices in vegetable farming compared with recommended standard in Vavuniya district in Sri Lanka. The study revealed that almost all farmers depended on synthetic pesticides for the management of pest and 51 per cent of the farmers applied the pesticides 10-20 per cent higher than recommended level. Sixty two per cent of the farmers used banned pesticides and 95 per cent of farmers read the instructions given in the label but they did not follow the label instructions. Nearly 62 per cent of farmers had no awareness about banned pesticide. Chlorpyrifos, Paraquat, glyphosate and cabaryl were banned by Registrar of pesticide. 34 per cent of farmers used chloropyrifos whereas it was 20 per cent in glyphosate, 6 per cent in paraquat and 2 per cent in carbaryl respectively.

2.3 Resource use efficiency in the production of vegetables

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

Tripathi *et al* (2005) estimated cobb-Douglas production function for comparing resource use efficiency of potato cultivation under contract and non-contract farming system in Punjab. The coefficient of multiple determinations (R^2) was 0.794 and 0.751 for non-contract and contract farming system respectively which was significant at 5 per cent level of probability in both the production systems. The R^2 value indicated 79 per cent and 75 per cent variation in the gross income from potato production because of variation in the use of machine power, manure and fertilizers, irrigation and plant protection inputs considered for analysis under the non-contract and contract farming situation. The regression analysis had indicated significant influence of manure and fertilizers and human labour (with elasticity of production of 12.6 and 16.2 respectively) on the return of potatoes grown under contract farming situation. Whereas in the case of non-contract system irrigation and plant protection (with elasticity of production of 17.8 and 10.02 respectively) had shown sufficient scope to raise the crop income. The yield uncertainty had been found less in contract than non-contract potato production. The negative ratio of irrigation (-2.96) under contract farming indicated that there was excess use of irrigation water on these farms.

Adil *et al.* (2007) analysed the economics of three summer vegetable production (bitter gourd, tinda gourd and muskmelon) in different areas of the Punjab in Pakistan. Cobb Douglas production function was estimated to determine resource use efficiency of various inputs. The study indicated that values of R^2 in all three vegetables were considerably high indicating that the vegetable cultivation required a huge amount of financial resources. The elasticity of production was found to be positive for irrigation variable in all the three vegetables, indicated that more use of irrigation increased per acre yield of vegetables and coefficients of this variable were statistically significant. The coefficient of plant protection measures was found to be negative and non-significant for bitter gourd and muskmelon, where positive sign and significant coefficient of tinda gourd showed with one per cent increase in plant protection measures, the yield of tinda increased by 0.03 per cent.

Asmatoddin *et al.* (2009) examined the resource productivity in tomato crop grown in all the season, in Ahemadnagar district of Maharashtra. The results revealed that the regression coefficient of plant protection, nitrogen, phosphorus were positive but non-significant. The coefficient of multiple determination (R^2) was 0.829. In Rabi season the coefficient of N, P and K were positive but non-significant. The coefficient of multiple determinations (R^2) was 0.979.

Ayoola *et al.* (2009) analysed the resource-use efficiency in dry season vegetables production in Oyo state of Nigeria. The average cultivation cost per ha was 58,062 naira (Nigerian monetary unit) of which the share of variable costs (40,593 naira) was 69.9 per cent and 30.1 per cent (17,468 naira) was fixed cost.

Mohan (2009) by estimating that the production function for IPM farmers indicated that output elasticity of seed (0.138), human labour (0.148) and IPM component (0.279) had significant influence on the cotton yield. Whereas in non-IPM farmers chemical fertilizer (0.087) and plant protection chemicals (-0.047) found to exert significant positive and negative influence on cotton production.

Akter *et al.* (2011) estimated production function for tomato, cabbage and cauliflower vegetables in Narsingdi district of Bangladesh. The per hectare gross returns of vegetable crops were significantly influenced by the use of human labour, tillage, seeds, fertilizers, irrigation and insecticides. The production elasticity of human labour (0.354) and tillage cost (0.30) was found to be positive and significant at one per cent probability for cauliflower which indicated that one per cent increase of human labour and tillage cost, keeping other factors constant, would increase the gross return by 0.35 and 0.30 per cent respectively. Similarly in the case of cabbage the estimated coefficient of tillage cost (0.568) and fertilizer cost (0.091) were found positive and significant at one per cent probability level.

Ayinde *et al.* (2011) studied the profitability and resource use efficiency of fluted pumpkin production. The coefficient of multiple determinations (R^2) indicated that 78.9 per cent of total variation in output was due to changes in explanatory variables in the model. The result indicated that fertilizer and seed were production inputs significantly influenced pumpkin output. One per cent increase in quantity of fertilizer used was expected to increase 0.29 per cent output. If seed use was increased by 1 per cent, output would increase by 0.67 per cent. Because farmers use less than the recommended rate of seed and fertilizer, increasing the use of these inputs to the optimum recommended should significantly improve yield of pumpkin. The return to scale coefficient (1.024) indicated that production of fluted pumpkin was witnessing constant return to scale with respect to input use.

Gnanasekaran and Vijayalakshmi (2012) studied the determinants of yield and factors causing yield gap in regard to small and large tomato growers in Dindigul district of Tamil Nadu. In fitting regression model, yield was treated as dependent variable and input factors namely human labour, bullock labour, fertilizer, FYM, pesticide and capital were included as independent variables. The study revealed that most of the variables were statistically significant at the 10 per cent or lower level of significance. The analysis showed that large farmers earned high profit compare to the small farmers. But small farmers are facing low risk compare to the large farmers engaged in tomato cultivation.

Lokapur (2013) analysed resource use efficiency in vegetable production in Belagavi district of Karnataka. The Cobb-Douglas production function indicated decreasing returns to scale for all the vegetable crops. The MVP to MFC ratio for seed was 19.06, 3.10, 12.53 and 7.49 for onion, potato, green chilli and tomato farmers, respectively indicated higher scope to intensify use of the inputs. In tomato, the regression co-efficient for seed (0.211), chemical fertilizers (0.038) and organic manure (0.026) was significant. And in the case of potato farmers, seed (0.336) and human labour (0.406) parameters were significant.

Meshram *et al.* (2015) used Cobb-Douglas type of production function to determine the efficiency of input on the output in case of brinjal production in Maharashtra. The inputs included in the model explained 84.50 per cent of variation in brinjal as revealed by the coefficient of multiple determinations (R^2). All The estimated parameters of independent variable viz. human labour, bullock pair, seed, nitrogen, phosphorus, irrigation and land did not show any positive or negative impact.

Shende and Meshram (2015) analysed the cost benefit and marketing of tomato in Bhandara district of Maharashtra. The cobb-Douglas production function was estimated to analyse the relationship between inputs and the output. The inputs included in the model explained 84.5 per cent variation in tomato production as revealed by R^2. The estimated parameters of expenditure on hired human labour, phosphorus and number of irrigation were negatively significant at 5 per cent of probability level. This indicated that one per cent increase in use of these inputs would result in decrease of gross income by 0.053 per cent, 0.568 per cent and 0.162 per cent.

2.4 Marketing costs and margins in vegetable marketing

Zulfikar *et al.* (2005) examined the marketing chain operating for major vegetable crops in Peshawar, Pakistan. The result revealed that the producer received only 31, 45 and 40 per cent, of the consumer rupee for tomato, potato and onion respectively. The physical losses of the vegetables were reported to be 22, 12 and 9 per cent for tomato, potato and onion, respectively.

Shelke (2009) studied market arrivals, prices, marketing costs and marketing margins of major vegetable crops viz cauliflower, brinjal, potato, tomato and chili in Maharashtra. The results revealed that the margin of the retailer was high in all the vegetables under study. The retailers share ranged between 12 and 41 per cent while the producer's net share ranged between 42 and 57 per cent. The retailers received considerable share of the consumer's rupee. Producers who sold directly to consumer received the share of 95.85 per cent.

Baba *et al.* (2010) examined marketed surplus and price spread of cauliflower, cabbage, tomato, brinjal and kale, in Kashmir valley. The producers' marketed surplus was more than 92 per cent of the total production of selected vegetables. The price spread of vegetables with respect to various marketing channels indicated that the producers' share had inverse relationship with the number intermediaries. In channel-I (producer -consumer) producers realized more than 89 per cent of consumer's price as net return in all vegetables. The marketing cost incurred by producer varied from 7.7 per cent in tomato to 12 per cent in cabbage of consumer price. The producer received around 50 per cent and 43.9 per cent in channel-II (producer-retailer-consumer) and channel-III (producer-pre harvest contractor- wholesaler-retailer-consumer) respectively. Across different vegetables, producers received higher absolute net returns in tomato, followed by brinjal and cauliflower in all the channels.

Gaurav (2011) analysed marketed surplus and price spread for brinjal in western Uttar Pradesh. It was observed that the producer who received higher price (₹ 862.25/q) for their produce opted for channel-III (producer- wholesaler- retailer- consumer) followed by (₹ 830.5/q) channel-II (Producer-commission agent-wholesaler-retailer- consumer) and (₹ 754/q) channel-I (Producer-village traders – wholesaler -retailer- consumer). The respective share of producer in consumer rupee was 56.36 per cent, 54.29 per cent and 49.29 per cent for channels- III, II and I in Delhi market. The marketing cost paid by the producer through channels- I, II and III were estimated to be 4.30 per cent, 10.21 per cent and 4.03 per cent of the consumer price respectively. The marketing cost incurred by retailer worked out to be ₹ 64.32 and the net marketing margin was ₹ 249.15 which were 4.21 per cent and 16.29 per cent respectively of the consumer rupee.

Sangeetha and Banumati (2011) in the study on economics of vegetables marketing in Tamil nadu, identified 3 marketing channel in brinjal and tomato, namely Channel-I (Producer–Commission agent-cum-wholesaler- Retailer – Consumer), Channel-II (Producer-Commission agent cum Wholesaler-Consumer) and Channel-III (Producer - Consumer). The producer's net price for tomato was 39.57 per cent, 53.54 per cent and 93.87 per cent of consumer rupee in channel-I, II and III respectively. The modified marketing efficiency index showed that in channel-II, the index was greater than unity which indicated that the producers' net price was greater than marketing cost and margin. Though the producer's net price was low in channel-III, the index was very high. It showed that the channel-III where there was a direct contact between grower and consumer was the most efficient channel. Commission agent cum wholesaler incurred ₹ 32.70/quintal and ₹ 46.11/quintal as marketing cost for brinjal and tomato respectively. Transport cost constituted major share of total marketing cost. In Channel-I the share of marketing margin was more than 50 per cent but in channel-II it was less than 50 per cent. The marketing cost and marketing margin accounted for 60.43 per cent, 40.46 per cent in channel-I and II respectively for tomato .While in brinjal marketing it accounted for 54.97 per cent and 30.34per cent in Channel-I and II respectively.

Dastagiri *et al.* (2013) examined the different market channels and marketing efficiency of vegetables in India. The most common marketing channel for majority of the crops was that producer →wholesaler →retailer →consumer. The results further showed that the producer share in consumer rupee was higher in Punjab, Tamil Nadu and Manipur compared to Andhra Pradesh, West Bengal and Rajasthan. The producers share in consumers' rupee for vegetables was 48.54 per cent for potato, 63.26 per cent for tomato and 24.48 per cent for baby corn in Andra Pradesh. In Tamil Nadu, it was 90.9 per cent, 92.05 per cent, 95.45 per cent for brinjal, potato and tapioca respectively. In West Bengal, the producers' share in the consumers' price of brinjal was estimated to be 44 per cent and the same was 26 per cent for bhendi, 26 per cent for tomato.

Nandeshwar *et al* (2013) in the study of marketing channel and price spread of cabbage, cauliflower, brinjal, onion and capsicum in Maharashtra, reported that the producer share in consumer rupees was highest in channel-III (producer-consumer) i.e. 96.1 per cent (₹ 817/q) and 95.7 per cent (₹ 766/q) in cauliflower and cabbage respectively followed by channel-II (Producer-retailer-consumer) 80.7 per cent and 81.6 per cent, then channel-I (Producer-wholesaler-retailer-consumer) i.e. 59.15 per cent and 60.3 per cent respectively. Same trend was followed in brinjal, onion and capsicum.

Sharma and Dahiy (2013) estimated the marketing cost in different marketing channels in Jaipur district of Rajasthan. The marketing cost in different marketing channels borne by farmers was ₹ 55.35 in channel-I, ₹ 53.57 in channel-II and ₹ 40.3 in channel-III. The share of producer in consumer rupee was highest in channel-II (56.79 per cent) and lowest in channel-I (52.50 per cent). The price spread was 47.50 per cent in channel-I, 43.21 per cent in channel-II and 43.65 per cent in channel-III.

Study by Swaminathan *et al.* (2013) revealed that the farmer's share in consumer's rupee was highest in wholesale market (72.23 per cent) followed by farmers' market (66.83 per cent) and retail market (60.33 per cent). The Shepherd's index was more tilted in the favour of farmer's market (3.33) and it was 3.03 and 2.07 in wholesale and retail markets respectively. Variation in marketing cost by quantity marketed was found to be very high for small onion with regression co-efficient of 0.91. The marginal value of distance in general was found to be 5.50 and it implied that for every increase in distance by one KM, the marketing cost per quintal of vegetables increased by ₹.5.50. In individual commodities, the marginal value of distance was highest for small onion (9.47) and lowest for tomato (1.42).

Meshram *et al.* (2015) reported that channel-I (Producer- consumer) was best channel for marketing for brinjal. However very less quantity of produced was sold through this Channel. The most widely noticed channel for disposal of brinjal was channel-III (producer-wholesaler-retailer-consumer) which accounted 49.03 per cent of total quantity disposed. The price spread for brinjal was around 40 per cent. The marketing efficiency declined with increase in number of intermediaries. The producer's share in consumer rupee was 95.46 per cent (₹ 943/q) 47.81 per cent (₹ 977.14/q) and 39.54 per cent (₹ 1,131.43/q) in channel-I, II and III respectively.

2.5 Problems faced by farmer in production and marketing of vegetables

Chandrashekhar (2007) in his study on onion production and marketing behaviour of farmers in Gadag district of Karnataka reported that the high cost of fertilizers (94.16 %), high cost of pesticides (94.16 %), labour expenses (93.33 %), labour problem during harvesting (85.00 %), ineffective and costly weedicides (80.83 %), lack of knowledge about recommended fertilizer doses for onion crop (80.83 %) and lack of knowledge about improved varieties, non-availability of seed or planting material (68.33 %) as the major problems faced by sample farmers.

Asmatoddin *et al.* (2009) listed non-availability of labour in time which was reported by (70.00 per cent) farmer which was severe in summer followed by Kharif and rabi season. Non-availability of seedlings in time (53.33 per cent), non-availability of loan facilitate in time (45.55 %) in Western Maharashtra as problems faced by farmers in production of tomato. In marketing of tomato the problem faced by farmers were low and fluctuating prices (78.88 %), cost of packaging material (72.22 %), high transport cost (70.00 %), high commission charges (62.11 %).

Marimuthu (2010) examined the constraints in marketing of vegetables. He reported that the production and marketing of vegetables were affected by many constraints like insufficient and imperfect markets, abundance of intermediaries in channel resulting exploitative practices in marketing of fresh produce, scattered production and sometimes in isolated places where even the transportation facilities and other infrastructure was not sufficient, lack of proper grading, improper pre and post-harvest care and handling.

Badhe and Saiyad (2011) summarised the problems faced by farmers in brinjal production and marketing in Anand district of Gujarat. The major constraints faced by growers were high cost of inputs (93.33 %), fluctuations in market rates (90.00 %), non-availability of healthy seedlings (85.00 %), non-availability of labours (81.66 %), high cost of transportation (77.50 %), lack of technical guidance (75.00 %), high wages of labours (71.66 %), non-availability of timely credit (60.83 %), lack of market facilities (55.83 %), irregular supply of irrigation (39.16 %) and irregular supply of electricity (35.83 %).

