

**PRODUCTION AND MARKETING MANAGEMENT OF
WATERMELON – A COMPARATIVE ANALYSIS IN
KARNATAKA AND ANDHRA PRADESH**

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WATERMELON – A COMPARATIVE ANALYSIS IN
KARNATAKA AND ANDHRA PRADESH**

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CERTIFICATE

This is to certify that the thesis entitled **“PRODUCTION AND MARKETING MANAGEMENT OF WATERMELON – A COMPARATIVE ANALYSIS IN KARNATAKA AND ANDHRA PRADESH”** submitted by **Mr POTNURU SANTOSH KUMAR** for the degree of **MASTER OF BUSINESS ADMINISTRATION** in **AGRIBUSINESS** to the University of Agricultural Sciences, Dharwad is a record of research work done 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 of the award of any degree, diploma, associateship, fellowship or other similar titles.

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LIST OF ABBREVIATIONS

Sl. No	Abbreviations	
1	mm	Millimeter/s
2	kg	Kilogram/s
3	g	Gram/s
4	km	Kilometer/s
5	t	Tonne/s
6	ha	Hectare/s
7	q	Quintal/s
8	%	Percentage
9	Md	Man days
10	MT	Metric Tonne/s
11	hr	Hour/s
12	l	Litre/s
13	FYM	Farm yard manure
14	₹	Rupees
15	sq. km	Square kilometer/s
16	°C	Centigrade
17	CAGR	Compound Annual Growth Rate
18	C.V	Coefficient of Variation
19	R ²	Coefficient of Multiple Determination
20	PPC	Plant Protection Chemicals
21	FL	Family Labour
22	HL	Hired Labour
23	THL	Total Human Labour

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Introduction

1. INTRODUCTION

Indian economy depends upon agriculture, and about 70 per cent of the population lives in rural areas. The main occupation of rural people is agriculture. About 14 per cent of the national income originates from the agriculture sector. About 75 per cent of the population and 66.67 per cent of labour force directly or indirectly depends on agriculture for livelihood. Large number of important industries like jute, textiles, edible oils, tobacco, sugar etc. receives the raw materials produced by agriculture sector. All types of crops representing cereals, pulses, oilseeds, fibers, spices and condiments and many others are grown in our country.

Watermelon (*Citrullus lanatus*) is one of the most important fruits cultivated in the tropics and consumed throughout the world. Watermelon is good for human consumption and livestock needs as it contains most of the basic daily nutritional requirements of the body and other essential nutrients that prevents human health problems like cancer, stroke, high blood pressure, high vague, heart attack and other cardiovascular diseases.

Melons, as a general term, are sweet, juicy and tasty fruits being consumed mainly in the hot season. Among melons, two species, viz., watermelon [*Citrullus vulgaris* L. sin *C. lanatus* (Thlumb) Mansf.] and muskmelon [*Cucumis melo* L.], belonging to the Cucurbitaceae family, are drought tolerant crops, being cultivated in a wide range of tropical, semitropical and arid regions of the world. Watermelon originated from the Kalahari desert, South Africa, where it is being grown wildly, while there it is spread to many countries of the world. In China, India and the Arabian countries it was known even from 1500 B.C. In the 16th century it started to be cultivated in Europe too from where it was brought in America by the colonists.

Watermelon could be eaten raw when it is fresh after being washed and sliced into bits. One of the USDA publications has referred watermelon to as the “chief of the world’s luxuries and king over all fruits of the earth” (Anon., 1998). Watermelon can be cultivated best on sandy loam soils with good organic matter content having a pH range of 5.5-6.5. They are resistant to dry conditions and adapt to 25-30⁰ C temperature range. Excessive or high rainfall discourages flowering and high humidity tampers with its growth and development.

Watermelon is also known as tarbuj, tarmuj, kalingad and kalindi in different parts of India. Though it is grown in garden land, it is a major river-bed crop for Maharashtra, Uttar

Pradesh, Rajasthan, Gujarat, Andhra Pradesh, Punjab, Haryana, Karnataka, Assam, West Bengal, Orissa, Himachal Pradesh and Tamil Nadu.

According to FAO (2016) statistics, world's largest producers of watermelon are China, Iran, Turkey, Brazil and the United States. In India area under watermelon was 95,520 hectares with a production of 23,62,160 tonnes in the year 2016-17 (Horticulture Statistics Division, DAC & FW.2016-17). The global consumption of the fruit is greater than that of any other cucurbits.

Watermelon has a green shell, various shapes, sizes and weights, flesh in different colours (red, yellow, orange and white) and its seeds could be black, but also red and green colored, existing even seedless varieties. Watermelon is a fruit extremely appreciated by consumers due to its rich content in water and carbohydrates which makes it juicy, hydrating and tasty. It has a fine texture, full of flavor and sweet.

Watermelon, a well-known cash crop yields good profit in short period. It is highly accepted by the consumers for its sweet juicy fruits. Watermelon juice with salt and pepper is a popular cool and refreshing drink in summer season. The fruits are delicious and sweet when ripe, very seldom cooked as vegetable when immature.

Climatic requirements

Watermelon requires hot dry climate and a long growing season, preferably with warmer days and cooler nights. It cannot withstand frost or very low temperature. For seed germination, optimum moisture and a soil temperature in between 25-30°C is needed. Similarly plant growth is optimum under 28-30°C, while fruiting is better at 24-27°C. Higher temperatures are beneficial during ripening.

Sowing time

Watermelon is propagated by seed. In general, seed rate of 0.875 – 1.0 kg/ha for small-seeded type and 1.0 – 1.125 kg/ha for large seeded type is optimum. In North Indian plains, sowing is done during late-February to mid-March; in North-Eastern and Western India, sowing is done during November-January while in Central and South India with mild winters sowing is done during December-January.

Site and soil Requirements

Watermelon may be grown on a wide variety of soils. Sandy loams are best for early crop, while loams have higher-yielding potential. Alluvial river-beds are also good for

watermelon. Clay soils are generally avoided for watermelon cultivation, but they can be productive if irrigated with care to prevent prolonged saturation of the root zone. A pH of 6.5-7.0 is ideal for this crop.

In mulching method, land is ploughed three or four times by the tractor. Ten tones of farm yard manure are added to the land. Soil is softened with the help of rotator. Raised beds are made manually or with the help of machine. Raised beds are covered by mulching sheet with holes in it. Drip irrigation system is followed in the mulching method. For the first fifteen days, daily irrigation is done for one hour duration, for the next fifteen days for two hours duration, and thereafter, until harvesting, for three hours duration.

Indian scenario

India grows approximately 25 commercial varieties, a few of which have delightfully interesting names: “New Hampshire Midget,” “Madhuri 64,” “Black Magic,” and “Sugar Baby,” “Arun 0035”, “Hybrid Dragon”, “Namdhari NS – 295”, *etc.*,

Watermelon occupies 95,520 hectares in India; West Bengal is the leading producer of watermelon, where the area under watermelon is 16,540 hectares, followed by Uttar Pradesh (13,020 ha.), Karnataka and Odisha (11,730 ha. each), Andhra Pradesh (8,520 ha.) and Tamil Nadu (6,420 ha.). Total watermelon production in India during 2016-17 is 23,62,160 metric tonnes, out of which Uttar Pradesh is leading in production with 5,86,610 metric tonnes followed by Karnataka (3,88,550 MT.), West Bengal (2,30,100 MT.), Odisha (2,26,640 MT.), Andhra Pradesh (1,96,960 MT.) and Tamil Nadu (1,75,150 MT.). (Anon., 2016a)

The well-marked growing districts of watermelon cultivation in Karnataka are Mysore, Kolar, Haveri, Mandya, Chamarajanagar, Koppal, Bagalkot, Belgavi and Chikballapur districts and in Andhra Pradesh, Anantapur, Chittoor, Kadapa and Prakasam districts. According to data published by Ministry of Agriculture, Govt. of India, there is increase in area of watermelon cultivation in India from 70,600 hectares in 2011-12 to 95,520 hectares in 2016-17. Similarly, the production also increased from 17,27,500 metric tonnes in 2011-12 to 23,62,160 metric tonnes in 2016-17. (Anon., 2016b)

Although, India is the second largest producer of fruits in the world, India ranks 25th position in production of watermelon in the World and 18th position in harvested area of watermelon in the World (Anon., 2013). It stands in first position in yield of watermelon

among the SAARC countries, 15th position in yield of watermelon among the G-20 countries and 32nd position in yield of watermelon among the Asian countries. Whereas, India ranks 22nd position as an exporting country of watermelons in the World (Anon., 2016c).

Karnataka scenario

Watermelon occupies 11,730 hectares in Karnataka state; Mysore district is the leading producer of watermelon, where the area under watermelon is 1,490 hectares, followed by Haveri (1,430 ha.), Chamarajnagar (930 ha.), Kolar and Mandya (890 ha. each), Bagalkote (660 ha.), Koppal (610 ha.), Belgavi (550 ha.) and Chikballapur (230 ha.) districts. Whereas, total watermelon production in Karnataka state during 2016-17 was 3,88,550 metric tonnes, out of which Mysore district is leading in production with 50,080 metric tonnes, followed by Haveri (44,210 MT.), Kolar (39,360 MT.), Mandya (31,910 MT.), Chamarajnagar (28,510 MT.) and Kopal (24,900 MT.) districts. Productivity is highest in Kolar district (44.22 MT/ha), followed by Mysore (33.61 MT/ha) and Haveri (30.91 MT/ha) districts, respectively. Whereas, Karnataka state watermelon productivity is 33.12 MT/ha. (Anon., 2016d)

Andhra Pradesh scenario

In Andhra Pradesh, total area under watermelon was 8,520 hectares; Anantapur district is the leading producer in the state, where the area under watermelon is 3,170 hectares, followed by Chittoor (2,200 ha.), Prakasam (530 ha.) and Kadapa (360 ha.) districts. Total production of watermelon in the state was 2,37,890 metric tonnes; Anantapur is the leading district in production of watermelon (95,160 MT.) in Andhra Pradesh, followed by Chittoor (55,000 MT.), Kadapa (18,000 MT.) and Prakasam (15,750 MT.) districts. Productivity is highest in Anantapur district (30.00 MT/ha), Whereas, productivity of watermelon from Andhra Pradesh state as a whole is 27.92 MT/ha. (Anon., 2016e)

Nutritional benefits

Watermelon fruit has 78 per cent edible portion. The edible portion in watermelon fruit contains moisture (95.8 %), protein (0.2 %), minerals (0.3 %), carbohydrates (3.3 %) and energy (16 k. Cal). It also contains 11 mg. of calcium, 0.02 mg. of thiamine, 0.04 mg. of riboflavin and 1 mg. of ascorbic acid per 100 grams of edible portion (Gopalan *et al.* 1984). It is also an excellent source of vitamins. Watermelon is rich in antioxidants like lycopene which reduces the risk of diseases like asthma, atherosclerosis, diabetes, colon cancer and

arthritis. It is highly nutritious and thirst-quenching and also contains vitamins 'C' and 'A' in the form of diseases-fighting beta-carotene.

Health benefits of watermelon

Watermelons have 92 per cent water by weight. It is a nature's gift to thirst quencher in hot summer days. It is an excellent fruit, which acts as a natural moisturizer as well as a toner and keeps the skin cool, glowing and fresh. It is a good source of potassium; which helps in controlling blood pressure thereby ensuring the health of one's heart. Watermelon is also rich in lycopene, an antioxidant which helps the body to fight against cancer and prevent diseases. Studies have also shown that lycopene protects skin damage from UV rays and from prostate cancer. Watermelon is an excellent source of vitamin A; which helps to protect from lung and oral cavity cancer. Watermelons are very low in calories and fat, which is considered as an ideal diet food and is high in energy, making it a great energy boost. Watermelon contains high amount of calcium. It helps to build strong bones (Lilly, 2013).

In the light of the above facts, the present study entitled on "Production and marketing management of watermelon – A comparative study in Karnataka and Andhra Pradesh" was undertaken with the following specific objectives.

The specific objectives of the study are as follows

1. To analyze the growth in area, production and productivity of watermelon in Karnataka and Andhra Pradesh.
2. To analyze the production management of watermelon in the study area.
3. To study the marketing management of watermelon in the study area.
4. To study the problems associated with production and marketing of watermelon.

Special features of the study

Watermelon fruits typically constitute an essential part of the diet in India and they are in great demand round the year from all sections of the population. The commercial value of the fruits has risen substantially in recent years. Their economic importance has also increased. In light of these issues, it was felt to examine the production and market environments for watermelon.

The comparative studies in two different locations can be very helpful in identifying alternative solutions that may be adopted by farmers, marketers and policy makers. This is

other way to link more farmers, to reduce the spatial differences in the plain of production and marketing and it will narrow down the spatial price differences so that both consumers and producers will be benefited.

Limitations of the study

As far as the limitations of the study were considered, the study was based on sample survey of selected watermelon growers. The information about cost and returns was collected by survey method with the help of specially designed questionnaires on cultivation and production practices by recollecting their memories on these aspects. Hence, there may be some lacuna in the information given by farmers.

As the study was conducted in a selected area, the results may not be applicable exactly to other areas of watermelon cultivation but it will be helpful as a guideline for further studies.

Presentation of the study

The entire study has been presented in six chapters. In Chapter – I, the introduction, importance, specific objectives and limitations of the study have been indicated. Chapter – II deals with review of the relevant research studies connected with the objectives. Chapter – III outlines briefly the main features of the study area, the nature and sources from where relevant data have been collected, sampling design and the statistical tools and techniques employed for evaluating the objectives. Results and discussion are presented in Chapter – IV and Chapter – V respectively. Finally, Chapter – VI deals with the summary, conclusions and suggestions for the future research work. References and appendices are given at the end of the thesis.

Review of Literature

2. REVIEW OF LITERATURE

The present study envisages to examine the management of production and marketing of watermelon in Karnataka and Andhra Pradesh states.

The review of the research work on the related field helps in formulating the frame work of the study, deciding objectives and appropriate methodology to the situation under which research is to be carried out. The review of research work carried out in past on production and marketing of different crops is presented in this chapter under following headings.

- 2.1 Growth in area, production and productivity of horticulture crops.
- 2.2 Production management in horticulture crops.
- 2.3 Marketing management in horticulture crops.
- 2.4 Constraints faced in production and marketing management of horticulture crops.

2.1 Growth in area, production and productivity of horticulture crops

Ramachandra (2006) studied the growth rate in area, production and productivity of sapota in Dharwad and Belgaum districts of Karnataka from 1994-95 to 2004-05. Growth rate in area (3.73%) and production (4.77%) of sapota were found to be higher in Dharwad district. Belgaum district registered CAGR of -3.07 per cent in case of area, -9.18 per cent in production and -6.30 per cent in productivity. On the contrary, higher growth rates were observed in the case of the state as a whole, with a positive growth rate in area (4.54%) and negative growth in both production (-1.98%) and productivity (-6.24%) of sapota.

Saraswat and Rane (2006) conducted a study on production and marketing of peach fruit in Rajgarh area of Sirimour district in Himachal Pradesh. The compound growth rate with respect to area and production showed that the area under peach increased at the rate of 4.31 per cent per annum. The highest area under peach was recorded in Sirimour district. Whereas, Mandi district registered the highest growth rate of production in the state (9.32 per cent per annum). Out of 12 districts in Himachal Pradesh, only four districts have registered a positive growth in production, i.e. Solan (22.55%) followed by Una, Bilapur and Mandi.

Wasim (2011) conducted a research on trends in growth and variability of major fruit crops in Balochistan- Pakistan. Researcher conducted the study in two different periods,

period 1 (1989-90 to 1998-99) and period 2 (1999-00 to 2008-09). The study revealed that in period 1, the increase in production growth in majority of fruit crops was mostly due to area rather than productivity. The productivity growth of all the fruits except plums recorded negative and significant growth in period 2 as compared to period 1. The decline in production and productivity growth in period 2 was mainly due to drought from the year 2000 onwards.

Poudel *et al.* (2012) conducted a research on growth in area, production and productivity of major crops in Karnataka. Researchers have used only secondary data for their study. The necessary secondary data were collected for a period of 26 years from 1982-83 to 2007-08. The data were analyzed by using the compound growth function. The results indicated positive growth in area under pulses, vegetables and spices, whereas fruits, nuts and cereals showed significant negative growth. The production and productivity of oilseeds and commercial crops registered insignificant positive growth.

Singh and Rani (2013) studied the growth in area, production and productivity of fruit crops in Jharkhand. The study revealed that, the positive growth rate in litchi, mango, guava and banana except citrus. It had also been observed that among periods, fifth period (2005-10) was found to be favorable for litchi, mango and guava particularly, while negative growth rate was found in banana and citrus. The productivity growth rates were also observed to be positive and were 2.56 per cent, 2.56 per cent, 1.50 per cent, 5.21 per cent, respectively in litchi, mango, guava and banana in that order. This trend resulted in positive growth in volume of these fruits in the state. The study further revealed that variability in area was highest in litchi (71 %) due to shifting in area from other fruit crops in the litchi area followed by mango and banana. Similarly variability in productivity was observed to be highest in banana and there was no considerable variation in the yield of other fruit crops.

Hembara and Yogesh (2014) made a study on production and marketing management of papaya growers in North Karnataka, wherein growth rates for area, production and productivity were also worked out for the period 2001-02 to 2011-12 in Gulbarga and Bidar districts, CAGR were 12.43 per cent, 29.43 per cent, 2.28 per cent for area, production and productivity, respectively in Gulbarga district. Area, production and productivity in Bidar recorded a CAGR of 8.78 per cent, 11.62 per cent and -2.90 per cent, respectively. The reason

for negative growth rate in productivity of papaya in Bidar district was because of the constraints like virus attack and scarcity of water during the years.

Vinayaka *et al.* (2014) conducted a study on growth and instability analysis of fruit crops in India. The study was based on secondary data from 2000-01 to 2010-11. The data were collected from several government publications and websites. Compound annual growth rate, coefficient of variation and instability indices were used to estimate the trends in area, production and productivity. The study revealed that the growth rate of fruit crops productivity in India was positive (1.05%) with an instability index of 10.16 per cent. In the same period a positive growth rate of area was observed (7.34%) with an instability index of 10.16 per cent, while positive growth rate of production (8.48%) with an instability index of 0.10 per cent was observed in the production of fruits.

Ali and Jabbar (2015) conducted a study on growth and variability in area, production and yield of selected fruit crops in Khyber Pakhtunkhwa. The study was based on secondary data from 1975-76 to 2011-12 which was further bifurcated into three periods; period-I (from 1975-76 to 1990-91), period-II (from 1991-92 to 2011-12), and period-III (from 1975-76 to 2011-12). The study revealed that growth in production of selected fruits remained positive with area under fruits was a major contributor during period-I. Period-II witnessed either low or negative growth in fruit production except peach. Variability in fruit production was higher in period-II as compared to period-I. Main contributor to fluctuations in fruit production during period-I was variability in area under fruit, whereas, both area and yield variability were mainly responsible for variability in fruit production during period-II.

Choudhary and Kundal (2015) conducted a study on area, production and productivity of tomatoes in India. The data had been collected from the reliable sources such as research papers, journals, newspapers, periodicals, governmental websites like Ministry of Agriculture, Government of India, Indian Council of Agricultural Research (ICAR) and Food and Agriculture Organization (FAO). The researchers used ACGR to analyze the trends of growth in area and production. The study revealed that the annual compound growth rates (ACGR) of area, production and yield of tomatoes in India for the time period of ten years (2002 to 2011) were 5.60, 8.08 and 2.34 per cent per annum, respectively. The study concluded that there exist a raising trend in terms of area, production and yield in India with respect to tomato. Such a rise assures a bright future of the horticulture sector of India in the coming times.

Kireeti *et al.* (2015) conducted a research on trends in area, production and productivity of apple orchards in Himachal Pradesh. Researchers used secondary data (1973-74 to 2011-12) for their study. The study revealed that, India has registered a compound growth rate of 1.1MT/ha which was on par with the world average of 1.2 MT/ha in the context of apple productivity whereas in Himachal Pradesh, it was 0.03 MT/ha during the time period 1973-74 to 2011-12. The maximum mean productivity was noticed in France with apple yield of 33.60 MT/ha over the 39 years. Shimla and Kinnaur districts of Himachal Pradesh show a positive trend in all aspects of apple cultivation.

Islam and Sunita (2017) analysed the growth in area, production and productivity of apples in Jammu and Kashmir from 2006-07 to 2015-16. The reserchers used annual compound growth rates (ACGR) of area, production and productivity of apples in Jammu and Kashmir for a period of ten years. The results of the study indicated that, there had been a rising trend in the area under apples in the state during the time period of the study. The area under apples had increased from 119.041 (000'ha) in 2006-07 to 161.773 (000' ha) in 2015-16. Similarly, the production of the same has gone up from 12, 22,176 (000't) in 2006-07 to 19, 66,417 (000't) in 2015-16 the yield of apples from 2002 to 2011 has gone up from 10.27 (t/ha) to 12.25 (t/ha). The productivity of apples in the state of Jammu and Kashmir has shown a rising trend during the study period except in the years 2009- 10, 2012-13 and 2014-15. The highest fall in the productivity can be seen in the year 2014-15 and the reason was low production due to Sep. 2014 floods.

2.2 Production management in horticulture crops

Jain and Tegar (2003) conducted a study on economics of production and marketing of tomato in Jashpur district of Chhattisgarh. The total cost was estimated by adding variable cost, fixed cost and marketing cost. The total marketing cost ranged from 19.87 per cent at marginal farm to 13.52 per cent at medium farms. Net returns on various sizes of farms was examined as ₹ 25,317 per ha at marginal, ₹ 28,022 per ha at small, ₹ 29,987 per ha at medium and ₹ 52,192 per ha at large farms. The cost-benefit ratio on large farms was observed to be highest among various sizes of farms. It was noted as 1:1.91, 1:1.98, 1:2.22 and 1:2.90 at marginal, small, medium and large farms, respectively.

Singh (2004) fitted Cobb – Douglas production function to analyse the resource use efficiency in vegetable crops and it 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, whereas for okra, brinjal and potato these coefficients were found less than one indicating decreasing returns to scale. The sum of regression coefficients of variables ($\sum b_i$) turned out to be less than one for onion, okra and potato and more than one for tomato and brinjal, indicating gross value of these vegetable crops increased proportionally with an increase in the variable factors and vice – versa.

Rane and Bagade (2006) studied economics of production and marketing of banana in Sindhudurg district of Maharashtra. The study revealed that the per hectare cost at cost C in Dadamarg and Sawantawadi tehsil were ₹ 1.52 lakhs and ₹ 1.53 lakhs, respectively. In Dodamarg tehsil, banana grown as a sole crop where per hectare cost of cultivation was ₹ 1.28 lakh and in Sawantawadi tehsil, the per hectare cost was ₹ 1.15 lakh. Benefit cost ratio in Dadamarg tehsil and Sawantawadi tehsil were 2.20 and 2.33, respectively. The average benefit cost ratio of banana cultivation was 2.27.

Rohile *et al.* (2006) conducted a study to determine the resource use efficiency in banana production in Sindhudurg district, Dapoli, Maharashtra. The banana growers ($n=90$) were classified into two groups based on the type of banana orchards, viz., mixed cropping and sole cropping. Out of 90 growers, 67 growers practiced mixed cropping and 23 growers employed sole cropping. The variation in yield due to various inputs used in banana cultivation in both the groups. The results revealed that in mixed cropping, planting material and fertilizers were significant variables, while in sole cropping, planting material, male labour, fertilizers and irrigation charges were statistically significant. The ratio of marginal value product to marginal fixed cost of chemical fertilizers in mixed cropping and planting material, female labour and plant protection in sole cropping was less than one, which indicated that excess utilization of these resources.

Shah *et al.* (2009) conducted a research for estimation of production and marketing of Kashmir saffron in Kareula areas of Jammu and Kashmir. Researchers have used both primary and secondary data for their study. The primary data on total cost of cultivation, net returns and marketing channels were collected from 180 saffron growers selected through random sampling technique. The data were analyzed by using tabular analysis, feasibility analysis *etc.* The results indicated that total cost of cultivation was Rs 2, 94,935 per hectare

and net returns was Rs 24, 75,000 in a planting cycle of five years. The benefit cost ratio was estimated as 1:13. The results also indicated that among marketing channels, channel 1 (Grower→Wholesaler→Retailer) was profitable for saffron growers, because of few intermediaries involved in it. The absolute margin per tola (10 g of saffron) was highest for retailer in channel 2 (Grower→ Retailer) (Rs 600/-) followed by channel 3(Grower→Retailer) and channel 1.

Mukul and Rahman (2013) conducted a study on production and profitability of banana in Bangladesh by collecting primary and secondary data from Narsingdhi district. The interviewers were divided into three major groups; farmers, wholesalers and retailers. The sample size was 40 consisting of 20 farmers, 10 wholesalers and 10 retailers. The researchers concluded that the farmers can obtain positive net returns from cultivation of banana. The profit of retailers was higher than that of other intermediaries and the profit was found reasonable.

Amutha (2014) conducted a study on analysis of sapota fruit cultivation in Tuticorin district to examine the cost and returns of sapota cultivation in Tuticorin District. The study is based on primary data, collected from 60 sapota farmers from Vilathikulam and 60 Sapota farmers from Puthur blocks of Tuticorin district. Researcher used percentage analysis, averages, ranking method and standard deviation, chi square tests and probability analysis were used for the analysis. The study found that the total cost of production per block was ₹ 9257.10 in Vilathikulam. Whereas, in Puthur, cost of production was ₹ 6034.60 per block. The direct cost accounted for 70.14 per cent in total cost of production in Vilathikulam whereas in Puthur it accounted for 60.48 per cent. The indirect costs accounted for 29.89 per cent of total cost of production in Vilathikulam and 39.52 per cent in Puthur. Among the components of indirect costs, interest on fixed capital formed the major item. It accounted for ₹ 1327 in Vilathikulam and ₹ 1259.80 in Puthur. The other components of indirect cost included, annual share of establishment cost, depreciation and interest on working capital and they accounted for 3.44 per cent, 4.49 per cent and 7.59 per cent, respectively in Vilathikulam and 4.83 per cent, 5.31 per cent and 8.51 per cent, respectively in Puthur. Thus, it could be concluded that investment in sapota orchard was economically feasible and financially viable in both the blocks.

Datarkar *et al.* (2014) conducted a study on economics of production and marketing of mango in Gadchiroli district of Maharashtra. The study was conducted to examine the cost and returns in mango orchards. Per hectare establishment cost of mango orchard during five years for overall age groups of orchard were ₹ 41,796.08. Among the different items of expenditure, share of human labour was higher followed by bullock labour. Whereas, per hectare establishment cost for bearing life of the orchard *i.e.* 20 years were ₹ 2,089.80 and per hectare cost of cultivation (Cost "C") of mango orchard for the sample as a whole were ₹ 63,964.85. Averages per year gross income for the sample as a whole were ₹ 1, 48,956.00. The output-input ratio was higher in Dhanora tahsil (1:2.57).

Bondar *et al.* (2015) conducted a study on economics of production of banana in Kolhapur district of Maharashtra. The study revealed that, per hectare cost of cultivation was ₹ 2, 72,876.10. The major items of cost were rental value of owned land (34.39 %), seedlings (17.42 %), human labour (9.18 %) and interest on fixed capital (0.21 %). The percentage of cost A and cost B in the total cost of cultivation were 63.10 and 97.71 per cent, respectively. The benefit cost ratio was 2.07 indicating profitability of crop. The study revealed that production of banana was economically feasible and financially viable in Kolhapur district of Maharashtra.

Ropan *et al.* (2015) conducted a study on economics of orange production in Nagpur district of Maharashtra. Primary data were collected from 30 orange growers from villages *viz.* Sawangi, Ghorad and Ubali of Kalmeshwar tahsil of Nagpur district for the year 2010-11. Farmers were distributed according to age of the orange orchard which was group I (6-10 year old), group II (11-15 year old), group III (16-20 year old), respectively. The study reveals that per hectare establishment cost during the first five years and cost of cultivation during the year 2010-11 of orange orchard were ₹ 2, 07,604 and ₹ 1, 07,824, respectively. Average gross return was ₹ 20, 42,094. The highest net return obtained from the age group (II) of 11-15 year *i.e.*, ₹ 1, 65,935. The benefit: cost ratio on the sample as a whole was 2.24.

Pokharkar *et al.* (2016) conducted a study on economics of production and marketing of guava in western Maharashtra. Researchers collected primary data from 90 randomly selected guava growers from six villages. The study was conducted to examine the resource use pattern, costs and returns in guava production. The per hectare cost 'A', cost 'B' and cost

'C at the overall level, worked out to ₹ 48,451.10, ₹ 81,324.33 and ₹ 97,168.82, respectively. The major items of cost were rental value of land ₹ 23,332.45 (24.12%), followed by hired human labour ₹ 19,681.84 (20.25%), family human labour ₹ 15,844.49 (16.30%), manure ₹ 8,139.11 (8.38%) and amortized establishment cost ₹ 8,105.02 (8.34%), respectively. The production elasticity coefficient of human labour (X_1), factor expenses on nitrogen per hectare (X_4), use of phosphorus per hectare (X_5), expense on plant protection (X_6) and factor expenses on irrigation (X_7) were found significant at overall level of the guava production. Whereas, the production elasticity of bullock labour (X_2) and manure use per hectare (X_3) were found significant at overall level of the guava production.

Dhuri *et al.* (2017) analysed the economics of production of alphonso mango in Sindhudurg district of Maharashtra. The study was conducted to examine the cost and returns structure and resource use efficiency of alphonso mango in Sindhudurg district of Maharashtra. The functional analysis was carried out by using Cobb-Douglas type of production function. The study revealed that at the overall level, per hectare cost of establishment of mango orchards were worked out to ₹ 1, 23,919.44. Whereas, per hectare total cost of maintenance (Cost C) at overall level of mango orchard were ₹ 2, 12,196.22 out of which share of Cost-A was 50.45 per cent and Cost B was 93.00 per cent, respectively. Total benefit cost ratio of alphonso mango was 1.30 at overall level. Production function analysis explains 64 per cent variation in production under alphonso mango. The elasticity coefficient for Nitrogen (X_4) and number of plants (X_9) was positive and found statistically significant at 1 per cent and 10 per cent level of probability.

2.3 Marketing management in horticulture crops

Sundaravaradarajan and Jaganmohan (2002) studied the marketing cost, margin, price spread and marketing efficiency of cashew in Tamil Nadu observed the following four different marketing channels of cashew. Channel 1: Farmer - village trader – wholesaler – processor – trader. Channel 2: Farmer – cooperative marketing society. Channel 3: Farmer – commission agent – wholesaler – processor. Channel 4: Farmer – processor. A majority of farmers (60%) adopted channel 1 followed by channel 2 (26.25%), channel 3 (10%) and channel 4 (3.75%).

Talathi *et al.* (2005) conducted a study on economics of marketing of sapota in Konkan region. They reported that commodity passes through four different channels of trade

namely. Channel I: Producers -fruit merchants – commission agents – retailers – consumers. Channel II: Producer – commission agents – retailers - consumers. Channel III: Producers – cooperative society – commission agents – retailers – consumers. Channel IV: Producers – fruit merchants – hawkers – consumers. The producers share in consumers rupee was highest (34.40%) in channel II and it was lowest (28.39%) in channel I, 32.23 and 31.61 per cent in channel III and IV, respectively.