Gupta (2012) listed problems encountered in production and marketing of fruit and vegetable. He reported that the invasion of fungi, bacteria, insects and other organisms on fruits and vegetables was a major problem. Late-blight of tomato and powdery-mildew in the case of peas are quite common. The large number of functionaries/intermediaries such as pre-harvest contractors, commission agents, wholesalers, retailers, etc. operated in the unregulated and unsupervised vegetable markets, resulting in a large gap between the producer price and consumer price.

Some of the major problems identified by Singh *et al.* (2012) were lack of quality seeds (60 % and 75 % in garden pea and cowpea respectively) inadequacy of farm inputs (73.33 % in garden pea and 65 % in cowpea). Others problems in production of these vegetables included non-unavailability/ high cost of human labour, high cost of agro chemicals and pest problems.

Sreedhara *et al.* (2013) in capsicum production in Belagavi and Haveri district of Karnataka noticed high cost of seeds (78.83 %) and inadequate availability of quality seeds (72.91 %) as major constraint faced by the vegetable growers. Other important problems encounter by farmers included inadequate availability of labour (63.83 %), high incidence of pest and diseases (62.17 %) and inadequate irrigation facilities (59.83 %).

Chendake and Chauhan (2015) identified production problems like high cost of fertilizers (71.42 %) and disease problems (35 %) by vegetable growers. Nearly half of the vegetables and flower growers (49 %) expressed that there was less response from agricultural universities about the new ideas of the cultivation practices and harvesting techniques etc. Majority of the respondents expressed marketing problems like fluctuation in price (82 %), less response from government (76 %), delayed cash payment (72 %), high cost of transportation (66 %) and remoteness of market (64 %).

As notice by Meshram *et al.* (2015) the major production constraints encountered by brinjal cultivators were damage by diseases and pests (77.5 %)followed by lack of skill manpower (67.5 %), lack of finance (60 %) and low level of crop production (52.5 %). Important marketing problem faced by farmer were arbitrary charges by market intermediary (67.5 %) and lack of packaging material (52 %).

Shende and Meshram (2015) noticed damages due to insect and pest (80 %) and lack of finance (67.5 %) as the major problems in production of tomato in Bhandara district of Maharashtra. With respect to marketing of vegetables, arbitory charges by marketing agent (72.50 %) mal-practices by labour (42.50 %) lack of pacca roads (40.00 %) were the main.

3. METHODOLOGY

This chapter explains the general characteristics of the study area, nature and source of data, the sampling procedure followed for selection of taluk, villages and sample farmers, the various analytical tools adopted to investigate and quantify the objectives. In this chapter a few concepts are defined and explained to facilitate a clear understanding of the issues with which the present study is concerned.

The present study was conducted during the year 2015-16 in the Belagavi district of Karnataka with the objective to study economics of production and marketing of cabbage and cauliflower. Belagavi district was selected as it has the highest production of cabbage and cauliflower in the state (Appendix I). The methodology followed in conducting this research is delineated 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 tools and techniques employed

3.5 Definition of the terms and concepts

3.1 Description of the study area

3.1.1 Location and area

Belagavi district is located in the North Western part of Karnataka. It is situated between 15°23 to 16°58 North latitude and 74°5‘ to 75°28‘ East longitude. The district is situated at the height, ranging from 900 to 4,500 meters above the Mean Sea Level (MSL) and extends over an area of 13,415 sq. kms, which is 6.99 per cent of total geographical area of state. The district is surrounded by Maharashtra state in the north, Vijayapura in the east, Dharwad and Uttar Kannada districts in south and Goa state in the south west. The location of the district is shown in Fig.1.

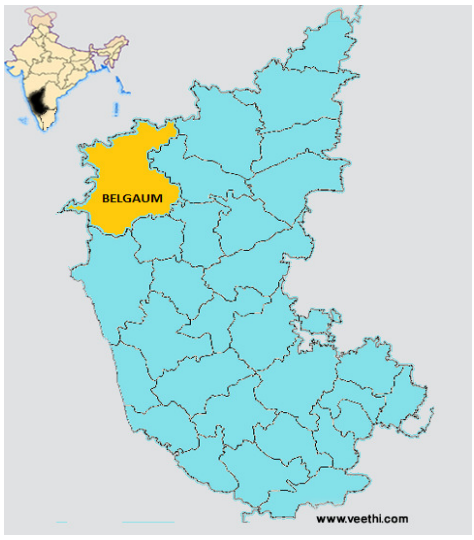
3.1.2 Demography and literacy in the study area.

According to the 2011 census data (Table 3.1), the population of Belagavi district was 47, 79,661 of which 35, 68,466 (74.64 %) were residing in rural and 12, 11,195 (25.34 %) in urban area. Literacy percentage of the district is 73.48 per cent. The literacy with respect to male is slightly more (82.20 %) as compared to the female (64.58 %).

3.1.3 Topography, climate, rainfall and soil type

The total geographical area of the district (Table 3.1) is 13, 44,382 hectares and stands first in the state with respect to area. Geographically, the district is classified in to three zones viz. i) Northern transition zone ii) Northern dry zone iii) Hilly zone. Belagavi, Bailhongal, Chikkodi and Hukkeri taluks fall under Northern transition zone, whereas Athani, Rayabag, Gokak, Ramdurg and Saundatti taluks come under Northern dry zone and Khanapur comes under Hilly zone. The major rivers flowing in the district are Krishna, Malaprabha and Ghataprabha. The main irrigation sources for the district are bore well followed by open well, canal and lift irrigation.

Karnataka state



Belagavi District

--selected Taluk

Fig. 1. Map showing study area

Table 3.1 Demographic features of Belagavi district and Belagavi taluk

Sl. No.	Particulars	Belagavi district		Belagavi Taluk	
1	Geographical area (ha)	13,44,382		1,03,721	
2	Population	Number	(%)	Number	(%)
	Rural	35,68,466	74.65	3,13,511	32.74
	Urban	12,11,195	25.34	6,43,862	67.26
	Total	47,79,661	100	9,57,878	100
3	Density (Sq. Km)	356		924	
4	Literacy rate (per cent)				
	Male	82.20		89.63	
	Female	64.58		77.54	
	Total	73.48		83.63	
5	Net Irrigated area (ha)				
	Sources	Area (ha)	(%)	Area (ha)	(%)
	Bore well	1,67,684	33.99	8,805	61.36
	Open well	1,48,276	30.06	5,544	38.64
	Canal	77,670	15.74	0	0.00
	Lift irrigation	17,640	3.58	0	0.00
	Tanks	307	0.06	0	0.00
	Others	81,730	16.57	0	0.00
	Total	4,93,307	100.00	1,4349	100.00
6	Average Rainfall (mm)	823.3		542.0	

Source: Belagavi district at a glance 2013-14, District Statistical Office, Belagavi

The climate is generally dry and healthy, except during the monsoon season. The hot season begins by March with the maximum temperature of 38 ºC and minimum temperature of 14 ºC during December, which is generally the coldest month.

The Belagavi district receives an average annual rainfall of 823.3 millimetres with major portion of it being received from south-west monsoons. The rainfall is well distributed during months of June to October, while in the month of September the intensity of rainfall is high. The district witnessed an average of 53 rainy days annually. The total irrigated area was 4,93,307 ha (2013-14), out of which bore wells serve major area (1,67,684 ha), followed by open wells (1,48,276 ha), canals (77,670 ha) and lift irrigation (17,640 ha). Major portion of the district land comprises of medium to deep black soils, whereas some parts are having light black, red and black sandy soils.

3.1.4 Land utilization pattern

The land utilization pattern of Belagavi district during the year 2013-14 is presented in Table 3.2. Out of the total geographical area of the district (13, 44,382 ha) the area under forest is 1,90,424 hectares (14.16 %) with net sown area of 6, 55,960 hectares (48.79 %) and fallow land around 3,44,391 hectares. Area which is not available for cultivation is 1,14,172 hectares. Belagavi taluk has around 1,03,721 hectares sharing 7.71 per cent of geographical area of the district. The net sown in the taluk is 48,650 hectares, the fallow land is around 16,084 hectare, and area not available for cultivation is 9,543 ha during year 2013-14.

The area, production and productivity of major vegetable crops in Belagavi district are presented in Table 3.3. The Belagavi district has 44,078 ha area under vegetables cultivation with total vegetable production of 8,47,413 metric tonne during year 2014-15. The major vegetable crops grown in the district include potato, tomato, brinjal, green chilli, okra, cabbage, cauliflower and bean. Among all vegetable crops onion occupy largest area of 6,852 ha followed by green chilli (6,445 ha), tomato (6,217 ha) and potato (5,274 ha).

Taluk wise area, production and yield of total vegetables including cabbage and cauliflower is shown in Table 3.4. In Belagavi district, Belagavi, Bailahongal, Saundatti, Khanapur and Gokak taluks are major vegetable producing taluks occupy an area of 10,901 ha, 9,687.12 ha, 7,067 ha, 5,207 ha, and 3,064 ha respectively. In cauliflower, Belagavi taluk has largest area of cultivation (330 ha) with production of 6,600 metric tonne followed by Gokak and Hukkeri taluks. In case of cabbage Belagavi has third highest acreage (499 ha) after Bailahongal and Gokak with production of 12,475 metric tonne during the year 2014-15.

3.2 Sampling procedure

Multistage sampling procedure was used to select the respondents to obtain the required data. Belagavi district is one of the leading producer of cabbage and cauliflower in north Karnataka and come under jurisdiction of UAS Dharwad. Hence this district was selected in the first stage purposively for the study. There are totally ten taluks in Belagavi district, among those, Belagavi taluk was selected in the second stage for both the crops for study, as it is having highest area under cauliflower and third highest area under cabbage after Bailahongal and Gokak in the district. The reason for selecting Belagavi taluk is to compare economics of cabbage and cauliflower production in the same locality.

Table 3.2 Land utilization pattern in Belagavi district and Belagavi taluk

Sl. No.	Particulars	Belagavi District		Belagavi taluk	
		Area (ha)	%	Area (ha)	%
1	Total Geographical Area	13,44,382	100.00	1,03,721 (7.71)	100.00
2	Area under forest	1,90,424	14.16	22,643 (11.89)	21.83
3	Area not available for cultivation	1,14,172	8.49	9,543 (8.35)	9.20
4	Other uncultivable land excluding fallow land	39,435	2.93	6,801 (17.2)	6.56
5	Fallow Land	3,44,391	25.62	16,084 (4.67)	15.51
6	Net sown area	6,55,960	48.79	48,650 (7.42)	46.90

Figures in parenthesis are percentage to total area in district
Source: District at a glance 2013-14, District Statistical Office, Belagavi

Table 3.3 Area, production and productivity of vegetables in Belagavi district

Sl. No	Vegetables	Area (ha)	%	Production (Tonnes)	%	Productivity (Tonne/ha)
1	Onion	6,852.02	15.55	1,37,862.5	16.27	20.12
2	Green chilies	6,445.25	14.62	93,984.6	11.09	14.58
3	Tomato	6,217.6	14.11	18,9952	22.42	30.55
4	Potato	5,274.06	11.97	94,345	11.13	17.89
5	Brinjal	4,009.1	9.10	1,09,152.4	12.88	27.23
6	Okra	2,409.3	5.47	19,946	2.35	8.28
7	Cabbage	1,946	4.41	46,902	5.53	24.10
8	Cauliflower	1,127	2.56	21,997	2.60	19.52
9	Bean	1,080.2	2.45	11,408.6	1.35	10.56
10	Peas	318.04	0.72	3,966.2	0.47	12.47
11	Leafy vegetables	1,754.53	3.98	18,719.18	2.21	10.67
12	Gourd Vegetables	1,877	4.26	24,508	2.89	13.06
13	Root vegetables	1,533.06	3.48	22,362.5	2.64	14.59
14	Other vegetables	3,234.84	7.34	52,307.02	6.17	16.17
	Total vegetables	4,4078	100	8,47,413	100	

Source: - Department of Horticulture, 2014-15, Belagavi district

The area under cabbage and cauliflower in different taluks of the district is shown in Table 3.4. Six villages predominantly growing cabbage and cauliflower were selected in the third stage in consultation with Agriculture Assistant. From each selected village, 15 farmers for each crop were randomly selected at the final stage to constitute total sample of 90 farmers each for cabbage and cauliflower.

For the study of marketing channels and price spread, Belagavi market was selected. From the selected market 10 wholesalers, 10 village trader and 10 retailers were randomly selected for both crops. The study pertains to the agriculture year 2014-15 and is limited to 180 sample farmers selected randomly from six villages and 30 market intermediaries from one major market.

3.3 Nature and sources of data

The study is mainly based on the primary data obtained from sample respondents in Belagavi district. To evaluate the objectives of the study, the information was collected from sample farmers by interviewing personally using a pre-tested structured interview schedule. The socio economic aspects of respondents such as family size and composition, education level, land holdings, cropping pattern etc. were elicited. The details pertaining to cabbage and cauliflower cultivation like area under crop, land preparation operations, inputs used and outputs obtained were collected. Data on price of inputs and outputs, method of sale, use of plant protection chemicals (PPC), marketing information like sale of output, marketing cost incurred, problems faced and profit obtained in the marketing of cabbage and cauliflower were obtained from market intermediaries (Traders/ wholesaler/retailers).

Secondary data with regards to area under crops and vegetables and other necessary data were collected from the District Statistical Office (DSO) and Department of Horticulture, Belagavi.

3.4 Analytical tools and techniques employed

For assessing the objectives of the present study quantitatively, following analytical tools, techniques and statistical devices were employed.

3.4.1 Tabular presentation techniques

3.4.2 Budgeting technique

3.4.3 Production function analysis

3.4.4 Price spread and marketing margin

3.4.5 Garret ranking techniques

3.4.1 Tabular presentation techniques

The data collected were presented in tabular form to facilitate easy comparison. The tabular presentation technique was followed to study the economic characteristics of sample farmers, such as size of land holding, cropping pattern, types and extent of different plant protection chemicals used in cabbage and cauliflower. The data were summarized in the form of appropriate tables with the aid of statistical tools like averages, percentages *etc.* to obtain the meaningful information.

3.4.2 Budgeting technique

To work out the cost and returns in cultivation of cabbage and cauliflower, the budgeting technique was employed. It is an important technique which considers various cost items viz variable cost, fixed cost including interest charges along with imputed values of family labour and owned land to determine the economic profitability of crop production. The different parameter in budgeting technique like per hectare gross income, net return and benefit-cost ratio were computed to indicate the profitability.

Table 3.4 Taluk-wise Area, production and yield of cabbage, cauliflower and total vegetables in Belagavi District

S. No.	Taluk	Total Vegetables			Cabbage			Cauliflower		
		Area (ha)	Production t	Yield t/ha	Area (ha)	Production t	Yield t/ha	Area (ha)	Production t	Yield t/ha
1	Belagavi	10,901 (24.73)	2,18,474	20.04	258 (13.26)	6,450	25	330 (29.28)	6,600	20
2	Bailahongal	9,687.12 (21.98)	1,64,315.8	16.96	629.74 (32.37)	15,743.5	25	22.11 (1.96)	442.2	20
3	Saundatti	7,067 (16.03)	1,49,513	21.16	30 (1.54)	750	25	0	0	0
4	Kanapur	5,207 (11.81)	1,10,261	21.18	122 (6.27)	2,440	20	169 (15.0)	2,535	15
5	Gokak	3,064 (6.95)	61,257.75	19.99	499 (25.65)	12,475	25	268 (23.78)	5,628	21
6	Chikkodi	2,824.07 (6.41)	42,360.44	15	118 (6.06)	2,300	19.4	54 (4.79)	1,114	20.6
7	Hukkeri	2,407 (5.46)	49,643	20.62	193 (9.92)	4,825	25	194 (17.21)	3,880	20
8	Rayabag	2,048.39 (4.65)	34,439.61	16.81	95.9 (4.93)	1,918	20	89.9 (7.98)	1,798	20
9	Ramadurg	583.8 (1.32)	13,288.43	22.76	0	0	0	0	0	0
10	Athani	288.2 (0.65)	3,860	13.39	0	0	0	0	0	0
	Total	44,077.58 (100.0)	8,47,413	19.23	1945.64 (100.0)	46,901.5	24.10	1,127.01 (100.0)	21,997.2	19.51

Figure in parenthesis indicate percentage to total area
Source: - Department of Horticulture, 2014-15, Belagavi district

Table 3.5 Details of sample villages for the study

District	Crops	Village	Sample farmers
Belagavi	Cabbage	1. Kadoli	15
		2. Kakati	15
		3. Agasage	15
		4. Honaga	15
		5. Handingur	15
		6. Kangrali (KH)	15
		Total	90
	Cauliflower	1. Kadoli	15
		2. Kakati	15
		3. Agasage	15
		4. Honaga	15
		5. Handingur	15
		6. Kangrali (KH)	15
		Total	90

3.4.3 Production function analysis

The Cobb-Douglas (CD) production function was estimated to study the resource use efficiency in cabbage and cauliflower production. The production function of the following type was specified in the present study.

$$Y = AX_1^{a1}X_2^{a2}X_3^{a3}X_4^{a4}X_5^{a5}e^u$$

Where,

Y= Gross income from cabbage/cauliflower (₹/ha)

X_1= Expenditure on Seeds (₹/ha)

X_2= Expenditure on manures and fertilizers (₹/ha)

X_3 = Expenditure on pesticides (₹/ha)

X_4 =Expenditure on labour (₹/ha)

X_5 = Expenditure on machine and bullock labour (₹/ha)

A = Constant

a_i = Production elasicities of input (i = 1,2,3….)

u= Random error

The above function was converted into linear form through logarithmic transformation of all variables and was written as

$$\ln Y = \ln A + a_1 \ln X_1 + a_2 \ln X_2 + a_3 \ln X_3 + a_4 \ln X_4 + a_5 \ln X_5 + \ln u.$$

The marginal value products for each input were calculated at the geometric mean levels of the respective resources and gross income by using formula,

Marginal value product of $X_i = a_{i*} \bar{Y} / \bar{X}i$

Where,

$\bar{Y}$ = geometric mean of gross income

$\bar{X}_i$ = geometric mean of i^{th} resource

a_i = production elasticity of i^{th} resource

To determine the optimum quantity of pesticide use, under the assumption of profit maximization behavior, the following relationship was computed.

MVP = MFC

$a_4 . \bar{Y} / \bar{X} = P_P$

$X^* = a_4 . \bar{Y}/P_P$

Where,

X* = optimum quantity of pesticides (lit or kg)

a_4 = production elasticity of pesticides

P_p = average unit price of pesticides (₹ per lit or kg a.i.)

$\bar{Y}$= geometric mean of gross income from cabbage/cauliflower (₹)

In order to determine, allocative efficiency of the resources, the value of the marginal product was compared with its marginal cost.

The criterion for determining optimality of resource use was,

MVP/MFC > 1 underutilization of resource

MVP/MFC = 1 optimal use of resource

MVP/MFC < 1 excess use of resource

3.4.4 Price spread (PS) or marketing margin (MM)

The price spread (PS)

The price spread (PS) which is also called marketing margin (MM) is computed as the difference between producer's net price (PNP) and retailer's selling price (RP).

$$PS = RP - PNP.$$

Producer's share in the consumer's rupee (PSCR)

Producer's net price (PNP) expressed as a percentage of the retail price (RP) is defined as producer's share in the consumer's rupee.

$$PSCR = PNP/RP \times 100$$

3.4.5 Garrett's ranking technique

This technique was used to evaluate the problems encountered in production of cabbage and cauliflower in the study area by the farmers. The farmers were asked to assign preferential orders to a given problem according to the magnitude of the problem. The orders of merit given by respondents were converted into ranks by using the following formula.

$$\text{Percentage Position} = \frac{100\ (R_{ij} - 0.5)}{N_j}$$

Where,

R_{ij}= Rank given for i^{th} item by j^{th} individual

N_j= Number of items ranked by j^{th} individual

The percentage position of each rank thus obtained was converted into scores by referring to the table given by Garrett. Then for each factor the scores of individual respondents were added together and divided by total number of respondents for whom the scores were added. The mean scores of all the factors were arranged in the order of their ranks and inferences were drawn.

3.5 Definitions of terms and concepts

Various concepts and terms used in the study are explained in detail here under to facilitate easy understanding.

Cost concepts:-The total costs were divided into two broad classes.

I. Variable or operational costs

II. Fixed costs

I Variable or operational costs:

These were the costs incurred by the farmers during the production process. Broadly, these were the actual costs along with incidental charges incurred towards labour and material costs. The different items and their measurement of these costs are as follows.

Seeds: The cost of the seeds was calculated at the local market price for the seed including expenses in nursery preparation and inputs or actual expenditure incurred in the case of purchased seedlings.

FYM: The quantity of FYM used was measured in tonnes and the cost computed by taking prevailing market price in the village including the cost of transportation and other incidental charges.

Fertilizer: Cost of fertilizers were measured based on the actual price paid by the sample farmers including the cost of transportation and incidental charges.

Human Labour: The labour input was measured in terms of men days. Women days were converted into adult men days of eight hours per day using conversion factor 0.72 on the basis of wage differential between men (₹ 180 /day) and women labour (₹130 /day).

Bullock labour: Bullock labour was estimated in terms of bullock pair days. Both owned and hired bullock labours were charged at the prevailing market rate paid per day of eight hours in the study area

Machine power: The cost of machine power both owned and hired was calculated at the different rates for different operations prevailed in the study area.

PPC's: The costs of different insecticides, herbicides and fungicides used were calculated based on the actual price paid by the farmers towards those chemicals.

Irrigation charges: The actual charges incurred by the farmers including incidental charges were considered.

Interest on Working Capital: This was calculated on the entire working cost of the enterprise at the prevailing bank rate of interest @ 7 per cent per annum and apportioned for the crop period.

II Fixed costs

Fixed costs include land revenue, rental value of land, interest on fixed capital and depreciation on farm implements and machinery. Explanation on the measurement of different items included under fixed costs are as follows

Land revenue: Actual land revenue paid by the farmers at the rates fixed by the government was considered.

Rental Value of the land: It was computed by taking prevailing lease value of land in the study area per hectare per annum.

Interest on Fixed Capital: This was calculated at the rate of 12 per cent per annum on the fixed capital.

Depreciation: Depreciation on each equipments and machinery owned by the farmers and used for cultivation was calculated for individual farmer based on the purchase value using the straight line method.

Annual depreciation = (Purchase value-Junk value) / life span

The annual depreciation is apportioned to each crop on area basis.

Cropping pattern: The proportion of the area under various crops at a point of time (*kharif, rabi* and bi season) represents the cropping pattern.

Cropping Intensity (CI): Cropping intensity was computed as the ratio of the gross cropped area to the net sown area and expressed in percentage.

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

Marketing channels and its concepts

Marketing Channels: Marketing channels are defined as the routes through which the producers dispose-off their produce.

Village Trader: Village trader is a person who purchases the agricultural produce in village directly from the producers for the purpose of subsequent selling.

Wholesaler: Wholesale trader is a person who buys the notified agricultural products in the market yard either for himself or on behalf of others for the purpose of reselling the same either in the original form or after processing.

Marketing Costs: Marketing costs are the actual expenses incurred in moving goods from the producer to the consumers.

Price spread: The difference between the price paid by consumer and price received by the producers is the marketing margin or price spread.

Marketing margins: Margin refers to the difference between the price paid and received by a specific marketing agency such as a single retailer, or by any type of marketing agency, *i.e.,* retailers or wholesalers or by any combination of marketing agencies in the marketing system as a whole. Total marketing margin includes cost involved in moving the vegetables from producer to consumer and profits of various market functionaries.

Producer's net price (PNP): This is computed as the price per unit of output that a producer realizes after deducting the marketing costs from the gross price, which is the price that he receives from the market intermediaries when he sells his produce.

4. RESULTS

The data were collected from the sample farmers spread over 6 villages of Belagavi taluk, Belagavi district of Karnataka. Various statistical tools and techniques were used to analysis the data and draw meaningful conclusions. The major findings of the study are presented in this chapter under the following heads.

4.1 General characteristics and cropping pattern of the sample farmers

4.2 Cost and returns in the production of cabbage and cauliflower

4.3 Nature and extent of pesticide use in cabbage and cauliflower

4.4 Resource productivity in cabbage and cauliflower

4.5 Optimum quantity of pesticide use in cabbage and cauliflower

4.6 Marketing channels and price spread in cabbage and cauliflower

4.7 Production and marketing problems faced by the farmers

4.1 General characteristics and cropping pattern of the sample farmers

General information about the sample farmers in the study area is shown in Table 4.1. The general information includes age, educational status, family size, type of family, and occupational pattern. About 53.3 per cent of farmers belonged to middle age groups (35-50) followed by young age and old age farmers with the percentage of 25.5 and 21.2 respectively with average age of 42.93 years in cabbage growers. In cauliflower, about 50 per cent of farmers were in the middle age groups (35-50) followed by old age and young age farmers with the average age of 43.03 years.

The analysis of educational status revealed that one fourth of farmers studied primary school (26.6 %). More than 20 per cent of respondents in both the crops had secondary school and college education. The proportion of illiterate farmers was less (16.67 %) among cabbage crop growers. Only 10 per cent of farmers were illiterates among cauliflower respondents.

Table 4.1 revealed that majority of the cabbage growing farmer belonged to medium size (4-6) family which formed 46.6 per cent, while 30.0 per cent belonged to large size family, 13.3 per cent belonged to small size family and 10.0 per cent of sample farmers belonged to very large size family. Half of the cauliflower farmers belonged to medium size family (50.0 %), 26.6 per cent belonged to large size family, 13.3 per cent belonged to very large size family and 10.0 per cent of farmers belonged to small size family.

More than 60 per cent of the cabbage farmers belonged to nuclear family (65.5 %), and 34.4 per cent of sample farmers belonged to joint family. In cauliflower the respective proportions were 68.9 per cent and 31.1 per cent of sample farmers.

The occupational pattern of farmers was shown in Table 4.1. For majority of the farmers, agriculture was the main occupation (57 % in cabbage and 50 % in cauliflower) and few farmers also practiced subsidiaries activities like dairy and poultry (23 % in cabbage and 26 % in cauliflower). Agriculture with other jobs was also practiced by 18.8 per cent of cabbage and 23.3 per cent of cauliflower growers.

Table 4.1 General characteristics of the sample farmers

Sl No	Particulars	Cabbage		Cauliflower	
		Number n= 90	Percentage	Number n = 90	Percentage
1	Age				
	Young age (<35 Years)	23	25.5	21	23.3
	Middle age(35-50 years)	48	53.3	45	50
	Old age (> 50 years)	19	21.2	24	26.6
	Average age	42.93		43.03	
2	Educational status				
	Illiterate	15	16.67	9	10.0
	Primary (1-7)	24	26.67	21	23.3
	Secondary school (8-12)	21	23.3	24	26.7
	College education (11-12)	18	20	21	23.3
	Graduate (above 12)	12	13.3	15	16.7
3	Family size				
	Small size(1-3)	12	13.33	9	10.0
	Medium size (4-6)	42	46.67	45	50.0
	Large size (7-9)	27	30.0	24	26.6
	Very large size (> 9)	9	10.0	12	13.3
4	Type of family				
	Nuclear	59	65.6	62	68.9
	Joint	31	34.4	28	31.1
5	Occupation pattern				
	Only agriculture	52	57.78	45	50
	Agriculture + Dairy, poultry	21	23.34	24	26.7
	Agriculture + other jobs	17	18.88	21	23.3

Table 4.2 indicated the land holding details of the sample farmers. The average land holding was 2.82 ha for cabbage growers with a dry land share of 61.27 per cent. The average size of the operational land holding was 2.79 ha. Leasing of land was also practiced by few farmers. Similarly in cauliflower, average land holding was 2.27 ha in which dry land accounted for 58.07 per cent. The average size of the operational land holding was 2.17 ha.

4.1.1 Cropping pattern and major crops grown by the sample farmers

The farmers cultivated a number of crops on their farm. Sugarcane, maize jowar and soybean were the major crops. Vegetables were found to be grown all-round the year by sample farmers and the details are presented in Table 4.3.

The total gross cropped area of cabbage growers was 5.92 ha and that of cauliflower growers were 4.76 ha. In cabbage farmers the total area under kharif was 1.73 ha (29.22 %). The crops grown during kharif season were maize, soybean, jowar, tomato, chilli and onion. Among these crops onion occupied highest area of 0.385 ha (6.50 %), followed by chilli, tomato, jowar, maize and soybean. Similarly in the case of cauliflower farmers, the total area under kharif was 1.40 ha and maize occupied highest area of 0.28 ha (6.05 %), followed by chilli, onion, jowar, soybean and tomato.

The crops grown during rabi season include cabbage, cauliflower, potato, beans, green gram, chickpea and other vegetables. With respect to cabbage growers, the total cropped area was 1.767 ha (29.81 %), in which cabbage occupied highest area of 0.97 ha (16.40 %), followed by cauliflower, chickpea and green gram. Potato, beans and other vegetable were found occupy an area of 0.07 each for cabbage growing farmers. Among cauliflower growing farmers, the total cropped area was 1.492 ha (31.87 %) in rabi season. The cauliflower occupied highest area of 0.95 ha (20.32 %), followed by cabbage, potato, chickpea, green gram, other vegetables and beans with a respective area of 0.198, 0.108, 0.097, 0.058, 0.058 and 0.022 ha.

In the summer season, cabbage, cauliflower, brinjal, tomato, okra and other vegetable were the important crops grown. For cabbage growing farmers, the area under summer crops was 1.03 ha (17.41 %). The cabbage was cultivated on an area of 0.27 ha (4.56 %), followed by tomato, other vegetables, brinjal, okra and cauliflower with a respective area of 0.21, 0.19, 0.16, 0.12 and 0.08 ha. Among cauliflower farmers, during summer out of total cropped area of 1.21 ha the other vegetables occupied highest area of 0.32 ha (6.81 %), followed by tomato, cabbage, cauliflower, okra and brinjal.

The total area under cabbage was 1.24 ha (20.95 %) and cauliflower was 0.418 ha (7.05 %) for cabbage growers in the year. With respect to cauliflower farmers the proportion of area under cabbage and cauliflower was 7.78 per cent (0.364 ha) and 23.78 per cent (0.113 ha) respectively. Sugarcane was grown extensively which was cultivated on an area of 1.40 (23.55 %) and 0.66 ha (14.12 %) among cabbage and cauliflower growing farmers respectively. The cropping intensity was 212.43 and 218.86 per cent for cabbage and cauliflower growing farmers.

4.2 Cost and returns in the production of cabbage and cauliflower

The per hectare cost and returns structure in cabbage and cauliflower cultivation is presented in Table 4.4. The share of total variable cost in total cost of cultivation of cabbage was 78.86 per cent (₹ 45,487.74).