Matin *et al.* (2008) conducted a study on mango marketing system in selected areas of Bangladesh. Three important mango growing areas, namely Dinajpur, Chapai Nwabgonj and Meherpur districts were selected. Primary data were collected randomly from 90 farmers and 55 traders. Out of 55 traders, 15 were bairals, 15 were beparis. 9 aratdar (local), 6 aratdar (urban), 10 retailers (both local and urban). Five major channels were identified as dominant in the study. They are Channel-I (Farmer → Bairal →Bepari →Aratdar (Local) → Aratdar (Dhaka) → Retailer (Dhaka) → Consumer), Channel-II (Farmer → Bepari → Aratdar (Local)→Aratdar (Dhaka) → Retailer (Dhaka) →Consumer), Channel-III (Farmer → Bepari→ Aratdar (Local) → Aratdar(Other district) →Retailer (Other district) → Consumer), Channel-IV (Farmer → Retailer (Other district) → Aratdar (Local) → Retailer (Of the district) → Consumer), Channel-V (Farmer → Retailer (Local) → Consumer) and the researcher concluded that Channel-V-(farmer- retailer (Local)-consumer) possesses the highest marketing efficiency followed by channel IV, III, and II. The performance indicators revealed that the channel-I and channel-II were not relatively efficient in the mango producing regions. The researchers suggested to establishing mango processing plant in the intensive growing areas, which will ensure fair prices for the farmer. The researchers concluded that if the farmers sell their mango directly to the ultimate consumers then they will get more benefit.

Anchal and Sharma (2009) studied on price spread of litchi in Punjab. The study was undertaken in Gurdaspur district of Punjab with a view to examine various marketing channels and price spreads of litchi in the study area. The results of the study showed that the producer received the maximum share in consumer's rupee whereas the consumers paid the minimum price when the litchi was sold as well as bought in local market. The margins of the middle man between producer and consumer was found to be at the tune of ₹ 255.80/q in the channel of producer – retailer – consumer in local market, ₹ 524.80/q in the marketing

channel of producer – pre harvest contractor- retailer- consumer in Amritsar market and ₹ 910.49/q in the marketing channel of producer – pre harvest contractor – retailer – consumer in Delhi market. This increase in margins of the middle man and cost of litchi per quintal lead to the higher price spreads in the marketing of litchi from local to Amritsar and further to Delhi market. Thus, from the economic point of view the local market was most suitable channel.

Karutagi *et al.* (2009) conducted a study in marketing of sapota in Belgaum and Dharwad districts of North Karnataka and identified major channels. Channel – I was more remunerative to the farmers: Producer – pre harvest contractor – cum wholesaler – retailer – consumer. Major variable of marketing cost incurred by producers was commission charges at 10 per cent of the value constituting more than 52 per cent of the total marketing cost. Producer's share in the consumer's rupee in channel – I was higher (59.85 %) than that in the channel – II (48.14 %). Similarly, price spread in channel – I was less (26.32 %) compared to channel – II (42.11 %). Major marketing problems were higher commission charges, lack of nearest markets and lack of storage facilities.

Murthy *et al.* (2009) in their study on marketing and post-harvest losses in fruits, and identified three channels of marketing of pomegranate in Bijapur, which are; Channel I: Producer – contractor – wholesaler/ commission agent – retailer – consumer. Channel II: Producer – wholesaler/commission agent (distant market) – retailer – consumer. Channel III: Producer – pre harvest contractor - wholesaler/ commission agent (distant market) – retailer – consumer. The marketing cost and marketing efficiency for channel II were highest ₹ 5664 per ton and 1.01, respectively.

Anil *et al.* (2011) conducted a study on economic appraisal of Kinnow production and its marketing under North-Western Himalayan region of Jammu. Four marketing channels were identified; Channel I: Producer – forwarding/commission agent – retailer – consumer. Channel II: Producer – wholesaler – retailers – consumers. Channel III: Producer – retailer – consumer. Channel IV: Producer – consumer. The average per quintal marketing cost at producer's level was found to vary to the extent of ₹ 450, 375, 303 and 223 for channels I, II, III and IV, respectively. The average per quintal marketing cost borne by the wholesaler in the channel 2 was ₹ 61, while it was ₹ 30, 32 and 19 in channels I, III and IV, respectively. The

producers share in consumers rupee was highest in channel IV (18%) due to self-sale in the local market. The marketing efficiency has been found to be highest in channel IV.

Mavi *et al.* (2012) studied on investigating the efficiency of various marketing models and problems of Kinnow growers of Punjab. Accordingly, three local markets near the producing area namely Abohar, Malout and Maur, one of each from the selected districts of Ferozpur, Mukatsar and Bhatinda were selected respectively. Six channels were identified; Channel-I (for Delhi market): Producer – pre-harvest contractor – wholesaler – retailer – consumer. Channel-II (for Ludhiana market): Producer – pre-harvest contractor – wholesaler – retailer – consumer. Channel-III (for Delhi market): Producer – wholesaler – retailer – consumer. Channel-IV (for Ludhiana market): Producer – wholesaler – retailer – consumer. Channel-V (for local market): Producer – wholesaler – retailer – consumer. Channel-VI (for local market): Producer – retailer – consumer. The study revealed that in absolute terms, the proportionate share of producers share in consumers rupee was found to be highest in channel-VI (73.36 %), followed by channel-V (68.48 %), channel-III (50.09 %), channel-IV (49.22 %), channel-II (34.07 %) and channel-I (29.90 %). The marketing cost of producers in channel-III was highest which accounted to 16.62 per cent.

Verma *et al.* (2013) conducted a study on production and marketing of Cumin in Jodhpur district of Rajasthan, using primary data collected from 60 producers. The study revealed that cumin cultivation in Rajasthan was profitable. The cumin producers have been found to follow two channels for marketing of cumin, they were Channel-I: farmer-village trader-wholesaler-retailer; and Channel-II: farmer- wholesalers-retailers. The marketing cost was found to be higher in Channel-I. The study recommended farmers to sell their produce in the regulated markets which fetch higher returns as compared to village level marketing

Vinay *et al.* (2013) made a study on marketing of sweet orange (malta) in Uttarkhand, India. Three marketing channels were identified and they were; channel-I: Producer – commission agent – retailer – consumer. Channel-II: Producer – retailer – consumer. Channel-III: Producer – cooperative society – retailer – consumer. More than 68 per cent of the produce was sold directly to the village commission agent/contractor. The producers were earning ₹ 8.64 per kg marketing margin in channel-I, followed ₹ 6.64 per kg, ₹ 4.64 per kg in channel-II and channel-III, respectively. The price spread was found to be high (₹ 7.05 per kg) in channel-I, followed by (₹ 5.07 per kg) channel-II and (₹ 3.12 per kg) in channel-III,

respectively. The producers share in consumer rupee was highest (70.29 per cent) in channel-III, while it was 54.93 per cent and 42.45 per cent in channel-II and I, respectively. Channel-III was the most efficient channel with an efficiency of 1.72 and channel-I was least efficient with an efficiency of 0.69.

Thejeswini (2015) conducted a research on production and marketing of acid lime in Vijayapura district. Researchers observed the following two different marketing channels of acid lime. Channel-I: Producer – commission agent - distant traders – distant retailers – distant consumers. Channel-II: Producer – commission agent cum wholesaler – local retailer – local consumer. The marketing cost ranged from ₹ 119.55 per bag in Indi and ₹ 151.97 per bag in Vijayapura. Price spread was highest under channel-I (₹ 1023.66 and ₹ 1226.37 in Indi and Vijayapura) and channel-II (₹ 715.04 and ₹ 792.37 in Indi and Vijayapura), respectively.

2.4 Constraints faced in production and marketing management of horticulture crops

Hendge *et al.* (2007) conducted a study to determine the constraints encountered by banana growers in Nanded district, Marathwada region, Maharashtra. Majority of the growers (97.50 %) opined about high fluctuations in selling price of bananas, 99.66 per cent growers stated that there are less cooperatives helping out in marketing of bananas. Further, four-fifths of the growers opined that inorganic fertilizers are costly and 75 per cent growers reported problem of extortion by middleman. About 68 per cent growers stated unavailability of labour at proper time, 55.33 per cent growers expressed problems on lack of improved implements, 51.66 per cent growers experienced lack of guidance and 50.83 per cent growers reported lack of information regarding improved practices.

Dhakane *et al.* (2009) studied constraints in grape production technology in Barshi tehsil of Solapur district. The study was carried out with a sample of 150 grape growers. The major constraints reported by the grape growers in adoption of recommended grape production technology were lack of technical knowledge about control measure of insect, pest and diseases, lack of technical knowledge about doses of manures and fertilizers.

Adeoye *et al.* (2011) studied an economic analysis of watermelon based production system in Oyo state, Nigeria. The study revealed that inadequate credit facilities (78.00 %), pest and diseases (76.30 %), inadequate fertilizer (69.50 %) and high transportation cost (54.20 %) were the prominent constraints to watermelon production in the study area.

Mavi *et al.* (2012) studied on problems faced by growers in marketing of kinnow in Punjab. 84 per cent of the respondents reported that price fluctuations acted as a deterrent to expand kinnow cultivation followed by poor marketing infrastructure (67 %), inadequate processing facilities (65 %). Among the total respondents and pre harvest contractors, 54 per cent of the sample farmers and about 57 per cent of the pre harvest contractors reported that market intelligence system was not sound followed by malpractices (47 %) and inadequate post-harvest infrastructure (38 %).

Thorat and Shelke (2012) conducted a study to know the constraints faced by ber growers in production and marketing in Beed district. The study was conducted in Kaij and Beed talukas of Beed district. From each taluka, 6 villages were selected in which 48 respondents were selected. The findings of the study revealed that fluctuation in market prices was the major problem which accounted to 87.50 per cent., high commission charges accounted to by 83.33 per cent, followed by irrigation i.e. less water in summer (64.58 %), non-availability of transport facility in time and at cheap rate (54.16 %), non-availability of labour in time and proper wages (52.08 %), high cost of FYM and fertilizer (47.91 %), non-availability of good quality packing material (45.83 %). To overcome these constraints, they suggested that transport facility should be made in time and cheap charges, good quality packing material be available at lower price, availability of mechanical grading and packing facility, should create export facility for ber, pruning should be done in second fortnight of April, need to establish cold storage houses and ancillary industries for preparation of ber products.

Kuwornu *et al.* (2013) conducted a research on financial viability, value addition and constraint analysis of certified organic pineapple production and marketing in Ghana. The results of the study revealed that in the central region, lack of access to cash credit is the main constraint followed by unreliable market, pest and disease control, difficulty in accessing farm land, inadequate tractor services *etc.* While in the eastern region, high weed competition with plants is the main constraint followed by lack of access to cash credit, no premium paid for certified organic pineapple fruits, higher post-harvest losses, unreliable market, difficulty in accessing labour, inadequate organic production technology, bad weather condition, difficulty in accessing farm lands, less access to extension services *etc.*,

Sain *et al.* (2013) conducted a research on constraints faced by guava growers in production and marketing of districts of Haryana state. The primary data were collected from

60 growers through random sampling. The research study revealed that major problems faced by the guava growers in production were damage due to aberrant weather conditions, non-availability of good seedling and lack of support prices, lack of market organization and non-availability of processing facilities *etc.*,

Sudarshan and Sudalaimutu (2013) studied on efficiency of marketing channels for pomegranate in Koppal district of Karnataka, wherein constraints in marketing of pomegranate was also studied. The study revealed that lack of processing facilities, absence of market information; facilities at market place, skilled labour and transport facility bags revealing that producer encounter these constraints more severely than other constraints in marketing their produce. Other problems like price fluctuations, risk bearing, high commission charges are least encountered constraints.

Vairam (2013) studied economic analysis of the production and marketing of grape cultivation in Theni district, Tamil Nadu. In this study, the farmers reported that they are facing the problems like lack of remunerative price for their product and protecting the grape vineyard from the diseases; whereas, the traders complain that there are no adequate infrastructural facilities such as road, transportation and cold storage *etc.*,

Vinayak *et al.* (2013) conducted a research on constraints in production and marketing of onion in Northern Karnataka. The primary data were collected from 90 sample respondents. The research study revealed that non-availability of labour were found to be major problem during production followed by rainfall distribution, management problems, credit problem, resource availability, power supply *etc.* Whereas under marketing, price fluctuations was found to be the major problem followed by storage, grading, commission charges, transportation, availability of market information, mutual understanding between commission agents and traders *etc.*

Bhandare *et al.* (2014) conducted a research on constraints faced by sweet orange growers while adopting recommended package of practices. The primary data were collected from 120 sample respondents in Marathwada region of Maharashtra. The constraints faced by farmers in adoption of recommended package of practices are soil, plantation, training and pruning, intercultural operation, irrigation, fertilizer, pesticides, withholding of water, harvesting and post-harvest and price for fruits.

Vinayaka *et al.* (2014) studied the growth and instability analysis of fruits crops in India. The study revealed that farmers were facing absence of support price in the case of glut, absence of regulated markets and fluctuations in market prices were major marketing constraints while non-availability of quality testing laboratories and lack of adequate cold storage facilities were the major area and productivity constraints in India.

Jawale and Ghulghule (2015) conducted a research on constraints and suggestions of kesar mango production in export zone of Marathwada region. Primary data were collected from 60 sample respondents of export zone of Marathwada region. The major constraints faced by farmers in production were effect of heavy rains, winds and hailstone during flowering and fruit setting time, problem of scarcity of labour with high wage rate, irregular electricity supply, non-availability of quality grafts in locality and high cost of inputs *etc.*,

Gunasekaran (2016) conducted a research on production and marketing problems faced by banana farmers in Karur district. The research study revealed that major problems in production were heavy damage by wind followed by severity of pests, deteriorating soil quality, severity of diseases, deteriorating water quality, heavy weed occurrences *etc.*, Where as in marketing indebtedness to traders is the major problem followed by heavy commission charges, inadequate finance, price fluctuations, absence of grading processing, high transportation cost, lack of storage facilities *etc.*, were some of the problems faced by the banana growers during cultivation.

Methodology

3. METHODOLOGY

This chapter deals with the details of the study area and description, sampling procedure, the nature and sources of data and various analytical techniques employed. This chapter is presented under the following sub-headings:

- 3.1 Description of the study area.
- 3.2 Sampling procedures
- 3.3 Nature and sources of data
- 3.4 Analytical techniques employed
- 3.5 Definition and concepts

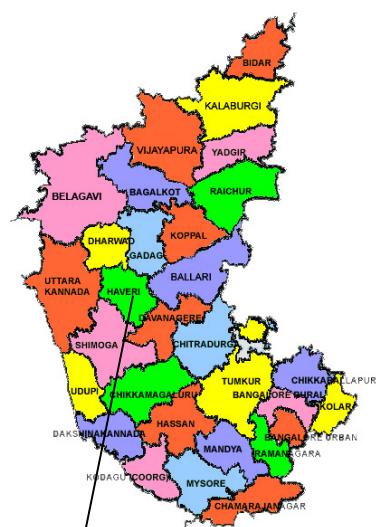
3.1 Description of the study area

The study was conducted in Karnataka and Andhra Pradesh states.

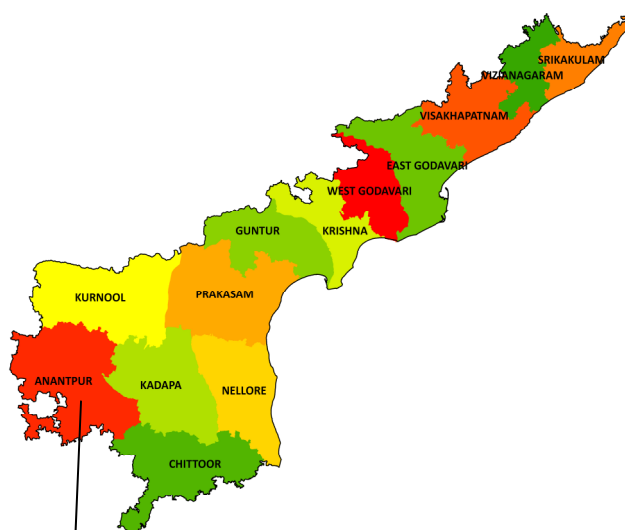
3.1.1 Karnataka

Karnataka is the seventh largest state in India covering an area of 1, 91,791 Sq. kilometers. It is situated in tropical zone and enjoys warm climate throughout the year. The mean temperature ranges from 21.5⁰C to 31.7⁰C, the maximum and minimum temperature being 42⁰C and 14⁰C, respectively. The average temperature in the state is about 24⁰C. In general, the climatic conditions are favorable for crop cultivation. The geographical area of Karnataka state is 190.50 lakh hectores of which an area of 121.82 lakh hectares comes under the cultivable area.

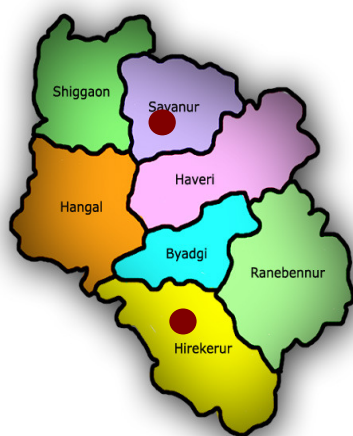
Normal rainfall of the state ranges from as low as 569 mm to as high as 4,029 mm. The average annual rainfall of the state is 1,354 mm. Major part of the rainfall of the state is received from southwest monsoon, which commences in the first week of June and continues till the end of September. Major part of the state has red soils, laterite soils are found in the hilly and coastal regions of the western parts. The northern part of the state has black soils with high moisture holding capacity. In Karnataka, Haveri district was selected for the study because area under the crop was highest among the Northern districts of Karnataka (Table 3.1).



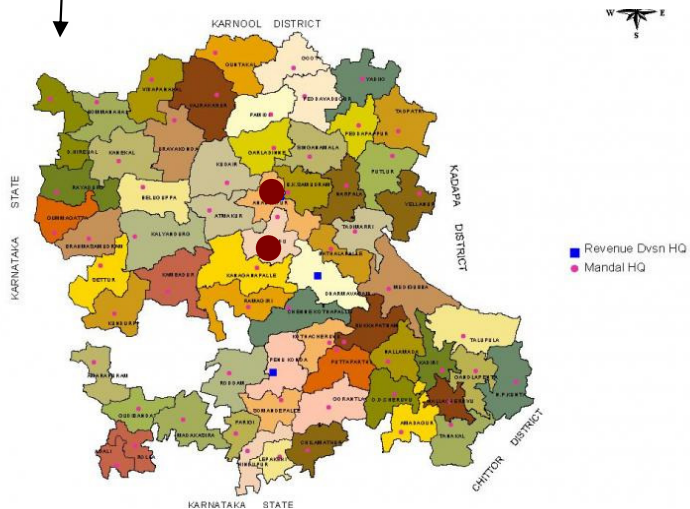
a) Karnataka state



b) Andhra Pradesh state



c) Haveri district



d) Ananthapur district

● Study area

Fig. 1. Map showing study area

Table 3.1: Area, production and productivity of watermelon for major producing districts in Karnataka and Andhra Pradesh (Triannual average of 2014-15 to 2016-17)

Sl. No	Karnataka				Andhra Pradesh			
	Districts	Area ('000 hectares)	Production ('000 metric tonnes)	Productivity (metric tonnes/ha)	Districts	Area ('000 hectares)	Production ('000 metric tonnes)	Productivity (metric tonnes/ha)
1	Mysore	1.44	44.89	31.10	Ananthapur	3.05	91.42	30.01
2	Kolar	0.91	39.96	44.07	Chittoor	2.44	65.93	26.98
3	Haveri	1.47	39.59	26.93	Kadapa	0.36	18.38	51.06
4	Mandya	0.90	32.44	36.05	Prakasam	0.52	13.82	26.75
5	Chamarajanagar	0.92	29.70	32.40				
6	Koppal	0.57	23.23	40.75				
7	Bagalkot	0.60	18.31	30.35				
8	Baigavi	0.51	17.96	35.22				
9	Chikballapur	0.25	11.57	46.92				
	Total	7.57	257.65	34.03	Total	6.37	189.55	29.76

3.1.1.1 Haveri district

The study was carried out in Haveri district of Karnataka as it is one of the major watermelon cultivating districts of the state. It falls under Northern Transitional Zone (Zone-8) of Karnataka state. It is geographically lying within the interior of Deccan peninsular between 14°19' and 14°48' North latitude and between 70°15' and 75°50' East longitude. The area of the district is 4,85,156 hectares and bound on the North by Dharwad and Gadag districts, on the South by Shimoga and Davanagere districts, on the East by Bellary district and on the West by Uttar Kannada district. Dharma, Kumadwati, Varada and Tunga-Bhadra are the four major rivers flowing in this district.

3.1.1.2 Geographic and demography features

Table 3.2 shows the geographic and demographic profile of the study area. The geographical area of Haveri district is 4, 85,156 hectares spread over seven taluks. The district has 691 inhabited villages and seven uninhabited villages spread in seven taluks viz., Haveri, Byadagi, Savanur, Ranebennur, Hirekerur, Hangal and Shiggaon. The population of the district according to district at a glance report during 2015-16, was 15, 98,506 with 1000:950 male and female ratio. Out of this, 12, 42,442 were in rural areas (77.73%) and rest were in urban and semi-urban areas. The population density of the district was 298 persons per sq. km and the decadal growth of the population in the district was 11.02 per cent. The literacy rate was 77.60 per cent. Constituting 84.20 per cent were among males and 70.70 per cent were among females. The total irrigated area in the district was 98,666 hectares. The major irrigation sources in the district are tube wells (63,016 ha), followed by tanks (9,698 ha), canals (5,134 ha), lift irrigation (753 ha) and other sources (20,045 ha).

3.1.1.3 Climate, rainfall and soil type

There are three distinct agricultural seasons in the district viz., *kharif* (June-September), *rabi* (October- January) and *summer* (February- May). The south west monsoon commences by the end of September. The average annual rainfall in the district is 791.6 mm with average rainy days of 61 days and major portion of which is received from South-West monsoon. The average temperature ranged from 16°C to 34°C. In the major part of the district red sandy soil is occurring, followed by the medium black soil and deep black soils. The red loamy soil and lateritic soil are seen in very small parts on southern border of the district.

Table 3.2: Demographic profile of the study area

Sl. No	Particulars	Haveri district	Ananthapur district
1.	Geographical area (ha)	4,85,156	19,13,000
2.	Population (numbers)	15,98,506 (100%)	40,83,315 (100%)
	Rural	12,42,442 (77.73%)	29,36,312 (71.91%)
	Urban	3,56,064 (22.27%)	11,47,003 (28.09%)
	Decadal growth (%)	11.02	12.10
	Sex ratio (No. of Females per 1000 Males)	950	978
3.	Population density (person per sq. km)	298	213
4.	Literacy rate (%)	77.60	64.28
	Male	84.20	73.02
	Female	70.70	53.97
5.	Net area irrigated (ha)	99,028	1,08,900
	Canals	5,134	22,400
	Tanks	9,698	4,300
	Tube well	63,016	91,000
	Lift irrigation	753	-
	Other	20,045	1,500
6.	Rainfall (mm)		
	Normal	791.6	328
	Actual	656.1	560

Source: District Statistical Office (2015-16)

Figures in parentheses indicate percentage to the respective total.

3.1.1.4 Land utilization pattern

Table 3.3 shows the land utilization pattern in the district for the year 2015-16. The total geographical area of the district is 4, 85,156 hectares, out of which, the net cultivable area is 3, 61,908 hectares (74.60 %) and area sown more than once is 70,256 hectares (14.48 %). The area not available for cultivation is around 39,150 hectares (8.06 %) which comprise of non-agricultural area (33,357 ha or 6.87 %) and barren land (5,793 ha or 1.19 %). About 19,156 hectares (3.95 %) of land is fallow and 47,454 hectares (9.78 %) is under forests. The cultivable waste is 2,989 hectares (0.62 %) and other uncultivable land is 17,488 hectares (3.60 %).

3.1.1.5 Cropping pattern

The area under major crops in Haveri district is presented in Table 3.4. It can be observed from the table that 57.99 per cent of the total cropped area was under cereal crops. Maize (39.10 %), paddy (10.30 %) and sorghum (8.06 %) were the major cereals grown in the district. Out of the total cropped area, the share of pulses and oil seeds were 2.77 per cent and 6.97 per cent respectively. The major pulse crops in the district were horse gram (0.98 %), bengal gram (0.46 %), green gram (0.60 %) and red gram (0.40 %). The crops like ground nut (4.07 %), soybean (1.71 %), sunflower (0.87%) and safflower (0.21%) were the major oil seed crops. The share of commercial crops, fruits and vegetables was 22.74 per cent, 1.46 per cent and 2.49 per cent respectively. The major commercial crops grown in the district are cotton (19.34 %) and sugar cane (3.40 %). The share of condiments and spices, plantation crops and flowers was 2.81 per cent, 1.87 per cent and 0.91 per cent respectively.

3.1.2 Andhra Pradesh

Andhra Pradesh is one of the 29 states of India. The state, which is situated on the southeastern coast of the country, is the eighth-largest state in India covering an area of 162,970 km² (62,920 square miles). As per the 2011 Census of India, the state is tenth-largest by population with 49,386,799 inhabitants. The largest city in the state is Visakhapatnam. On 2nd June 2014, the north-western portion of Andhra Pradesh was separated to form a new state of Telangana. The new riverfront de facto capital, Amaravati, is under the jurisdiction of the Andhra Pradesh Capital Region Development Authority (APCRDA).

Table 3.3: Land use pattern in the study area during 2015-16

Sl. No	Classification of land	Haveri district (ha)	%	Ananthapur district (ha)	%
1	Total geographical area	4,85,156	100.00	19,13,000	100.00
2	Area under forest	47,454	9.78	1,97,000	10.29
3	Non- agricultural area	33,357	6.87	1,21,200	6.33
4	Barren land	5,793	1.19	1,66,425	8.69
5	Cultivable waste	2,989	0.62	51,900	2.71
6	Other uncultivable waste	17,488	3.60	1,83,500	9.59
7	Fallow land	19,156	3.95	2,27,000	11.86
8	Net area sown	3,61,908	74.60	11,13,000	58.18
9	Area sown more than once	70,256	14.48	74,000	3.86

Source: District Statistical Office (2015-16)

Table 3.4: Area under major crops in Haveri district in 2015-16

Sl. No	Crop	Area (ha)	Percentage (%)
1	Cereals		
	Paddy	44,968	10.30
	Sorghum	35,186	8.06
	Maize	1,70,696	39.10
	Wheat	983	0.23
	Ragi	154	0.04
	Other cereals and minor millets	1,143	0.26
	Total cereals	2,53,130	57.99
2	Pulses		
	Red gram	1,739	0.40
	Horse gram	4,275	0.98
	Black gram	140	0.03
	Green gram	2,616	0.60
	Cowpea	958	0.22
	Bengal gram	1,991	0.46
	Aware	377	0.09
	Total pulses	12,106	2.77
3	Oil seeds		
	Ground nut	17,789	4.07
	Sunflower	3,803	0.87
	Safflower	910	0.21
	Sesamum	114	0.03
	Niger seed	125	0.03
	Soya been	7,450	1.71
	Others	169	0.05
	Total oil seeds	30,406	6.97
4	Commercial		
	Sugarcane	14,826	3.40
	Cotton	84,424	19.34
	Total commercial	99,250	22.74
5	Fruits	6,389	1.46
6	Vegetables	10,866	2.49
7	Condiments and spices	12,253	2.81
8	Plantation crops	8,170	1.87
9	Flowers	3,952	0.91
	Total	4,36,522	100.00

Source: Haveri district at a glance 2015-16. Government of Karnataka

The state has a coastline of 974 km with jurisdiction over nearly 15,000 sq. kms of territorial waters, the second longest coastline among the states of India after Gujarat. It is bordered by Telangana in the north-west, Odisha in the north-east, Karnataka in the west, Tamil Nadu in the south and the water body of bay of Bengal in the east. A small enclave of 30 sq. km of Yanam, a district of Puducherry, lies south of Kakinada in the Godavari delta on the east side of the state.

Andhra Pradesh is composed of three major regions: Coastal Andhra, Uttar Andhra and Rayalaseema, in the inland southwestern part of the state. These three regions comprise 13 districts, with three in Uttar Andhra, six in Coastal Andhra and four in Rayalaseema. The six districts in Coastal Andhra are Srikakulam, Vizianagaram, Visakhapatnam, West Godavari, East Godavari and Krishna, followed by four districts in Rayalaseema are Ananthapur, Chittoor, Kadapa and Kurnool. Whereas three districts in Uttar Andhra are Guntur, Prakasham and Nellore. Based on highest production of watermelon in the state, Ananthapur district was purposively selected for the study (Table 3.1).

3.1.2.1 Ananthapur

The study was carried out in Ananthapur district of Andhra Pradesh as it is one of the major watermelon cultivating districts of the state. Ananthapur is a district in the Rayalaseema region of Andhra Pradesh. The district headquarters is located at Ananthapur city. It is the largest district of Andhra Pradesh spanning an area of 19,130 sq. km. It is bounded on the north by Kurnool district, on the east by Kadapa district, on the southeast by Chittoor district, and on the southwest and west by Karnataka state. Its northern and central portions are a high plateau, generally undulating, with large granite rocks or low hill ranges rising occasionally above its surface. In the southern portion of the district the surface is more hilly, the platea rising to 2,000 ft. (610 m) above the sea. Six rivers flow within the district: Penna, Chithravathi, Vedavathi, Papagni, Swarnamukhi and Thadakaleru. The district receives an average annual rainfall of 381 mm.

3.1.2.2 Population and demography

Table 3.2 shows the demographic profile of the study area. The geographical area of Ananthapur district is 19, 13,000 hectares spread over 5 revenue divisions viz., Ananthapur, Dharmavaram, Kadiri, Kalyandurg and Penukonda divisions. Kadiri and Kalyandurg divisions are formed in 2013. These revenue divisions are further divided into 63 mandals.

The population of the district according to district at a glance report during 2015-16, was 40, 83,315 with 1000:978 male and female ratio. Out of this, 29, 36,312 were in rural areas (71.91 %) and rests were in urban 11, 47,003 (28.09 %). The literacy rate was 64.28 per cent. The total irrigated area in the district was 1, 08,900 hectares. The major irrigation sources in the district are tube wells (91,000 ha), followed by canals (22,400 ha), tanks (4,300 ha) and others (1,500 ha).

3.1.2.3 Climate, rainfall and soil type

There are three distinct agricultural seasons in the district viz., *kharif* (June-September), *rabi* (October- January) and *summer* (February- May). The south west monsoon commences by 2nd week of June. The average annual rainfall in the district is 560 mm and major portion of which is received from South-West monsoon (328 mm) followed by North – West monsoon (154 mm), winter (4 mm) and summer (74 mm). The average temperature ranged from 16⁰C to 42⁰C. The soils of Anantapur district are predominantly of red, black and sandy loamy soils.