Table 4.2 Average size of land holding of sample farmers (ha)

Sl. No.	Particulars	Cabbage (n =90)	Cauliflower (n = 90)
1	Total Dry land	1.732 (61.27)	1.323 (58.07)
2	Total Irrigated land	1.094 (38.73)	0.955 (41.93)
3	Total land holding	2.827	2.279
4	Total Leased in Land	0.125	0.103
5	Total Leased out land	0.161	0.203
6	Total operational land holding	2.791	2.179

Figure in parentheses indicate percentage to average land holding

Table 4.3 Cropping pattern and major crops grown by sample farmers

(in ha)

Sl. No.	Crop/ Season	Cabbage (n = 90)		Cauliflower (n = 90)	
		Area (ha)	Percentage	Area (ha)	Percentage
1	Khariff				
	Onion	0.385	6.50	0.261	5.58
	Chilies	0.382	6.45	0.265	5.66
	Tomato	0.324	5.47	0.189	4.04
	Jowar	0.223	3.76	0.216	4.61
	Maize	0.216	3.64	0.283	6.05
	Soybean	0.202	3.41	0.193	4.12
	Sub total	1.732	29.22	1.407	30.06
2	Rabi				
	Cabbage	0.972	16.40	0.198	4.23
	Cauliflower	0.337	5.69	0.951	20.32
	Chick pea	0.148	2.50	0.097	2.07
	Green gram	0.108	1.82	0.058	1.24
	Beans	0.067	1.13	0.022	0.47
	Potato	0.072	1.21	0.108	2.31
	Other vegetables	0.063	1.06	0.058	1.24
	Sub total	1.767	29.81	1.492	31.87
3	Summer				
	Cabbage	0.270	4.56	0.166	3.55
	Tomato	0.209	3.53	0.191	4.08
	Brinjal	0.162	2.73	0.126	2.69
	Okra	0.121	2.04	0.157	3.35
	Cauliflower	0.081	1.37	0.162	3.46
	Other vegetables	0189	3.19	0.319	6.81
	Sub total	1.032	17.41	1.21	23.95
4	Sugarcane	0.466		0.220	
5	Gross cropped area	5.929 (100.00)		4.769 (100.00)	
6	Net cultivated area	2.791		2.179	
7	Cropping intensity (%)	212.43		218.86	

The expenditure on human labour accounted for about 23.92 per cent of the total cost of cultivation (₹ 13,797.4) followed by seeds (14.78 %), PPC (12.25 %), fertilizers (11.41 %) and bullock labour (8.79 %). The total fixed cost incurred for cultivation of cabbage was ₹ 12,193.55/ha (21.14 %). Among the fixed costs, the highest share was accounted for rental value of owned land (17.34 %) followed by interest on fixed capital (2.26 %), depreciation on farm machinery (1.32 %) and land revenue (0.21 %). The total cost of cultivation of cabbage growers amounted to ₹ 57,681.29. The net returns per hectare realised for cabbage cultivation was found to be ₹ 79,088.37 with gross returns of ₹ 13,6769.7 leading to an undiscounted benefit to cost ratio of 1.37.

The total cost of cultivation of cauliflower was ₹ 60,288.79/ha. The total variable cost accounted for 79.74 per cent (₹. 1,84,826.4/ha) of the total cost. The expenditure incurred on human labour accounted for about 22.79 per cent (₹ 13,736.95) followed by seeds (16.48 %), PPC (10.69 %), fertilizers (9.34 %) and bullock labour (8.61 %). The total fixed cost in cauliflower was ₹ 12,212.50/ha. Among the fixed costs, the highest share was accounted for rental value of owned land (16.59 %) followed by interest on fixed capital (2.17 %), depreciation on farm machinery (1.29 %) and land revenue (0.20 %). The net returns per hectare of cauliflower cultivation were found to be ₹ 1,24,537.6 with gross returns of ₹ 1,84,826.4. The undiscounted benefit to cost ratio was 2.06.

4.3 Nature and extent of pesticide use in cabbage and cauliflower

Pesticide use in cabbage and cauliflower cultivation has become regular and inevitable feature. Organophosphates, organochlorines, carbamates, thio-carbamate, pyrethroids and fungicides were the major groups of pesticide used by farmers in the study area which is presented in Table 4.5. In the case of cabbage, out of total 90 sample farmers, organophosphates group of pesticide was found to be used by 82.0 per cent of farmers, followed by carbamates (42.1 %), pyrethroids (39.9 %), thio-carbamates (34.4 %) and organochlorine (16.6 %). It was observed that 74.3 per cent of sample farmer used fungicide and the proportion of farmers using weedicide was 25.5 per cent. Dimethoate was used by majority of the farmer (27.7 %), followed by quinalfos (22.2 %), chlorpyriphos (17.7 %) and dichlorvos (14.4 %) in the group of organophosphate. Organochlorines (16.6 %), carbamates in the form of Indoxacarb (25.5 %) and carbaryl (16.6 %) were used by the farmers. Cartap hydrochloride belonging to thio carbamates group was used by 34.4 per cent farmers. Under pyrethroids, fenvelarate (28.8 %) and cypermethrin (11.1 %) were commonly used pesticides. Novaluron and spinosad were the new class lesser dose pesticides which were also used by 15.5 per cent and 10 per cent of sample farmers respectively. It was observed 12.2 per cent farmers used neem formulation for control of pests. Farmers were found to use fungicides like copper oxy chloride (47.7 %), carbendazim (26.6 %) and butachlor (25.5 %) under herbicide.

In the case of cauliflower, out of total 90 sample farmers organophosphates group of pesticides was found to use by majority of farmers (87.6 %), followed by carbamates (43.3 %), pyrethroids (42.1 %) and thio-carbamates (31.3 %). It was observed that 60.0 per cent of sample farmer used fungicide and 34.4 per cent used weedicide. Quinalfos was used by majority of the farmer (26.6 %), followed by dimethoate (25.5 %), dichlorvos (20.0 %) and chloropyriphos (15.5 %) in the group of organophosphates. Organochlorine was used by 13.3 per cent of farmers.

Table 4.4 Per hectare cost and returns in cabbage and cauliflower

Sl.No.	Particulars	Units	Cabbage			Cauliflower		
			Quantity	Value (₹)	Percentage	Quantity	Value (₹)	Percentage
1	Seeds	Grams or No of seedling	311.8 30,522	8,526.02	14.78	266.21 26170	9,935.16	16.48
2	Organic manure	Tonnes	4.19	2,218.88	3.85	5.06	2,659.36	4.41
3	Fertilizers a) Urea b) DAP c) Potash & complex	kg	 193.48 111.15 167.75	 1,228 2,763.93 2,587.32	 2.13 4.79 4.49	 180.99 87.30 159.52	 1,142.16 2,156.99 2,332.09	 1.89 3.58 3.87
	Total		472.38	6,579.25	11.41	427.81	5,631.24	9.34
4	Human Labour	Man days	76.65	13,797.42	23.92	76.31	13,736.95	22.79
5	Bullock Labour	Pair days	7.32	5,067.61	8.79	7.904	5,191.11	8.61
6	Machine Labour	Hours	3.21	1,255.58	2.18	2.90	1,296.75	2.15
7	Plant protection Chemicals	kg/lit	3.08	7,067.81	12.25	2.549	6,442.28	10.69
8	Irrigation charges	Times		148.2	0.26		148.2	0.25
9	Interest on working Capital @ 7 % per annum	₹		2,975.83	5.16		3,145.17	5.22
10	Total variable cost (TVC)	₹		45,487.74	78.86		48,076.28	79.74
11	Depreciation on farm machinery & equipment	₹		763.6	1.32		780.52	1.29
12	Land revenue and taxes	₹		123.5	0.21		123.5	0.20
13	Rental value of land	₹		10,000	17.34		10,000	16.59
14	Interest on Fixed cost @12 %	₹		1,306.45	2.26		1,308.48	2.17
15	Total fixed cost (TFC)	₹		12,193.55	21.14		12,212.50	20.26
16	Cost of cultivation (TVC+ TFC)	₹		57,681.29	100		60,288.79	100
17	Total output/ Returns	t	24.99	1,36,769.7		19.48	1,84,826.4	
18	Net returns	₹		79,088.37			1,24,537.6	
19	Benefit cost ratio		1.370			2.065		

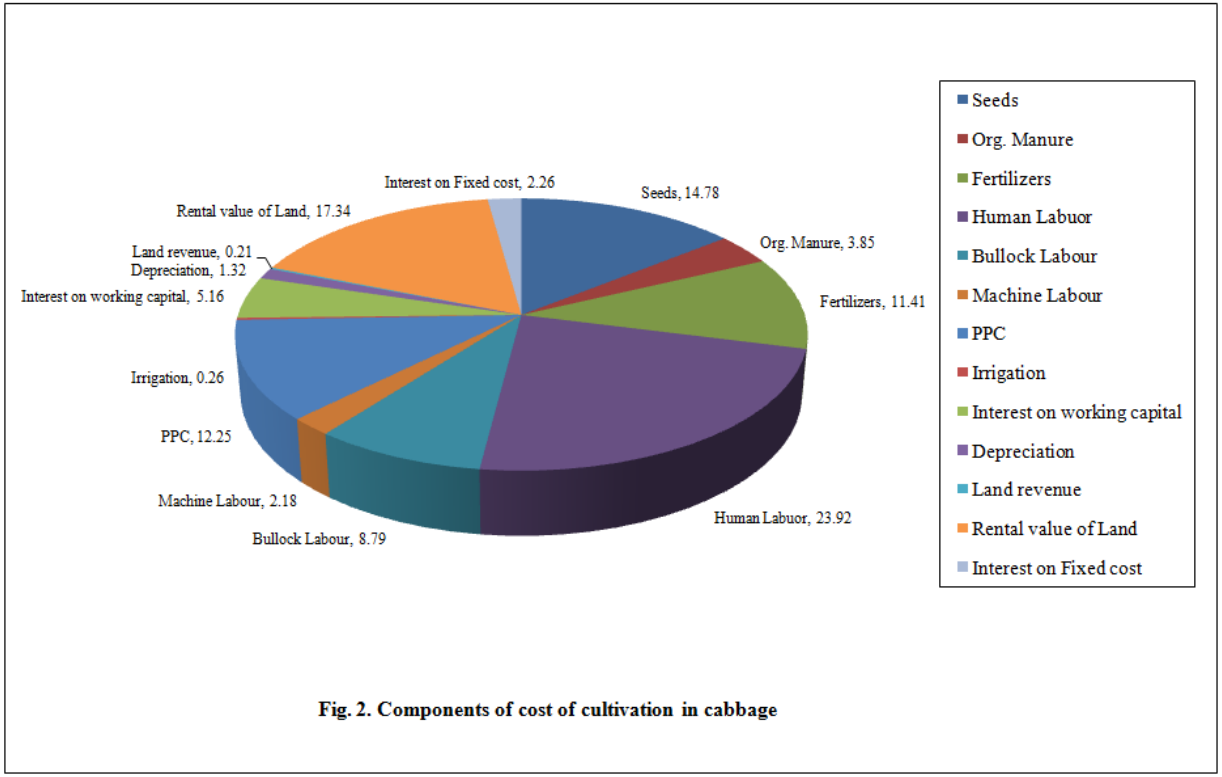


Fig. 2. Components of cost of cultivation in cabbage

Fig. 2. Components of cost of cultivation in cabbage

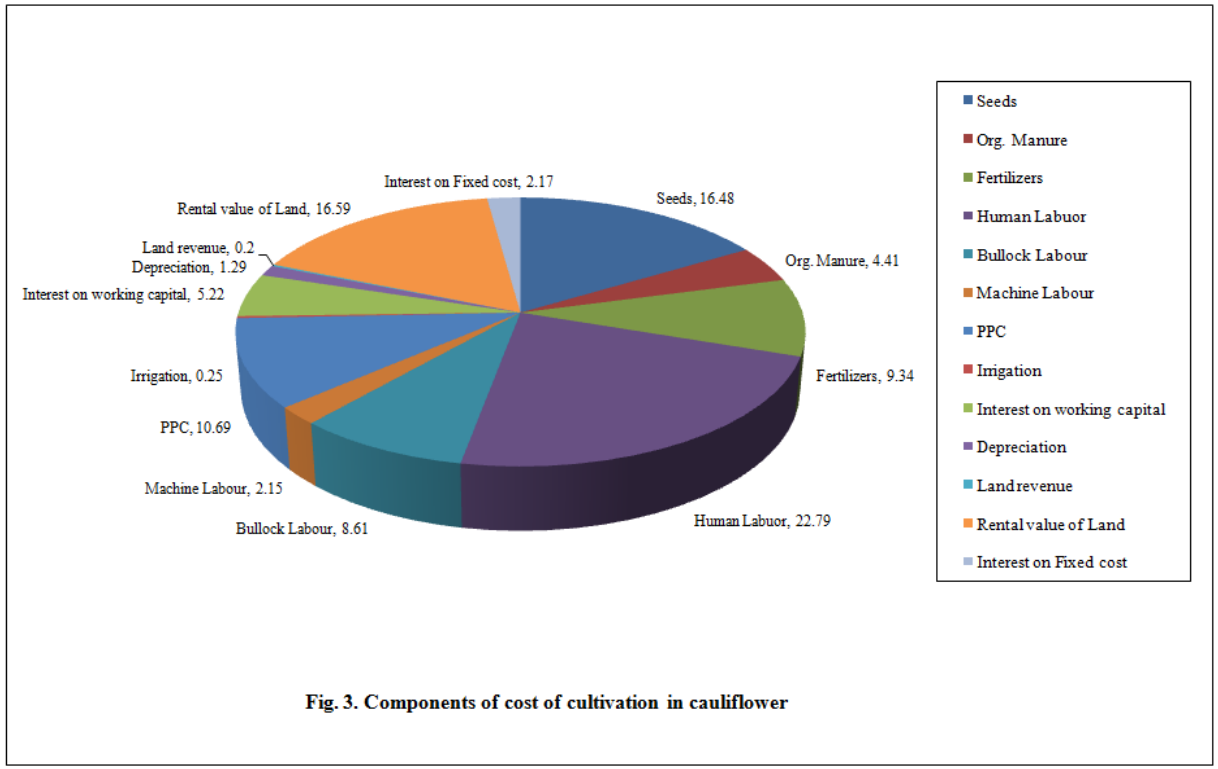


Fig. 3. Components of cost of cultivation in cauliflower

Fig. 3. Components of cost of cultivation in cauliflower

Table 4.5 Distribution of sample farmers according to type of pesticide used in cabbage and cauliflower

Sl No.	Name of Pesticides	Cabbage		Cauliflower	
		No. of farmer (n= 90)	Percent	No. of farmer (n= 90)	Percent
1	Organophosphates		82.0		87.6
	Dimethoate 30 % EC	25	27.7	23	25.5
	Quinalfos 25 % EC	20	22.2	24	26.6
	Chloropyriphos 20 % EC	16	17.7	14	15.5
	Dichlorvos 76 % EC	13	14.4	18	20.0
2	Organochlorine	15	16.6	12	13.3
3	Carbamates		42.1		43.3
	Indoxacarb 14.5 % SC	23	25.5	21	23.3
	Carbaryl 50 % WP	15	16.6	18	20.0
4	Thio carbamates		34.4		31.3
	Cartap hydrochloride 50 % SP	31	34.4	28	31.3
5	Pyrethroids		39.9		42.1
	Fenvalerate 20 % EC	26	28.8	25	27.7
	Cypermethrin 10 % EC	10	11.1	13	14.4
6	Others				
	Nuvaluron 10 % EC	14	15.5	16	17.7
	Spinosad 2.5 % SC	9	10	12	13.3
	Neem formulation 0.03 % EC	11	12.2	13	14.4
7	Fungicides and Herbicides				
	Copper oxy Chloride50 % WP	43	47.7	36	40.0
	Carbendazim 50 % WP	24	26.6	18	20.0
	Butachlor 50 % EC	23	25.5	31	34.4

Thio-carbamates group was used by 31.3 per cent farmers. Among pyrethroids, fenvelarate (27.7 %) and cypermethrin (14.4 %) were used. Novaluron and spinosad were also used by 17.7 per cent and 13.3 per cent of sample farmers respectively. Neem formulation was found to be used by only 14.4 per cent farmers. Farmers were using fungicides like copper oxychloride (40.0 %) and carbendazim (20.0 %), and butachlor (34.4 %) under herbicide.

Table 4.6 provided the information on per hectare quantity of pesticides used by cabbage and cauliflower growers. In both the crops, higher doses of all chemicals than the recommended dose in organophosphate were used by the farmers. Organochlorine, indoxacarb, carbaryl and cartap were used at higher level than the recommended dose. In pyrethroids, fenvelarate and cypermethrin, the excess quantity used was to extent of 0.19 a.i. l/ha 0.11 a.i. l/ha at an additional cost ₹ 329.46/ha, ₹ 600.2/ha respectively. Nuvaluron and spinosad were also used in higher quantity. Carbendazim was major fungicide used (1.049 a.i kg/ha against recommended dose 1.0) followed by copper oxy chloride. Similar pattern of excess dose use than their recommendation of most chemicals was also noticed.

4.4 Resource productivity in cabbage and cauliflower

The Cobb- Douglas production function was estimated to analyze the relationship between resource use and productivity of cabbage and cauliflower using the data collected from sample farmers. The gross returns in ₹/ha was taken as dependent variable while, expenditure incurred on seeds (₹/ha), fertilizers and manures (₹/ha), human labour (₹ /ha), bullock and machine labour (₹/ha) and PPCs (₹/ha) as independent variables. The estimated production functions are presented in the Table 4.7.

The coefficient of multiple determination (R^2) for cabbage was found to be 0.856. This indicated that the variables included in the function explained 85.6 per cent of the variation in the gross return of cabbage. The estimated parameters of seed (0.704) and human labour (0.302) were positive and significant at one per cent indicating that one per cent increase in expenditure on seeds and human labour would result in increase of gross return by 0.704 and 0.302 per cent respectively. Whereas expenditure on PPC (-0.137) was negative and significant at one per cent probability level reflecting one per cent increase in expenditure on PPC keeping the use of other resources constant would result in decrease of gross income by 0.137 per cent. Expenditure on fertilizers and manures (-0.052) was also negative and significant at five per cent probability level. For bullock and machine labour, the estimated production elasticity was positive (0.164) but non-significant. The summation of regression coefficients for cabbage was less than one ($\sum bi = 0.981$) and thus indicated decreasing returns to scale *i.e.,* one per cent incremental use of all inputs simultaneously, farmers would realize less than one per cent incremental gross returns.

The coefficient of multiple determination (R^2) indicated that the variables included in the function explained 87.8 per cent of the variation in the gross returns in cauliflower. The estimated parameters of seed (0.536) and human labour (0.362) were positive and significant at one per cent. Whereas expenditure on PPC (-0.046) was negative and significant at one per cent. The manure and fertilizer (-0.034) as well as bullock and machine labour (0.058) failed to exert significant influence on gross returns. The summation of regression coefficients for cauliflower was less than one ($\sum b_i = 0.875$) indicating decreasing returns to scale.

Table 4.6 Extent of major pesticides used in cabbage and cauliflower

(per ha)

Sl. No	Name of Pesticides	Rate ₹/ lit or kg of formulation	Recommended dose a.i. lit or kg /ha	Cabbage		Cauliflower	
				Quantity used a.i in kg or lit /ha	Value ₹/ha	Quantity used a.i in Kg or lit /ha	Value ₹/ha
1	Organophosphates						
	Chloropyriphos 20 % EC	310	0.4	0.482	747.32	0.407	630.87
	Quinalfos 25 % EC	425	0.5	0.629	1,070.7	0.519	883.53
	Dichlorvos 76 % EC	570	1.2	1.407	1,055.92	1.24	930.22
	Dimethoate 30 % EC	325	0.2	0.223	240.8	0.213	230.79
2	Organochlorine	300	0.30	0.39	333.45	0.345	296.4
3	Carbamates						
	Indoxacarb 14.5 % SC	3800	0.035	0.037	963.08	0.037	966.75
	Carbaryl 50 % WP	660	0.60	0.88	1,173.7	0.768	1,014.34
4	Thio carbamates						
	Cartap hydrochloride 50 % SP	1100	0.25	0.36	802.75	0.33	728.15
5	Pyrethroids						
	Fenvalerate 20 % EC	340	0.12	0.19	329.46	0.18	311.1
	Cypermethrin 10 % EC	540	0.06	0.11	600.21	0.083	453.49
6	Others						
	Nuvaluron 10 % EC	3700	0.05	0.053	1,958.35	0.049	1,827.8
	Spinosad 2.5 % SC	11340	0.003	0.003	1,400.49	.0029	1,344.47
	Neem formulation 0.03 % EC	250	0.005	0.0044	3705	0.0041	3473.43
7	Fungicides and Herbicides						
	Carbendazim 50 % WP	450	1.0	1.049	944.77	1.04	938.6
	Copper oxy Chloride 50 % WP	450	0.6	0.86	778.05	0.815	733.59
	Butachlor 50 % EC	250	1.5	1.80	900.6	1.79	897.34

Table 4.7 Cobb-Douglas production function estimates for cabbage and cauliflower

Sl No.	Explanatory variable	Cabbage		Cauliflower	
		Production elasticity	S.E.	Production elasticity	S.E.
1	Intercept	2.804	0.649	3.951	0.651
2	Expenditure on Seeds (₹/ha)	0.704**	0.033	0.536**	0.022
3	Expenditure on manures and fertilizers (₹/ha)	-0.052*	0.033	-0.034	0.019
4	Expenditure on plant protection chemicals (₹/ha)	-0.137**	0.025	-0.046**	0.017
5	Human labour (₹/ha)	0.302**	0.037	0.362**	0.042
6	Bullock and Machine labour (₹/ha)	0.164	0.093	0.058	0.030
	R^2	0.856**		0.878**	
	Calculated F value	100.26		121.84	
	Return of scale ($\sum b_i$)	0.981		0.875	

Note: *and ** denote significance at 5 and 1 per cent, respectively.

The Cobb-Douglas function estimates and geometric levels of inputs were used to estimate the marginal value product. The knowledge of the marginal value product of resources facilitated comparison of marginal value product with marginal factor cost of the resources to arrive at optimal use of resources. The results on MVP to MFC ratios are given in Table 4.8.

In cabbage the MVP to MFC ratios for seeds (11.25) and human labour (2.97) were more than one indicating that there was scope for higher utilization of these inputs to increase the gross income. This would help to maximize profit in cabbage production. The MVP to MFC ratios for manures and fertilizer (-1.06), PPC (-2.64) and bullock and machine labour (0.91) were negative and less than one. This indicated that these resources were over used and there was a need to reduce the use of these inputs to optimize returns.

In cauliflower the MVP to MFC ratios for seeds (10.02) and human labour (4.85) was more than one indicating the possibility of increasing gross income by increasing the use of these inputs. The MVP to MFC ratios for manures and fertilizer (-0.795), PPC (-1.33) and bullock and machine labour (0.76) were negative and less than one indicating the use of these resources in third stage of production.

4.5 Optimum quantity of pesticide use in cabbage and cauliflower cultivation

The optimum quantity of pesticides required for cabbage and cauliflower was estimated (Table 4.9) to be 2.462 and 2.466 (kg/l) respectively. But the actual quantity of pesticides used by farmers was 3.082 and 2.549 (kg/l) respectively. Thus farmers were found to use more than the optimal quantity of pesticides. In other words farmers lost ₹ 1,421.53 and ₹ 210.86 per ha because of indiscriminate use of pesticides in cabbage and cauliflower.

4.6 Marketing channels and price spread in cabbage and cauliflower

The following three marketing channels were identified in the study area in marketing of the cabbage and cauliflower (Table 4.10).

Channel- I: Producer →Commission agent-cum-wholesaler → Retailer →Consumer.

Channel- II: Producer →village trader → Commission agent-cum-wholesaler →Retailer →Consumer.

Channel- III: Producer →Retailer → Consumer.

About 62.29, 30.07 and 7.46 per cent of the marketable surplus of cabbage was sold through channel-I, II and III respectively. In the case of cauliflower 55.66, 34.06 and 10.29 per cent of the sample farmers sold through channel-I, II and III respectively.

Marketing cost of different market intermediaries through respective marketing channels in cabbage and cauliflower is shown in Table 4.11. In the case of cabbage marketing cost per quintal incurred by producer was ₹ 40.3 (channel-I) and ₹ 42.98 (channel-III), in which the share of transportation cost was highest (33-35 %) followed by expenditure on gunny bag and packing, wastages and commission charges. Marketing cost was lowest for producer in channel-II (₹ 20.87/q) because of absence of transportation cost and commission charges. Marketing cost of village traders in channel-II was ₹ 41.25/q which was majorly contributed by cost of transportation (26.33 %), gunny bag (17.72 %) shorting and packing (16.27 %). The salary of permanent labour accounted for 16.75 per cent of marketing cost (₹ 41.25/q) of commission agent-cum-wholesaler. The marketing cost incurred by retailer was ₹ 153.9/q in channel-I, where value of wastage accounted for highest (42.53 %) followed by transportation cost (37.68 %) and others (8.02 %).

Table 4.8 Allocative efficiency in cabbage and cauliflower cultivation

(per ha)

Sl No.	Explanatory variable	Cabbage	Cauliflower
		MVP/ MFC	MVP/ MFC
1	Seeds (₹/ha)	11.25	10.02
2	Manures and fertilizers (₹/ha)	-1.06	-0.795
3	Plant protection chemicals (₹/ha)	-2.64	-1.33
4	Human labour (₹/ha)	2.97	4.85
5	Bullock and Machine labour (₹/ha)	0.91	0.76

Table 4.9 Optimum and actual quantity of pesticide use in cabbage and cauliflower

(per ha)

Particulars	Optimal use		Actual use	
	Quantity a.i. (kg or lit)	Value (₹)	Quantity a.i. (kg or lit)	Value (₹)
Cabbage	2.462	5,646.27	3.082	7,067.80
Cauliflower	2.466	6,231.42	2.549	6,442.28

Table 4.10 Marketing channels identified for cabbage and cauliflower

Channel	Intermediate involved	Cabbage		Cauliflower	
		Farmer (n= 90)	Quantity (q)	Farmer (n= 90)	Quantity (q)
I	Producer--Commission agent-cum-wholesaler-- - Retailer- consumer	58 (64.44)	5,476.5 (62.29)	51 (56.66)	3,906.5 (55.66)
II	Producer---village traders Commission agent-cum- wholesaler -- Retailer- - Consumer	24 (26.66)	2,643.75 (30.07)	28 (31.11)	2,390.25 (34.06)
III	Producer-- Retailer-- Consumer	7 (7.77)	672 (7.64)	11 (12.22)	722 (10.29)
	Total farmers	90 (100.00)	8,792.25 (100.00)	90 (100.00)	7,018.75 (100.00)

Figures in parentheses indicates percentage to total

Table 4.11 Marketing cost incurred by different intermediaries in cabbage and cauliflower

(₹/q)

	Particulars	Cabbage			Cauliflower		
		Channel I	Channel II	Channel III	Channel I	Channel II	Channel III
A	Marketing cost incurred by producer						
1	Gunny bag and packing	7.39 (18.34)	7.94 (38.05)	7.90 (18.38)	7.57 (18.84)	8.07 (34.87)	7.68 (16.97)
2	Loading/Unloading	2.54 (6.30)	2.33 (11.16)	3.49 (8.12)	2.59 (6.45)	2.39 (10.33)	3.59 (7.93)
3	Transportation	14.16 (35.14)		14.27 (33.20)	14.6 (36.34)		14.74 (32.57)
4	Fee/commission	5.13 (12.73)			3.88 (9.66)		
5	Wastages	5.88 (14.59)	5.1 (24.44)	7.37 (17.15)	6.09 (15.16)	7.08 (30.60)	9.78 (21.61)
6	Others	5.2 (12.90)	5.5 (26.35)	9.95 (23.15)	5.45 (13.56)	5.6 (24.20)	9.46 (21.61)
	Total	40.3 (100.0)	20.87 (100.0)	42.98 (100.0)	40.18 (100.0)	23.14 (100.0)	45.25 (100.0)
B	Marketing cost incurred by village traders						
1	Gunny bag		7.31 (17.72)			7.2 (17.71)	
2	Sorting & packing		6.71 (16.27)			6.61 (16.26)	
3	Loading/Unloading		2.85 (6.91)			2.81 (6.91)	
4	Transportation		10.86 (26.33)			10.65 (26.20)	
5	Tax/Market fee		5.27 (12.78)			5.32 (13.09)	
6	Wastages		4.52 (10.96)			4.40 (10.82)	
7	Others		3.73 (9.04)			3.66 (9.00)	
	Total		41.25 (100.0)			40.65 (100.0)	
C	Marketing cost incurred by commission agent-cum- wholesaler						
1	Permanent staff	8.28 (16.75)	8.28 (16.75)		8.88 (17.46)	8.88 (17.46)	
2	Loading/Unloading	5.05 (10.20)	5.05 (10.20)		5.41 (10.63)	5.41 (10.63)	
3	Transportation	13.15 (26.55)	13.15 (26.55)		13.23 (26.01)	13.23 (26.01)	
4	Tax/ license	6.49 (13.11)	6.49 (13.11)		6.79 (13.35)	6.79 (13.35)	
5	Wastage	7.94 (16.03)	7.94 (16.03)		7.88 (15.49)	7.88 (15.49)	
6	Others	8.61 (17.39)	8.61 (17.39)		8.68 (17.06)	8.68 (17.06)	
	Total	49.52 (100.0)	49.52 (100.0)		50.87 (100.0)	50.87 (100.0)	
D	Marketing cost incurred by Retailer						
	Packing material	6.23 (4.05)	6.23 (4.05)	6.23 (5.29)	6.86 (4.38)	6.86 (4.38)	6.86 (5.71)
	Loading/Unloading	2.54 (1.65)	2.54 (1.65)	2.54 (2.15)	2.33 (1.49)	2.33 (1.49)	2.33 (1.94)
	Transportation	57.99 (37.68)	57.99 (37.68)	21.97 (18.64)	58.41 (37.31)	58.41 (37.31)	22.03 (18.33)
	Wastages	65.46 (42.53)	65.46 (42.53)	65.46 (55.53)	66.38 (42.40)	66.38 (42.40)	66.38 (55.23)
	Market fee	9.34 (6.07)	9.34 (6.07)	9.34 (7.92)	8.91 (5.69)	8.91 (5.69)	8.91 (7.41)
	Others	12.34 (8.02)	12.34 (8.02)	12.34 (10.47)	13.67 (8.73)	13.67 (8.73)	13.67 (11.37)
	Total	153.9 (100.0)	153.9 (100.0)	117.88 (100.0)	156.56 (100.0)	156.56 (100.0)	120.18 (100.0)

Figures in parentheses indicate percentage to marketing cost

In cauliflower, the marketing cost incurred by the producer was ₹ 40.18/q (channel-I) and ₹ 45.25/q (channel-III), in which the proportion of transportation cost ranged from 32 to 36 per cent, whereas marketing cost was ₹ 23.14/q in channel-II. With respect to village traders marketing cost was ₹ 40.65/q which was majorly contributed by cost of transportation (26.20 %), gunny bag (17.71 %) shorting and packing (16.26 %). The share of transportation cost was 26.01 per cent of the total cost incurred by commission agent-cum-wholesaler followed by permanent staff (17.46 %), wastage (15.49 %). The marketing cost incurred by retailer was ₹ 156.56/q in channel-I and channel-II, where the value of wastage accounted for highest (42.40 %) followed by transportation cost (37.31 %) and others (8.73 %). The value of wastages shared highest (55.23 %) in the marketing cost incurred by retailer (₹ 120/q) in channel-III.

Price spread and profit margin in marketing of cabbage in different marketing channels is shown in the Table 4.12. The net price for producer was ₹ 508 /q in channel-I, ₹ 511.12 / q in channel-II and ₹ 638.3 /q in channel-III. The ultimate price paid by consumer was ₹ 1,133.35/ q, ₹ 1,442.02/q and ₹ 1,211.5 /q respectively. The average price spread of ₹ 756.25/q in channel-I, ₹ 930.3/q in channel-II and ₹ 573.18/q in channel-III was noticed. The producer's share in consumer rupee was 43.4 per cent, 35.4 per cent and 52.68 per cent respectively in channel-I, II and III. Marketing cost incurred by producer in different channels was ₹ 40.3, ₹ 20.87 and ₹ 42.98 per q accounting for 5.32 per cent, 2.24 per cent and 7.49 per cent of the total price spread. Marketing cost incurred by commission agent-cum-wholesaler (Table 4.12) was 6.54 per cent and profit margin was 20.15 per cent in the channel-I. Marketing cost incurred by village trader was 4.43 per cent and profit margin was 13.7 per cent in the channel-II. The marketing cost incurred by retailer was 20.30 per cent in channel-I, 16.37 per cent in channel-II and 20.56 per cent in channel-III. The profit margin of retailer was 47.67 per cent, 41.31 per cent and 71.93 per cent in channel-I, II and III respectively.