3.1.2.4 Land utilization pattern

Table 3.3 shows the land utilization pattern in the district for the year 2015-16. The total geographical area of the district is 19,13,000 hectares, out of which, the net cultivable area is 11,13,000 hectares (58.18 %) and area sown more than once is 74,000 hectares (3.86 %). The area not available for cultivation is around 2,87,625 hectares (15.02 %) which comprise of non-agricultural area (1, 21,200 ha or 6.33 %) and barren land (1, 66,425 ha or 8.69 %). About 2,27,000 hectares (11.86 %) of land is fallow and 1, 97,000 hectares (10.29 %) is under forests. The cultivable waste is 51,900 hectares (2.71 %) and other uncultivable land is 1,83,500 hectares (9.59 %).

3.1.2.5 Cropping pattern

The area under major crops in Ananthapur district is presented in Table 3.5. It can be observed from the table that 8.48 per cent of the total cropped area was under cereal crops. paddy (3.34 %), maize (2.44 %) and sorghum (2.11 %) were the major cereals grown in the district. Out of the total cropped area, the share of pulses and oil seeds were 13.95 per cent and 66.94 per cent respectively. The major pulse crops in the district were bengal gram (7.79 %), red gram (4.30 %) and horse gram (1.35 %). The crops like ground nut (64.73 %), castor

Table 3.5: Area under major crops in Ananthapur district in 2015-16

Sl. No	Crop	Area (ha)	Percentage (%)
1.	Cereals		
	Paddy	29,211	3.34
	Sorghum	18,452	2.11
	Bajra	1,799	0.21
	Maize	21,313	2.44
	Ragi	1,870	0.21
	Korra	738	0.08
	Total minor millets	691	0.08
Total food grains		74,120	8.48
2.	Pulses		
	Red gram	37,562	4.30
	Bengal gram	68,092	7.79
	Horse gram	11,771	1.35
	Green gram	3,014	0.34
	Black gram	230	0.03
	Cowpea	1,216	0.14
Total Pulses		1,21,885	13.95
3.	Oil seeds		
	Groundnut	5,65,751	64.73
	Sunflower	8,452	0.97
	Safflower	310	0.04
	Castor	10,549	1.21
Total oil seeds		5,85,062	66.94
4.	Commercial crops		
	Cotton	32,618	3.73
	Chillies	2,923	0.33
Total commercial crops		35,571	4.07
5.	Total vegetables	8,248	0.94
6.	Total fruits	38,808	4.44
7.	Total condiments and spices	6,686	0.77
8.	Total aromatic plants and flowers	714	0.08
9.	Total fodder crops	2,900	0.33
Total		8,73,994	100.00

Source: Ananthapur district at a glance 2015-16. Government of Andhra Pradesh

(1.20 %), sunflower (0.97 %) and safflower (0.04 %) were the major oil seed crops. The share of commercial crops, fruits and vegetables was 4.07 per cent, 4.44 per cent and 0.94 per cent, respectively. The major commercial crops grown in the district were cotton (3.73 %) and chilies (0.33 %). The share of condiments and spices, aromatic plants and flowers and fodder crops was 0.77 per cent, 0.08 per cent and 0.33 per cent, respectively.

3.2 Sampling procedure

For the present study, multistage sampling procedure was adopted. The first stage was comprised of selection of districts. Two districts, Haveri in Karnataka and Ananthapur in Andhra Pradesh were selected based on the highest area and production of watermelon across the districts in Karnataka and Andhra Pradesh, respectively and were purposively selected for the study.

The second stage comprised of selection of taluks from Haveri and mandals from Ananthapur districts. In this stage, out of seven taluks in Haveri district, two taluks namely Hirekerur and Savanur were selected for the study because commercial watermelon production was more potential in these two taluks of the district. In Ananthapur district, two mandals namely Raptahdu and Ananthapur were selected for the study based on highest area in watermelon production across the mandals in the district.

The third stage comprised of selection of watermelon cultivators from the selected taluks and mandals of Karnataka and Andhra Pradesh, respectively. In Haveri district, 25 sample respondents each from Hirekerur and Savanur taluks were selected randomly. In Ananthapur district, 25 sample respondents each from Raptahdu and Ananthapur mandals were selected randomly. Thus in all 50 farmers from Karnataka and 50 farmers from Andhra Pradesh were selected for the study.

For studying the marketing aspects of watermelon, 5 intermediaries at each stage were selected from the two districts.

3.3 Nature and sources of data

The study was based on both primary and secondary data. The secondary data on area, production and productivity of watermelon was collected from Directorate of Economics and Statistics, District Statistical Office and District horticulture offices and other published sources for the period from 2001-02 to 2016-17 to analyze the growth in area, production and

productivity. For evaluating the other objectives of the study, required primary data were collected from sample farmers through personal interview method with the help of pre-tested and well-structured schedule. The data collected were pertained to agricultural year 2016-17. The data were collected on general characteristics of farmers, production management, input management, resource use management and consequent costs and returns including marketing. Majority of the respondents did not maintain records on watermelon cultivation. Hence, data collected were based on the memory of the respondents. Similarly, the data on marketing aspects from producers and marketing intermediaries were collected through personal interview method with the help of pre-tested and well-structured schedule. The information on problems in production and marketing were collected through opinion survey of the respective respondents.

3.4 Analytical tools

The following were the major analytical tools used in the analysis of the data collected from the study areas.

3.4.1 Growth rate analysis

For computing compound annual growth rates of area, production and productivity of watermelon, the exponential function of the following form was used.

$$Y = a b^t e^U \dots\dots\dots (1)$$

Where,

Y = Dependent variable (Area / Productivity / Production)

a = Intercept term

b = Regression coefficient

(‘a’ and ‘b’ are the parameters to be estimated)

t = time period

e^U = Error term

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

$$\log Y = \log a + t \log b + Ut \dots\dots\dots (2)$$

Equation (2) was estimated by using Ordinary Least Squares (OLS) technique.

Compound growth rate (g) was then computed

$$g = (b - 1) \times 100 \dots\dots\dots (3)$$

Where,

g = Compound growth rate in per cent per annum

b = Antilog of log b

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

3.4.2 Instability index:

The coefficient of variation was used to measure the variability in area, production and productivity. The coefficient of variation or index of instability was computed by using the following formula

$$CV = \frac{\text{Standard deviation } (\sigma)}{\text{Mean } (\bar{X})} \times 100$$

Linear trend were fitted to the original data of area, production and productivity, for the period of 16 years from 2001-02 to 2016-17. The trend coefficients were tested for their significance. Whenever the trend of series found to be significant; the variation around the trend rather than the variation around mean was used as an index of instability. The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend. That is coefficient of variation was multiplied by the square root of the difference between the unity and coefficient of multiple determinations (R^2), in the cases where R^2 was significant to obtain the Instability Index.

$$\text{Instability index} = \frac{\text{Standard deviation } (\sigma)}{\text{Mean } (\bar{X})} \times 100 \times \sqrt{1-R^2}$$

3.4.3 Tabular analysis

The technique of tabular analysis was employed for determining the cultivation cost and returns. The tables were made separately for operation wise labour requirements, input management, cost of cultivation, marketing management etc.,

Tabular presentation was adopted to compile the general characteristics of the sample farmers such as type of land, hybrids sown, sowing time and market intermediaries to determine the resource structure, cost structure, returns, profits and opinion regarding the production and marketing. Simple statistical tools like averages and percentages were used to compare, contrast and interpret results properly.

3.4.4 Functional analysis

The Cobb – Douglas type of production function was used to study the effect of various inputs on watermelon output. On account of its well – known property of its computational simplicity, justifies its wide application in analyzing production relations (Handerson and Quandt, 1971). It being a homogeneous function provided a scale factor enabling one to measure the returns to scale. The estimated regression coefficients represented the production elasticities.

The form of Cobb – Douglas type of production function used in the present study is as follows.

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} X_9^{b_9} X_{10}^{b_{10}} X_{11}^{b_{11}} X_{12}^{b_{12}} X_{13}^{b_{13}} X_{14}^{b_{14}} X_{15}^{b_{15}} X_{16}^{b_{16}} e^u \quad (3)$$

Where,

Y = Gross Yield (tonnes)

a = Intercept term

X₁ = Seeds (g)

X₂ = FYM (tonnes)

X₃ = Neem cake (kg)

X₄ = Human labour (man days)

X₅ = Bullock labour (pair days)

X₆ = Machine labour (hours)

X₇ = Nitrogen 'N' (kg)

X₈ = Phosphorus 'P' (kg)

X₉ = Potassium 'K' (kg)

X₁₀ = Sulphur 'S' (kg)

X₁₁ = Calcium 'Ca' (kg)

X_{12} = Boron 'B' (g)

X_{13} = PPC in solid form (kg)

X_{14} = PPC in liquid form (lt)

X_{15} = Growth regulators (g)

X_{16} = Herbicides (lt)

e^u = Error term

b_i 's = Output elasticity's of respective factor inputs, $i = 1, 2, 3, \dots$ and

The Cobb – Douglas type of production function was converted into log linear form as given below and parameters (coefficients) were estimated by employing Ordinary Least Square Technique (OLS) as given below.

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + b_8 \log X_8 + b_9 \log X_9 + b_{10} \log X_{10} + b_{11} \log X_{11} + b_{12} \log X_{12} + b_{13} \log X_{13} + b_{14} \log X_{14} + b_{15} \log X_{15} + b_{16} \log X_{16} + u \log e \quad (4)$$

3.4.5 Allocative efficiency

Given the technology, allocative efficiency exists when resources are allocated within the farm according to quantity which implies the proper level of input use in production. To decide whether a particular input is used rationally or irrationally, its marginal value products would be computed. If the marginal value product (MVP) of an input just covers its acquisition quantity, it is said that is used efficiently.

The MVP was calculated at the geometric mean levels of variables by using the following formula.

$$\text{MVP } i^{\text{th}} \text{ resource} = b_i \times \frac{\text{GM } (\bar{Y})}{\text{GM } (\bar{X})}$$

Where,

$\text{GM } (\bar{Y})$ = Geometric mean of the output

$\text{GM } (\bar{X})$ = Geometric mean of i^{th} input

b_i = The regression coefficient of the i^{th} input

A ratio of the value of marginal product (MVP) to the factor price (MFC) was compared and if it is more than unity implied that the resources were advantageously employed. If the ratio was less than one, it suggested that the resource was over utilized.

The criterion for determining optimality of resource use was,

$MVP/MFC > 1$ underutilization of resources

$MVP/MFC = 1$ optimal use of resources

$MVP/MFC < 1$ excess use of resources.

3.4.6 Marketing channels, marketing cost and price spread

An attempt was made to study some aspects of marketing from the view point of watermelon cultivators and sellers. The aspects include the marketing channels, marketing costs, margin and price spread.

Marketing channel refers to the alternate routes of product flow from the producer to final destiny. Marketing cost is the cost incurred by the producers and sellers from the point of production up to sale. The cost per tonne was worked out by adding different components namely transportation cost, loading and unloading, tax, commission charges, weighing charges and miscellaneous charges.

Price spread was worked out by computing the differences between the prices received by the producer and prices paid by the retailer.

$$\text{Price spread} = P_p - P_f$$

Where,

P_p = prices paid by the retailer

P_f = prices received by the producer

3.4.5 Garrett Ranking Technique

To know the acceptance and constraints of farmers in production and marketing of watermelon, Garrett's ranking technique was used. Basically it gave the change of orders of constraints or advantages into numerical scores. The major advantage of this technique as compared to simple frequency distribution was that the constraints or advantages were arranged based on their importance from the point of view of respondents. Hence, the same number of respondents on two or more constraints may have been given different rank.

Garrett's formula for converting ranks into per cent was given by

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

Where,

R_{ij} = rank given for i^{th} factor by j^{th} individual

N_j = number of factors ranked by j^{th} individual

The per cent position of each rank then converted into scores referring to the Table given by Garret and Woodsworth (1996). For each factor, the scores of individual respondents were added together and divided by the total number of the respondents for whom scores were added. These mean scores for all the factors were arranged in descending order, ranks were given and most important factors were identified.

3.5 Terminologies used in the study

3.5.1 Costs

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

- 1) **Variable costs:** The variable costs include cost on seeds, FYM, neem cake, wages of human, bullock and machine labour, chemical fertilizers, plant protection chemicals, growth regulators, herbicides, drip irrigation structure, mulching rolls and interest on working capital. The computation of different terms of variable cost components are as follows:

Seeds: The cost of purchased seeds was based on the actual amount paid by the respondents.

Farm Yard Manure (FYM): Manure was organic matter used as organic fertilizer in agriculture. Manures contribute to the fertility of the soil by adding organic matter and nutrient, such as nitrogen, that are trapped by bacteria in the soil. The quantity of FYM used in the cultivation of watermelon was measured in terms of tonnes and the value of FYM generated on their farm was imputed by considering the rates prevailing in the locality at the time of its application.

Neem cake: Neem cake was used as organic fertilizer in agriculture. Neem cake increases the fertility of the soil by adding organic matter and nutrient, such as nitrogen. The quantity of

neem cake used in the cultivation of watermelon was measured in terms of kilograms and the value of neem cake was based on the actual amount paid by the respondents.

Human labour: It was measured in human man days. The eight hours of work per day was considered as one man day.

Bullock labour: It was measured in pair days. Hence, one pair day means eight hours of work by a pair of bullocks.

Machine labour: The cost of machine labour both hired and owned was calculated as per prevailing rates paid for particular type of operation employed in the study area.

Chemical fertilizers: Fertilizers and soil amendments applied to promote plant growth. The main nutrient present in fertilizers are nitrogen (N), phosphorus (P) and potassium (K) are the primary/ macro nutrients, Calcium (Ca), Sulphur (S) and Boron (B) are the micro nutrients are added in small amounts. Cost of fertilizer was computed by considering the actual price paid by the farmers including the transportation cost and other incidental charges incurred if any.

Plant Protection Chemicals (PPC): Plant protection chemicals are applied to control the pests and diseases in the crop. PPC were applied both in solid form (wetttable powder) as well liquid form (solvents). Cost of PPC was computed by considering the actual price paid by the farmers including the transportation and other incidental charges if any.

Growth regulators: Growth regulators were applied to promote plant growth and increase the incidence of female flower set in the crop. It leads to development of more fruits with attainable size. Cost of growth regulators was computed by considering the actual price paid by the farmers.

Herbicides: Respondents applied pre-emergence herbicides to control weed growth at early stages of the plant growth. Cost of herbicides was computed by considering the actual price paid by the farmers.

Drip irrigation structures: Drip irrigation is used for water use efficiency and also cultivation of watermelon in dry land areas. So, drip irrigation was the major source of irrigation in the study area. Drip irrigation structures include laterals, sub laterals and drippers *etc.*, the cost of drip irrigation structures was computed by considering the actual price paid by the respondents including the transportation and other incidental charges if any.

Mulching rolls: Mulching sheet is used to control weed growth in the cultivation of watermelon. Cost of mulching sheet was computed by considering the actual price paid by the farmers including the transportation and other incidental charges if any.

Interest on working capital: This was calculated at the rate of 8 per cent for crop period (4 months) on the total value of the seeds, FYM, neem cake, wages of human, bullock and machine labour, chemical fertilizers, plant protection chemicals, growth regulators, herbicides, drip irrigation structure, mulching rolls (based on the interest rates charged by financial institutions)

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

Depreciation charges: It is the decline in the value of an asset due to its wear and tear. In the present study, depreciation was calculated by using straight line method and subsequently apportioned.

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

Interest on fixed capital: Interest on fixed capital was calculated at the rate of 12 per cent, as the fixed deposits in commercial banks and private banks would fetch this rate of interest. The items considered under fixed capital were implements, machinery and rental value of land. Interest was considered on the value of these assets after deducting the depreciation for the year. The amount calculated was apportioned to the crop acreage based on duration of the crop.

Land revenue: land revenue was taken at the rates levied by the Government.

Rental value of land: Rental value of land was calculated at the prevailing rate per hectare per annum in the study area and was apportioned to the respective crop.

3.5.2 Returns

1. Gross returns per rupee of investment = Gross returns / Total cost
2. Cost of production per tonne = Total cost (₹/ha) / Yield (tonnes/ha)
3. Gross returns per tonne = Gross returns (₹/ha) / Yield (tonnes/ha)

4. Net returns over total cost / Net returns: Net returns over total cost were worked out by deducting total cost (TC) of production from gross returns.

$$\text{Net returns} = \text{Gross returns} - \text{Total cost}$$

5. Benefit cost ratio: This was worked out by dividing gross returns by total cost.

$$\text{Benefit cost ratio} = \text{Gross returns} / \text{Total cost}$$

3.5.3 Marketing definitions

Marketing channels: Marketing channels are defined as the routes through which the producer sellers dispose – off their produce. Two main channels were noticed in both the districts.

Channel-I: Producer – Retailer – Consumer

Channel-II: Producer – Wholesaler - Retailer – Consumer

Commission agent: Commission agent is a person who operates in the regulated market / market on behalf of producer – seller and purchasers (wholesale trader). He receives commission at a fixed rate on the amount involved in each transaction and is responsible for disbursement in each transaction, sales proceeds received from buyers. In the study area, commission agent just makes a platform between farmer to wholesaler/ retailer. He does not handle any produce in the transaction.

Wholesaler: Wholesaler is a person who buys the notified agriculture / horticulture produce 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.

Retailer: The retailer is a person who purchases produce directly from producers through commission agents in the study area.

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

Marketing costs: Marketing costs are the actual expenses incurred in bringing goods and services from the producer to the consumers.

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. This refers to the marketing costs and profit margins of different market intermediaries of a particular produce.

Commission charges: It is the payment made to commission agents for facilitating the process of bringing buyers and sellers of a commodity together in the marketing process.

Miscellaneous charges: In addition to the above costs, some other charges are also levied. These include handling, cleaning, charity contribution in cash and kind *etc.*, These charges may be payable either by the sellers or by the buyers.

Producer's net price: This was the difference between the price received (PR) and the cost incurred (MC) by the producer.

$$\text{Producers net price} = \text{PR} - \text{MC}$$

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

$$\text{Producer's share in consumer's rupee} = \frac{\text{Producer's net price}}{\text{Retail price}} \times 100$$

Results

4. RESULTS

This chapter deals with the presentation and interpretation of the results. Keeping the objective in view, the data were collected from sample watermelon farmers and market intermediaries, to draw meaningful conclusions. The data were analyzed by using appropriate tools and techniques and the results are presented under the following sub heads:

- 4.1 Growth in area, production and productivity of watermelon in Karnataka and Andhra Pradesh.
- 4.2 Production management of watermelon in the study area.
- 4.3 Marketing management of watermelon in the study area.
- 4.4 Problems associated with production and marketing of watermelon.

4.1 Growth in area, production and productivity of watermelon in Karnataka and Andhra Pradesh

The growth rates in area, production and productivity of watermelon in Karnataka and Andhra Pradesh states for the period of sixteen years from 2001-02 to 2016-17 are depicted in Table 4.1. The time series data are presented in Appendix – I.

It is observed from the table that the average area, production and productivity under watermelon in Karnataka were 8,739.25 ha, 2, 83,649.81 MT and 32.40 MT/ha respectively. In Andhra Pradesh, the corresponding figures were 8,901.81 ha, 1, 55,384.68 MT and 17.08 MT/ha respectively.

The area and production of watermelon in Karnataka were increasing significantly with 3.92 and 4.35 per cent per annum and productivity was found to be increasing at 0.41 per cent per annum, respectively. The area, production and productivity of watermelon in Andhra Pradesh were increasing significantly with 4.33, 9.20 and 4.66 per cent per annum, respectively.

As seen from the Table 4.1, coefficient of variation in area, production and productivity of watermelon in Karnataka and Andhra Pradesh states were analyzed. The results showed that in Karnataka, coefficient of variation in area, production and productivity of watermelon were 19.54, 20.55 and 4.71 per cent respectively. In Andhra Pradesh, coefficient of variation in area, production and productivity of watermelon were found to be 22.99, 40.81 and 30.38 per cent, respectively.

Table 4.1: Growth in area, production and productivity of watermelon in Karnataka and Andhra Pradesh (2001-02 to 2016-17)

Particulars	Karnataka			Andhra Pradesh		
	Area (ha)	Production (MT)	Productivity (MT/ha)	Area (ha)	Production (MT)	Productivity (MT/ha)
Average	8,739.25	2,83,649.81	32.40	8,901.81	1,55,384.68	17.08
CAGR (%)	3.92** (0.0034)	4.35** (0.0025)	0.41 (0.0024)	4.33** (0.0090)	9.20** (0.0085)	4.66** (0.0087)
R²	0.89	0.94	0.17	0.61	0.88	0.66
C. V. (%)	19.54	20.55	4.71	22.99	40.81	30.38

Note: Figures in the parentheses indicate standard error.

** Significant at one per cent probability level.

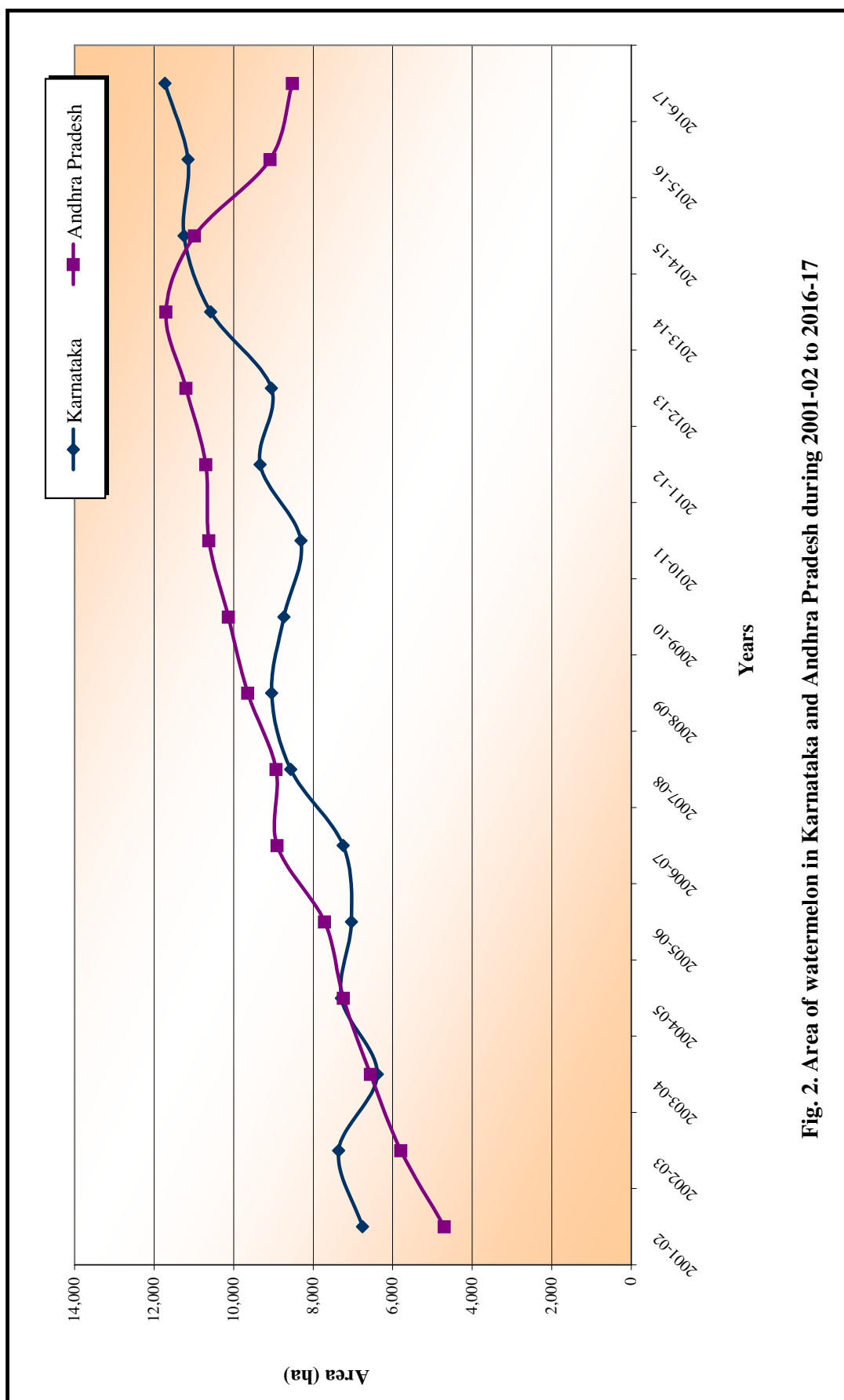


Fig. 2. Area of watermelon in Karnataka and Andhra Pradesh during 2001-02 to 2016-17

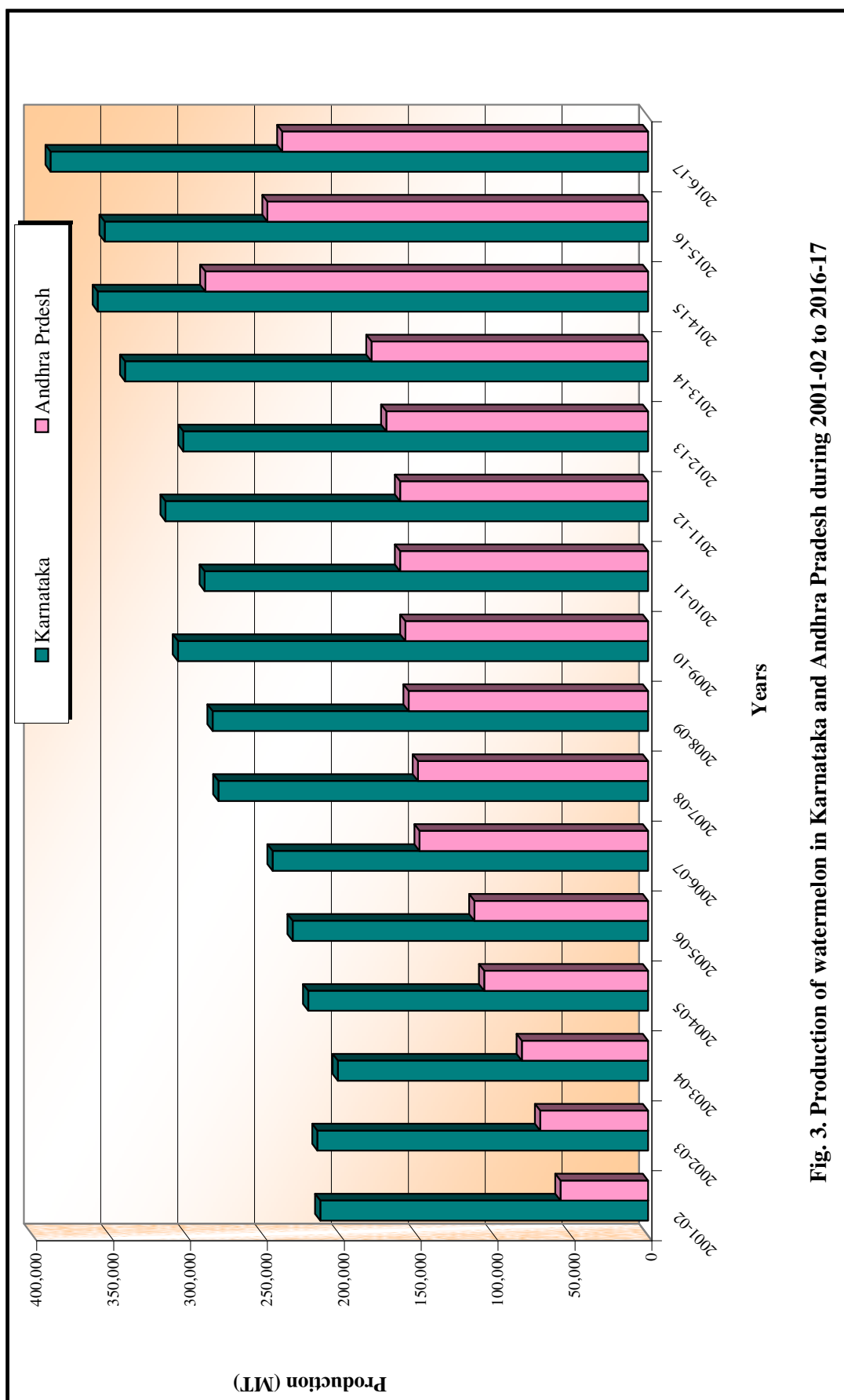
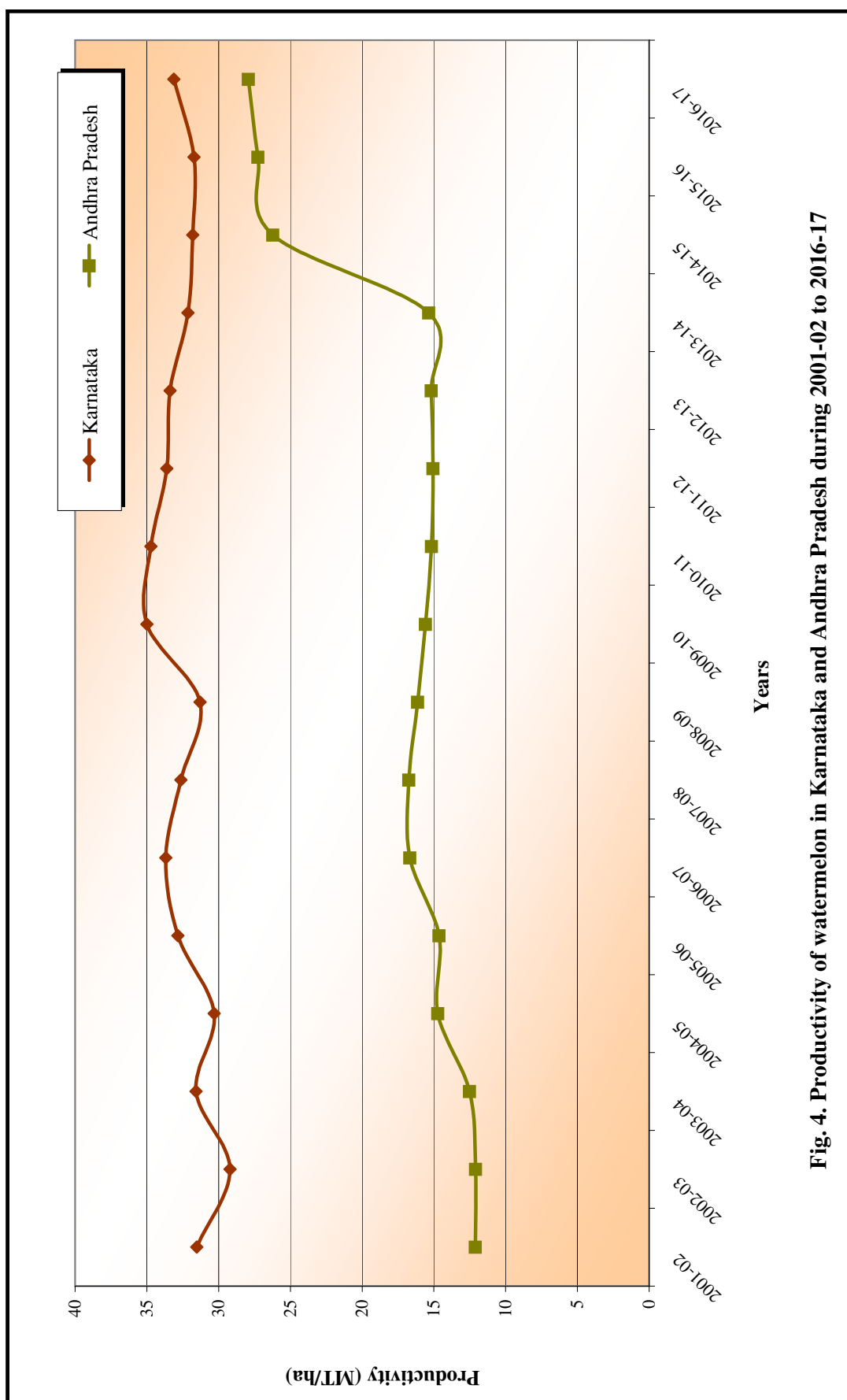


Fig. 3. Production of watermelon in Karnataka and Andhra Pradesh during 2001-02 to 2016-17



4.1.1 Growth in area, production and productivity of watermelon in Haveri and Ananthapur districts

The growth rates in area, production and productivity of watermelon in Haveri and Ananthapur districts for the period of sixteen years from 2001-02 to 2016-17 are depicted in Table 4.2. The time series data are presented in Appendix – II.