Price spread and profit margin in marketing of cauliflower in different marketing channels is shown in the Table 4.13. The per quintal net price for producer was observed highest in channel-III ₹ 1,088.84, followed by channel-I (₹ 980.22) and channel-II (₹ 940.06). The consumer price was least (₹ 1,709.87/q) in channel-III. The price spread worked out to be ₹ 852.01/q in channel-I, ₹ 1,064.62/q in channel-II and ₹ 621.03/q in channel-III. The producer share in consumer rupee was highest in channel-III (63.67 %), followed by channel-I (53.49 %) and channel-II (46.89 %). There was marginal difference in marketing cost of producer between channel-I (₹ 40.18) and channel-III (₹ 45.25). Marketing cost incurred by farmers was lowest (₹ 23.14/q) in channel-II due to saving on transportation cost. Marketing cost incurred by commission agent-cum-wholesaler was ₹ 50.86/q with a profit margin of ₹ 194.7/q. Marketing cost incurred by village trader was 3.81 per cent and profit margin was 16.01 per cent of the price spread in the channel-II. In respect of retailer, the share of marketing cost were 18.37 per cent, 14.7 per cent and 19.35 per cent of the total price spread and the share of profit margin were 48.08 per cent, 40.20 per cent and 73.36 per cent in channel-I, II and III respectively.

Table 4.12 Price spread and profit margin in marketing of cabbage in different channels

(₹/q)

Sl. No.	Particulars	Channel-I	Channel -II	Channel - III
A	Producer			
1	Gross price	620.4	532	681.31
2	Marketing cost	40.3 (5.32)	20.87 (2.24)	42.98 (7.49)
3	Net price	508.1	511.12	638.33
B	Village traders			
1	Purchasing price		532	
2	Marketing cost		41.25 (4.43)	
3	Profit margin		128.35 (13.78)	
C	Commission agent-cum- wholesaler			
1	Purchasing price	620.4	701.6	
2	Marketing cost	49.5 (6.54)	49.52 (5.31)	
3	Profit margin	152.4 (20.15)	152.4 (16.37)	
D	Retailer			
1	Purchasing price	822.3	903.5	681.31
2	Marketing cost	153.9 (20.35)	153.9 (16.53)	117.88 (20.56)
3	Profit margin	360.15 (47.62)	384.62 (41.31)	412.32 (71.93)
E	Consumer price	1,336.35	1,442.02	1,211.51
F	Producer share in consumer rupees %	43.4	35.44	52.68
G	Price spread	756.25 (100)	930.3 (100)	573.18 (100)

Figure in parentheses indicate percentage to total price spread in respective marketing channel

Table 4.13 Price spread and profit margin in marketing of cauliflower in different channels

(₹/q)

Sl. No.	Particulars	Channel-I	Channel -II	Channel - III
A	Producer			
1	Gross price	1,020.4	963.2	1,134.09
2	Marketing cost	40.18 (4.71)	23.14 (2.17)	45.25 (7.28)
3	Net price	980.22	940.06	1,088.84
B	Village traders			
1	Purchasing price		963.2	
2	Marketing cost		40.65 (3.81)	
3	Profit margin		170.5 (16.01)	
C	Commission agent-cum- wholesaler			
1	Purchasing price	1,020.4	1,174.35	
2	Marketing cost	50.87 (5.97)	50.87 (4.77)	
3	Profit margin	194.7 (22.85)	194.7 (18.28)	
D	Retailer			
1	Purchasing price	1,265.97	1,419.92	1,134.09
2	Marketing cost	156.56 (18.37)	156.56 (14.7)	120.18 (19.35)
3	Profit margin	409.7 (48.08)	428.2 (40.2)	455.6 (73.36)
E	Consumer price	1,832.23	2,004.68	1,709.87
F	Producer share in consumer rupees %	53.49	46.89	63.67
G	Price spread	852.01 (100)	1,064.62 (100)	621.03 (100)

Figure in parentheses indicate percentage to total price spread in respective marketing channel

4.7 Production and marketing problems faced by the farmers

Problems faced by sample farmers in production and marketing of cabbage and was analysed by using Garret score ranking technique. Lack of labour availability (Table 4.14) was major production problem faced by farmers (Garret mean score 72.8), followed by problems on pest and disease (mean score 62.76), lack of funds to buy inputs (seeds, fertilizer and plant protection chemicals) (mean score 58.43), irregular power supply (mean score 37.46) and inadequate irrigated water (mean score 30.73).

In the case of marketing, fluctuation of price (mean score 138.36) was major problem as reported by majority of farmers, followed by poor transportation facility (mean score 118.7), exploitation by middleman (mean score 111.46) and poor marketing facilities (mean score 70.63).

Table 4.14 Problems in production and marketing of cabbage and cauliflower

(n=180)

Sl.No.	Particulars	Score sum	Mean score	Rank
A	Production problems			
1	Labour scarcity	6552	72.8	I
2	Problems of pest and diseases	5649	62.76	II
3	Lack of funds to buy inputs	5259	58.43	III
4	Irregular power supply	3372	37.46	IV
5	Inadequate irrigated water	2766	30.73	V
B	Marketing problems			
1	Fluctuation in Price	12453	138.36	I
2	Poor transportation facility	10689	118.76	II
3	Exploitation by middlemen	10032	111.46	III
4	poor marketing facility (storage, market information, sanitary)	6357	70.63	IV

5. DISCUSSION

The results presented in the previous chapter are discussed in this chapter. It aims to explain the possible causes for the results obtained and are presented under the following sub-heads.

5.1 General characteristics and cropping pattern of the sample farmers

5.2 Cost and returns in the production of cabbage and cauliflower

5.3 Nature and extent of pesticide use in cabbage and cauliflower

5.4 Resource productivity in cabbage and cauliflower

5.5 Optimum quantity of pesticide use in cabbage and cauliflower

5.6 Marketing channels and price spread in cabbage and cauliflower

5.7 Production and marketing problems faced by the farmers

5.1 General characteristics and cropping pattern of the sample farmers

The information regarding age, educational status, family size, types of family and occupational pattern is presented in Table 4.1. Most of the cabbage and cauliflower growing farmers were of middle age (35- 50 years) group. Thus it could be inferred that the middle age farmers are interested in growing vegetable crops which requires more resources, management and time. Moreover in marketing the produce, vegetable cultivation requires risk bearing ability.

With respect to the literacy rate, it was noticed that majority of farmers (84 %) were literates. Literacy level of sample respondents ranged from primary level education to graduation level. Majority of the cabbage and cauliflower farmers (50 %) had education up to secondary level, and only less than 16 per cent were illiterates. Thus this indicated that the literate farmers prefer to grow vegetables. Higher education helped them to acquire better knowledge on production technology and facilitated better decision making. Education also facilitates farmers to understand and follow new crop technology which is profitable. They show more interest in participating training programmes and other extension programmes and overcome agronomic, financial and marketing problems.

Majority of the sample cabbage (65.6 %) and cauliflower growers (68.9 %) were from nuclear family type, and only one third of them belonged to joint family. This might be due to their realization regarding the increased cost of living and difficulties in maintenance of joint family. The average size of the family for cabbage and cauliflower growers ranged from 4 to 6 members. The farmers adopted profitable vegetable cultivation in the cropping pattern to meet increased cost of living especially when family size was large. The predominance of nuclear family was due to the realization of disadvantages of joint family in terms of fewer responsibilities, privacy and more freedom in taking family decisions.

All the respondents were involved in agriculture. More than 50 per cent were dependent on agriculture only as their source of livelihood. One fourth of respondents adopted subsidiary activities like dairy and poultry in addition to agriculture. Dairy was one of the most popular subsidiary enterprises in the area. Percentage of respondents involved in job along with agriculture which included government and private service, agricultural labourers was only around 20 per cent in cabbage and cauliflowers growers.

The proportion of average dry land (Table 4.2) compared to that of irrigated land was more among cabbage (61.27 %) and cauliflower (58.07 %) growers due to non-coverage of canal command area and also inadequate access to bore wells and open wells in the study area. There was marginal difference in size of land holding and operational land holding. This was because of less degree of leased in or leased out practices in the study area.

The respondents cultivated a number of crops (Table 4.3) on their farm. Chilli, onion, cabbage, cauliflower, tomato and brinjal were major vegetable crops. Sugarcane occupied more area compared to any other crops in both cabbage and cauliflower mainly because of prevalence of jaggery processing units, sugar factories supported by relatively better returns from cultivation of sugarcane. Maize, jowar, soybean, green gram and chick pea were also grown by sample farmers. Cabbage and cauliflower were grown mainly in rabi season which accounted for 16.4 per cent and 20.32 per cent of gross cropped area. Few farmers were also found to grow cabbage and cauliflower (3 to 4 %) in summer season wherever irrigation facilities were adequate. Cabbage and cauliflower are profitable crops on account of higher productivity and suitable climate in this area as well as greater demand in market. The kharif and rabi crops shared almost equal proportion in the total gross cropped area and summer crops occupied less area in cabbage and cauliflower growing farmers. The higher cropping intensity was witnessed for both cabbage (212.32 %) and cauliflower (218.86 %) farmers mainly because the study area comes under transitional belt and receives better rainfall.

5.2 Cost and returns in the production of cabbage and cauliflower

The cost of cultivation in cabbage was ₹ 57,681.29 /ha and it was ₹ 60,288.79 /ha in cauliflower (Table 4.4). The share of variable cost in total cost of cultivation in both the crops was major (nearly 78 to 80 %) and remaining about 20 per cent was shared by fixed cost. The cost incurred on human labour was found to be the major cost component in the cultivation of cabbage (23.92 %) and cauliflower (22.79 %). This was because most of the operations like harvesting/picking, spraying and weeding are labour intensive operations. The study by Priscilla, (2015) on vegetable production in Manipur reported that the share of human labour was 27.96 per cent of total cost of cultivation.

The seed materials and plant protection chemicals (PPC) were the next key items of expenditure which shared major portion in the total variable cost. This was due to fact that farmers get seedling from nursery at higher costs (ranged between ₹ 8,526 /ha to ₹ 9,935/ ha) and added to this pest and disease infestation in these two crops was more as compared to other vegetable crops. The share of plant protection chemical in the total cost was 12.25 per cent in cabbage and 10.69 per cent in cauliflower because farmers were observed to apply more number of times of pesticides sprays ranging from 6 to15. The share of machine labour was less than 3 per cent as cabbage and cauliflower cultivation has limited scope for using machine in cultivation operations except at the time of land preparation. The fixed cost items like land revenue, depreciation, rental value and interest on fixed cost was almost similar in both cabbage and cauliflower.

Total output per hectare was 24.99 tonnes in cabbage and 19.48 tonnes in cauliflower witnessing high potential and productivity of these two crops in the study area compared to average productivity (20.8 tonnes/ha in cabbage and 17.6 tonnes/ha in cauliflower) in Karnataka state. The

gross returns per ha was found to be higher in cauliflower (₹ 1,84,826.4 /ha) compared to cabbage (₹ 1,36,769.7/ha) due to higher price of cauliflower (₹ 947.1 /q) than that of cabbage (₹ 548.94/q). Net returns per hectare were ₹ 79,088.37 in cabbage and ₹ 1,24,537.3 in cauliflower. The B:C ratio per rupee spent in vegetable production was higher in cauliflower (2.06) than in cabbage (1.37). Nagendra (2009) reported a B:C ratio of 1.41 in cabbage cultivation in Belagavi district. High B: C ratio clearly indicated that cultivation of cauliflower was more profitable than cabbage though both crops are having high B:C ratio.

5.3 Nature and extent of pesticide use in cabbage and cauliflower

Cabbage and cauliflower cultivation is known for high infestation of pests and diseases may be due to placement of head or curd close to moist soil and development of pesticide resistance. The major insects in cabbage and cauliflower observed were diamond back moth (DBM), head borer, leaf webber, aphid and under diseases collar rot, leaf spot, and damping off. Head borer used to enter easily and cause enormous economic loss in one night to the cabbage and cauliflower. Thus sample farmers were found to use frequent and high dose of pesticides in cabbage and cauliflower. Number of pesticide existed with varying formulations and trade name, price, dozes and interval of application. Major types of pesticides including fungicide and herbicide used in the study area were presented in Table 4.5. Organophosphate was major group which used by majority of (82 to 87 %) farmers. Chlorpyriphos was used (17.7 %) for control of DBM, marketed under trade name Radar, Mukka, Strong etc. Dichlorvos, an extremely hazardous pesticide marked under different trade name Nuvan, Boom, Cyclone was also found to be used by considerable number of farmers (14.4 % in cabbage, 20.0 % in cauliflower) because it is effective pesticide to control aphids. Indoxacarb (carbamates), fenvalerate and cypermethrin (pyrethroids), Novaluron were the pesticides used distinctly to control diamond back moth.

Quinalphos and dimethoate, organochlorine, carbaryl (carbamate), cartap (thio-carbamate), fenvalerate and spinosad were important pesticides used under moderately hazardous group. These were effective on wide spectrum of pests namely DBM, aphids, leaf webber and head borer in cabbage and cauliflower. Synthetic pyrethroids (fenvalerate and cypermethrin) were used by one third of sample farmer in cabbage and cauliflower. These pesticides are less toxic and have less residual effect, as compared to other pesticides. Bio-pesticides (neem formulation) were applied by few farmers (ranged from 12 to 14 %). It was effective at higher doses (40-50 ml/lit) but cost was higher as compared to other chemical pesticides.

With respect to control of fungal and bacterial diseases was concerned more than 60 per cent farmer used different fungicides. Copper oxy chloride (47.7 % in cabbage, 40.0 %in cauliflower) was mainly used fungicide followed by carbendazim to control the collar rot, leaf spot, downy mildew and dumping off in seedling. Butachlor as weedicides was used by good number of farmers (25.5 % in cabbage and 34.4 % in cauliflower). Jeyanthi and Kombairaju (2005) noticed moderate consumption of high- risk pesticides (45 and 28 %) of area in cabbage and cauliflower). Further cypermethrin, fenvalerate and profenofos were also used most frequently in cabbage and cauliflower.

The severity of pest problems and difficulties in control prompted the farmers to try several formulations (Table 4.6). On an average the quantities of all the pesticides were found to be used in excess as against the recommended dose in cabbage and cauliflower cultivation. The high quantity of organophosphates was frequently used (4 to 5 times). The pesticides like indoxacarb (0.037) and cartap hydrochloride (0.36) were also used at higher dose by the cabbage and cauliflower growers even though the cost of these formulations was relatively more and are higher toxic. The use of synthetic pyrethroids (fenvalerate and cypermethrin) was also noticed because of their effectiveness against a broad spectrum of pests and less harmful to environment. These formulations were used in excess quantity above the recommended dose. The quantity of new class pesticides (novaluron and spinosad) were found to be used at the recommended dose due to fact they were high priced and more effective. Few farmers used bio-pesticide (neem formulation) and weedicide in cabbage and cauliflower because of inadequate availability market and low awareness about these formulations. The use of higher doses of pesticides was attributed to higher quantities suggested by pesticide dealers, limited access of extension services and training, dependence on experience of other farmers for advice to manage pests and diseases. Problems of pest outbreaks, resistance and resurgence of pests also led to higher use. Overuse of pesticide was also because of farmer misperception and lack of income, education, farm size, ownership and training practicing IPM as noted by Dasgupta *et.al.* (2007). Jeyanthi and Kombairaju (2005) noticed that 44 per cent of cauliflower growers overused pesticides in the range of 2 to 3 kg of a.i/ha.