It was observed from the table that the average area, production and productivity under watermelon in Haveri district were 1,011.43 ha, 28,422.82 MT and 26.84 MT/ha respectively. In Ananthapur district, the average area, production and productivity under watermelon were 1,517.75 ha, 39,739.56 MT and 22.97 MT/ha, respectively.

The area and production of watermelon in Haveri district were increasing significantly with 9.44 and 9.08 per cent per annum, respectively. Whereas, the productivity was found to be decreasing at 0.33 per cent per annum. In Ananthapur district, area, production and productivity of watermelon were increasing significantly with 20.21, 26.70 and 5.40 per cent per annum, respectively.

As seen from the Table 4.2, coefficient of variation in area, production and productivity of watermelon in Haveri and Ananthapur districts were estimated. The results showed that in Haveri district coefficient of variation in area, production and productivity of watermelon were 46.38, 45.68 and 14.28 per cents, respectively. In Ananthapur district, coefficient of variation in area, production and productivity of watermelon were found to be 70.25, 83.94 and 28.38 per cents, respectively.

4.2 Production management of watermelon in the study area

4.2.1 General characteristics of sample respondents

The general characteristics of sample watermelon farmers in the study area are presented in Table 4.3. The present study covered 100 watermelon farmers consisting of 50 farmers from Haveri district (Karnataka) and 50 farmers from Ananthapur district (Andhra Pradesh). The average age of sample farmer was 36.21 years in Haveri district and 39.20 years in Ananthapur district. The type of family was nuclear for majority of the farmers in Haveri and Ananthapur districts, in Haveri district 45 farmers (90%) were having nuclear family and 5 farmers (10%) were having joint family. Whereas, in Ananthapur district 43 farmers (86%) were having nuclear family and remaining 7 farmers (14%) were having joint

Table 4.2: Growth in area, production and productivity of watermelon in Haveri and Ananthapur districts (2001-02 to 2016-17)

Particulars	Haveri district			Ananthapur district		
	Area (ha)	Production (MT)	Productivity (MT/ha)	Area (ha)	Production (MT)	Productivity (MT/ha)
Average	1,011.43	28,422.82	26.84	1,517.75	39,739.56	22.97
CAGR (%)	9.44** (0.0118)	9.08** (0.0115)	-0.33 (0.0080)	20.21** (0.0142)	26.70** (0.0204)	5.40** (0.0134)
R²	0.80	0.80	0.01	0.92	0.90	0.52
C. V. (%)	46.38	45.68	14.28	70.25	83.94	28.38

Note: Figures in the parentheses indicate standard error.

** Significant at one per cent probability level.

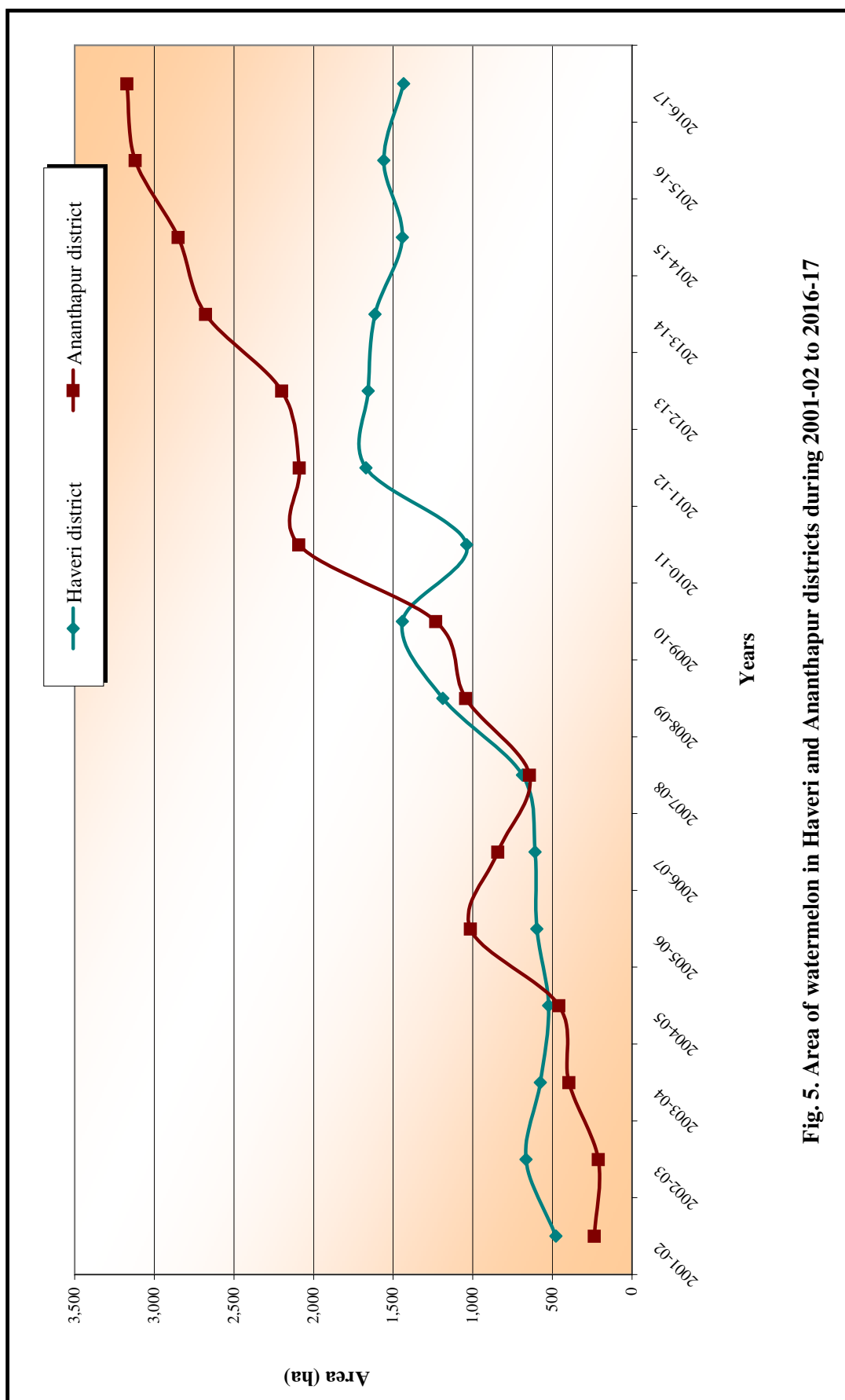


Fig. 5. Area of watermelon in Haveri and Ananthapur districts during 2001-02 to 2016-17

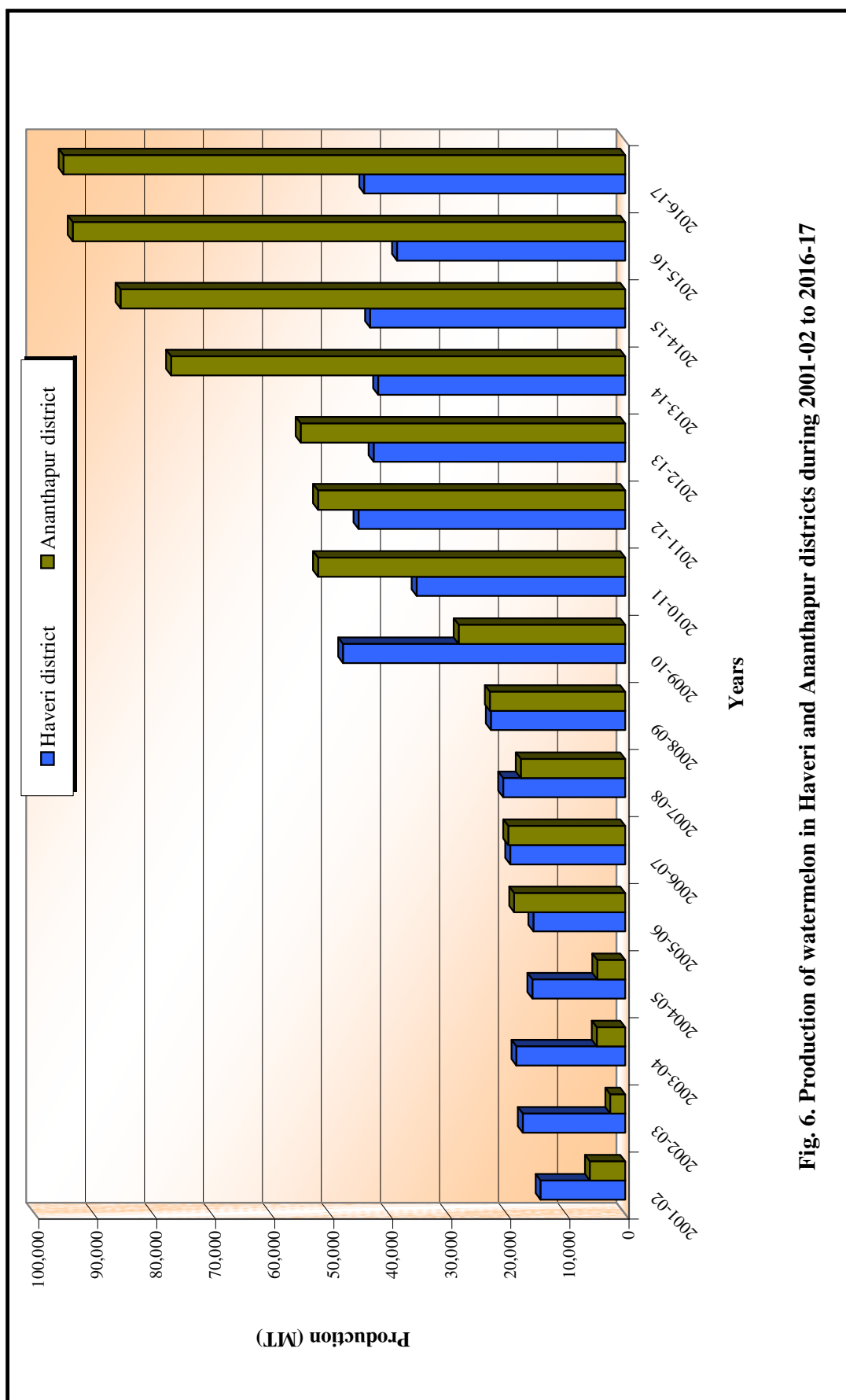


Fig. 6. Production of watermelon in Haveri and Ananthapur districts during 2001-02 to 2016-17

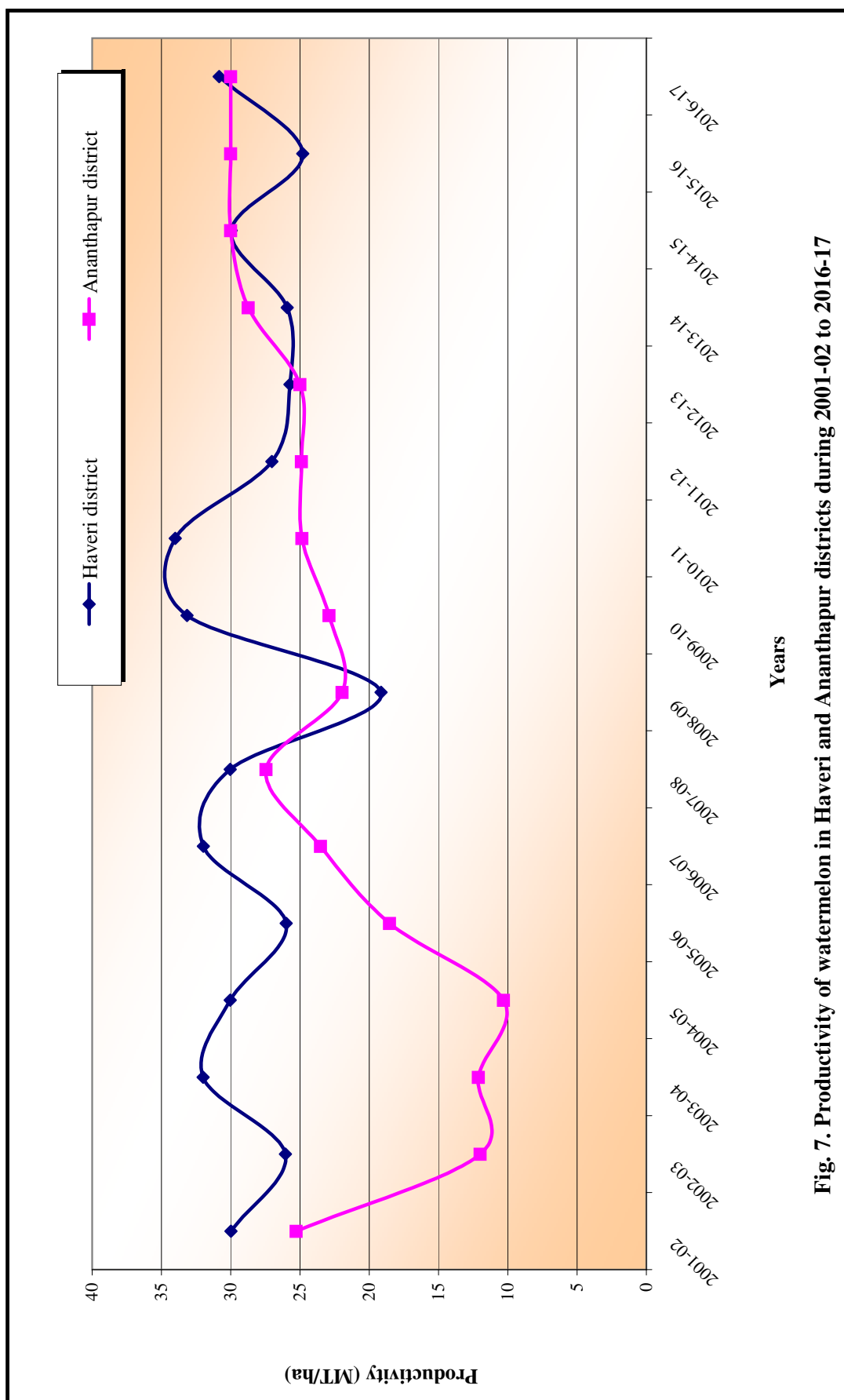


Table 4.3: General characteristics of sample farmers in the study area

Sl. No	Particulars	Units	Haveri district (n=50)	Ananthapur district (n=50)
1	Average age of sample farmer	Years	36.21	39.20
2	Type of family			
i.	Nuclear	No's	45 (90.00)	43 (86.00)
ii.	Joint	No's	5 (10.00)	7 (14.00)
3	Average family size	No's	4.52	4.60
i.	Male		1.10	1.20
ii.	Female		1.12	1.16
iii.	Children		2.30	2.24
4	Education	No's		
i.	Primary school		20 (40.00)	21 (42.00)
ii.	High school		24 (48.00)	20 (40.00)
iii.	PUC and above		6 (12.00)	9 (18.00)
5	Main occupation	No's		
i.	Agriculture		41 (82.00)	38 (76.00)
ii.	Business		6 (12.00)	8 (16.00)
iii.	Service		3 (6.00)	4 (8.00)
6	Average land holding	ha	3.49	2.88
i.	Small (< 2ha)	No's	16 (32.00)	14 (28.00)
ii.	Medium (2-5 ha)		31 (62.00)	33 (66.00)
iii.	Large (> 5 ha)		3 (6.00)	3 (6.00)
7	Average area under watermelon	ha	1.20	1.14
8	Percentage under area under watermelon	%	34.46	39.66

Note: Figures in the parentheses indicate percentage to the respective totals.

family. The average family size of watermelon farmers was 4.52 in Haveri district which comprises of 1.10 male, 1.12 female and 2.30 children and in Ananthapur district the average family size was 4.60 which comprises of 1.20 male, 1.16 female and 2.24 children. The education levels of sample watermelon farmers in both the districts reflect that they were literate. The main occupation was agriculture for majority of the farmers in Haveri and Ananthapur districts. In Haveri district 41 farmers (82%) were having agriculture as main occupation, while 6 farmers (12%) had business and 3 farmers (6%) had service as main occupation, respectively. In Ananthapur district, 38 farmers (76%) were having agriculture as main occupation and 8 farmers (16%) and 4 farmers (8%) had business and service as their main occupations, respectively. The average land holding of watermelon farmers was 3.49 hectares in Haveri district, in Ananthapur district the average land holding was 2.88 hectares. The average area under watermelon was 1.20 and 1.14 hectares in Haveri and Ananthapur districts respectively, in which 16 farmers (32%) were small farmers (below 2 hectares), 31 farmers (62%) were medium farmers (2-5 hectares) and 3 farmers (6%) were large farmers (more than 5 hectares) in Haveri district. In Ananthapur district, 14 farmers (28%) were small farmers, 33 farmers (66%) were medium farmers and 3 farmers (6%) were large farmers. In Haveri district, sample farmers were having 34.46 per cent of their land under watermelon. While, in Ananthapur district sample farmers were having 39.66 per cent of their land under watermelon.

4.2.2 General characteristics of watermelon growers in the study area

The general characteristics of watermelon growers in the study area are depicted in the Table 4.4. All the farmers (100%) in Haveri and Ananthapur districts selected sandy loamy soil for watermelon cultivation. The hybrids cultivated in Haveri district were Namdhari (NS-295) by 30 farmers (60%), followed by United Genetics (Hybrid Rubita) by 10 farmers (20%), Sugar Queen by 4 farmers (8%), Pahuja (Arun-0035) by 3 farmers (6%) and Hybrid Dragon by 3 farmers (6%) respectively. Whereas, in Ananthapur district majority of the farmers were growing Hybrid Pahuja (Arun-0035) by 30 farmers (60%) followed by Sagar King by 7 farmers (14%), Apoorva by 5 farmers (10%), Sugar Queen by 5 farmers (10%) and Hybrid Dragon by 3 farmers (6%), respectively.

All the farmers (100%) in both the districts had sown during *rabi* season. The average plants per hectare were 12,000 and 11,500 plants in Haveri and Ananthapur districts,

Table 4.4: General characters of watermelon growers in the study area

Sl. No	Particulars	Units	Haveri district (n=50)	%	Ananthapur district (n=50)	%
1	Type of soil	No's				
i	Red soil		-	-	-	-
ii	Black soil		-	-	-	-
iii	Loamy soil		-	-	-	-
iv	Sandy loamy soil		50	100.00	50	100.00
2	Hybrids sown	No's				
i	Pahuja (Arun-0035)		3	6.00	30	60.00
ii	Hybrid Dragon		3	6.00	3	6.00
iii	Namdhari NS-295		30	60.00	-	-
iv	Sagar King		-	-	7	14.00
v	Apoorva		-	-	5	10.00
vi	Sugar Queen		4	8.00	5	10.00
vii	United Genetics		10	20.00	-	-
3	Planting time	No's				
i	Kharif		-	-	-	-
ii	Rabi		50	100.00	50	100.00
iii	Summer		-	-	-	-
4	Average plant population	No/ha	12,000	-	11,500	-
5	Spacing followed	No's				
i	0.6 m × 1.5 m		25	50.00	20	40.00
ii	0.6 m × 1.8 m		20	40.00	30	60.00
iii	0.9 m × 1.5 m		5	10.00	-	-
6	Experience in watermelon cultivation	No's				
i	1-3 years		12	24.00	15	30.00
ii	3-6 years		28	56.00	30	60.00
iii	More than 6 years		10	20.00	5	10.00

respectively. In Haveri district, 25 farmers (50%) followed 0.6 m × 1.5 m spacing, 20 farmers (40%) followed 0.6 m × 1.8 m spacing and remaining 5 farmers (10%) followed 0.9 m × 1.5m spacing. Whereas in Ananthapur district, 20 farmers (40%) followed 0.6 m × 1.5 m spacing and remaining 30 farmers (60%) followed 0.6 m × 1.8 m spacing. In Haveri and Ananthapur districts, 28 and 30 farmers (56 % and 60 %) were having 3-6 years experience in cultivation of watermelon followed by 12 and 15 farmers (24 % and 30 %) having 1-3 years experience and 10 and 5 farmers (20 % and 10 %) were having more than six years experience in cultivation of the watermelon, respectively.

4.2.3 Production management aspects of watermelon in the study area

Management aspects in the production of watermelon in the study area are depicted in the Table 4.5. It was observed that in Haveri district, 15 farmers (30 %) followed seed rate as per recommendation (875 -1000 g/ha) and remaining 35 farmers (70 %) followed above the recommended seed rate. In Ananthapur district, 7 farmers (14 %) followed seed rate as per recommendation and remaining 43 farmers (86 %) followed more than the recommended seed rate respectively. All the respondents (100 %) in both the districts followed seed treatment. The seed treatment was done by the respective company itself.

Irrigation water was one of the major limited sources in the study area. Hence, irrigation management was one of the essential aspects in successful crop management. All the farmers (100 %) adopted drip irrigation system in both Haveri (Karnataka) and Ananthapur districts (Andhra Pradesh).

With respect to the nutrition management, all the respondents (100 %) in both the districts were using both organic and chemical fertilizers. It was observed that in Haveri district, 36 farmers (72 %) were using fertilizers above the recommendation and remaining 14 farmers (28 %) were using fertilizers as per recommendation (100:80:80 NPK kg/ha). In Ananthapur district, 27 farmers (54 %) were using fertilizers above the recommendation, 21 farmers (42 %) were using fertilizers as per recommendation and remaining 2 farmers (4 %) were using fertilizers below the recommendation, respectively. All the farmers in Haveri and Ananthapur districts applied fertilizers in split doses. Half nitrogen, entire P and K were applied at the time of sowing. Rest of nitrogen was applied 45-50 days after sowing (DAS).

With respect to growth regulators, in Haveri district, the sample respondents didn't use any growth regulators, but at the time of fruit setting stage they were using 10g multi-K per

Table 4.5: Production management aspects of watermelon in the study area

Sl. No.	Particulars	Units	Haveri district (n=50)	%	Ananthapur district (n= 50)	%
1	Seed rate/ha	No's				
a.	Below recommendation		-	-	-	-
b.	As per recommendation		15	30.00	7	14.00
c.	Above recommendation		35	70.00	43	86.00
2	Seed treatment	No's	50	100.00	50	100.00
3	Irrigation management	No's				
a.	Drip method		50	100.00	50	100.00
b.	Flood method		-	-	-	-
c.	Traditional methods		-	-	-	-
4	Nutrition management	No's				
a.	Type of fertilizer used		-	-	-	-
i.	Organic		-	-	-	-
ii.	Chemical		-	-	-	-
iii.	Organic and chemical		50	100.00	50	100.00
b.	Fertilizer dose					
i.	Below recommendation		-	-	2	4.00
ii.	As per recommendation		14	28.00	21	42.00
iii.	Above recommendation		36	72.00	27	54.00
c.	Method of fertilizer application					
i.	Single dose application		-	-	-	-
ii.	Split dose application		50	100.00	50	100.00
5.	Growth regulators	No's				
a.	Not used & Below recommendation		50	100.00	12	24.00
b.	As per recommendation		-	-	24	48.00
c.	Above recommendation		-	-	14	28.00
6.	Pest and Disease management	No's				
a.	Preventive measures		6	12.00	5	10.00
b.	Curative measures		44	88.00	45	90.00
c.	IPM		-	-	-	-
7.	Criteria for harvesting	No's				
a.	90 -110 Days after sowing		7	14.00	4	8.00
b.	Colour and size		43	86.00	46	92.00

liter. In Ananthapur district 12 farmers (24 %) applied growth regulators below the recommended dose, 14 farmers (28 %) applied growth regulators above the recommendation and remaining 24 farmers (48 %) applied growth regulators as per the recommendation, respectively. (1g NAA per 100 liters of water, 15 ppm GA₃, cycocel as per package of practice for watermelon crop).

The table also indicates that, with respect to pests and disease management in Haveri district most of the farmers *i.e.* 88 per cent (44 farmers) had adopted curative measures followed by preventive measures (12 %). Whereas, in Ananthapur district most of the farmers *i.e.* 90 per cent (45 farmers) had adopted curative measures and 10 per cent (5 farmers) had adopted preventive measures.

Proper stage of harvesting was very important as it determines the quality of fruits. The watermelon farmers in both the districts considered two criteria for deciding harvesting time; duration of the crop (90 to 110 DAS), colour and size of the fruit. As observed in Table 4.5, in Haveri district, most of the farmers *i.e.* 43 farmers (86 %) had adopted criteria of colour and size and remaining 7 farmers (14 %) had adopted criteria of duration (90-110 DAS). Similarly, in Ananthapur district majority farmers *i.e.* 46 farmers (92 %) had adopted criteria of colour and size of the fruit and remaining 4 farmers (8 %) had adopted criteria of duration (90-110 days). With respect to number of pickings, all the sample farmers in both the districts followed more than one pickings (2 to 3 pickings per crop).

4.2.4 Labour management in watermelon cultivation in the study area

An operation-wise labour requirement in watermelon cultivation was calculated in Haveri and an Ananthapur districts and the results were depicted in Table 4.6. The results indicated that, the average human labour employed in Haveri district were 109.68 man days out of which 41.04 man days (37.42 %) were family labour and rest 68.64 man days (62.58 %) were hired labour. Maximum number of man days were employed for intercultural operations such as weeding, thinning and apical shoot removing etc., (24.89 %), followed by harvesting (15.09 %), PPC application (10.61 %), sowing (10.32 %), mulching (8.91 %), manuring (8.29 %), fertilizer application (8.27 %), maintenance of drip irrigation channels (4.83 %), gap filling (2.91 %), bed preparation (2.18 %), earthing up (1.82 %), ploughing (0.92 %) and harrowing (0.92 %), respectively. Similarly, in Ananthapur district, the average human labour employed were 117.35 man days, out of which 41.40 man days (35.28 %) were

Table 4.6: Labour management in watermelon cultivation in the study area

(Per ha)

Sl. No	Particulars	Haveri district										Ananthapur district									
		Human labour (Mandays)					Bullock labour		Machine labour		Human labour				Bullock labour		Machine labour				
		FL	HL	THL	%		Pair days	%	Hrs	%	FL	HL	THL	%		Pair days	%	Hrs	%		
		Man days	Man days	Man days	Man days	Man days								Man days							
1	Ploughing	-	1.00	1.00	0.93	-	-	2.31	38.24	-	1.00	1.00	1.00	0.87	-	-	2.73	33.87			
2	Harrowing	-	1.00	1.00	0.93	-	-	1.86	30.80	-	1.00	1.00	1.00	0.87	-	-	2.67	33.13			
3	Manuring	1.00	8.10	9.10	8.29	-	-	-	-	-	1.20	10.12	11.32	9.65	-	-	-	-			
4	Bed preparation	1.00	1.40	2.40	2.18	-	-	1.87	30.96	-	1.00	1.28	2.28	1.94	-	-	2.66	33.00			
5	Sowing	2.22	9.10	11.32	10.32	-	-	-	-	-	2.36	13.74	16.10	13.71	-	-	-	-			
6	Gap filling	1.12	2.08	3.20	2.92	-	-	-	-	-	1.16	2.50	3.66	3.12	-	-	-	-			
7	Mulching	1.10	8.68	9.78	8.92	-	-	-	-	-	1.20	11.60	12.80	10.90	-	-	-	-			
8	Earthing up	1.00	1.00	2.00	1.82	4.18	100.00	-	-	-	1.00	1.00	2.00	1.70	4.32	71.52	-	-			
9	Maintenance of drip irrigation channels	1.00	4.30	5.30	4.83	-	-	-	-	-	1.00	4.00	5.00	4.26	-	-	-	-			
10	Fertilizers application	9.08	-	9.08	8.27	-	-	-	-	-	9.88	-	9.88	8.41	-	-	-	-			
11	Intercultural operations	9.66	17.64	27.30	24.89	-	-	-	-	-	8.08	17.19	25.27	21.53	1.72	28.48	-	-			
12	PPC application	11.64		11.64	10.61	-	-	-	-	-	12.16		12.16	10.36	-	-	-	-			
13	Harvesting	2.22	14.34	16.56	15.09	-	-	-	-	-	2.36	12.52	14.88	12.68	-	-	-	-			
	Total	41.04	68.64	109.68	100.00	4.18	100.00	6.04	100	100	41.40	75.95	117.35	100.00	6.04	100.00	8.06	100.00			

*FL: Family Labour

** HL: Hired Labour

***THL: Total Human Labour

family labour and rest 75.95 man days (64.72 %) were hired labour. Maximum number of man days was employed for intercultural operations (21.53 %), followed by sowing (13.71 %), harvesting (12.68 %), mulching (10.90 %), PPC application (10.36 %), manuring (9.65 %), fertilizer application (8.41 %), maintenance of drip irrigation channels (4.26 %), gap filling (3.11 %), bed preparation (1.94 %), earthing up (1.70 %), ploughing (0.86 %) and harrowing (0.86 %), respectively.

In Haveri district, bullock labours (4.18 pair days) were employed only for earthing up operation (100%). Whereas in Ananthapur district, maximum of bullock pair days (4.32) were employed for earthing up operations (71.52%), followed by intercultural operations (1.72 pair days). The average machine labour employed in Haveri district were 6.04 hours of which 38.24 per cent of machine hour were employed for ploughing, followed by bed preparation (30.96 %) and harrowing (30.79 %). In Ananthapur district the average machine labour employed were 8.06 hours. Maximum number of machine hours was employed for ploughing (33.87 %), followed by harrowing (33.13 %) and bed preparation (33.00 %). It is interesting to note that despite the use of bullock labour, machine labour was most common for land preparation. Majority of the farmers used hired tractor hours for field preparation.

4.2.5 Input procure management in watermelon cultivation in the study area

Input procurement in watermelon cultivation was calculated in Haveri and Ananthapur districts, considering group of inputs, and the results were depicted in Table 4.7.

Seeds: The results presented in Table 4.7 indicate that, 42 farmers (84 %) and 44 farmers (88 %) purchased seeds directly from retail outlets, followed by six farmers (12 %) and three farmers (6 %) from online markets and two farmers (4 %) and 3 farmers (6 %) from government institutions like KVK and DAATTC centers etc., in Haveri and Ananthapur districts, respectively. As per frequency of purchase concerned, 72 per cent of the farmers (36 farmers) and 82 per cent (41 farmers) of the farmers purchased seeds at once in the cropping period, and 24 per cent (12 farmers) and 12 per cent (6 farmers) of the farmers purchased seeds twice during the crop period in Haveri and Ananthapur districts, respectively. With respect to the time of purchase, 29 farmers (58 %) and 34 farmers (68 %) purchased the seeds one month prior to sowing and 21 farmers (42 %) and 16 farmers (32 %) purchased the seeds prior to one week before sowing in Haveri and Ananthapur districts, respectively.

Table 4.7 Input procure management in watermelon cultivation in the study area

Sl. No	Particulars		Haveri district (n=50)	Ananthapur district (n=50)
1	Seeds			
	Source of purchase	From retail outlets	42 (84.00)	44 (88.00)
		From online markets	6 (12.00)	3 (6.00)
		From Government institutions like KVK, DAATTC	2 (4.00)	3 (6.00)
	Frequency of purchase	Once	36 (72.00)	41 (82.00)
		Twice	12 (24.00)	6 (12.00)
		More than twice	2 (4.00)	3 (6.00)
	Time of purchase	Prior to one month before sowing	29 (58.00)	34 (68.00)
		prior to one week before sowing	21 (42.00)	16 (32.00)
2	Farm Yard Manure (FYM)			
	Source of purchase	Own	5 (10.00)	12 (24.00)
		From other farmers	35 (70.00)	20 (40.00)
		From dairy units	10 (20.00)	18 (36.00)
	Frequency of purchase	Once	35 (70.00)	28 (56.00)
		Twice	15 (30.00)	22 (44.00)
	Time of purchase	Prior to one month before sowing	36 (72.00)	24 (48.00)
		Prior to three months before sowing	14 (28.00)	26 (52.00)
3	Neem cake			
	Source of purchase	From retail outlets	-	32 (64.00)
		From oil mills	-	18 (36.00)
	Frequency of purchase	Once	-	16 (32.00)
		Twice	-	34 (68.00)
	Time of purchase	Prior to one month before sowing	-	24 (48.00)
		Prior to three months before sowing	-	26 (52.00)
4	Fertilizers			
	Source of purchase	From retail outlets	32 (64.00)	42 (84.00)
		From RSK/ Farmers' cooperative societies	18 (36.00)	8 (16.00)
	Frequency of purchase	Once	13 (26.00)	17 (34.00)
		Twice	27 (54.00)	21 (42.00)
		More than twice	10 (20.00)	12 (24.00)

Table 4.7. Contd.....

Sl. No	Particulars		Haveri district (n=50)	Ananthapur district (n=50)
	Time of purchase	Prior to one week before application	24 (48.00)	19 (38.00)
		Prior to two weeks before application	18 (36.00)	24 (48.00)
		Prior to one month before application	8 (16.00)	7 (14.00)
5	Plant Protection Chemicals			
	Source of purchase	From retail outlets	48 (96.00)	50 (100.00)
		From online markets	2 (4.00)	0
	Frequency of purchase	Once	11 (22.00)	8 (16.00)
		Twice	13 (26.00)	12 (24.00)
		More than twice	26 (52.00)	30 (60.00)
	Time of purchase	Prior to one week before application	42 (84.00)	38 (76.00)
		Prior to two weeks before application	8 (16.00)	12 (24.00)
6	Growth regulators			
	Source of purchase	From retail outlets	-	50 (100.00)
		From online markets	-	0
	Frequency of purchase	Once	-	8 (16.00)
		Twice	-	12 (24.00)
		More than twice	-	30 (60.00)
	Time of purchase	Prior to one week before application	-	38 (76.00)
		Prior to two weeks before application	-	12 (24.00)
7	Herbicides			
	Source of purchase	From retail outlets	48 (96.00)	47 (94.00)
		From online markets	2 (4.00)	3 (6.00)
	Frequency of purchase	Once	50 (100.00)	50 (100.00)
		Twice	0	0
	Time of purchase	Prior to one week before application	48 (96.00)	46 (92.00)
		Prior to two weeks before application	2 (4.00)	4 (8.00)
8.	Source of capital			
		Own	3 (6.00)	3 (6.00)
		Borrowed from non-institutions (private money lenders)	5 (10.00)	8 (16.00)
		Own and borrowed from non-institutions	6 (12.00)	5 (10.00)
		Borrowed from institutions (banks)	10 (20.00)	9 (18.00)
		Own and borrowed from institutions	26 (52.00)	25 (50.00)

Farm Yard Manure (FYM): As per farm yard manure concerned, 70 per cent (35 farmers) and 40 per cent (20 farmers) of the farmers procured FYM from other farmers in the region, followed by 20 per cent (10 farmers) and 36 per cent (18 farmers) of the farmers procuring FYM from dairy units and 10 per cent (5 farmers) and 24 per cent (12 farmers) of the farmers procuring from their own cattle shed in Haveri and Ananthapur districts, respectively. As per frequency of purchase, 35 farmers (70 %) and 28 farmers (56 %) were purchasing once during the cropping period and 15 farmers (30 %) and 22 farmers (44 %) were purchasing of FYM twice during the cropping period in Haveri and Ananthapur districts, respectively. With respect to time of purchase, 36 farmers (72 %) and 24 farmers (48 %) were purchasing prior to one month before sowing and 14 farmers (28 %) and 26 farmers (52 %) were purchasing prior to three months before sowing during the cropping season in Haveri and Ananthapur districts, respectively.

Neem cake: In Haveri district the sample respondents didn't use neem cake for cultivation of watermelon, while in Ananthapur district, all the respondents used neem cake as a nutrient supplement; and out of them, 32 farmers (64 %) were purchasing neem cake from retail outlets and 18 farmers (36 %) were purchasing from oil mills. As per frequency of purchase is concerned, 34 farmers (64 %) were purchased twice and 16 farmers (32 %) were purchased once in the cropping season. With respect to time of purchase, 24 farmers (48 %) purchased neem cake prior to one month before sowing and 26 farmers (52 %) were purchased prior to three months before sowing during the cropping period.

Fertilizers: In Haveri district, 32 farmers (64 %) were purchasing fertilizers from retail outlets and 18 farmers (36 %) were purchasing fertilizers from RSK's and farmers cooperative societies. With respect to frequency of purchase concerned, 54 per cent (27 farmers) of the farmers purchasing twice in the period, followed by 26 per cent (13 farmers) were purchasing once in the crop season and 20 per cent (10 farmers) were purchasing more than twice in the cropping period. As per time of purchase, 24 farmers (48 %) were purchased one week prior to before application, followed by 18 farmers (36 %) were purchased two weeks prior to before application and 8 farmers (16 %) were purchased prior to one month before application during the cropping period. While in Ananthapur district, 42 farmers (84 %) were purchasing fertilizers from retail outlets and 8 farmers (16 %) were purchasing fertilizers from RSK's and farmers cooperative societies. With respect to frequency of

purchase concerned, 42 per cent (21 farmers) of the farmers purchasing twice in the period, followed by 34 per cent (17 farmers) were purchasing once in the crop season and 24 per cent (12 farmers) were purchasing more than twice in the cropping period. As per time of purchase, 19 farmers (38 %) were purchased prior to one week before application, followed by 24 farmers (48 %) were purchased prior to two weeks before application and 7 farmers (14 %) were purchased prior to one month before application during the cropping period.

Plant Protection Chemicals (PPC): As per plant protection chemicals, in Haveri district 96 per cent (48 farmers) were purchasing PPC from retail outlets and 4 per cent (2 farmers) were purchasing from online markets. While in Ananthapur district, cent percent (50 farmers) of the farmers were purchasing from retail outlets only. With respect to frequency of purchase concerned, 26 farmers (52 %) and 30 farmers (60 %) were purchasing more than twice in the cropping period, followed by 13 farmers (26 %) and 12 farmers (24 %) were purchasing twice in the cropping period and 11 farmers (22 %) and 8 farmers (16 %) were purchasing all plant protection chemicals once at a time in the cropping period in Haveri and Ananthapur districts, respectively. As per time of purchase, 42 farmers (84 %) and 38 farmers (76 %) were purchasing PPC prior to one week before application and 8 farmers (16 %) and 12 farmers (24 %) were purchasing prior to two weeks before application in the cropping period in Haveri and Ananthapur districts, respectively.

Growth regulators: With respect to growth regulators, in Haveri district, the sample respondents didn't use any growth regulators, but at the time of fruit setting stage they were using "10g multi-K" per liter. While in Ananthapur district, cent per cent (50 farmers) were purchasing growth regulators from retail outlets only. As per frequency of purchase, 30 farmers (60 %) were purchasing more than twice in the cropping season, followed by 12 farmers (24 %) were purchasing twice and 8 farmers (16 %) were purchasing once in the cropping season. With respect to time of purchase, 38 farmers (76 %) were purchasing growth regulators prior to one week before application and 12 farmers (24 %) were purchasing prior to two weeks before application in the cropping time period.

Herbicides: As per herbicides concerned, 48 farmers (96 %) and 47 farmers (94 %) were purchasing from retail outlets and 2 farmers (4 %) and 3 farmers (6 %) were purchasing from online markets. With respect to frequency of purchase, cent per cent farmers (50 farmers) in both the districts were purchasing once at a time in the cropping period. As per time of

purchase, 48 farmers (96 %) and 46 farmers (92 %) were purchasing herbicides prior to one week before application and 2 farmers (4 %) and 4 farmers (8 %) were purchasing herbicides prior to two weeks before application during the cropping period in Haveri and Ananthapur districts, respectively.

Capital: As per source of capital, 3 farmers (6 %) each in both the districts procuring capital from their own source, followed by 5 farmers (10 %) and 8 farmers (16 %) were procuring capital borrowed from non-institutions, 6 farmers (12 %) and 5 farmers (10 %) from own and borrowed from non-institutions, 10 farmers (20 %) and 9 farmers (18 %) borrowed from institutions and 26 farmers (52 %) and 25 farmers (50 %) from own and borrowed from institution in both Haveri and Ananthapur districts, respectively.

4.2.6 Input management in watermelon cultivation in the study area

In any cultivation, input management assumes a critical importance. Input use pattern in watermelon production in Haveri and Ananthapur districts is depicted in Table 4.8. The results show that, in Haveri and Ananthapur districts the overall seed rate used for sowing were 1,211 g and 1,057 g per hectare, respectively. The quantity of FYM applied in Haveri district were 5.58 tonnes per hectare and in Ananthapur district the quantity of FYM applied were 9.73 tonnes per hectare. In Haveri district the sample respondents didn't use neem cake for cultivation of watermelon, while in Ananthapur district, the average quantity of neem cake applied per hectare were 338 kg.

With respect to major nutrients, the quantity of N, P and K applied in Haveri district were 102.82, 143.03 and 129.70 kg per hectare respectively. Similarly, in Ananthapur district, the amount of N, P and K used were 114.68, 122.63 and 121.72 kg per hectare, respectively. With respect to micro nutrients, the quantity of Calcium (Ca) and Sulphur (S) applied in Haveri district were 0.45 and 14.56 kg per hectare respectively, while in Ananthapur district the quantity of the same were 17.68 and 32.88 kg per hectare, respectively. The quantity of Boron (B) applied in Haveri and Ananthapur districts were 287.70 and 266.70 g per hectare.

In Haveri district, the average quantity of plant protection chemicals used were 9.48 kg granules, 6.93 kg wettable powder and 6.99 liters of chemical solvents. Similarly, in Ananthapur district the average quantity of plant protection chemicals used were 6.52 kg granules, 6.52 kg wettable powder and 6.71 liters of chemical solvents respectively. In

Table 4.8: Input management in watermelon cultivation in the study area

(Per ha)

Sl. No	Particulars	Units	Haveri district	Ananthapur district
1	Seeds	g	1,211	1,057
2	FYM	tonnes	5.58	9.73
3	Neem cake	kg	-	338.00
4	Major nutrients			
	i. Nitrogen (N)	kg	102.82	114.68
	ii. Phosphorous (P)	kg	143.03	122.63
	iii. Potash (K)	kg	129.70	121.72
5	Micro nutrients			
	i. Calcium (Ca)	kg	00.45	17.68
	ii. Sulphur (S)	kg	14.56	32.88
	iii. Boron (B)	g	287.70	266.70
6	PPC			
	i. Granules	kg	9.48	6.52
	ii. Wettable powder	kg	6.93	6.52
	iii. Solvents	kg	6.99	6.71
7	Growth regulators	g	-	116.00
8	Herbicides	litres	1.86	4.02
9	Drip laterals	m	5270.68	5141.00
10	Mulching sheet	rolls	12.00	11.94
11	Human labour	man days	109.68	117.35
12	Bullock labour	pair days	4.18	6.04
13	Machine labour	hours	6.04	8.06

Ananthapur district, the average quantity of growth regulators used per hectare was 116 g. whereas, in Haveri district the sample respondents didn't use any growth regulators.

In Haveri and Ananthapur districts, the average quantity of pre-emergence herbicides used were 1.86 and 4.02 liters per hectare respectively. With respect to drip irrigation laterals, the average amount of laterals used in both the districts were 5270.68 meters and 5141.00 meters respectively. The average amount of mulching sheet used in Haveri district were 12.00 rolls and in Ananthapur district were 11.94 rolls.

The average amount of human, bullock and machine labour employed in Haveri district were 109.68 man days, 4.18 pair days and 6.04 machine hours respectively and in Ananthapur district, the average amount of human, bullock and machine labour employed were 117.35 man days, 6.04 pair days and 8.06 machine hours respectively.

4.2.6 Cost of cultivation of watermelon in the study area

The cost of cultivation indicates the investment on the variable inputs used in the cultivation and the services rendered by fixed assets. The cost incurred on inputs and returns realized from watermelon cultivation were calculated and are shown in Table 4.9 and 4.10. The total cost incurred by the sample farmers for per hectare cultivation in Haveri and Ananthapur districts were ₹ 1,09,945.78 and ₹ 1,43,306.17 respectively. In Haveri district, the share of total variable cost was 82.99 per cent in the total cost. The distribution pattern of operational cost under various inputs indicated that the human labour accounted for highest share (21.95 %) followed by PPC (12.71 %), seeds (10.66 %), macro nutrients (10.53 %), mulching sheet (6.55 %), drip irrigation structures (4.79 %), FYM (2.94 %), micro nutrients (2.25 %), machine labour (2.20 %), bullock labour (1.33 %) and herbicides (0.93 %), respectively. Similarly, in Ananthapur district, the share of total variable cost was 87.50 per cent in the total cost. The distribution pattern of operational cost under various inputs indicated that the seeds accounted for highest share (18.83 %) in the case of variable cost followed by human labour (16.57 %), PPC (10.48 %), macro nutrients (8.44 %), neem cake (8.26 %), mulching sheet (5.15 %), FYM (4.19 %), drip irrigation structures (2.58 %), machine labour (1.96 %), bullock labour (1.57 %), growth regulators (1.55 %) and micro nutrients (1.28 %), respectively.

In Haveri district, the share of total fixed cost was 17.01 per cent in the total cost. The distribution pattern of fixed cost under various inputs indicated that the rental value of land

Table 4.9: Cost of cultivation of watermelon in the study area

(₹/ha)

Sl. No.	Particulars	Haveri district (n=50)	%	Ananthapur district (n=50)	%
	A. Variable cost				
1.	Seeds	11,715.00	10.66	26,971.74	18.83
2.	Farm yard manure (FYM)	3,236.40	2.94	5,998.50	4.19
3.	Neem cake	-	-	11,830.02	8.26
4.	Human labour	24,129.60	21.95	23,752.10	16.57
5.	Bullock labour	1,463.00	1.33	2,260.00	1.57
6.	Machine labour	2,416.00	2.20	2,821.00	1.96
7.	Herbicides	1,024.10	0.93	1,040.40	0.73
8.	Chemical Fertilizers	11,579.00	10.53	12,079.80	8.44
9.	Micro nutrients	2,475.70	2.25	1,848.10	1.28
10.	Plant protection chemicals (PPC)	13,984.24	12.71	15,027.04	10.48
11.	Growth regulators	-	-	2,219.48	1.55
12.	Mulching sheet	7,200.00	6.55	7,390.14	5.15
13.	Drip irrigation structures	5,270.68	4.79	3,698.44	2.58
14.	Interest on working capital @8% per annum	6,759.50	6.15	8,467.85	5.91
	Subtotal (A)	91,253.22	82.99	1,25,404.21	87.50
	B. Fixed cost				
15.	Rental value of land	11,550.00	10.50	10,400.00	7.25
16.	Land revenue	50.00	0.04	200.00	0.15
17.	Depreciation	5,089.79	4.64	5,383.90	3.76
18.	Interest on fixed capital @12% per annum	2,002.77	1.83	1,918.06	1.34
	Subtotal (B)	18,692.56	17.01	17,901.96	12.50
	Total cost of cultivation (A+B)	1,09,945.78	100.00	1,43,306.17	100.00

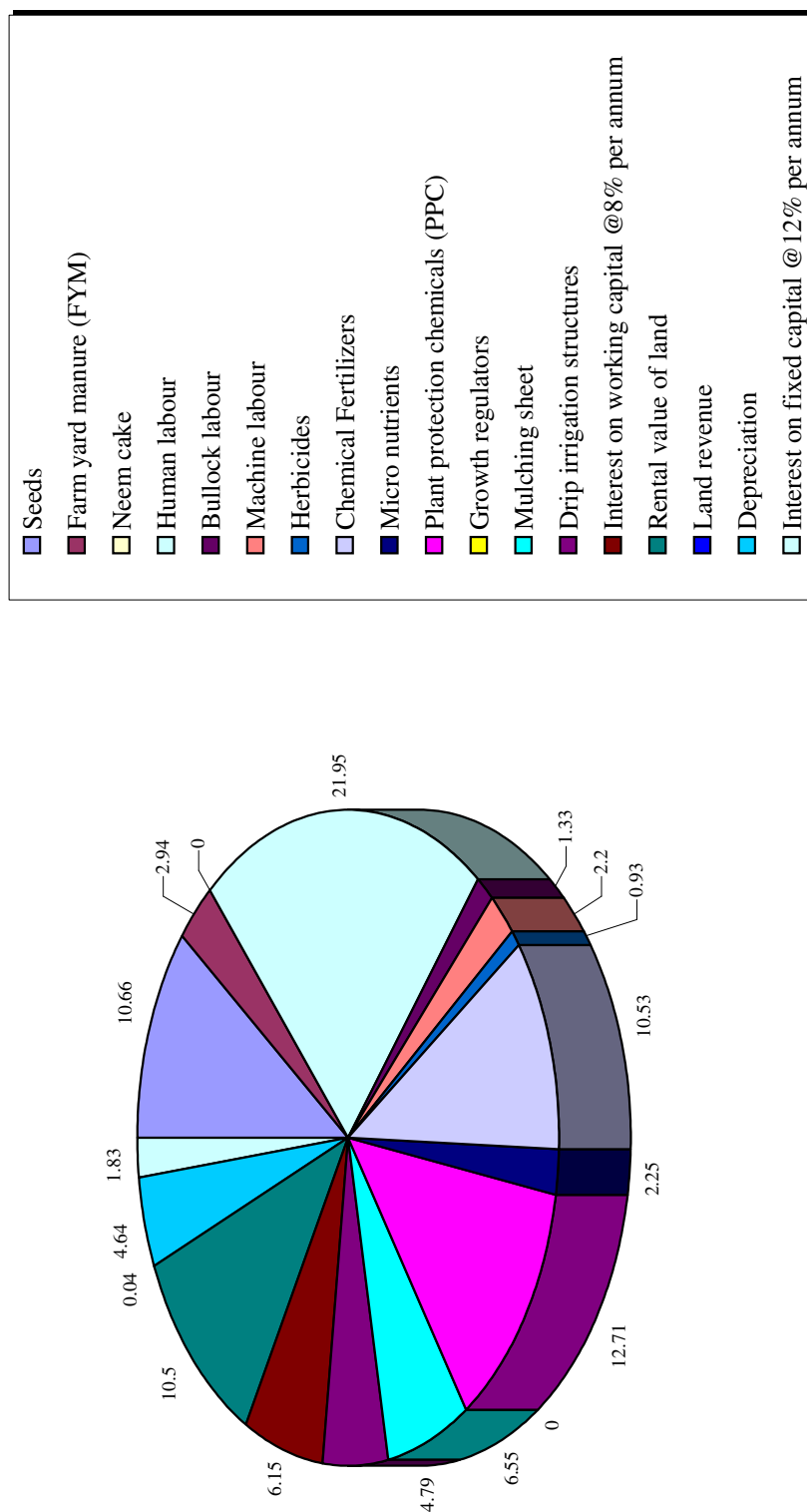


Fig. 8. Cost of cultivation of watermelon in Haveri district (Karnataka)

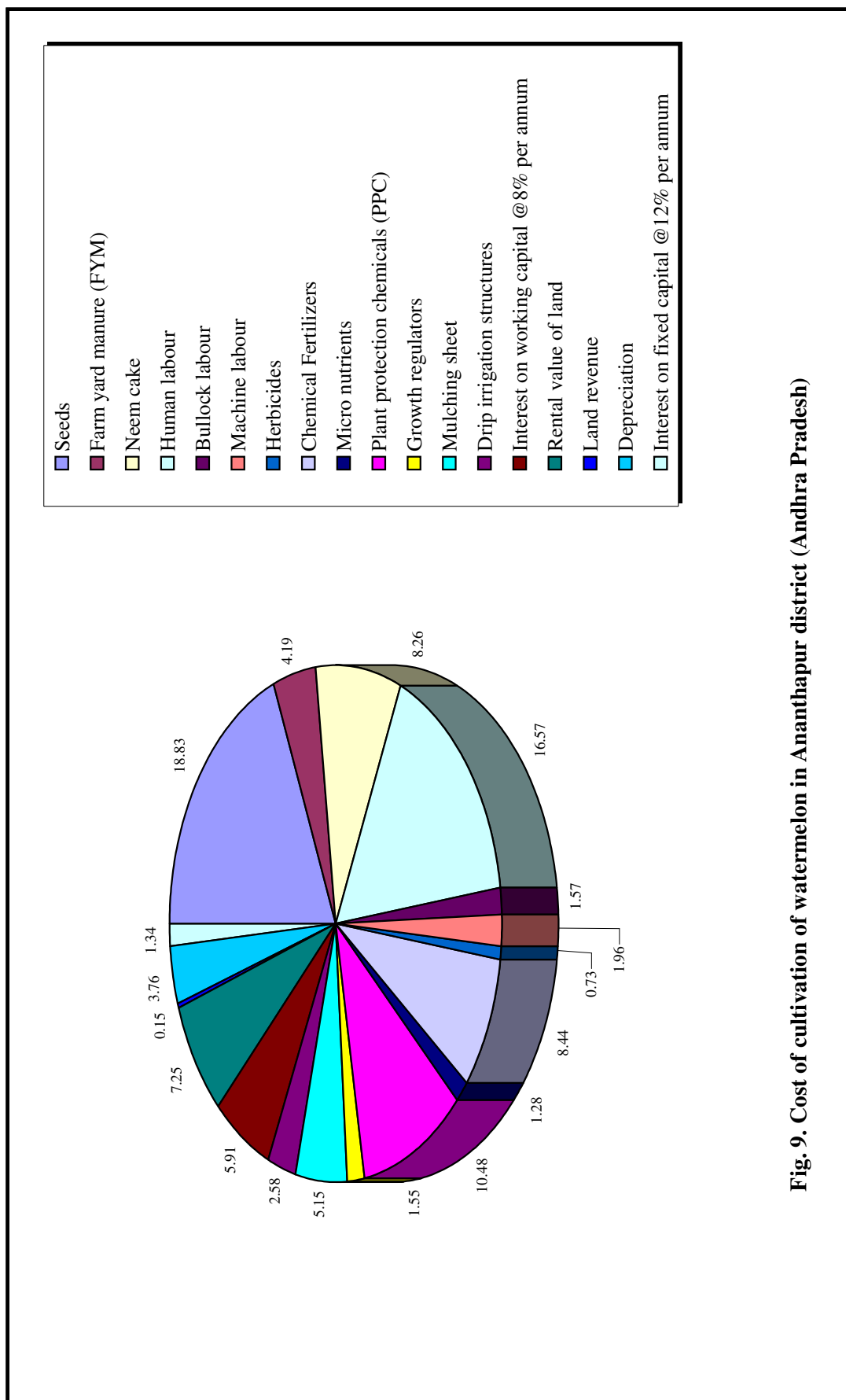


Fig. 9. Cost of cultivation of watermelon in Ananthapur district (Andhra Pradesh)

Table 4.10: Cost and returns of watermelon production in the study area

(Per ha)			
Sl. No	Particulars	Haveri district	Ananthapur district
1.	Yield (tonnes)	27.50	36.62
2.	Total cost of cultivation(₹)	1,09,945.78	1,43,306.17
3.	Selling price (₹/tonne)	7,183.00	6,175.00
4.	Gross returns (₹)	1,97,532.50	2,26,128.50
5.	Net returns (₹)	87,586.72	82,822.33
6.	B:C ratio	1.79	1.58

accounted for highest share (10.50 %) followed by depreciation (4.64 %) and land revenue (0.04 %), respectively. Similarly, in Ananthapur district, the share of total fixed cost was 12.50 per cent in the total cost. The distribution pattern of fixed cost under various inputs indicated that the rental value of land accounted for highest share (7.25 %) in case of fixed cost followed by depreciation (3.76 %) and land revenue (0.15 %), respectively.

The results presented in Table 4.9 on yield and returns realized by the watermelon cultivated farmers indicated that the average yield of the watermelon in both the districts were 27.50 and 36.62 tonnes per hectare. In Haveri and Ananthapur districts, the gross returns obtained per hectare were ₹ 1,97,532.50 and ₹ 2, 26, 128.50 respectively. Total cost of cultivation in both the districts was ₹ 1,09,945.78 and ₹ 1,43,306.17 respectively. The net returns obtained per hectare in both the districts were ₹ 87,586.72 and ₹ 82,822.33 respectively. Thus, cultivation of watermelon in both the districts was found to be profitable by magnitude of B: C ratio (returns per rupee of investment) of 1.79 and 1.58, respectively.

4.2.7 Resource use efficiency of inputs in watermelon cultivation

4.2.7.1 Estimated Cobb – Douglas production function coefficients

The Cobb – Douglas production function coefficients were estimated to analyze the relationship between resource and productivity of watermelon using the data from the respondents. Cobb – Douglas type of production function was fitted to estimate the resource productivity in watermelon cultivation.

The variable inputs used in the watermelon cultivation by the sample respondents were classified into sixteen major group's viz., seeds, FYM, neem cake, human labour, bullock labour, machine labour, Nitrogen (N), Phosphorus (P), Potassium (K), Sulphur (S), Calcium (Ca), Boron (B), PPC in solid form, PPC in liquid form, herbicides and growth regulators. The dependent variable was yield of watermelon per hectare and all the variables included in the model were expressed in quantitative terms.

The results of regression analysis in the production of watermelon by the sample respondents are presented in Table 4.11. It could be seen from the table that, in Haveri district, regression coefficient of seeds (0.1183), FYM (0.0642), human labour (0.4015), bullock labour (0.1029), machine labour (0.0119), sulphur (0.0516), calcium (0.0449) and herbicides (0.0755) were positive but non-significant at statistically both one per cent and five per cent level of probability. On the other hand, the regression coefficients of nitrogen

Table 4.11: Resource use efficiency of inputs in watermelon

Sl. No	Explanatory variables	Parameters	(Per ha)	
			Haveri district (n=50)	Ananthapur district (n=50)
1.	Intercept	A	0.7020 (0.9573)	1.0041 (0.6411)
2.	Seeds	b ₁	0.1183 (0.1083)	-0.1703 (0.1122)
3.	FYM	b ₂	0.0642 (0.0746)	0.0577 (0.0528)
4.	Neem cake	b ₃	-	-0.0021 (0.0028)
5.	Human labour	b ₄	0.4015 (0.2652)	0.2211 (0.2394)
6.	Bullock labour	b ₅	0.1029 (0.1023)	0.0180 (0.0437)
7.	Machine labour	b ₆	0.0119 (0.1268)	0.5800** (0.1458)
8.	Nitrogen (N)	b ₇	-0.0570 (0.1093)	0.2305 (0.1567)
9.	Phosphorus (P)	b ₈	-0.0057 (0.1236)	-0.0696 (0.1467)
10.	Potassium (K)	b ₉	0.2846@ (0.1530)	0.0559 (0.1172)
11.	Sulphur (S)	b ₁₀	0.0516 (0.0848)	-0.0054 (0.0406)
12.	Calcium (Ca)	b ₁₁	0.0449 (0.0670)	-0.0122 (0.0085)
13.	Boron (B)	b ₁₂	-0.0144 (0.0575)	0.0536 (0.0445)
14.	PPC in solid form	b ₁₃	-0.0366 (0.0776)	-0.0288 (0.0410)
15.	PPC in liquid form	b ₁₄	-0.0108 (0.1557)	-0.0074 (0.1172)
16.	Herbicides	b ₁₅	0.0755 (0.0941)	0.0070* (0.0575)
17.	Growth regulators	b ₁₆	-	0.0942 (0.0419)
18.	Coefficient of multiple determination	R ²	0.95	0.96
19.	Returns to scale	($\sum b_i$)	1.03	1.02

Note: Figures in the parentheses indicate standard errors.

**Significant at one per cent probability level.

*Significant at five per cent probability level.

@ Significant at ten per cent probability level.

(-0.0570), phosphorus (-0.0057), boron (-0.0144), PPC in solid form (-0.0366) and PPC in liquid form (-0.0108) were negative and non-significant at both one per cent and five per cent level of probability. The regression coefficient of potassium (0.2846) was positive and significant at ten per cent level of probability.

Similarly, in Ananthapur district, the results of regression analysis in the production of watermelon by the sample respondents revealed that regression coefficient of FYM (0.0577), human labour (0.2211), bullock labour (0.0180), nitrogen (0.2305), potassium (0.0559), boron (0.0536) and growth regulators (0.0942) were positive and non-significant at both one per cent and five per cent level of probability. Whereas, the regression coefficient of machine labour (0.5800) was positive and significant at one per cent level of probability and that of herbicides (0.0070) was positive and significant at five per cent level of probability. The regression coefficients of seeds (-0.1703), neem cake (-0.0021), phosphorus (-0.0696), sulphur (-0.0054), calcium (-0.0122), PPC in solid form (-0.0288) and PPC in liquid form (-0.0074) were negative and non-significant at both one per cent and five per cent level of probability.

The coefficient of multiple determinations in Haveri district was 0.95 which indicates that 95 per cent of variation in watermelon yield was explained by the independent variables included in the model, remaining 5 per cent of variation was explained by error term. In Ananthapur district, the coefficient of multiple determinations was 0.96, which indicates that 96 per cent of variation in watermelon gross yield was explained by the independent variables included in the model, remaining 4 per cent of variation was explained by error term.