5.4 Resource productivity in cabbage and cauliflower

The Cobb- Douglass production function considering gross income (₹/ha) realized from vegetables output as dependent variable and expenditure made on seed (₹/ha), fertilizers and organic manure (₹/ha), PPCs (₹/ha), human labour (₹/ha) and drought power (bullock and machine) (₹/ha) as independent variables was estimated to study the resource use efficiency. The (Table 4.7) variables included in the production function explained more than 85 per cent variation in gross income in cabbage and cauliflower. Decreasing returns to scale were observed for cabbage ($\sum b_i$ =0.981) and cauliflower ($\sum b_i$=0.875) indicating for each per cent incremental use of all inputs simultaneously farmers would get less than one per cent incremental gross returns. This clearly revealed that by reducing inputs to optimum level (expenditure on manure & fertilizer and PPC) in cabbage and cauliflower production returns could be optimized. The output elasticity's of seeds and human labour in both crops were found to be positive and significant at one per cent which implied the increased contribution of these inputs to the gross income. Since the vegetable crops were labour intensive and the operations such as inter cultivation, sowing, hand weeding and harvesting require more labour.

The output elasticity of manures and fertilizer (-0.052 in cabbage and -0.034 in cauliflower) and plant protection chemicals (-0.137 in cabbage and -0.046 in cauliflower) were negative and significant. Fertilizer use was seen relatively high in both vegetables. Application of excess manures and fertilizers would result in growth of plant as fleshy and greenly which in turn attracts more insects and pests this would lead to crop loss and finally reduces gross income. Also due to lack of awareness on exact requirement of these inputs and habit of applying more quantity of pesticides to

control pest and diseases resulted in reduced gross income. Thus, the scope for optimization exists with respect to manure and fertilizer use and plant protection chemicals. The production elasticities of bullock and machine labours were (0.164 in cabbage and 0.058 in cauliflower) positive but non-significant because of limited scope for using machine during cultivation operations except at the time of land preparation. The findings were in concurrence with the study by Nagendra (2009) in Belagavi district where he also reported significant influence of seeds on cabbage yield.

The Cobb-Douglas production function estimates and geometric mean values of inputs and outputs were used to estimate the ratio of marginal value products to marginal factor cost. The ratio less than one indicated excess use of the particular input. Optimal use of resources occurs when the ratio is unity. The Marginal Value Product to Marginal Factor Cost (Table 4.8) ratio was positive and greater than unity in the case of seeds (11.25 in cabbage and 10.02 in cauliflower) and human labour (2.97 in cabbage and 4.85 in cauliflower) indicating underutilization of these inputs.

The Marginal Value Product to Marginal Factor Cost ratio for manure and fertilizers (-1.06 in cabbage and-0.79 in cauliflower), PPC (-2.64 cabbage and -1.33 in cauliflower) were negative. This indicated that each additional rupee spent on manure and fertilizer and PPC, would result in reduction in the gross income. In other words these resources were used excessively by farmers with an intention of increasing yields. The ratio for bullock and machine labour (0.91 in cabbage and 0.76 in cauliflower) was found to be positive and near to unity indicating that this resource was utilized almost to optimum level.

5.5 Optimum quantity of pesticide use in cabbage and cauliflower

The recommended and optimum quantity of pesticide for cabbage and cauliflower was presented in Table 4.9. The optimum quantity of pesticide required for cabbage and cauliflower was estimated to be 2.462 and 2.466 (kg/lt) respectively. But the actual quantity of pesticide used by farmers was 3.082 and 2.549 (kg/lt) respectively. Thus farmers were found to use more than the optimal quantity of pesticide. In other words, farmers lost ₹1,421.53 and ₹ 210.86 per ha because of an irrational use of pesticides in cabbage and cauliflower production. Therefore any increase in pesticide use over and above the optimal level is uneconomical. This was because of the risk aversive nature of farmers to avoid crop loss due to pest. Moreover, in the process of overusing pesticide, environmental problems are inevitable. The study by Premlata (2015) on economics of pesticide use in brinjal in Belagavi district of Karnataka noticed that the excess use of pesticides. Study by Nagendra (2009) on pesticide use in cabbage production in Belagavi district also reported excess use of pesticides.

5.6 Marketing channels and price spread in cabbage and cauliflower

The three marketing channels were found to be popular in the study area in marketing of the cabbage and cauliflower. The commission agent-cum-whloesaler and retailer acted as intermediary between farmer and consumer in channel-I. In channel-II village trader, commission agent cum whloesaler and retailer operated between producer and consumer. The farmer sold his produce to retailer and retailer moved it consumer in channel-III. The most popular channel among these was channel-I as more than 50 per cent of cabbage and cauliflower reached the consumers in this channel

(Table 4.10). Majority of farmers preferred to sell their output to commission agent-cum- whloeseler because of easy access to nearby market place, also because of better price and credit facility offered by commission agents. The gross price obtained by producer was normally dependent on demand and arrival of the cabbage and cauliflower in local and nearby market. Most of wholesalers or their relatives in vegetable market assume the role of commission agent.

One fourth of surplus was moved through channel-II, where village traders used to collect cabbage and cauliflower directly from the farmers' field. In channel-II producer incurred less marketing cost saving on transportation cost, market cess, hamali charges etc. and also saved time. Only 7 to 10 per cent of surplus was sold by producers to retailer (channel-III) in local market. This was attributed to personal contact and accessibility between the producer and retailer.

The share of different items of marketing cost in various channels, presented in Table 4.11, revealed that the marketing cost per quintal incurred by producer was around 40 to 45 rupees in channel-I and channels II in both cabbage and cauliflower. The share of transportation was highest (33 to 36 %) followed by expenditure on packing material, fee and commission charges. The marketing cost was lesser in channel-II because output was sold directly from producer field to village trader, thereby no cost was incurred on transportation and commission charges. Transportation charges, followed by cost on packing constituted major items of total cost in all the channels of cabbage and cauliflower marketing. The wholesaler spent on loading/ unloading, packing, etc. and retained lower margins due to the fact that they were dealing with huge quantities of commodities. Cost of spoilage was accounted for more than 42 per cent of marketing cost of retailer, which was due to physical injury during frequent transit as retailers used to sell output in small quantities on a daily basis. The detachment of outer leaves in cabbage and removal of portion of head in cauliflower during transit also resulted in the loss. Loss at this level also included part of the unsold produce that went as waste due to rotting and injury.

The information regarding various market intermediaries, their marketing cost and profit margin, variation in total marketing margin/ price spread in cabbage and cauliflower was found almost similar (Table 4.12 and Table 4.13). The net price per quintal received by producer was highest in channel-III (₹ 638.3 in cabbage and ₹ 1088.8 in cauliflower) followed by channel-I and channel-II. The producers' directly sold their output to retailer which was very close to ultimate consumer and has more bargaining capacity depending upon consumer price prevailing in the market. The price paid by consumer per quintal were highest in channel-II (₹ 1,442.0 in cabbage and ₹ 2004.6 in cauliflower) followed by channel-I (₹ 1,336.3 cabbage, ₹ 1,832.2 cauliflower). The average price spread per quintal was ₹ 756.2 in cabbage and ₹ 852 in cauliflower in channel-I, ₹ 930.3 in cabbage and ₹ 1064.6 in cauliflower in channel-II and ₹ 573.1 in cabbage and ₹ 621 in cauliflower in channel-III. The price spread was least in channel-III (producer – retailer- consumer) due to less number of intermediaries operated in the channels. But this channel has its own limitation in that only small quantity of produce was traded.

The producer share in consumer rupees were highest in channel-III (cabbage- 52.68 %, cauliflower- 63.67 %) followed by channel-I (cabbage- 43.4 %, cauliflower- 53.49 %). The producer share in consumer rupees was inversely related to length of marketing channel. Marketing cost of producer in channel-II was least (2.5 %) in cabbage and cauliflower, because output was directly sold to village trader and there was no transportation cost, hamali charges, commission charges. Marketing cost per quintal of village trader ranged between 3.5 and 4.5 per cent with a profit margin ranging from 13 to 16 per cent in cabbage and cauliflower. The village traders played a very important role in moving the produce from village to the market with considerably lower profit margins.

The marketing cost of commission agent-cum-whloeseler ranged from 5 to 7 per cent and their profit margin ranged from 16 to 22 per cent. Among the commission agent-cum-whloeseler it was interesting to note that they were getting higher net margin to their cost incurred in the marketing process mainly due to higher commission charged, personal contacts, adequate market information regarding demand, arrivals and price in the nearby and district markets. The marketing cost of retailer ranged from 14 to 20 per cent with a high profit margin of 40.2 to 73.93 per cent in cabbage and cauliflower. It was worth noting that among the market intermediaries, the share of retailers in the marketing margin was higher than other intermediaries. This was attributed to the risk he assumes for loss due to wastage in handling, spoilage with passage of time, price fluctuations *etc.* Similar results were reported by Shelke (2009) while studying the economics of price spread in marketing of major vegetables in Parbhani market.

5.7 Production and marketing problems faced by the farmers

The opinion survey was conducted to know the problems faced by sample farmers and was subjected to Garrett's ranking technique. The results of the analysis are presented in Table 4.14.

Among the five major production constraints considered, lack of labour availability emerged as a major problems as expressed by most of the respondents which had a highest mean score (72.8) and was ranked I. This was due to excessive and instant demand for human labour for different agricultural operations particularly during peak period. In recent years labour migration from rural areas to urban areas in search of alternative employment for their livelihood. Hence, non availability of labour has become a universal problem in farming activities. High incidence of pest and diseases was perceived as another serious problem as expressed by majority of the respondents and was ranked II. The application of frequent and high doses of pesticides over years has resulted in pesticide resistance and resurgence of other secondary insects in cabbage and cauliflower. The high cost of inputs (seed material, fertilizers, PPCs) was ranked as III. The seeds of high yielding varieties are usually high priced as expressed by sample farmers. Besides few farmers also expressed that irregular power supply (mean score of 37.46) was a problem and was ranked IV. Irregular irrigated water (mean score30.73) was ranked V. Results reported by Asmatoddin *et al.* (2009) were in conformity with the results of the present study.

With respect to marketing problems, fluctuation in price (mean score of 138.36) was the most important. The prices of fresh vegetables (cabbage and cauliflower) are non-stable due to less shelf life, lack of grading facilities and dependence on market demand. Poor facility of transportation (mean score 118.7) followed by exploitation of middlemen (mean score 111.46) was ranked as III and poor market facility (mean score 70.63) was ranked last. The middlemen exploited by way of faulty weighment, high commission charges, delay in payment etc. Lack of standard grades and lack of market information about price, finance facility, drinking water and sanitary facility were also reported as constraints in vegetable marketing. Chendake and Chauhan (2015) while studying the 'marketing strategy of greenhouse vegetable and flower growers in Sabarkantha, district of Gujarat' reported similar constraints.

6. SUMMARY AND CONCLUSIONS

India is the second largest producer of vegetables in the world, next only to China. India shares about 14 per cent of the world vegetables output from about 2 per cent of the cropped area in the country. During 2014-15, India produced 169.47 million metric tonnes of vegetables on an area of 9.542 million hectares It occupies the second position in the production of both cabbage and cauliflower in the world. India has produced 8.58 million tonnes of cabbage and 7.92 million tonnes of cauliflower, during 2014-15. Karnataka occupies 10th place in the cabbage production and 14th place in cauliflower production in India. Cabbage is grown in an area of 10.4 thousand ha with an annual production of 216.6 thousand tonnes and cauliflower is grown in an area of 4.68 thousand ha with an annual production of 82.3 thousand tonnes in year 2014-15. Belagavi district is one of important vegetable growing districts in the state.

Belagavi is known for its varied agro-climatic conditions and soil types. Because of these favorable conditions wide variety of crops are cultivated in Belagavi district. The major crops of Belagavi district are, maize, sugarcane, jowar, chickpea, green gram, soybean, cotton, cauliflower, cabbage, chilli groundnut and sunflower.

In view of inadequate funds, majority of the farmers are unable to invest on their own in the externally purchased inputs and the demand for higher scale of finance is growing. The scale of finance for different crops is revised every year by taking into account the various components of cost of cultivation of major vegetable crops. The study on cost and returns in cabbage and cauliflower will provide insight into cost and return structure in these crops. It provides information on frequency, extent and different types of plant protection chemicals used in cabbage and cauliflower by farmers in the study area. Moreover the study of the marketing channels, marketing margins and costs assumes special significance in view of wider price spread. The information on cost of cultivation, pesticide use pattern, marketing and various constraints in production and marketing will be of immense use to the policy makers and scientists. Keeping this in view an attempt has been made in this study to analyze the economics of production and marketing of cabbage and cauliflower in Belagavi district.

6.1 Objectives

1. To study cost and returns in cabbage and cauliflower cultivation in Belagavi district.
2. To estimate the nature and extent of pesticides used in cauliflower and cabbage cultivation.
3. To analyse the resource use efficiency in cabbage and cauliflower production.
4. To study the marketing channels and price spread in marketing of cabbage and cauliflower.
5. To document the constraints in production and marketing of cabbage and cauliflower.

6.1 Methodology

Multistage sampling procedure was used to select the respondents to obtain the required data. Belagavi district is one of the leading producer of cabbage and cauliflower in the north Karnataka. . Hence this district was selected in the first stage purposively for the study. Belagavi taluk was selected in the second stage for both the crops for study. Six villages predominantly growing cabbage and cauliflower were selected in the third stage with the advice of Agriculture Assistant. From each selected village, 15 farmers for each crop were randomly selected at the final stage to

make a total sample of 90 farmers each for cabbage and cauliflower. For the study of marketing issues and price spread, Belagavi vegetable market was selected. From the selected market, 10 wholesalers, 10 village trader and 10 retailers were randomly selected.

The primary data relating to cost and returns involved in production and marketing of cabbage and cauliflower, extent and type of pesticide used, market channel, quantity sold and price received were obtained from the randomly selected farmers. Pre-tested and well-structured questionnaire was used to obtain information from farmers and market intermediaries. The data pertained to the crop year 2014-15.

The budgeting technique was used for estimating the cost and returns of cabbage and cauliflower. The Cobb-Douglas type of production function was used to estimate the production elasticities of the resources used in cabbage and cauliflower production, Garret's ranking technique was used to study the constraints in the production of cabbage and cauliflower.

6.2 Major findings

Socio-economic characteristics of the sample respondents

The average age of the sample respondents was 42.93 years in cabbage and 43.03 years in cauliflower, with family size of about 4 to 6 members. Majority of the respondent families were nuclear type. The agriculture was a sole means of livelihood for more than half proportion of cabbage (57.78 %) and cauliflower (50.0 %) growers. Large proportion of respondents (83.3 to 90 %) was having their education ranging from primary to degree level. The average size of land holding of cabbage and cauliflower growers was 2.79 ha and 2.27 ha respectively. Cabbage and cauliflower were grown mainly in rabi season which accounted for 16.4 per cent and 20.32 per cent of gross cropped area respectively. The major crops grown were onion, chilli and maize in kharif season, and tomato, brinjal and other vegetables in summer season. The cropping intensity was 212.43 and 218.86 per cent for cabbage and cauliflower growing farmers.

Cost and returns from cabbage and cauliflowers cultivation

The total cost incurred in cauliflower was the higher (₹ 60,288.79/ha) as compared to that in cabbage (₹ 57,681.29 /ha). The average yield of cabbage was 24.99 tonnes/ha and that of cauliflower was 19.48 tonnes/ha. The higher net returns were obtained from cauliflower (₹1,24,537.62 /ha) compare to cabbage (₹ 79,088.37/ha). The share of total variable cost was more (78.86 %) in cabbage than in (79.74 %) in cauliflower. Among the variable cost the expenditure on human labour had highest share (23.92 %) in cabbage and (22.79 %) in cauliflower. The B:C Ratio was 1.37 and 2.07 respectively for cabbage and cauliflower.

Nature and extent of pesticide use in cabbage and cauliflower cultivation

In cabbage and cauliflower organophosphate, organochlorine, carbamates, thio-carbamates, synthetic pyrethroids and fungicides were major groups of pesticides used by majority of farmers in the study area. Dimethoate and quinalphos belonged to organophosphate, indoxacarb (carbamates), fenvalerate (pyrethroids) and copper oxy chloride (fungicides) were also uses by farmers. Almost all pesticides were found to be used in excess than the recommended doses.

Resource use efficiency

The inputs included in production function explained 85.6 per cent variation in gross returns in cabbage and it was 87.8 per cent variation in cauliflower. In cabbage, the production elasticity of seeds (0.704) and human labour (0.302) were positive and significant. Whereas the production elasicities of expenditure on PPC (-0.137) and manure and fertilizers (-0.052) were negative and significant. In cauliflower estimated production elasicities for seeds (0.536) and human labour (0.362) were positive and significant, whereas the PPC (-0.046) exerted significant negative influence on returns.

The MVP to MFC ratio for seeds (11.25) and human labour (2.97) were more than one in cabbage. Whereas the ratio of manures and fertilizer (-1.06), PPC (-2.64) along with bullock and machine labour (0.91) were negative and less than one signifying there was a need to reduce the use of these inputs to optimize returns. In cauliflower, seeds (10.02) and human labour (4.85) have scope of additional use as indicated by more than one value of MVP to MFC ratio. This ratio were less than one for manures and fertilizer (-0.79), PPC (-1.33) and bullock and machine labour (0.76) implying that these resources are overused.

Optimum quantity of pesticide use in cabbage and cauliflower cultivation

The optimum quantity of pesticide required for cabbage and cauliflower was estimated to be 2.462 and 2.466 (a.i.kg or lt /ha) respectively. The actual quantity of pesticide used by farmers was 3.082 and 2.549 (a.i.kg or lt /ha) respectively. Thus farmers were found to use more than the optimal quantity of pesticides.

Marketing channels and price spread in cabbage and cauliflower marketing

Three marketing channels were identified in the study area in marketing of the cabbage and cauliflower. i.e., channel- I (Producer →Commission agent cum wholesaler→ Retailer →Consumer), channel- II (Producer →Village traders → Commission agent cum wholesaler →Retailer →Consumer) and channel- III: (Producer →Retailer → Consumer).

More than 50 per cent of the marketable surplus of cabbage and cauliflower was sold through channel-I. The channel-III was found to be more efficient than channel-I and channel-II, where producer share in consumer rupee was 52.68 per cent in cabbage. The price spread was highest in channel-II (₹ 930.3/q) followed by channel-I (₹ 756.25/q). The net price obtained by cauliflower producers was highest in channel-III (₹ 1,088.8/q) than in channel-I (₹ 980.2/q) resulting higher producer share in consumer rupee (63.67 %). The price spread was highest in channel-II (₹ 1064.62/q) followed by channel-I (₹ 852.01/ha). The profit margin for retailers was more among all market intermediaries in all channels.

Constraints in cabbage and cauliflowers production

With respect to production constraints lack of labour availability was major problem as expressed by majority of farmers, followed by problems of pest and diseases, lack of fund to buy inputs, irregular power supply and inadequate irrigated water. In marketing, fluctuation of price was reported to be a major problem, followed by poor transportation facility, exploitation by middleman and poor marketing facilities.

Policy implications

Based on the findings of the study the following policies are suggested.

1. The share of seed cost in cabbage and cauliflower cultivation was found to be high (about 14 to 16 %) in the total cost. Hence seed of vegetables may be made available timely at subsidized prices as is done in the case of the seeds of field crops.
2. The farmers in the study area were using 20 to 24 per cent more quantity of pesticides. Therefore farmers need to be educated about correct use of pesticides.
3. The farmers were not using the resources optimally as guided by the economic principles. The MVP/MFC ratios were negative for plant protection chemicals and fertilizers. Thus the withdrawal of these resources would optimize the returns from cabbage and cauliflower production. The farmers need to be educated and advised about the best combination of these two resources.
4. The margin of the retailer was found to be high (22 to 27 %) in both vegetables under study and producer's share ranged between 46 and 64 per cent. Producers can be benefitted by selling their vegetables directly to consumer.
5. Fluctuation in market prices was identified as major marketing constraint in study area. Hence, there is a need to promote direct marketing by setting up Raitha Santhe or farmers markets.

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APPENDIX I

District wise Area and Production of cabbage, cauliflower and total vegetables crops in Karnataka

Sl. No.	Districts	Total Vegetables		Cabbage		Cauliflower	
		Area (ha)	Production (t)	Area (ha)	Production (t)	Area (ha)	Production (t)
1	B'lore (U)	4182	71601	229	4736	129	2272
2	B'lore (R)	8821	165234	441	11887	350	5091
3	Chikkaballapura	13768	253912	719	16614	139	2288
4	Chitradurga	22628	408168	26	288	11	173
5	Davangere	16432	250930	169	3574	119	1869
6	Kolar	36084	993487	1758	34039	732	12078
7	Ramanagara	3914	60466	98	1050	18	260
8	Shimoga	619	10632	9	200		
9	Tumkur	4558	140507	19	380		
10	Bagalkote	22011	393950	23	575	3	64
11	Belgavi	39400	773734	1772	42805	1208	23638
12	Bijapura	22815	438348	16	320	9	135
13	Dharwad	27129	460366	90	1619	83	1484
14	Gadag	38160	612141	40	550	37	545
15	Haveri	34090	685766	1077	22795	413	7963
16	U.Kannada	562	10979			2	20
17	Bellary	16172	275538	111	1033	125	2140
18	Bidar	10391	162068	839	17619	611	10998
19	Gulberga	8805	133987	100	1211	40	533
20	Koppal	12535	231760	18	244	9	166
21	Raichur	9368	149232	79	1817	61	1281
22	Yadagiri	2989	51456	3	42	2	26
23	Chamarajanagara	15069	274054	719	14550	218	3483
24	Chikmagalore	17888	260912	370	6824	99	1382
25	D. Kannada	1709	21186				
26	Hassan	27040	350077	668	13979	45	605
27	Kodagu	487	5926	3	52	2	12
28	Mandya	16247	365045	389	8216	162	2649
29	Mysore	10811	215086	402	7801	103	1720
30	Udupi	993	23791				
TOTAL		445677	8250337	10186	214822	4729	82874

Source: Horticulture statistics, Karnataka state at a glance 2013-14

APPENDIX II

INTERVIEW SCHEDULE

A. SCHEDULE FOR DATA COLLECTION FOR FARMERS

Research Title: An Economic Analysis of Production and Marketing of Cabbage and Cauliflower in Belagavi District of Karnataka

I. GENERAL INFORMATION:

1. Name of the respondent: _____ 2. Age _____

3. Village: _____ 4. Taluk:_____

5. Education: a) Illiterate b) Primary c) Secondary d). High school e) College

6. Family particulars: a) Nuclear family b) Joint family

7. Family composition: Male_____ Female _____ Children_____

8. Land holdings

Sl.No.	Particulars	Irrigated(acre)	Dry land (acre)	Total (acre)
1	Owned			
2	Leased- in			
3	Leased –Out			
4	Permanent Fallow			
	Total			

9. Sources of family income:

Sl. No.	Sources of income	Income per year (Rs.)
1.	Agriculture	
2.	Agro-based subsidiary enterprises (like poultry, dairy, goat/sheep rearing etc.)	
5.	Others (specify)	
	Total	

10.Cropping pattern:

Season	Crop	Cropped area (In acre)			Yield (Q/acre)
		Rainfed	Irrigated	Total	
Khariff	1. 2. 3. 4. 5. 6.				
Rabi	1. 2. 3. 4. 5. 6. 7.				
Summer	1. 2. 3. 4. 5. 6.				

11. Farm Inventory

Major farm machine and implements

Sl. No.	Items	No	Year of Purchase	Purchase value (Rs.)	Current value (Rs.)
1	Tractor				
2	Bullock cart				
3	Pump set (Diesel / Electric)				
5	Plough				
	i. Iron plough				
	ii.Wooden plough				
4	Rotavator				
5	Harrow				
6	Leveler				
7	Intercultural implements				
8	Sprayer				
9	Bore well				
10	Others.				

Livestock:

Sl. No.	Item	No.	Current value	Income (Rs)/annum	Expenditure (Rs)/annum	Net income(Rs)/ annum
1	Cows					
2	Buffaloes					
3	Bullocks					
4	Others					

II. Costs and returns in cultivation of cabbage/cauliflower.

1. Vegetable crop grown:_____ 2. Variety:_____

3. Spacing: _____ 4. Soil type: _____

5. Area cultivated (acres) : Nursery bed area (m^2): ____Main field(acre):____Total: _____

7. Season (Khariff / Rabi / summer): _____

8. Labour wage rate (eight hrs. per day)

Male (Rs /man day) :_____Female (Rs /man day):_____Bullock pair(Rs/day): _____

Tractor(per acre) (Rs/hour):_____

9. Fixed cost

Land revenue (Rs)_____ Rental value of land (Rs)_____

A Details of Labor utilization pattern and their cost in crop grown (cabbage/ cauliflower)

Sl. No.	Operation	No. of times	Family labour (man days)			Cost (Rs)	Haired labour (man days)			Cost (Rs)	Total cost (Rs)
			M	F	BP/ T		M	F	BP/ T		
Nursery bed preparation:											
1	Seed bed preparation and FYM application										
2	Sowing and Irrigation										
3	Seedling pulling										
Main field preparation:											
1	Plouging and Clod crushing										
2	Harrowing										
3	FYM and fertilizer application										
4	Herbicide application										
5	Transplantation										
6	Irrigation										
7	Gap filling and hand weeding										
8	Inter cultivation										
9	PPC Spraying										
10	Harvesting										
11	Others(specify)										

Note: M= Male F= Female BP=Bullock pair T=Tractor

B. Details of input use pattern and their incurred cost in (Cabbage/ Cauliflower)

Sl. No.	Particulars	Quantity (kg/acre)	Price/unit (Rs)	Total cost (Rs)
1	FYM			
2	Seeds / Planting material			
3	Fertilizer application			
	Urea			
	DAP			
	Potash			
	Complex			
4	Irrigation charges			
5	Bio fertilizer or plant hormone application			
6	Others, if any a) b)			

C. Yield obtained and Returns realized:-

Particular	Quantity (q)	Price (per quintal)	Returns (Rs)
1. Main products			

III Nature and extent of pesticides in cabbage/ cauliflower

A. Plant protection chemicals:

Sl no	Particulars	Type of pesticide used	No. of times	Recommended doze a.i. (lit/kg)	Quantity a.i. (lit/kg)	Price (Rs.)	Total cost (Rs.)
Name of pest							
1.							
2.							
3.							
4.							
5.							
6.							
7.							
Name of disease							
1.							
2.							
3.							
Name of weed							
1.							
2.							
Others (specify)							
1.	Bio pesticide						
2.	Pheromone traps						
3.	Light traps						

IV. Marketing channels and price spread in marketing of cabbage and cauliflower.

A. Marketing cost:

Sl no	Particulars	Quantity	Cost/q.
1	Packing material		
2	Transportation cost		
3	Loading /un loading charges		
4	Commission charges		
5	Others if any(Specify) - Wastage		
	Total		

B. Marketing Channels for cabbage/cauliflower

1. Marketing pattern of Cabbage/cauliflower:

Sl. No.	Period of sale	Quantity sold (q.)			Price (Rs/q.)			Total returns (Rs)
		Good quality	Average quality	Poor quality	Good quality	Average quality	Poor quality	
1								
2								
3								

2. To whom sold the produce was?

a) Commission agent b) Wholesaler c) Village traders d) Retailer e)Local market f) Cooperative society g) Any other (specify):_____

V. Problems encountered during production and marketing of cabbage/cauliflower

1. Problems in production of cabbage/cauliflower?

	Problems/Constraints	Ranks
a.	Problems of pest and diseases	
b.	Lack of fund to buy inputs	
c.	Labour scarcity	
d.	Inadequate irrigated water	
e.	Irregular power supply	
f.	Others (specify)	

2. Problems in marketing of cabbage/cauliflower?

	Problems/Constraints	Ranks
a.	Fluctuation of price	
b.	Poor transportation facility	
c.	Poor marketing facility (storage, drinking water etc.)	
d.	Exploitation by middlemen	
e.	Others	

B. Schedule for data collection for Commission agent/wholesaler/retailers in Belagavi district

1. Name of the respondent :_____

2. Place : _____ 3.Taluka : _____

4. Quantity handled/annum : _____ tonnes

5. Types of ownership : Individual/partnership / any other.

6. Information on procurement and sale of cabbage/cauliflower

Sl. No.	Source	Quantity purchased (q)	Price/t (Rs)	Total cost (Rs)	Wastage	Qty sold (q)	Sale price (Rs)	Total value (Rs)
1.								
2.								
3.								

7. Cost incurred in marketing channel on intermediaries (per month)

SI No.	Particulars	No	Total value Rs/annum
Fixed cost			
1	Rent on Godowns /shop		
2	License fee		
3	Commission paid for maintenance		
4	Tax paid		
5	Insurance		
6	Salary of permanent labor		
7	Telephone/ electricity charge		
8	Other		
A	Total fixed cost		
Variable cost			
1	Gunny bag/ Baskets		
2	Sorting and Packing charges		
3	Loading/unloading		
4	Transportation		
5	Weighing charges		
6	Wastage		
7	Other		
B	Total variable cost		
	Total cost (A+B)		

8. Transaction activity

A Purchase Activity

Months	Total qty purchased	Price per q. (Rs.)	Total value (Rs.)	From whom	From where	Remarks

B. Selling activity

Month	To whom sold	Place of sale	Sale method	Qty sold	Price/ q. (Rs.)	Total value	Wastage		Commission paid	
							Qty	Value	Qty	Value

AN ECONOMIC ANALYSIS OF PRODUCTION AND MARKETING OF CABBAGE AND CAULIFLOWER IN BELAGAVI DISTRICT OF KARNATAKA

SATISH KUMAR BIRWA **2016** **DR. H. BASAVARAJA**
CHAIRMAN

ABSTRACT

Cabbage and cauliflower are important and extensively grown vegetables in Karnataka. The state ranks 10th place in area and production of cabbage with total cropped area of 10,483 hectare and production of 2,16,627 tonnes. Whereas, with respect to cauliflower the state ranks 14th place in area and production with total cropped area of 4,686 hectare (1.14 %) and production of 82,324 tonnes (1.04 %). The study was conducted to estimate cost and returns structure in cabbage and cauliflower in Belagavi district where these two vegetables are extensively grown. Multistage sampling procedure was adopted for selection of 90 sample farmers for each crop from Belagavi district. The cost of cultivation for cabbage was ₹ 57,681 per hectare and it was ₹ 60,288 in cauliflower. The variable cost (₹ 45,487 in cabbage and ₹ 48,076 in cauliflower) formed a substantial portion (more than 78.8 %) of the total cost of cultivation. The higher net returns were obtained from cauliflower (₹ 1,24,537 /ha) compared to cabbage (₹ 79,088 /ha). The B:C ratio was 1.37 and 2.07 respectively for cabbage and cauliflower. The optimum quantity of pesticide required for cabbage and cauliflower was 2.462 and 2.466 (a.i. kg or l/ha) respectively. The marginal value product to marginal fixed cost ratio for seeds (11.25) and human labour (2.97) were more than one in cabbage. Whereas, the ratio of manures and fertilizer (-1.06), plant protection chemicals (-2.64) along with bullock and machine labour (0.91) were negative. Similar results was found in the case of cauliflower. The channel-III was found to be more efficient than channel-I and channel-II. With respect to production constraints lack of labour availability was major problem as expressed by majority of farmers, followed by problem of pest and diseases. In marketing, fluctuation of price was reported to be a major problem, followed by poor transportation facility.