The sum of elasticity's ($\sum b_i$) in Haveri and Ananthapur districts were 1.03 and 1.02 respectively, which indicates increasing returns to scale (more than unity). A one per cent increase in all the inputs used in the production simultaneously would increase output by 1.03 per cent and 1.02 per cent in both the districts, respectively.

4.2.7.2. MVP to MFC ratios of resources in watermelon production

The Cobb–Douglas type production function coefficients which explains the output classification of production and geometric levels of inputs were used to estimate the marginal value product. The knowledge of marginal value products 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 4.12.

Table 4.12: MVP to MFC ratios of resources in watermelon production

Sl. No	Explanatory variables	Parameters	Haveri (n=50)	Ananthapur (n=50)
1.	Seeds	b_1	0.0027	-0.0059
2.	FYM	b_2	0.3222	0.2225
3.	Neem cake	b_3	-	-0.0013
4.	Human labour	b_4	0.1004	0.0652
5.	Bullock labour	b_5	0.6846	0.1137
6.	Machine labour	b_6	0.0542	2.6368
7.	Nitrogen (N)	b_7	-0.0153	0.0736
8.	Phosphorus (P)	b_8	-0.0011	-0.0208
9.	Potassium (K)	b_9	0.0605	0.0168
10.	Sulphur (S)	b_{10}	0.0987	-0.0063
11.	Calcium (Ca)	b_{11}	2.7781	-0.0415
12.	Boron (B)	b_{12}	-0.0014	0.0077
13.	PPC in solid form	b_{13}	-0.0623	-0.0842
14.	PPC in liquid form	b_{14}	-0.0426	-0.0406
15.	Herbicides	b_{15}	1.1269	0.8944
16.	Growth regulators	b_{16}	-	0.0022

Note: MVP- marginal value product
MFC- marginal factor cost

In Haveri district, the MVP to MFC ratio's for calcium (2.7781) and herbicides (1.1269) were more than one. The MVP to MFC ratio's for seeds (0.0027), FYM (0.3222), human labour (0.1004), bullock labour (0.6846), machine labour (0.0542), potassium (0.0605) and sulphur (0.0987) were positive but less than unity. The MVP to MFC ratio's for nitrogen (-0.0153), phosphorus (-0.0011), boron (-0.0014), PPC in solid form (-0.0623) and PPC in liquid form (-0.0426) were negative and less than unity.

In Ananthapur district, the MVP to MFC ratio of machine labour (2.6368) was more than one. The MVP to MFC ratio's for FYM (0.2225) followed by human labour (0.0652), bullock labour (0.1137), nitrogen (0.0736), potassium (0.0168), boron (0.0077), herbicides (0.8944) and growth regulators (0.0022) were positive but less than unity. The MVP to MFC ratio's for seeds (-0.0059) followed by neem cake (-0.00130), phosphorus (-0.0208), sulphur (-0.0063), calcium (-0.0415), PPC in solid form (-0.0842) and PPC in liquid form (-0.0406) were negative and less than unity.

4.3 Marketing management of watermelon in the study area

4.3.1 Marketing channels

Two marketing channels were identified through which watermelon from the study area passed from the producers to the ultimate consumers.

Channel – I: Producer – Retailer – Consumer.

Channel – II: Producer – Pre-harvest contractor cum wholesaler – Retailer – Consumer.

The common practice was to sell the standing crop to the pre-harvest contractor cum wholesaler/retailers, who visit the crop at the time of maturity. Majority of the sample farmers sold their produce to the pre-harvest contractor cum wholesalers. This type of sale at the farm itself is termed as 'on farm sale' or 'sale at farm gate'.

Watermelon cultivators received the payment in installments. A nominal amount was paid as advance at the time of negotiation. The substantial amount is paid before moving the last truck load of fruits out of the farm. Pre-harvest contractor cum wholesalers would bring the produce and sell them in distant market. From this point, the produce pass through the retailer to ultimate consumers.

4.3.2 Pattern of sales of watermelon by farmers in the study area

Percentage of produce sold through different market channels of watermelon in the study area was depicted in Table 4.13. The table revealed that, maximum farmers in both the districts preferred channel – II to sell their produce. In Haveri district, 84 per cent of the farmers (42 farmers) preferred channel – II and 16 per cent (8 farmers) preferred channel – I. Similarly, in Ananthapur district, 76 per cent (38 farmers) of the farmers preferred channel – II and 24 per cent (12 farmers) preferred channel – I.

4.3.3 Marketing characteristic features of Pre-harvest contractor cum wholesalers in the study area

The marketing characteristic features of Pre-harvest contractor cum wholesalers in both the study districts are presented in Table 4.14.

Age: The results presented in the Table 4.14 indicate that average age of the pre-harvest contractor cum wholesalers was 50.60 years in Haveri district and 47.20 years in Ananthapur district.

Education: As far as education is concerned, cent per cent of the pre-harvest contractors cum wholesalers were literate in both the districts. The results revealed that maximum number of respondents completed high school, followed by PUC and above in both the districts. In Haveri district, 20 per cent respondents had educated upto primary school, while high school, PUC and above were 40 per cent each. Similarly, in Ananthapur district 60 per cent respondents were PUC and above and 40 per cent respondents were having high school. This shows that all the respondents were sufficiently educated and most of them were educated up to secondary level.

Type of family: The type of family was nuclear for majority of the farmers in both Haveri and Ananthapur districts. In Haveri district cent per cent respondents had nuclear family. Whereas, in Ananthapur district 80 per cent had nuclear and 20 per cent respondents had joint family.

Experience of marketing: As far as experience concerned, majority of the respondents were having good experience in marketing of watermelon in both the districts. In Haveri and Ananthapur districts, 60 per cent respondents were having 2-5 years' experience and 40 per cent respondents were having more than 5 years' experience.

Table 4.13 Pattern of sale of watermelon in different channels

Sl. No	Channel	Haveri district		Ananthapur district	
		No. of farmers	%	No. of farmers	%
1	Channel – I	8	16	12	24
2	Channel – II	42	84	38	76

Table 4.14 Marketing characteristics of pre-harvester cum wholesalers in the study area

Sl. No	Particulars		Units	Haveri district	Ananthapur district
1	Age		Years	50.60	47.20
2	Education	Primary school	No's	1 (20)	0
		High school	No's	2 (40)	2 (40)
		PUC and above	No's	2 (40)	3 (60)
3	Type of family	Nuclear	No's	5 (100)	4 (80)
		Joint	No's	0	1 (20)
4	Experience of marketing	Below 2 Years	No's	0	0
		2-5 years	No's	3 (60)	3 (60)
		Above 5 years	No's	2 (40)	2 (40)
5	Mode of transportation	Tractor	No's	0	0
		Lorry/DCM	No's	5 (100)	5 (100)
		Auto	No's	0	0
6	Source of fruits	Directly from farm gate	No's	5 (100)	5 (100)
		From other sellers in the market	No's	0	0
7	Storage structures	Godowns	No's	0	0
		Shade nets	No's	5 (100)	5 (100)
8	Frequency of purchasing	1-5 times	No's	0	0
		5-10 times	No's	0	2 (40)
		more than 10 times	No's	5 (100)	3 (60)
9	Average quantity of fruits purchased		tonnes	2,205	2,747
10	quantity sold as	fruit as a whole	tonnes	1838.25 (82.00)	2388.30 (86.00)
		Fruit into slices	tonnes	366.75 (18.00)	358.70 (14.00)
11	Method of sale	fruit as a whole	%	20	20
		Fruit as a whole and slices	%	80	80
12	Quantity sold	With -in the state	%	59	66
		Out of the state	%	41	34

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

Mode of transportation: In Haveri and Ananthapur districts, cent per cent respondents were using lorry/DCM for transportation of fruits from farm gate to ultimate intermediaries.

Source of purchase: All the respondents in both the districts purchased the fruits directly at the farm gate itself.

Storage structures: In Haveri and Ananthapur districts, cent per cent respondents were using shade nets for storage.

Frequency of purchase: In Haveri district, cent per cent respondents purchased more than ten times in the season. Whereas, in Ananthapur district, 60 per cent respondents purchased more than ten times and 40 per cent respondents purchased 5-10 times in the season.

Average quantity of fruits handled: The average quantity of fruits purchased by the respondents in Haveri district was 2,205 tonnes, in that 82 per cent (1,838.25 tonnes) were sold as whole fruit and 18 per cent (366.75 tonnes) were sold as fruit into slices. Similarly, in Ananthapur district the average quantity of fruits purchased by the respondents was 2,747 tonnes, in that 86 per cent (2,388.30 tonnes) were sold as whole fruit and 14 per cent (358.70 tonnes) were sold as fruit into slices.

Method of sale: In Haveri and Ananthapur districts, 80 per cent of respondents sold whole fruits as well as slices and 20 per cent of respondents sold fruits as whole fruits only.

Quantity sold: In Haveri district, the sample respondents sold with-in the state and out of the state market which shared about 59 (1300.95 tonnes) and 41 (904.05 tonnes) per cent, respectively. Similarly, in Ananthapur district the sample respondents sold with-in the state and out of the state market which shared about 66 (1813.02 tonnes) and 34 (933.98 tonnes) per cent, respectively.

4.3.4 Marketing characteristic features of retailers in the study area

The marketing characteristic features of retailers in both the study districts are presented in Table 4.15.

Age: The results presented in Table 4.15 indicate that average age of the retailers was 41.20 years in Haveri district and 41.80 years in Ananthapur district.

Education: As far as education is concerned, cent per cent of the retailers were literate in both the districts. In Haveri district, 40 per cent respondents were having education upto

Table 4.15 Marketing Characteristics of retailers in the study area

Sl. No	Particulars		Units	Haveri district	Ananthapur district
1	Age		Years	41.20	41.80
2	Education	Primary school	No's	4 (40)	2 (20)
		High school	No's	2 (20)	4 (40)
		PUC and above	No's	4 (40)	4 (40)
3	Type of family	Nuclear	No's	10 (100)	8 (80)
		Joint	No's	0	2 (20)
4	Occupation	Marketing only	No's	6 (60)	8 (80)
		Marketing and farming	No's	4 (40)	2 (20)
5	Experience of marketing	Below 2 Years	No's	4 (40)	2 (20)
		2-5 years	No's	2 (20)	4 (40)
		Above 5 years	No's	4 (40)	4 (40)
6	Mode of transportation	Tractor	No's	2 (20)	2 (20)
		Lorry/DCM	No's	4 (40)	6 (60)
		Auto	No's	4 (40)	2 (20)
7	Source of purchase	Directly from farm gate	No's	5 (50)	8 (80)
		From other sellers in the market	No's	5 (50)	2 (20)
8	Storage structures	Godowns	No's	0	0
		Shade nets	No's	10 (100)	10 (100)
9	Frequency of purchasing (in the season)	1-2 times	No's	4 (40)	2 (20)
		2-5 times	No's	4 (40)	6 (60)
		more than 5 times	No's	2 (20)	2 (20)
10	Average quantity of fruits purchased		tonnes	68.80	73.30
12	quantity sold as	fruit as a whole	tonnes	54.35 (79.00)	61.30 (80.50)
		Fruit into slices	tonnes	14.45 (21.00)	12.00 (19.50)
11	Method of sale	fruit as a whole	tonnes	10.00	20.00
		Fruit as a whole and slices	tonnes	90.00	80.00

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

primary school followed by 20 per cent were having high school education and 40 per cent were having the education of PUC and above. Similarly, in Ananthapur district 20 per cent of the respondents were having primary schooling followed by high school and PUC and above were 40 per cent each, respectively.

Type of family: The type of family was nuclear for majority of the retailers in both Haveri and Ananthapur districts. In Haveri district, cent per cent respondents were having nuclear family, whereas, in Ananthapur district 80 per cent respondents were having nuclear and 20 per cent respondents were having joint family.

Occupation: In Haveri district, for 60 per cent of the respondents marketing was the main occupation and for 40 per cent of the respondents, marketing as well as farming was the main occupation. Whereas, in Ananthapur district for 80 per cent of the respondents, marketing was the main occupation and for 20 per cent of the respondents, marketing as well as farming was the main occupation.

Experience of marketing: As far as experience concerned, majority of the respondents were having good experience in marketing of watermelon in both the districts. In Haveri district, 40 per cent respondents were having below two years experience followed by 20 per cent were having 2-5 years and 40 per cent were above five years experience in marketing of watermelon. Similarly, in Ananthapur district 20 per cent respondents were having below two years experience followed by 40 per cent respondents each were in 2-5 years and above five years experience in marketing of watermelon.

Mode of transportation: In Haveri district, 20 per cent of the respondents were using tractor for transportation of fruits, followed by 40 per cent respondents each were using lorry/DCM and auto for transportation. Whereas, in Ananthapur district, 20 per cent respondents were using tractor for transportation of fruits followed by 60 per cent were using lorry/DCM and 20 per cent respondents were using auto for transportation.

Source of purchase: In Haveri district, 50 per cent respondents were purchasing fruits directly from farm gate and remaining 50 per cent were from other sellers (wholesalers) in the market. Whereas, in Ananthapur district 80 per cent respondents were purchasing fruits directly from farm gate and remaining 20 per cent were from other sellers (wholesalers) in the market.

Storage structures: In Haveri and Ananthapur districts, cent per cent respondents were using shade nets for storage of purchased fruits.

Frequency of purchase: In Haveri district, 40 per cent respondents each were purchasing 1-2 times, 2-5 times in the season and remaining 20 per cent were purchasing more than five times in the season. Whereas, in Ananthapur district, 60 per cent respondents were purchasing 2-5 times and 20 per cent respondents each were purchasing 1-2 times and more than five times in the season.

Average quantity of fruits purchased: The average quantity of fruits purchased by the respondents in Haveri district was 68.80 tonnes. In that 79 per cent (54.35 tonnes) was sold as fruit as whole fruit and 21 per cent (14.45 tonnes) of fruits were sold as fruit into slices. Similarly, in Ananthapur district the average quantity of fruits purchased by the respondents was 73.30 tonnes. In that, 80.50 per cent (61.30 tonnes) was sold as whole fruit and 19.50 per cent (12 tonnes) of fruits were sold as fruit into slices.

Method of sale: In Haveri district, 90 per cent of respondents sold fruits as a whole fruits and slices and 10 per cent of respondents sold fruits as whole fruits only. Similarly, in Ananthapur district, 80 per cent of respondents sold fruits as whole fruits alone and slices and remaining 20 per cent of respondents sold fruits into fruit as whole fruits.

4.3.5 Marketing cost incurred by the farmer

Marketing cost incurred by the producer of watermelon was simply the miscellaneous charges which worked out to around ₹ 95.00 per tonne in Haveri district and it was around ₹ 130.00 per tonne in Ananthapur district. In miscellaneous charges, around ₹ 56.00 per ton was accounted for loading and unloading labour charges in Ananthapur district and remaining was commission and other miscellaneous charges. In Haveri district, no loading and unloading charges were by the farmers. They bear only commission and miscellaneous charges which worked out to be around ₹ 95.00 per ton.

4.3.6 Marketing cost incurred by market intermediaries

4.3.6.1 Marketing cost incurred by pre-harvest contractor cum wholesaler in the study area

The per ton item wise marketing cost incurred by pre-harvest contractor cum wholesaler in the channel – II are presented in Table 4.16. In Haveri district, the average total marketing cost incurred by the pre-harvest contractor cum wholesaler was ₹ 1,163.56 per ton.

Table 4.16: Marketing costs incurred by different intermediaries in different channels in Haveri and Ananthapur districts

(₹/tonne)					
Sl. No	Particulars	Haveri district		Ananthapur district	
		Channel I	Channel II	Channel I	Channel II
Pre harvester cum wholesaler					
1	Transportation	-	840.65 (72.25)	-	915.80 (76.50)
2	Loading and unloading	-	200.91 (17.26)	-	171.40 (14.32)
3	Tax	-	20.00 (1.72)	-	10.00 (0.83)
4	Weighing charges	-	15.00 (1.29)	-	15.00 (1.25)
5	Miscellaneous charges	-	87.00 (7.48)	-	85.00 (7.10)
	Total	-	1163.56	-	1197.20
Retailer					
1	Transportation	627.13 (69.80)	100.00 (57.47)	616.66 (70.98)	154.85 (68.32)
2	Loading and unloading	168.31 (18.73)	32.00 (18.39)	147.15 (16.94)	24.80 (10.94)
3	Tax	20.00 (2.23)	10.00 (5.75)	10.00 (1.15)	7.00 (3.09)
4	Weighing charges	15.00 (1.67)	5.00 (2.87)	15.00 (1.73)	10.00 (4.41)
5	Miscellaneous charges	68.00 (7.57)	27.00 (15.52)	80.00 (9.20)	30.00 (13.24)
	Total	898.45	174.00	868.81	226.65

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

In that, transportation cost accounted major item of cost ₹ 840.65 (72.25 %) per ton, followed by loading and unloading charges ₹ 200.91 (17.26 %) per ton, miscellaneous charges - 7.48 per cent (₹ 87.00 per ton), tax - 1.72 per cent (₹ 20.00 per ton) and weighing charges -1.29 per cent (₹ 15.00 per ton), respectively.

In Ananthapur district, the average total marketing cost incurred by the pre-harvest contractor cum wholesaler was ₹ 1,197.20 per ton. It could be seen from the table 4.16 that the major item of cost was transportation cost constituting 76.50 per cent (₹ 915.80 per ton), followed by loading and unloading charges 14.32 per cent (₹ 171.40 per ton), miscellaneous charges - 7.10 per cent (₹ 85.00 per ton), weighing charges - 1.25 per cent (₹ 15.00 per ton) and tax - 0.83 per cent (₹10.00 per ton), respectively. Miscellaneous charge included cushioning materials for transportation such as paddy straw, card boards and glue tapes etc.

4.3.6.2 Marketing cost incurred by retailers in the study area

The per tonne item wise marketing cost incurred by retailers in the channel-I and channel-II are presented in Table 4.16. The results revealed from the table that in Haveri district, the cost incurred by retailers in the channel-I was ₹ 898.45 per ton. The major item of costs were transportation charges constituting 69.80 per cent (₹ 627.13 per ton), followed by loading and unloading charges - 18.73 per cent (₹ 168.31 per ton), miscellaneous charges - 7.57 per cent (₹ 68.00 per ton), tax - 2.23 per cent (₹ 20.00 per ton) and weighing charges - 1.67 per cent (₹ 15.00 per ton). Miscellaneous charge includes cushioning materials for transportation such as paddy straw, card boards and glue tapes etc.

The cost incurred by retailers in the channel-II in Haveri district was ₹ 174.00 per ton. The major item of costs were transportation charges constituting 57.47 per cent (₹ 100.00 per ton) followed by loading and unloading charges - 18.39 per cent (₹ 32.00 per ton), miscellaneous charges - 15.52 per cent (₹ 27.00 per ton), tax - 5.75 percent (₹ 10.00 per ton) and weighing charges - 2.87 per cent (₹ 5.00 per ton), respectively.

In Ananthapur district, the cost incurred by retailers in the channel-I was ₹ 868.81 per ton. In that, transportation charges accounted major item of cost i.e., 70.98 per cent (₹ 616.66 per ton), followed by loading and unloading charges 16.94 per cent (₹ 147.15 per ton), miscellaneous charges - 9.20 per cent (₹ 80.00 per ton), weighing charges - 1.73 per cent (₹ 15.00 per ton) and tax - 1.15 per cent (₹ 10.00 per ton). Miscellaneous charges in this case

also include cushioning materials for transportation such as paddy straw, card boards and glue tapes etc.

The cost incurred by retailers in the channel-II was ₹ 226.65 per ton. The major item of costs were transportation charges, constituting 68.32 per cent (₹ 154.85 per ton), followed by miscellaneous charges - 13.24 per cent (₹ 30.00 per ton), loading and unloading charges - 10.94 per cent (₹ 24.80 per ton), weighing charges - 4.41 per cent (₹ 10.00 per ton) and tax - 3.09 percent (₹ 7.00 per ton).

4.3.6 Marketing costs, margins and price spread in marketing of watermelon in the study area

Watermelon passes through different intermediaries from farmers to reach ultimate consumers. The intermediaries rendered different services in the process of marketing and at the same time expected the rewards for their services.

The price spread refers to the difference between the price paid by the consumer and the net price received by the producer for an equivalent quantity of farm produce. This spread consists of marketing expenses and margin of intermediaries, which ultimately determined the overall effectiveness of a marketing system and efficiency of the marketing system. The detailed price spread of per tonne of watermelon through different channels is presented in Table 4.17.

In Haveri district, the results revealed from the table that, in channel-I the farmers sold their produce to the retailers at the farm gate itself. Retailers purchased the produce at ₹ 7,430.00 per ton and cost incurred by the retailer was ₹ 898.45 per ton and keeping a profit margin of ₹ 1,294.26 per ton and he sold to the ultimate consumer at ₹ 9,577.71 per ton. The net price received by the producer after deducting the cost incurred by the producer was ₹ 7,335.00 per ton. Thus the producer received 76.58 per cent of the consumer price, which was higher than that of channel-II.

Further, from the table it could be seen that in channel-II farmers sold their produce to pre-harvest contractor cum wholesaler at the farm level itself. Pre-harvest contractor cum wholesaler purchased the produce at ₹ 7,180.00 per ton and cost incurred by pre-harvest contractor cum wholesaler was ₹ 1,163.56 per ton. The profit margin was ₹ 834.35 per ton. The retailer purchased the produce from pre-harvest contractor cum wholesaler and sold to the

Table 4.17: Marketing cost, margin and price spread in marketing of watermelon in different channels

Sl. No	Particulars	(₹/tonne)			
		Haveri district		Ananthapur district	
		Channel I	Channel II	Channel I	Channel II
1	Producer price	7,430.00	7180.00	6,390.00	6,090.00
2	Marketing cost incurred by producer	95.00	95.00	131.00	131.00
3	Producers net price (1-2)	7,335.00	7,085.00	6,259.00	5,959.00
4	Purchase price of wholesaler	-	7,180.00	-	6,090.00
5	Cost incurred by wholesaler	-	1,163.56	-	1197.20
6	Profit margin of wholesaler	-	834.35	-	728.72
7	Purchase price of retailer	7,430.00	9,177.91	6,390.00	8,015.92
8	Cost incurred by retailer	898.45	174.00	868.81	226.65
9	Profit margin of retailer	1,249.26	1,402.78	1,088.82	1,236.38
10	Purchase price of consumer	9,577.71	10,754.69	8,347.63	9,478.95
11	Producer's share in consumer's rupee	76.58	65.88	74.98	62.86
12	Price spread (10-3)	2,242.71	3,669.69	2,088.63	3,519.95

ultimate consumer. In this process, retailer incurred a cost of ₹ 174.00 per ton of watermelon and realized net earnings of ₹ 1,402.78 per ton of watermelon. Producer received a net price of ₹ 7,085.00 per ton after deducting the marketing cost incurred by the producer. Thus producer received 65.88 percent of the consumer price.

In Ananthapur district, the results revealed from the table that, in channel-I, the farmers sold their produce to the retailers at the farm gate itself. Retailers purchased the produce at ₹ 6,390.00 per ton and cost incurred by the retailer was ₹ 868.81 per ton and keeping a profit margin of ₹ 1,088.82 per ton and he sold to the ultimate consumer at ₹ 8,347.63 per ton. The net price received by the producer after deducting the cost incurred by the producer was ₹ 6,259.00 per ton. Thus, the producer received 74.98 per cent of the consumer price.

Further, from the table it could also be seen that in channel-II farmers sold their produce to pre-harvest contractor cum wholesaler at the farm level itself. Pre-harvest contractor cum wholesaler purchased the produce at ₹ 6,090.00 per ton and cost incurred by pre-harvest contractor cum wholesaler was ₹ 1,197.20 per ton. The profit margin was ₹ 728.72 per ton. The retailer purchased the produce from pre-harvest contractor cum wholesaler and sold to the ultimate consumer. In this process, retailer incurred a cost of ₹ 226.65 per ton of watermelon and realized net earnings of ₹ 1,236.38 per ton of watermelon. Producer received a net price of ₹ 5,959.00 per ton after deducting the marketing cost incurred by the producer. The producer's share in consumer's rupee was 62.86 per cent.

4.4 Problems associated with production and marketing of watermelon in the study area

An opinion survey was conducted to identify the problems faced by the farmers at different stages of production and marketing of watermelon in the study area. Problems were analyzed by using Garrett's ranking technique and the results are presented in this section.

4.4.1 Production problems faced by watermelon growers in the study area

Ten major problems were identified in watermelon and the opinion survey results are presented in Table 4.18. The results revealed that the major problems faced by the sample farmers in Haveri district were water scarcity (1st rank) followed by severe incidence of pests and diseases (2nd rank), non-availability of labour during peak season (3rd rank), high cost of

Table 4.18: Constraints in production of watermelon in Haveri and Ananthapur districts

Sl. No	Problems	Haveri district		Ananthapur district	
		Garrett score	Rank	Garrett score	Rank
1	Water scarcity	76.84	I	68.60	II
2	Severe incidence of pests and diseases	71.26	II	78.24	I
3	Non-availability of labour during peak season	61.72	III	47.72	VI
4	High cost of inputs	59.26	IV	63.32	III
5	Lack of timely availability of credit	50.72	V	59.00	IV
6	Damage due to unfavorable weather conditions	50.60	VI	53.06	V
7	Maintenance problems of irrigation structures	41.78	VII	40.70	VII
8	Lack of technical guidance	34.74	VIII	27.80	IX
9	Non-availability of FYM	29.62	IX	36.26	VIII
10	Breakage of fruits at the time of harvesting.	23.14	X	22.62	X

inputs (4th rank), lack of timely availability of credit (5th rank), damage due to unfavorable weather conditions (6th rank), maintenance problems of irrigation structures (7th rank), lack of technical guidance (8th rank), non-availability of FYM (9th rank) and breakage of fruits at the time of harvesting (10th rank) respectively.

In the case of Ananthapur district, the major problems faced by the sample farmers were severe incidence of pests and diseases (1st rank) followed by water scarcity (2nd rank), high cost of inputs with respect to seeds (3rd rank), lack of timely availability of credit (4th rank), damage due to unfavorable weather conditions (5th rank), non-availability of labour during peak season (6th rank), maintenance problems of irrigation structures (7th rank), non-availability of FYM (8th rank), lack of technical guidance (9th rank) and breakage of fruits at the time of harvesting (10th rank) respectively.

4.4.2 Marketing problems faced by watermelon growers in the study area

Ten major marketing problems were identified in watermelon and the opinion survey results are presented in Table 4.19. The results revealed that the major problems faced by the sample farmers in marketing front in Haveri district were lack of storage facility (1st rank) followed by lack of transportation facilities (2nd rank), breakage of fruits at the time of transportation, loading and unloading (3rd rank), lack of support price (4th rank), lack of regulated and co-operative market (5th rank), lack of awareness about market information (6th rank), markets far away from farm (7th rank), low prices due to seasonal gluts (8th rank), lack of processing industries related to watermelon (9th rank) and few purchasers available in local market (10th rank) respectively.

In the case of Ananthapur district, the major problems faced by the sample farmers in the order of their severity were lack of storage facility (1st rank) followed by lack of support price (2nd rank), lack of transportation facilities (3rd rank), breakage of fruits at the time of transportation, loading and unloading (4th rank), lack of regulated and co-operative market (5th rank), low prices due to seasonal gluts (6th rank), lack of awareness about market information (7th rank), markets far away from farm (8th rank), lack of processing industries related to watermelon (9th rank) and few purchasers available in local market (10th rank) respectively.

Table 4.19: Constraints in marketing of watermelon in Haveri and Ananthapur districts

Sl. No	Problems	Haveri district		Ananthapur district	
		Garrett score	Rank	Garrett score	Rank
1	Lack of storage facility	75.52	I	77.44	I
2	Lack of transportation facilities	65.76	II	56.70	III
3	Breakage of fruits at the time of transportation, loading and unloading.	61.52	III	54.90	IV
4	Lack of support price	53.22	IV	74.56	II
5	Lack of regulated market	48.78	V	51.98	V
6	Lack of awareness about market information	47.98	VI	44.46	VII
7	Markets far away from farm	47.00	VII	33.52	VIII
8	Lower prices due to seasonal gluts	36.94	VIII	47.66	VI
9	Lack of processing industries related to watermelon	32.32	IX	28.60	IX
10	Few purchasers available in local market	28.96	X	28.18	X

Discussion

5. DISCUSSION

The results of the study presented in the results chapter are discussed in detail in this chapter. The main focus here is concentrated in throwing light on the possible cause for the results obtained and were presented under following sub headings. Keeping in view the objectives of the study in mind, the results are discussed under the following headings.

5.1 Growth in area, production and productivity of watermelon in Karnataka and Andhra Pradesh.

5.2 Production management of watermelon in the study area

5.3 Marketing management of watermelon in the study area

5.4 Problems associated with production and marketing of watermelon in the study area

5.1 Growth in area, production and productivity of watermelon in Karnataka and Andhra Pradesh

The growth and instability in area, production and productivity of watermelon in Karnataka and Andhra Pradesh for period of sixteen years from 2001-02 to 2016-17 were analyzed and the results are presented in Table 4.1

The results indicated positive growth in area, production and productivity of watermelon in Karnataka and Andhra Pradesh. It could be seen from the Table 4.1 that, highest growth rate in production was observed in both the states. This increased production growth in Andhra Pradesh was equally and significantly due to area expansion and growth in productivity. Improved hybrids and advanced package of practices like usage of mulching sheet, drip irrigation. Watermelon requires less water and can withstand moderate temperature. Normally, watermelon cultivation is considered as summer cash crop to the farmers. Area under watermelon has steadily increased in dry land areas like Kolar, Davangere, Haveri and Belgavi districts in Karnataka state, and Kadapa, Chittoor and Ananthapur districts in Andhra Pradesh. From productivity front and crop diversification from traditional crops to profitable watermelon cultivation might have lead to enormous growth rate (9.2 % per annum) in Andhra Pradesh and in Karnataka the scenario was slightly different. There was no much productivity expansion during the period of study, but area expansion was significant which lead to substantial expansion in production.

Instability index for area, production and productivity of watermelon in Karnataka and Andhra Pradesh were also analyzed (Table 4.1). The results showed that in Karnataka state production has shown more fluctuations (20.55 %), followed by area (19.54 %) and productivity (4.71 %). Similarly, in Andhra Pradesh also production has shown more fluctuations (40.81 %), followed by productivity (30.38 %) and area (22.99 %). The more fluctuations in production was probably due to crop improvement strategies and crop diversification strategies in Andhra Pradesh and solely due to crop diversification strategies in Karnataka as indicated by compound annual growth rate values.

Similar findings were recorded in the study on growth and instability analysis of fruit crops in India by Kadli *et al.* (2014).

5.1.1 Growth in area, production and productivity of watermelon in Haveri and Ananthapur districts

The results of growth and instability in area, production and productivity of watermelon in Haveri and Ananthapur districts are presented in Table 4.2, which revealed that the increase in area and production of watermelon in Haveri district was significant at one per cent level of probability. It indicates the positive impact of area expansion for watermelon production in the district. With respect to productivity, negative growth rate was observed. It may be probably due to non-development of high yielding varieties/hybrids suitable to the region during the recent years (study period).

In Ananthapur district also there was positive and significant growth in area, production and productivity of watermelon. The increase in area under watermelon might be due to replacing the groundnut crop by watermelon because of drip irrigation technology and high returns from the crop over the years. Improvement in production and productivity was mainly area driven with very insignificant contribution of productivity expansion. However, it is seen from the table that growth in productivity of watermelon in both the study districts across the states found to be not substantial. This calls for research efforts from scientific fraternity and private organizations to come out with improved varieties/hybrids, production technologies to increase the productivity. Since, area expansion is a limiting factor, production growth can only be increased through increased growth in productivity.

The results also showed that in Haveri district, area has shown more instability (46.38 %) compared with production (45.68 %) and productivity (14.28 %). Area under

watermelon should be stabilized through crop insurance scheme to protect the producers from fluctuations in net returns. In Ananthapur district, production has shown more fluctuations (83.94 %) compared with area (70.25 %) and productivity (28.38 %). Larger spread of high yielding varieties/ hybrids, expansion of irrigation facilities, development of crop varieties resistant to pests and diseases, technologies to mitigate effect of weather on yield, may help in reducing variability in area, production and productivity of watermelon in the study area. Similar findings were recorded in the study of growth and instability in area, production and productivity of fenugreek in Rajasthan by Boyal *et al.* (2015).

5.2 Production management of watermelon in the study area

5.2.1 General characteristics of the sample respondents

5.2.1.1 Age of the respondents

From the Table 4.3, it could be observed that, the average age of the sample farmers was about 36.21 years in Haveri district and 39.20 years in Ananthapur district. This revealed that most of the farmers were of middle age group. Medium age farmers usually have more experience and enthusiasm in using and adopting new technologies in the production of watermelon and thus, aiming for higher profits.

5.2.1.2 Type of family

The family size of sample farmers was 4.52 in Haveri district, 4.60 in Ananthapur district. In both the study districts, majority of the respondents (nearly 90 %) were residing in nuclear family under present social set up, setting up of nuclear family is not a surprising factor. The management decisions with regard to crop production will be more clear and quick in case of nuclear families. Since, watermelon is a non-field crop taking a decision to grow it would be rather difficult in joint families.

5.2.1.3 Educational status of the respondents

As per literacy concerned, it was observed that cent per cent of the sample respondents were literate in both the districts. In Haveri district, 40 per cent had primary education and the rest 60 per cent had completed their high school education. In Ananthapur district, 42 per cent had primary education and the rest 58 per cent had completed their high school education. It was noticed that majority of respondents were educated in the study area. The fact that higher

the education level more would be the knowledge and better would be the understanding capacity of the new technologies. Education might have enabled the respondents to allocate manageable size of the watermelon farms to get higher returns.

5.2.1.4 Occupational pattern

In Haveri district, 82 per cent of the sample respondents had agriculture as their main occupation and 76 per cent sample respondents in Ananthapur district dependent on agriculture to lead their life. Therefore any decision to improve their standard of living should come from agricultural front. This shows that watermelon cultivation in these two districts has significant role to play to improve their standard of living.

5.2.1.5 Land holding pattern of the sample respondents

The average land holding of sample respondents in Haveri and Ananthapur districts was 3.49 and 2.88 ha respectively. The average area under watermelon in Haveri and Ananthapur districts was 1.20 and 1.14 ha, respectively, which indicated that in Haveri district about 34.46 per cent of land holding and in Ananthapur district about 39.66 per cent of land holdings were under watermelon. Watermelon was the most common *rabi* crop in the study area. Among the average land holding 32 per cent respondents are small farmers, 62 and 6 per cent respondents were medium and large farmers in Haveri district. In Ananthapur district, 28, 66 and 6 per cent respondents are small, medium and large farmers in the study area. It is revealed from the study that, majority of the farmers were having medium size land holding with an average size of 2-5 hectares. Therefore allocating about 1.10 and 1.20 hectares of land for watermelon cultivation has not been a problem for the farmers in the study area.

5.2.2 General characters of watermelon growers in the study area

All the respondents in both the selected districts, cultivating watermelon in sandy loamy soils and sowing was done during *rabi* season. In Haveri district, majority of the respondents *i.e.*, 60 per cent grown Namdhari (NS – 295), which was found to be a popular hybrid, followed by United Genetics (Hybrid Rubita) (20 %), Sugar Queen (8 %), Hybrid Dragon and Pahuja (Arun – 0035) 6 per cent each. In Ananthapur district, majority of the respondents *i.e.*, 60 per cent grown Pahuja (Arun – 0035) which was found to be a popular hybrid followed by Sagar King (14 %), Apoorva and Sugar Queen (10 % each) and Hybrid Dragon (6%). Average plant population per hectare in Haveri district was 12,000 plants and in

Ananthapur district 11,500 plants. In Haveri district, 50 per cent farmers followed 0.6 m × 1.5 m spacing, 0.6 m × 1.8 m (40 %) and 0.9 m × 1.5 m (10 %), respectively. In Ananthapur district, majority of the farmers *i.e.*, 60 per cent respondents followed 0.6 m × 1.8 m and rest 40 per cent were 0.6 m × 1.5 m spacing. In Haveri district, 56 per cent farmers were having 3-6 years experience in cultivation of the watermelon followed by 24 per cent having 1-3 years experience and 20 per cent farmers were having more than six years experience in cultivation. Similarly, in Ananthapur district, majority of the farmers were having 3-6 years experience followed by 30 per cent were having 1-3 years and 10 per cent were having more than six years experience in cultivation of the watermelon. The above figures indicate in the study area more than 70 per cent of the farmers were having more than three years of experience in cultivating watermelon. More the experience more will be the perfectness in cultivating crops. Therefore, it can be concluded that majority of the farmers are more perfect in watermelon cultivation in the study area.

5.2.3 Production management aspects of watermelon in the study area

The results of the production management aspects of watermelon in the study area, depicted in the Table 4.5, majority of the farmers in both the study districts used seeds above the recommendation as per the package of practices for watermelon cultivation. From the farmers point of view they seem to be right on using highest seed rates to confirm themselves to get better plant population, which will definitely influence on total production. On the other hand they have to be very cautious while using the excess seeds because these hybrid seeds are very costly which will unnecessarily add to the total cost, in turn effecting on the net returns. Therefore those are to be cautious in management of seed rate. Cent per cent of the sample farmers in both the districts followed drip irrigation for cultivation. Since, the study area falls under dry land area, in both the states farmers found using drip irrigation to get high water use efficiency. Most of the sample respondents in both the districts applied chemical fertilizers over and above the recommended doses anticipating better yield. Majority of the sample farmers in Haveri district were not using any growth regulators, some of them used multi-K, a micro nutrient as growth regulator, but well below the recommended dosage. In Ananthapur district, sizable proportions of sample farmers were found using growth regulators either at a recommended dose or slightly above the recommendation. Usage of growth regulators would increase the plant growth, female flower settings which lead to

increase in the yield due to more fruit settings. NAA (@ 1 gram per 100 liters of water) or GA₃ (15 ppm) or cycocel were the common growth regulators used in Ananthapur district. The farmers of Haveri district can also go for using growth regulators to harness better yield and in turn increase net returns. Most of the sample farmers in Haveri and Ananthapur districts (88 % and 90 %) followed curative measures for pest and disease management. Watermelons are not prone to pests and diseases to a longer extent. Hence, no need of preventive measures, only certain curative measures as and when pest and disease incidence occurs is enough. Majority of the farmers in both districts were deciding harvesting time based on the size and colour of the fruit because visual observations were easy and the best method. It also indicated that cent per cent sample farmers were picking fruits more than one time, because the fruits should be harvested after gaining full maturity and based on demand in the market.

5.2.4 Labour and input management in watermelon cultivation in the study area

5.2.4.1 Labour management

The labour use patterns followed by respondents in the study area (Table 4.6) revealed that, in Ananthapur district, farmers employed more human labour, bullock and machine labour compared to Haveri district farmers in cultivation of watermelon crop. The results also revealed that operation wise estimated labour utilization among various operations of watermelon cultivation, intercultural operations consumed highest man days of labour because farmers usually go for hand weeding, thinning and removing apical shoots. Moreover since watermelon is a creeper it becomes difficult to use bullock or machine labour for weeding operations. Only during the beginning (early) 30 days when the plants are small Ananthapur farmers were found using bullock labour for intercultural operations. Machine labour usage was also more in Ananthapur district compared to Haveri district. However, among different categories of labour utilization, a slight difference was observed between the districts with respect to human, bullock and machine labour. But current trend in farming is that farmers found reducing maintenance of bullock pairs on their farms and getting majority of the farm operations done by using machines, like tractors. Watermelon is highly labour intensive crop as compared to field crops. Hence, advocating machine labour in place of human labour would not only reduce the cost of cultivation but also reduce the pressure of human labour on land which has become very active because of scarcity of labour in recent

times. The study reveals that on an average 110 and 117 man days of labour were used in watermelon cultivation in Haveri and Ananthapur districts, respectively. These findings are in conformity with the findings of Ahmad *et al.* (2017) were in they made an economic analysis of production of watermelon in Allahabad district, Uttar Pradesh, India.

5.2.4.2 Input procure management

The input procure management in watermelon in both Haveri and Ananthapur districts (Table 4.7) indicated that in both the districts the majority of the respondents were purchases from retail outlets due to farmers can save money in shipping costs, receive instant gratification, inspect the items carefully before purchasing and also there is a chance of replacing the input when it is not upto the mark. As per frequency of purchase, majority of the inputs such as seeds, farm yard manure, neem cake and herbicides were purchased once before the cultivation and some of the inputs like fertilizers, plant protection chemicals and growth regulators were purchased more than twice, as these inputs are applied in split doses to the crop. With respect to time of purchase, in both the districts majority of the respondents purchases maximum inputs prior to one month before application (seeds, farm yard manure and neem cake) and some of them are purchased one week before application (fertilizers, plant protection chemical, growth regulators and herbicides) by seeing the prices in the market and also concern with others in the society. This is mainly because, the inputs account for major cost in cost of cultivation. As per capital concerned, majority of the respondents in both the districts procured capital from own and borrowed from institutions (banks) such as crop loans, due to private money lenders (non-institutions) charges higher amount of interest rates than institutions. With respect to repayment also is easy and affordable in institutions.

5.2.4.3 Input management

The input utilization pattern in watermelon production in both Haveri and Ananthapur districts indicated that in Haveri district, the farmers used around 200 g more seeds as compared to farmers of Ananthapur district. Normally 875 to 1000 g of seeds are required for planting one hectare of area in case of hybrids. In case of varieties 2-3 kg seeds are required per hectare. The utilization of seeds depends on the spacing and type of planting in the field. Usually triangular method of sowing is followed in both the districts. However more seed density in Haveri district might have resulted in higher seed rate as compared to Ananthapur district. Farmers in the Haveri district used less quantity of farm yard manure (5.58 tonnes per

hectare) compared to farmers of Ananthapur district (9.73 tonnes FYM per hectare). While farmers of Ananthapur district were found using around 340 kg neem per hectare. Non usage of neem cake on part of Haveri farmers may be due to the lack of awareness of benefits of neem cake application. Hence, there is a need to educate the watermelon farmers of Haveri district in this regard. The amount of fertilizer applied in Haveri and Ananthapur districts during cropping time indicated that Ananthapur district farmers applied more fertilizers compared to Haveri district farmers. Boron was applied at the time of fruit forming and at maturity stage in both the districts to reduce fruit cracking. Plant protection chemicals (PPC) were used to minimize / control the pests and diseases and PPC use was found to be high in Haveri district in comparison with Ananthapur district. Growth regulators were used only by the farmers of Ananthapur district for increased plant growth, female flower setting in watermelon which leads to increased yield due to high fruit formation. In Haveri district, growth regulators usage was very less in quantity. In both the districts, watermelon cultivation was done by using drip irrigation and mulching technique was used to control the weeds as well as increasing the water use efficiency (WUE), because, both districts belongs dry land areas. The total human labour, bullock labour and machine labour employed were more in Ananthapur district than in Haveri district.

5.2.5 Cost of cultivation of watermelon in the study area

The cost of cultivation of watermelon presented in Table 4.9 indicates the investment on the variable inputs used in the cultivation and the services rendered by fixed assets. The average total cost incurred by the Ananthapur district farmers were found to be higher (₹ 1,43,306.17 / ha) compared to Haveri district (₹ 1,09,945.78 / ha) farmers. This might be attributable to the fact that Ananthapur district farmers used more inputs like seeds, human, bullock and machine labour, neem cake and applied more fertilizer than their counterparts.

In both the districts, the cost of human labour, seeds, plant protection chemicals and chemical fertilizers were the main items of cost with major share in the variable costs (82.99 % and 87.50 %), because most of the operations like harvesting, spraying, mulching, irrigation and weeding were human labour intensive operations and the other operations like land preparation, ploughing, harrowing and earthing up were machine and bullock labour intensive activities respectively. The distribution pattern of operational cost under various inputs between the districts revealed that cost of seeds, FYM, neem cake and growth

regulators were more in Ananthapur district as compared to Haveri district. Contrary to it the expenditure on fertilizers and micronutrients was more in Haveri district (₹ 14,054.70 / ha) compared to Ananthapur district (₹ 13,927.90 / ha). Ananthapur district farmers were using more quantity of FYM (9.73 tonnes / ha) and neem cake (338.00 kg / ha) to increase the fertility of the soil in place of chemical fertilizers as nutrient supplement to the crop.

In wake of current marketing scenario of agricultural commodities, organic farming is gaining an edge over chemical farming. In this respect, the farmers of Ananthapur district tend to gain over the farmers of Haveri district. Similar findings were observed by Vani (2015) in her study on production and marketing management of organic vegetables, where she also observed that farmers using organic inputs tend to gain over the farmers using chemicals.

5.2.6 Cost and return structure of watermelon in the study area

It was observed from the Table 4.10 that, in Ananthapur district, the average yield obtained per hectare was more than in Haveri district because of improved hybrid seeds, better management and practices, apart from incurring more expenditure on FYM, neem cake, growth regulators, bullock and machine labour. It was observed that the average selling price per tonne was more in Haveri district compared to Ananthapur district, because of high demand and less supply of watermelon in Karnataka. The average gross returns obtained per hectare was more in Ananthapur district compared to Haveri district only due to high yield per hectare. The average net returns obtained per hectare was more in Haveri district compared to Ananthapur district, because selling price per tonne was more in Haveri district. In both the districts, the net returns realized by the respondents from cultivation of watermelon worked out with returns per rupee of investment (B : C ratio) of 1.79 and 1.58. This indicates that cultivation of watermelon is a profitable agribusiness enterprise.

5.2.7 Resource use efficiency in watermelon cultivation

5.2.7.1 Estimated Cobb – Douglas production function coefficients

The Cobb – Douglas type of production function with yield realized from watermelon, as dependent variable while the quantity of seeds (g), FYM (tonnes), neem cake (kg), human labour (man days), bullock labour (pair days), machine labour (hours), nitrogen (N), phosphorus (P), potassium (K), Sulphur (S) and calcium (Ca) in kilogram and boron (B) in

grams, solid form of PPC (kg), liquid form of PPC (lt), growth regulators (g) and herbicides (lt) as independent variables were used to study the resource use efficiency.

The results presented in Table 4.11 revealed that, in Haveri district, the variables included in the function explained 95 per cent variation in the dependent variable and in Ananthapur district, 96 per cent variation in the dependent variable respectively. Therefore the independent variables included in the model could explain the majority of the variation in the dependent variable and it could be concluded that the production function fitted was a good fit. In both the districts increasing returns to scale were observed (1.03 and 1.02). The positive return to scale was due to the operation of economies of scale and proper management of resources in the production process.

In Haveri district, the estimated production coefficients for potassium (0.2846) was significant at ten per cent, while regression coefficient parameters for seeds (0.1183) followed by FYM (0.0642), human labour (0.4015), bullock labour (0.1029), machine labour (0.0119), sulphur (0.0516), calcium (0.0449) and herbicides (0.0755) were positive and non-significant which indicates that farmers were operating these inputs at second stage of production. The use of these inputs had positive impact on the yield. Whereas the regression coefficients for nitrogen (-0.0570) followed by phosphorus (-0.0057), boron (-0.0144), PPC in solid form (-0.0366) and PPC in liquid form (-0.0108) were negative and non-significant indicating over utilization of these inputs which had negative impact on the yield.

In Ananthapur district, the estimated production coefficient for machine labour (0.5800) was significant at one per cent and herbicides (0.0070) were significant at five per cent level of probability. While, regression coefficient parameters for FYM (0.0577), followed by human labour (0.2211), bullock labour (0.0180), nitrogen (0.2305), potassium (0.0559), boron (0.0536) and growth regulators (0.0942) were positive and non-significant which indicating that farmers were operating these inputs at second stage of production. The use of these inputs had positive impact on the yield. Whereas, the regression coefficient for seeds (-0.1703) followed by neem cake (-0.0021), phosphorus (-0.0696), sulphur (-0.0054), calcium (-0.0122), PPC in solid form (-0.0288) and PPC in liquid form (-0.0074) were negative and non-significant indicating over utilization of these inputs which had negative impact on the yield.

5.2.7.2 Allocative efficiency in watermelon production

The ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC), presented in the Table 4.12 revealed the allocative efficiency in watermelon production. In Haveri district, the allocative efficiency was positive and greater than unity in the case of calcium and herbicides indicating that still there was scope to use these inputs and increase the yield and gross returns of watermelon production in the study area. The allocative efficiency was positive and less than unity in the case of seeds (0.0027), followed by FYM (0.3222), human labour (0.1004), bullock labour (0.6846), machine labour (0.0542), potassium (0.0605) and sulphur (0.0987), indicating that the resources were in excessive use. That means, decrease in the use of these inputs would enhance the yield and gross returns in watermelon production. While in nitrogen (-0.0153) followed by phosphorus (-0.0011), boron (-0.0014), PPC in solid form (-0.0623) and PPC in liquid form (-0.0426) where the allocative efficiency was less than zero (negative), indicates that there was a need to reduce usage of these inputs in cultivation of watermelon.

In Ananthapur district, the allocative efficiency was positive and greater than unity in the case of machine labour indicating that still there was scope to use machine labour which would increase the yield and gross returns in watermelon production in the study area. The allocative efficiency was positive and less than unity in the case of FYM (0.2225) followed by human labour (0.0652), bullock labour (0.1137), nitrogen (0.0736), potassium (0.0168), boron (0.0077), herbicides (0.8944) and growth regulators (0.0022), indicating that the resources were in excessive use. That means, decrease in the use of these inputs would enhance the yield and gross returns in watermelon production. While in case of seeds (-0.0059) followed by neem cake (-0.0013), phosphorus (-0.0208), sulphur (-0.0063), calcium (-0.0415), PPC in solid form (-0.0842) and PPC in liquid form (-0.0406) where the allocative efficiency was less than zero (negative), indicates that there was a need to reduce usage of these inputs in cultivation of watermelon.

5.3 Marketing management of watermelon in the study area

As indicated in results, the following two channels of marketing of watermelon are common in both the districts. Watermelon produced in both the districts are marketed to

distant places like Bengaluru, Mumbai, Pune and Goa etc., and the produce passes through the intermediaries.

The producers sell their produce directly to the local retailers and finally the produce reaches the local consumers in channel-I, whereas in channel-II, the producers sell their produce to the pre harvest contractor cum wholesaler through commission agent and then it moves to distant market retailers and reaches ultimately to the consumers.

The study revealed that packing, transportation and selling were the major functions involved in the process of marketing of watermelon. Watermelons were transported by trucks/lorries. The producer sold their maximum quantity through channel-II only.

5.3.1 Marketing channels and pattern of sale of watermelon in the study area

There are no separate markets for watermelon in both Haveri and Ananthapur districts, as watermelon is not a notified commodity (fruit) in the regulated market like other fruits and vegetables. Two channels of marketing of watermelon were identified in each district,

Channel – I: Farmer – Retailer – Consumer

Channel – II: Farmer – Pre-harvester contractor cum wholesaler - Retailer – Consumer

Most of the farmers sold their produce through channel-II in both Haveri and Ananthapur districts. In Haveri district, 84 per cent of the respondents most commonly followed channel-II and rest 16 per cent followed channel-I. Similarly, in Ananthapur district 76 per cent respondents commonly followed channel-II and remaining 24 per cent followed channel-I for marketing of watermelon. The retailers in channel-I indicate the local retailer who will handle only the fewer quantity to cater to the needs of local consumers. Hence, movement of the quantity through channel-I is restricted. But in channel-II pre-harvest contractor cum wholesaler will procure the entire field from the farmers, harvest the fruits and transport to the distant markets and sell to the retailers spread in wide areas meeting the requirements of more number of consumers. Therefore, movement in channel-II was very high.

5.3.2 Marketing characteristic features of pre-harvest contractor cum wholesalers in the study area

The marketing and socio-economic characteristics of the pre harvester contractor cum wholesalers are included in the Table 4.14. Age of the respondents is one of the important factors that influence the marketing pattern in terms of adoption of technology. Majority of

the sample respondents in both the districts were in the middle age group. This indicates that the respondents were very well experienced in watermelon marketing in the study area. As far as the literacy levels are concerned it was observed that all the respondents in both the districts were literates. This might have positive influence and enable the respondents to allocate the manageable marketing under watermelon to get high profits and margins over the other crops. In both districts, majority of the respondents were having nuclear type of family. This might be due to their awareness regarding the increased cost of living because of large numbers in family makes differences in taste and preferences. The predominance of nuclear family was due to the realization of advantages of nuclear family. Majority of the respondents in both the districts had fairly satisfactory experience in watermelon marketing. This experience might have helped them to have favorable attitude and skill towards marketing and to get high profits. All the respondents in both the districts were using trucks/ Lorries for transportation of fruits from farm gate to ultimate intermediaries. Watermelon requires more space than other fruits due to its shape and size. All the respondents in both the districts purchased fruits directly from the farm gate itself only and using shade nets as storage structures. Majority of the respondents in both the districts purchasing fruits 5-10 times in the season, because, watermelon is a season based fruit and also demand is regular during summer months. In Haveri district, the average quantity of commodity purchased were 2,205 tonnes per season and 2,747 tonnes in Ananthapur district. Out of which, in both the district, 82 per cent and 86 per cent quantity of fruit was sold as wholefruit and the rest 18 per cent and 14 per cent of the fruits were fruit in to slices. Fruit made into slices gives more profit than fruit as a whole. Majority of the respondents in both the districts sold fruits with-in the state only (59 and 66 %) and the remaining was sold out of the state (41 and 34 %).

5.3.3 Marketing characteristic features of retailers in the study area

The marketing and socio-economic characteristics of the retailers in the study area are presented in the Table 4.15. Age of the respondents is one of the important factor that influence the marketing pattern in terms of adoption of technology. Majority of the sample respondents in both the districts were in the middle age group. Hence, the respondents had more experience in using and adopting new technology in marketing of watermelon and thus aiming for higher profits. It indicates that the higher the education level more would be the knowledge and better would be the understanding capacity of the marketing. Majority of the

respondents in both the districts were having nuclear family. The predominance of nuclear family was due to the realization of the advantages of having nuclear family. In Haveri and Ananthapur districts, 60 and 80 per cent respondents main occupation was marketing alone and the rest 40 and 20 per cent respondents were having marketing along with farming because of their small holdings. Majority of the respondents in both the districts (60 and 80% respectively) were having experience in marketing of fruits for above 2 years and the rest (40 and 20 % respectively) were having experience of less than 2 years, indicating that all the respondents in the study area were having good knowledge in marketing of watermelon. In both the districts major mode of transportation was through Lorries/ trucks only. Majority of the respondents in both the districts purchased fruits directly from the farm gate itself (50 and 80 %) and rest were purchasing from other sellers (wholesalers) in the market 50 and 20 per cent, respectively. All the respondents using shade nets as storage structures. As far as frequency of purchasing was concerned, in Haveri district 20 per cent respondents were purchasing more than five times in the season and 1-2 times and 2-5 times in the season were 40 per cent each respectively. Whereas, in Ananthapur district, 60 per cent respondents were 2-5 times in the season, 1-2 times and more than five times purchasers were 20 per cent each respectively. Majority of the retailers in both the districts (90 and 80 %) sold fruits into both slices and fruit as a whole, because Fruit made into slices gives more profit than fruit as a whole.

5.3.4 Marketing cost incurred by the producer

The producers of watermelon in Ananthapur district incurred more marketing costs as compared to counter parts in Haveri district. The producer has to make arrangement for loading and unloading of watermelon in Ananthapur district, the same cost was born by the pre-harvest contractor himself in Haveri district.

5.3.5 Marketing cost incurred by the intermediaries

5.3.5.1 Marketing cost incurred by the pre-harvester contractor cum wholesaler in the study area

It could be observed from the Table 4.16 that, in Haveri and Ananthapur districts, the per tonne of marketing cost incurred by pre harvester contractor cum wholesaler in channel-II was ₹ 1,163.56 and 1,197.20 per tonne respectively. The major item of cost incurred by the pre harvester contractor cum wholesaler was transportation cost. Because, pre harvester

contractor cum wholesaler goes to the farm level and then purchase the produce directly from the farm at low prices and sell them in the distant market at higher competitive prices to get profit. In both the districts, the significant item of cost was transportation cost (₹ 840.65 and 915.80 per ton), followed by loading and unloading charges (₹ 200.91 and 171.40 per ton), miscellaneous charges (₹ 87.00 and 85.00 per ton), tax (₹ 20.00 and 10.00 per ton) and weighing charges (₹ 15.00 per ton each.). The transportation cost varied depending upon the distance to the market.

5.3.5.2 Marketing cost incurred by the retailers in the study area

In Haveri district, the per tonne of marketing cost incurred by retailers in channel-I and Channel-II were ₹ 898.45 and ₹ 174.00 per tonne, respectively. In channel-I, marketing cost incurred by retailers were higher than in channel-II. Because, in channel-I the retailers go to the farm level and then purchase the produce directly from the farm gate itself, but in channel-II the retailers were purchasing the produce from pre-harvester contractor cum wholesaler at distant markets. In both the channels, the significant item of cost was transportation cost (₹ 627.13 and 100.00 per ton), followed by loading and unloading charges (₹ 168.31 and 32.00 per ton), miscellaneous charges (₹ 68.00 and 27.00 per ton), tax (₹ 20.00 and 10.00 per ton) and weighing charges (₹ 15.00 and 5.00 per ton). The transportation cost varied depending upon the distance to the market.

In Ananthapur district, per tonne of marketing cost incurred by retailers in channel-I and Channel-II were ₹ 868.81 and ₹ 226.65 per tonne, respectively. In channel-I, marketing cost incurred by retailers were higher than in channel-II. Because, in channel-I the retailers go to the farm level and then purchase the produce directly from the farm gate itself. But in channel-II, the retailers were purchased the produce from pre-harvester contractor cum wholesaler at distant markets. In both the channels, the significant item of cost was transportation cost (₹ 616.66 and 154.85 per ton) followed by loading and unloading charges (₹ 147.15 and 24.80 per ton), miscellaneous charges (₹ 80.00 and 30.00 per ton), tax (₹ 15.00 and 10.00 per ton) and weighing charges (₹ 10.00 and 7.00 per ton).

5.4.4 Marketing cost, margin and price spread in marketing of watermelon in different channels in the study area

Total marketing cost incurred in different channels in the study area was observed in the Table 4.17, the table reveals that high marketing cost was incurred in channel-II of both

the districts. Because, in channel-II pre harvester contractor cum wholesalers sold their produce to distant retailers, where transportation charges were more.

The producers share in consumer's rupee was found to be more in channel-I of marketing in both the districts which is a local marketing channel and it accounted for around 76.58 per cent in Haveri district and 74.98 per cent in Ananthapur district. Whereas, in channel-II, it accounted for 65.88 per cent in Haveri district and 62.86 per cent in Ananthapur district. The above discussion indicate that the superiority of channel-I over channel-II in respective districts in terms of producer share in consumer rupee and hence, the hypothesis that, fewer the intermediaries efficient would be the channel, is established in marketing of watermelon also.

Price spread was more in channel-II of both the districts as the number of market intermediaries present were more and this channel operated during the glut period in the market and hence farmers received lower price per ton. The price spread in channel-II of Haveri district was ₹ 3,669.69 per ton and ₹ 3,519.95 per ton in Ananthapur district. Whereas, the price spread in channel-I of Haveri district was ₹ 2,242.71 per ton and ₹ 2,088.63 per ton in Ananthapur district.

The purchase price of consumer was more in channel-II of both the districts. Because, in channel-II pre harvester contractor cum wholesalers sold their produce to distant retailers and the number of market intermediaries present were more in this channel. The purchase price of consumer in channel-II of Haveri district was ₹ 10,754.69 per ton and ₹ 9,478.95 per ton in Ananthapur district. Whereas, the purchase price of consumer in channel-I of Haveri district was ₹ 9,577.71 per ton and ₹ 9,478.95 per ton in Ananthapur district. Hence, channel-I was considered to be the best marketing channel as the price spread was less in both the districts.

The results are in conformity with a similar study conducted by Ahmad *et al.* (2017) on marketing of watermelon in Allahabad district (UP) India.

5.4 Problems associated with production and marketing of watermelon in the study area

5.4.1 Production problems

An informal discussion with the sample farmers revealed that as such there were problems in production of watermelon. The opinion survey was conducted for the sample

farmers who produce watermelon, to ascertain the problems faced. The results of the opinion survey presented in Table 4.18 are discussed here.

The results revealed that the major production problems faced by the sample farmers in Haveri and Ananthapur districts were water scarcity (76.84 % and 68.60 %), because watermelon cultivation is practiced under dry land areas in the districts.

About 71.26 per cent of Haveri district farmers and 78.24 per cent of Ananthapur district farmers expressed the problem of severe incidence of pests and diseases which needs to be addressed effectively. Research and extension machinery has to be geared up in this region to mitigate this problem.

About 61.72 per cent of Haveri district farmers and 47.72 per cent of Ananthapur district farmers expressed the problem non-availability of labour during peak season. Because, watermelon was a labour intensive crop and availability of the labour was a problem especially during the peak time of harvesting and weeding, which coincides with the other agricultural operations.

Nearly 59.26 per cent of Haveri district farmers and 63.32 per cent of Ananthapur district farmers faced the problem of high cost of inputs, especially in watermelon seeds, which accounts major cost in cultivation followed by fertilizers and PPC.

About 50.72 per cent of Haveri district farmers and 59.00 per cent of Ananthapur district farmers faced the problem of timely availability of credit (non-availability of credit) on time. They could not get credit from institutional agencies and maximum farmers borrowed from money lenders and others.

About 50.60 per cent of Haveri district farmers and 53.06 per cent of Ananthapur district farmers expressed the problem damage due to unfavorable weather conditions.

About 41.78 per cent of Haveri district farmers and 40.70 per cent of Ananthapur district farmers faced the problem of maintenance problems in irrigation structures. Because, in both the districts cultivating watermelon was practiced by using drip irrigation technology. In drip irrigation, maintaining of laterals, sub laterals and drippers is a difficult task. Accumulation of salt or any fine sand particles may choke the dripper nozzles.

About 34.74 per cent of Haveri district farmers and 27.80 per cent of Ananthapur district farmers expressed the problem of technical guidance. Watermelon is considered as

minor crop under fruits and vegetables. Because of minor crop, there is lack of technical guidance towards the cultivation and also usage of technology under the crop. Research and extension activities have to be geared up in this region to mitigate this problem.

Nearly 29.62 per cent of Haveri district farmers and 36.26 per cent of Ananthapur district farmers faced the problem of non-availability of FYM. This problem was due to reduction in maintenance of livestock in the study areas.

Another problem was that breakage of fruits at time of harvesting expressed by 23.14 per cent of Haveri district farmers and 22.62 per cent of Ananthapur district farmers. This problem was due to boron deficiency and higher temperature.

5.4.2 Marketing problems

An informal discussion with the sample farmers revealed that with the marketing of watermelon they had problems. The opinion survey was conducted for the sample farmers who sold their produce to the wholesaler or retailer to know the problems in marketing of watermelon. The results of the opinion survey presented in Table 4.19 are discussed here.

About 75.52 per cent of Haveri district farmers and 77.44 per cent of Ananthapur district farmers expressed the problem of lack of storage facilities. Watermelon fruits occupy more space compared to other fruits. Because of high cost for storage construction, farmers were unable to have the storage structures with their own interest and cost. They dispose their produce at whatever the price prevailing in the market.

About 76 per cent of Haveri district farmers and 56.70 per cent of Ananthapur district farmers opined that there was lack of transportation facilities viz., poor road conditions and lower frequencies of vehicles for transportation. A minimum of 8-10 tonnes was a must for the economic transportation.

Nearly 61.52 per cent of Haveri district farmers and 54.90 per cent of Ananthapur district farmers expressed the problem of breakage of fruits at the time of transportation, loading and unloading. There was lack of packing structures in watermelon during transportation because fruits are bigger in size and not possible for packing. Watermelon outer green shell is tender and delicate in nature. So, breakage of fruits was observed during produce handling such as loading and unloading.

About 53.22 per cent of Haveri district farmers and 74.56 per cent of Ananthapur district farmers opined that there was lack of support price in market. Because of arrival of large quantity of fruits to the market at the same time (seasonal glut). The price would crash substantially.

Nearly 48.78 per cent of Haveri district farmers and 51.98 per cent of Ananthapur district farmers reported that the absence / lack of regulated markets. Markets for watermelon fruits were located at distant places and watermelon is not a notified commodity in regulated markets.

About 47.98 per cent of Haveri district farmers and 44.46 per cent of Ananthapur district farmers faced the problem of lack of awareness about market information at farmer's level. The market for watermelon in the study area was not an organized one. The market was mainly controlled by some wholesalers and retailers who do not share the information to the farmers. Hence, the farmers had to solely depend upon the market intermediaries to sell their produce.

Nearly 47 per cent of Haveri district farmers and 33.52 per cent of Ananthapur district farmers opined that markets far away from farms. Markets for watermelon fruits were located at distant places. So, farmers were selling their produce to wholesalers or retailers at their farm gate only. Farmers were not satisfied with the price what they are getting at present.

About 36.94 per cent of Haveri district farmers and 47.66 per cent of Ananthapur district farmers expressed lower prices due to seasonal gluts. Watermelon is summer season based fruit crop. So, arrival of large quantity of fruits to the market at the same time results in makes the lower prices. Bad climatic conditions and involvement of market intermediaries were the reasons also for lower prices in the market.

About 32.32 per cent of Haveri district farmers and 28.60 per cent of Ananthapur district farmers expressed that lack of processing industries related to watermelon like other fruit crops was a problem to get better prices.

Around 28.96 per cent of Haveri district farmers and 28.18 per cent of Ananthapur district farmers opined that only few purchasers were available in local market. Hence due to less competition among the purchasers they may end up in facing oligopolistic market situation which is less beneficial to the farmers.

Thus the watermelons growers have large number of problems in marketing their produce. There was a need for an agency to help the growers in marketing of the produce. Even-though the watermelon cultivation was profitable, there was lots of lacuna in marketing of watermelon. Hence, there was an immediate need to organize marketing of watermelon on the cooperative lines and also establishment of regulated markets in the study area.

Summary and Policy Implications

6. SUMMARY AND POLICY IMPLICATIONS

Watermelon (*Citrullus lanatus*) is one of the most important fruits cultivated in the tropics. It is consumed throughout the world and is mainly cultivated in the tropical countries. Watermelon is good for all human consumption and livestock needs as it contains most of the basic daily nutritional requirements of the body and other essential nutrients that prevents human health problems like cancer, stroke, high blood pressure, heart attack and other cardiovascular disease.

Watermelon occupies 95.52 thousand hectares and 2,362.16 thousand metric tonnes of production (24.72 MT/ha productivity). The most important watermelon growing states in India are Maharashtra, Uttar Pradesh, Rajasthan, Gujarat, Andhra Pradesh, Punjab, Haryana, Karnataka, Assam, West Bengal, Orissa, Himachal Pradesh and Tamil Nadu (Horticulture at a glance – 2017)

The area under watermelon in India was 95.52 thousand hectares; West Bengal is the leading producer of watermelon, where the area under watermelon is 16.54 thousand hectares, followed by Uttar Pradesh (13.02 thousand hectares), Karnataka and Odisha (11.73 thousand hectares), Andhra Pradesh (8.52 thousand hectares) and Tamil Nadu (6.42 thousand hectares).

The well-marked growing districts of watermelon cultivation in Karnataka are Mysore, Kolar, Haveri, Mandya, Chamarajanagar, Koppal, Bagalkot, Belgavi and Chikballapur districts and in Andhra Pradesh are Anantapur, Chittoor, Kadapa and Prakasam districts.

To know the present status of watermelon cultivation, the economics associated with it and marketing of watermelon in the study area, the present study was conducted with following specific objectives.

The specific objectives are:

1. To analyze the growth in area, production and productivity of watermelon in Karnataka and Andhra Pradesh.
2. To analyze the production management of watermelon in the study area.
3. To study the marketing management of watermelon in the study area.
4. To study the problems associated with production and marketing of watermelon.

Methodology

The study was based on both primary and secondary data. The primary data were collected through personal interview method from farmers, pre-harvest contractor-cum-wholesalers and retailers with the help of well-structured and pre-tested questionnaire exclusively designed for the study. For the present study, multistage sampling procedure was adopted. In the first stage two districts, Haveri in Karnataka and Ananthapur in Andhra Pradesh were selected based on the highest production of watermelon. In the second stage two taluks namely Hirekerur and Savanur were selected from Haveri district and two mandals namely Rappthadu and Ananthapur were selected for the study based on highest area in watermelon production. In the third stage, 25 farmers from each taluk and mandal were selected randomly from each district.

For studying in the marketing aspects of watermelon, five pre harvest contractor cum wholesalers and ten retailers each from Haveri and Ananthapur districts were selected randomly. Thus the total sampling size for studying market channels were 30 in the study area.

Secondary data on the area, production and productivity of watermelon in Karnataka and Andhra Pradesh, for the period from 2001-02 to 2016-17 were obtained from National Horticulture Board, Department of Horticulture-Karnataka, Directorate of Economics and Statistics-Karnataka, Department of Horticulture-Andhra Pradesh, Directorate of Economics and Statistics-Andhra Pradesh, Horticulture at a glance and other published sources.

Analytical tools

Compound annual growth rate analysis was employed to estimate the growth in area, production and productivity of watermelon in Karnataka and Andhra Pradesh.

The techniques of tabular analysis were employed for determining the input management, labour management, cost of cultivation, marketing costs, margins and price spread in the watermelon. In order to know the resource use efficiency in watermelon, Cobb – Douglas production function analysis was employed.

In order to know the constraints faced in production and marketing of watermelon Garret's ranking technique were employed.

Major Findings

Area under watermelon in Karnataka and Andhra Pradesh was significantly increasing at the rate of 3.92 and 4.33 per cent per annum over the years, respectively. Similarly production of watermelon has shown significant increasing growth at the rate 4.35 and 9.20 per cent per annum. In Karnataka, productivity recorded a growth rate of 0.41 per cent per annum which is statistically insignificant. But in Andhra Pradesh, productivity shows significant increasing growth at the rate 4.66 per annum.

Area under watermelon in Haveri and Ananthapur districts was significantly increasing at the rate of 9.44 and 20.21 per cent per annum over the years, respectively. Similarly production of watermelon has found to be significant increasing trend at the rate 9.08 and 26.70 per cent per annum. In Haveri district, productivity shows negative growth rate of -0.33 per cent per annum and shown insignificant growth. But in Andhra Pradesh, productivity was found to be 5.40 per cent per annum, which is statistically significant.

Per hectare cost of cultivation of watermelon was found to be ₹ 1,09,945.78 and ₹ 1,43,306.17 in Haveri and Ananthapur districts, respectively. Out of the total cost, variable cost (82.99 % and 87.50 %) shared maximum proportion compared to fixed cost. The gross returns obtained per hectare by Haveri district farmers were ₹ 1,97,532.50 with a yield of 27.50 tonnes per hectare and ₹ 2,26,128.50 with a yield of 36.62 tonnes per hectare in Ananthapur district, respectively. The B: C ratio (returns per rupee of investment) was found to be 1.79 in Haveri district and 1.58 in Ananthapur district. B: C ratios are greater than unity in both the districts which indicated that cultivation was found to be profitable. However B: C ratio was higher in Haveri district than in Ananthapur district.

As per resource use efficiency, the inputs included in the model explained 95 per cent (Haveri district) and 96 per cent (Ananthapur district) of the variation in watermelon output as revealed by the coefficient of multiple determinations (R^2). The summation of regression coefficients indicated increasing returns to scale for both Haveri (1.03) and Ananthapur (1.02) districts.

In Haveri district, the estimated parameters of the resources, potassium (0.2846) was significant at ten per cent level of probability. In Ananthapur district, the estimated parameters of the resources, machine labour (0.5800) was positive and significant at one per cent and

herbicides (0.0070) positive and significant at five per cent level of probability. Most of the resources were over utilized as revealed by MVP: MFC ratios. In Haveri district, calcium and herbicides were under-utilized and in Ananthapur district machine labour shows under-utilized.

Major marketing channels identified in the study area

Two marketing channels were identified through which watermelon from the study area passed from the producers to the ultimate consumers.

Channel-I: Producer – Retailer – Consumer.

Channel-II: Producer – Pre-harvest contractor cum wholesaler - Retailer – Consumer.

Majority farmers in both the districts preferred channel-II to sell their produce. In Haveri district, 84 per cent of the farmers (42 farmers) preferred channel-II and 16 per cent (8 farmers) preferred channel-I. Similarly, in Ananthapur district, 76 per cent of the farmers (38 farmers) preferred channel-II and 24 per cent (12 farmers) preferred channel-I.

The marketing analysis reveals that channel-I in both the districts was seen efficient, where producer share in consumer rupee was 76.58 per cent and 74.98 per cent respectively in Haveri and Ananthapur districts. As in this channel there is only one intermediate i.e., retailer. The superiority of the channel-I over channel-II in respective district in terms of producer share in consumer rupee and hence the hypothesis that, fewer the intermediaries efficient would be the channel. Similarly, in Ananthapur district, producer share in consumer rupee was highest in channel-I (74.98 %) compared to channel-II (62.86 %) respectively. The price spread was highest in channel-II compared to channel-I due to involvement of intermediaries.

Major production problems faced by the sample farmers in Haveri and Ananthapur districts were water scarcity, severe incidence of pests and diseases, non-availability of labour during peak season, high cost of inputs, non-availability of credit in time and damage due to unfavorable weather conditions.

Major marketing problems faced by the sample farmers in Haveri and Ananthapur districts were lack of storage facility, lack of transportation facilities, breakage of fruits at the time of transportation, loading and unloading, lack of support price and lack of regulated markets.

Policy implications

Despite the remunerative returns and immense importance of watermelon it is rather unfortunate that this sector could not achieve the required level of development.

1. The growth in area and production of watermelon showed increasing trend in both the districts, while productivity indicated stable trend. Hence, concentrated efforts need to be made to enhance productivity by better management practices vice versa new hybrids either using productivity increasing technologies or by strengthening the existing research and development activities with new economically feasible technologies.
2. The use of resources like seeds, FYM, fertilizers, plant protection chemicals, herbicides and growth regulators can be decreased to optimize the resource use and get maximum returns in watermelon cultivation. So, there is a scope for farmers to reorganization of resources in watermelon cultivation as revealed by MVP: MFC ratios of the resources.
3. Majority of the respondents expressed storage and distant of market as an acute constraint. Hence, village level community storage points and suitable transport facilities need to be thought to strengthen the fruit growers in both the districts.
4. The outbreak of pests and diseases was major constraint for the reduction in productivity of watermelon. Therefore it is necessary to gear up research and extension activities in the region to mitigate this problem.
5. Watermelon is considered as a minor crop under fruits and vegetables. Because of this, there is lack of technical guidance for the cultivation and also usage of technology under the crop. Therefore it is necessary to develop the extension activities in the region.
6. Government should make the watermelon fruits as a notified commodity in the regulated market.
7. The farmers may be advised for growing high yielding hybrids like Pahuja (Arun – 0035) and Hybrid Dragon F₁, Hybrid Rubita F₁. These hybrids showed good productivity compared to others.
8. The cost of watermelon seeds is high. Watermelon seeds of high quality should be made available to the farmers at affordable rates to increase the use by farmers and to increase their profitability. There is need to develop varieties instead of hybrids for replacing of seed which should also be resistant to pests and diseases.

References

REFERENCES

- Adeoye, I. B., Taiwo, F. B. O., Adelani, O. A., Usman, J. M. and Badmus, M. A., 2011, Economic analysis of watermelon based production system in Oyo state, Nigeria. *ARP. J. Agric. Biol. Sci.*, 6(7): 1990-1996.
- Ahmad, A., Prasad, L. P., Dinesh, K., Nahar, S., Prasad, V. M. and Anupriya, P., 2017, Marketing of watermelon in Allahabad district, UP, India. *Int. J. Multidisciplinary Res. Develop.*, 4(8): 135-138.
- Ahmad, A., Prasad, L. P., Dinesh, K., Nahar, S., Prasad, V. M. and Anupriya, P., 2017, An economic analysis of production of watermelon in Allahabad district, UP, India. *Int. J. Adv. Edu. Res.*, 2(4): 206-210.
- Ali, S. and Jabbar, A., 2015, Growth and variability in area, production and yield of selected fruit crops in Khyber Pakhtunkhwa. *Pak. J. Agric. Res.*, 28(1):64-69.
- Amutha, D., 2014, An analysis of sapota fruit cultivation in Tuticorin district, India. *Int. J. Econ. Manage. Sci.*, 3(4): 1-4.
- Anchal, D. and Sharma, V. K., 2009, Price spread of litchi in Punjab. *Ind. J. Agric. Mktg.*, 23(2): 147-153.
- Anil, B., Kachroo, J. and Kachroo, D., 2011, Economic appraisal of kinnow production and its marketing under North-Western Himalayan region of Jammu. *Agric. Econ. Res. Rev.*, 24(2): 283-290.
- Anonymous, 1998, Emperical studies of the organization and performance of industries USDA (United States Department for Agriculture), Washington, D. C., pp.26-31.
- Anonymous, 2013, Food and Agriculture Organization, Italy, pp.36-39.
- Anonymous, 2016a, 1st advance estimates, state wise area and production of watermelon in India, Ministry of Agriculture and Farmer's Welfare, Govt. of India, New Delhi, p.221.
- Anonymous, 2016b, Indian Horticulture Database, National Horticulture Board, Ministry of Agriculture, Govt. of India, Gurgaon, p. 221.
- Anonymous, 2016c, Agricultural and Processed Food Products Export Development Authority, Govt. of India, New Delhi, p. 391.

- Anonymous, 2016d, *Horticulture Statistics at a Glance*, Department of Horticulture, Govt. of Karnataka, Bangalore, p. 326.
- Anonymous, 2016e, *Horticulture Statistics at a Glance*, Department of Horticulture, Govt. of Andhra Pradesh, Guntur, p. 327.
- Bhandare, C. L., Kamble, V. B. and Sidam, V. N., 2014, Constraints faced by sweet orange growers while adopting recommended package of practices. *Agric. Update*, 9(3): 403-406.
- Bondar, U. S., Daundkar, K. S. and Khedkar, S. R., 2015, Economics of production of banana in Kolhapur district of Maharashtra. *Int. Res. J. Agric. Eco. Stat.*, 6(2): 336-341.
- Boyal, V. K., Pant, D. C., Burark, S. S. and Mehra, J., 2015, Growth and instability in area, production and productivity of fenugreek in Rajasthan. *Int. J. Seed Spices*, 5 (1): 18-23.
- Choudhary, K. and Kundal, R., 2015, A study on area, production and yield of tomatoes in India. *Int. J. Adv. Res. Computer Sci. Manage. Stud.*, 3(7): 90-93.
- Cuddy, D. A. and Della, P. A., 1978, Measuring the instability of time series data, *Oxford Bulletin Econ. Stat.*, 40(1): 79-85.
- Datarkar, S. B., Darekar, A. S., Dangore, U. T. and Parshuramkar, K. H., 2014, Economics of production and marketing of mango in Gadchiroli district of Maharashtra. *Int. Res. J. Agric. Eco. Stat.*, 5 (2):278-283.
- Dhakane, S. S., Khalache, P. G. and Gaikwad, J. H., 2009, Constraints in grape production technology in Barshi tehsil of Solapur district. *Agric. update*, 4(1):23-25.
- Dhuri, S. S., Jadhav, M, S. and Misal, S, J., 2017, Economics of production of alphonso mango in Sindhudurg district of Maharashtra. *Int. J. Chem. Stud.*, 5(4): 544-549.
- Garrett, H. E. and Woodworth, R. S., 1996, *Statistics in Psychology and Education*, Vakils, Feffer and Simons Pvt. Ltd., Bombay, pp.29-35.
- Gopalan, C., Rama satri, B. V. and Balasubramanian, S. C., 1984, *Nutritive value of Indian foods*. National Institute of Nutrition, Hyderabad, India, p.52.
- Gunasekaran, M., 2016, Production and marketing problems faced by banana farmers in Karur district. *Asian Pacific J. Res.*, 1(35):137-142.
- Handerson, J. and Quandt, R. E., 1971, *Microeconomic Theory*, McGraw Hill Company, New York, pp. 45-51.

- Hembara, H. S. and Yogesh, M. S., 2014, Production and marketing problems of papaya growers in North Karnataka. *Int. Acad. Res. J. Busi. Manage.*, 16(7):20-23.
- Hendge, Y. G., Kadam, R. P., More, S. S., Patil, S. S. and More, P. S., 2007, Constraints faced by banana growers of Nanded district. *J. Soils Crops*, 17(2): 425-426.
- Horticultural Statistics Division, DAC and FW, 2016-17, www.indiastat.com.
- Islam, R. T. and Sunita, S., 2017, A study on area, production and productivity of apples in Jammu and Kashmir from 2006-07 to 2015-16. *Int. J. Sci. Res. Manage.*, 5(7): 6513-6519.
- Jain, B. C. and Tegar, A., 2003, Economics of production and marketing of tomato in Jashpur district of Chhattisgarh. *Agric. Mktg.*, 46(3): 5-10.
- Jawale, S. V. and Ghulghule, J. N., 2015, Constraints and suggestions of kesar mango production in export zone of Marathwada region. *Int. J. Comm. Busi. Manage.*, 4(5):713-721.
- Kadli, V., Lokapur, S., Gurikar, R. and Hosali, R., 2014, Growth and instability analysis of fruit crops in India – An economic analysis. *J. Environ. Sci.*, 3(4): 1808-1813.
- Karutagi, M. G., Ramachandra, V. A., Kunnal, L. B., Mahajanshetti, S. B. and Shirol, A. M., 2009, Marketing of sapota in Northern Karnataka. *Ind. J. Agric. Mktg.*, 23(2):57-65.
- Kireeti, K., Devi, N. and Sharma, L.R., 2015, Trends in area, production and productivity of apple orchards in Himachal Pradesh. *Int. J. Farm. Sci.*, 5(2):146-160.
- Kuwornu, K. M. J., Nafeo, A. A. and Osei-Asare, B.Y., 2013, Financial viability, value addition and constraint analyses of certified organic pineapple production and marketing in Ghana. *African J. Basic App. Sci.*, 5(1):12-24.
- Lilly, V., 2013, Watermelon production in Tamil Nadu - At a glance. *Indian J. App. Res.*, 3(6): 78-79.
- Matin, M. A., Baset, M. A., Alam, Q. M., Karim, M. R. and Hasan, M. R., 2008, Mango marketing system in selected areas of Bangladesh. *J. Agric. Res.*, 33(3): 427-438.
- Mavi, H. K., Sindhu, R. S. and Sindhu, J. S., 2012, Investigating the efficiency of various marketing models and problems of Kinnow growers of Punjab. *Agric. Econ. Res. Rev.*, 25(1):87-97.

- Mukul, A. Z. A. and Rahman, A. Md., 2013, Production and profitability of banana in Bangladesh- An economic analysis. *Int. J. Econ. Fin. Manage.*, 1(3): 159-165.
- Murthy, D. S., Gajanana, T. M., Sudha, M. and Dakshinamoorthy, V., 2009, Marketing and post-harvest losses in fruits: its implications on availability and economy. *Indian J. Agric. Econ.*, 64(2):259-271.
- Pokharkar, V. G., Sangle, S. A. and Kulkarni, A. R., 2016, Economics of production and marketing of guava in western Maharashtra. *Int. Res. J. Agric. Eco. Stat.*, 7(2): 234-242.
- Poudel, S., Basavaraja, H., Kunnal, L. B., Mahajanashetti, S. B. and Bhat, A. R. S., 2012, Growth in area, production and productivity of major crops in Karnataka. *Karnataka J. Agric. Sci.*, 25(4): 431-436
- Ramachandra, V. A., 2006, Production and marketing of sapota in Northern Karnataka – An economic analysis. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).
- Rane, A. A. and Bagade, S. R., 2006, Economics of production and marketing of banana in Sindhudurg district of Maharashtra. *Indian J. Agric. Mktg.*, 20(1): 38-45.
- Rohile, V. V., Naik, V. G. and Talathi, J. M., 2006, Resource use efficiency in banana production in Sindhudurg district of Maharashtra. *Int. J. Agric. Sci.*, 2(1): 198-200.
- Ropan, B., Sarju, P. and Ravi, S., 2015, Economics of orange production in Nagpur district of Maharashtra. *Int. Res. J. Agric. Eco. Stat.*, 6(1): 136-139.
- Sain, V., Luhach, V. P., Singh, V. K., Mehla, M. S. and Jyothi, V., 2013, Constraints faced by guava growers in production and marketing of districts of Haryana. *IOSR J. Agric. Veter. Sci.*, 5(5):17-20.
- Saraswat, S. P. and Rane, T., 2006, Production and marketing of peach fruit – A case study of Rajgarh village of Himachal Pradesh. *Indian J. Agric. Mktg.*, 8(5):318-325.
- Shah, A. A., Tripathi, R. B. and Hussain, T., 2009, An estimation of production and marketing of Kashmir saffron. *Sher-E-Kashmir Univ. Agric. Sci. Technol. Res.*, 8(2): 186-191.

- Singh, M. K., 2004, Economics of efficiency in vegetable business system of Mahakoshal region in Madhya Pradesh. *Indian J. Mktg.*, 36(3):3-7.
- Singh, R. P. and Rani, N., 2013, Trends in area, production and productivity of fruit crops in Jharkhand. *J. Econ. Soc. Dev.*, 9(1):52-60
- Sudarshan, G. M. and Sudulaimuttu, 2013, Efficiency of marketing channels for pomegranate in Koppal district of Karnataka. *Int. Acad. Res. J. Busi. Manage.*, 2(7):45-78.
- Sundaravaradarjan, K. R. and Jaganmohan, K. R., 2002, Marketing cost, margin, price spread and marketing efficiency of cashew in Tamil Nadu. *Agric. Situ. India*, 59(1):9-16.
- Talathi, J. M., Wadkar, S. S., Veekar, P. D. and Vaidya, K. P., 2005, Economics of marketing of sapota in Konkan region. *Indian J. Agric. Mktg.*, 48(2):53-64.
- Thejaswini, R. 2015, Production and marketing of acid lime in Vijayapura district – An economic analysis. *M.Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).
- Thorat, M. V. and Shelke, R. D., 2012, Constraints faced by ber growers in production and marketing and suggestions made by them in Beed district. *Adv. Res. J. Soc. Sci.*, 3(2): 288-289.
- Vairam, R. and Muniyandi, B., 2013, Production and marketing of grape cultivation in Theni district, Tamil Nadu. *Int. J. Res. Commerce. Econ. Manage.*, 3(9):2231-2245.
- Vani, N., 2015, Production and marketing management of organic vegetables – A case of Bengaluru. *M.Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).
- Verma, V. K., Meena, V. S and Kumar, V., 2013, Production and marketing of cumin in Jodhpur district of Rajasthan. *Indian J. Agric. Mktg.*, 26(2):352-356.
- Vinay, G., Mayank, R., Mustfa, H. and Divya, R., 2013, Marketing of sweet orange (Malta) in India. *Int. J. Emerging Res. Manage. Tech.*, 2(3):45-49.
- Vinayak, N., Jalikatti. and Patil, B.L., 2013, Constraints in production and marketing of onion in Northern Karnataka. *Karnataka J. Agric. Sci.*, 26(3):436-438.
- Vinayaka, K., Sameer, L., Ravi, G. and Roopa, H., 2014, Growth and instability analysis of fruit crops in India – An economic analysis. *J. Environ. Sci. Comp. Sci. Engg. Tech.*, 3(4):1808-1813.
- Wasim, M. P., 2011, Trends in growth and variability of major fruit crops in Balochistan-Pakistan. *ARPJ. Agric. Biol. Sci.*, 6(12):27-36.

Appendices

Appendix I: Area, production and productivity of watermelon in Karnataka and Andhra Pradesh during 2001-02 to 2016-17

Years	Karnataka			Andhra Pradesh		
	Area (ha)	Production (MT)	Productivity (MT/ha)	Area (ha)	Production (MT)	Productivity (MT/ha)
2001-02	6,758	2,13,087	31.53	4,701	56,973	12.11
2002-03	7,361	2,15,045	29.21	5,793	70,143	12.10
2003-04	6,390	2,01,732	31.57	6,560	82,092	12.51
2004-05	7,292	2,21,006	30.31	7,238	1,06,602	14.72
2005-06	7,036	2,31,067	32.84	7,714	1,12,918	14.63
2006-07	7,246	2,44,124	33.69	8,909	1,48,557	16.67
2007-08	8,566	2,79,450	32.62	8,933	1,49,650	16.75
2008-09	9,045	2,83,134	31.30	9,647	1,55,700	16.13
2009-10	8,735	3,05,697	35.00	10,128	1,57,800	15.58
2010-11	8,307	2,88,296	34.71	10,626	1,61,200	15.17
2011-12	9,337	3,13,803	33.61	10,700	1,61,200	15.06
2012-13	9,049	3,02,178	33.39	11,200	1,70,200	15.19
2013-14	10,580	3,40,025	32.14	11,700	1,79,800	15.36
2014-15	11,250	3,57,810	31.81	10,980	2,87,900	26.22
2015-16	11,146	3,53,393	31.71	9,080	2,47,530	27.26
2016-17	11,730	3,88,550	33.12	8,520	2,37,890	27.92

Appendix II: Area, production and productivity of watermelon in Haveri and Ananthapur districts during 2001-02 to 2016-17

Years	Haveri district			Ananthapur district		
	Area (ha)	Production (MT)	Productivity (MT/ha)	Area (ha)	Production (MT)	Productivity (MT/ha)
2001-02	478	14,335	29.99	237	5,989	25.27
2002-03	666	17,350	26.05	211	2,532	12.00
2003-04	576	18,432	32.00	396	4,800	12.12
2004-05	524	15,740	30.04	459	4,736	10.31
2005-06	598	15,548	26.00	1,015	18,817	18.53
2006-07	609	19,478	31.98	843	19,824	23.51
2007-08	688	20,659	30.03	644	17,677	27.44
2008-09	1,188	22,749	19.15	1,044	22,933	21.96
2009-10	1,442	47,810	33.16	1,232	28,207	22.89
2010-11	1,039	35,326	34.00	2,093	52,050	24.86
2011-12	1,671	45,173	27.03	2,090	52,050	24.90
2012-13	1,657	42,635	25.73	2,200	55,000	25.00
2013-14	1,614	41,842	25.92	2,678	76,950	28.73
2014-15	1,442	43,216	29.97	2,850	85,500	30.00
2015-16	1,559	38,667	24.80	3,120	93,600	30.00
2016-17	1,434	44,219	30.84	3,172	95,168	30.00

PRODUCTION AND MARKETING MANAGEMENT OF WATERMELON – A COMPARATIVE ANALYSIS IN KARNATAKA AND ANDHRA PRADESH

POTNURU SANTOSH KUMAR

2018

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ABSTRACT

The present study was conducted at UAS, Dharwad on production and marketing management of watermelon in Haveri and Ananthapur districts of Karnataka and Andhra Pradesh. Districts were selected purposively based on highest production. A sample of 50 farmers and 15 market intermediaries were selected from each district randomly for collecting primary data through well-structured questionnaire by personal interview method, during 2017-18. Compound annual growth rate, functional analysis and Garret ranking method were employed for analysis of data.

The growth in area, production and productivity of watermelon in Karnataka (3.92, 4.35 and 0.41% per annum, respectively) and in Andhra Pradesh (4.33, 9.20 and 4.66% per annum, respectively) showed significant increase. Cost of cultivation for watermelon in Haveri district (₹ 1,09,945.78) was lower compared to Ananthapur (₹ 1,43,306.17) district. Contrarily, the yield and gross returns were higher in Ananthapur district (36.62 tonnes/ha, ₹2,26,128.50) than in Haveri district (27.50 tonnes/ha, ₹ 1,97,532.50). Net returns were higher in Haveri district (₹ 87,586.72) compared to Ananthapur district (₹ 82,822.33) due to difference in the selling price. Cultivation of watermelon in both the districts were found to be profitable as supported by a magnitude of B:C ratio of 1.79 and 1.58, respectively. In Haveri district, the MVP:MFC ratio for calcium and herbicides, and in Ananthapur district, machine labour were more than unity indicating underutilization of these resources. Among the marketing channels identified, more than two-thirds of the farmers in the study area traded through channel-II (Farmer – Pre-harvester contractor cum wholesaler - Retailer – Consumer) than channel-I (Farmer – Retailer – Consumer). Price spread was higher under channel-II (₹3,669.69 and ₹3,519.95 in Haveri and Ananthapur districts, respectively) than under channel-I (₹2,242.71 and ₹ 2,088.63). Water scarcity, severe incidence of pests and diseases were the major production, whereas lack of storage facility and support price were the major marketing constraints identified.