

**AN ECONOMIC ANALYSIS OF PRODUCTION AND
MARKETING OF AJWAIN (*Trachyspermum ammi* L.) IN
HYDERABAD-KARNATAKA REGION**

MANASA D.J

**DEPARTMENT OF AGRICULTURAL ECONOMICS
COLLEGE OF AGRICULTURE, RAICHUR
UNIVERSITY OF AGRICULTURAL SCIENCES
RAICHUR - 584 104
JULY, 2018**

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MARKETING OF AJWAIN (*Trachyspermum ammi* L.) IN
HYDERABAD-KARNATAKA REGION**

*Thesis submitted to the
University of Agricultural Sciences, Raichur
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By

MANASA D.J

**DEPARTMENT OF AGRICULTURAL ECONOMICS
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**DEPARTMENT OF AGRICULTURAL ECONOMICS
COLLEGE OF AGRICULTURE, RAICHUR
UNIVERSITY OF AGRICULTURAL SCIENCES, RAICHUR**

CERTIFICATE

This is to certify that the thesis entitled “AN ECONOMIC ANALYSIS OF PRODUCTION AND MARKETING OF AJWAIN (*Trachyspermum ammi* L.) IN HYDERABAD-KARNATAKA REGION” submitted by Ms. MANASA D.J, for the degree of MASTER OF SCIENCE (AGRICULTURE) in AGRICULTURAL ECONOMICS to the University of Agricultural Sciences, Raichur is a record of research work carried out by her during the period of her study in this university, under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

RAICHUR

July, 2018

**(LOKESH G.B.)
(MAJOR ADVISOR)**

**Approved by
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(RAMESH G.)

Affectionately
Dedicated to
My beloved parents
Father Late Jagadheesh D.M
and
Mother Smt. Padma

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With ever regardful memories.....

At last the moment has come to look into the deeper layer of my heart which is filled with the feeling of togetherness and loneliness; consolation and satisfaction. Some are permanent and some are momentary, but both involve a number of persons to whom I acknowledge my warm regards.

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Raichur
July, 2018

(MANASA D.J)

LIST OF ABBREVIATIONS

Abbreviation	Expansion
<i>et al.</i>	: And others
<i>viz.,</i>	: Namely
\$: Dollar
Fig.	: Figure
ha	: Hectare/s
MT	: Metric tones
MT/ha	: Metric tonnes per hectare
cm	: Centimeter
Sq.kms	: Square kilometers
mm	: Millimeter
H-K	: Hyderabad-Karnataka
K ₂ O	: Potassium
kg	: Kilogram/s
<i>i.e.,</i>	: That is
MVP	: Marginal value product
MFC	: Marginal factor cost
FYM	: Farm Yard Manure
<i>etc.</i>	: Etcetera
₹	: Rupees
kg ha ⁻¹	: Kilogram/s per hectare

%	:	Per cent
&	:	And
@	:	At the rate
N	:	Nitrogen
no.	:	Number
P ₂ O ₅	:	Phosphorous
PPC	:	Plant protection chemicals
q	:	Quintal/s
B:C ratio	:	Benefit Cost ratio

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Introduction

I. INTRODUCTION

Among ancient civilizations, India has been known to be a rich repository of medicinal plants. The forest in India is the principal repository of large number of medicinal and aromatic plants, which are largely collected as raw materials for manufacture of drugs and perfumery products. Out of 17,000 species of higher plants found in India, 7500 are known for medicinal uses. Thus, India is called as the “Emporium of medicinal plants”. Indian traditional medicinal systems like Ayurveda, Siddha and Unani have a very rich history of their effectiveness. About 8,000 herbal remedies have been codified in AYUSH systems in India. The Charaka Samhita, an age-old written document on herbal therapy, reports on the production of 340 herbal drugs and their indigenous uses. Medicinal plants are one of the most important components of the Non-wood Forest Produce (NFP) sector, which supplies over 80 per cent of India’s net forest export earnings annually (Singh, 2006).

Recently, WHO estimated that 80 percent of the people worldwide rely on herbal medicines for some aspect of their primary health care needs. It is estimated that 11 per cent of the total 252 drugs found in the essential medicine list of WHO are exclusively of plant origin (Sen and Raja, 2016). Currently, approximately 25 per cent of the drugs are derived from plants and many others are synthetic analogues built on prototype compounds isolated from plant species in modern pharmacopoeia.

Foreign trade of medicinal plants is an age old practice. A large number of botanicals of foreign origin find a place in the Indian Systems of Medicine. Many botanicals are exported from India as well. The foreign trade of botanicals has a direct bearing on their domestic demand and supply. The export of Ayush and herbal products is showing an upward trend and it is increasing at a compound annual growth rate of 8.80 per cent. The export of Ayush and herbal products from India was least during 2005-06, accounting for US \$139.55 million and it was highest during 2016-17, accounting for US \$403.59 million (Table 1.1).

The present study deals with Ajwain, which is botanically known as *Trachyspermum ammi* L. This seed spice belonging to the family Apiaceae, is highly valued and medicinally important (Bairwa *et al.*, 2012). It is also called by other names such as Bishop’s weed, Carom seed, Yaviniki, Omu etc. Ajwain is a native of Egypt and

it is mainly grown in arid and semi-arid regions of the world such as Afghanistan, Pakistan, Iraq, Iran and India. In India, the major ajwain producing states are Rajasthan, Gujarat, Madhya Pradesh, Andhra Pradesh, Telangana, Maharashtra, Uttar Pradesh, Bihar, West Bengal and Karnataka.

1.1 History of ajwain cultivation in Karnataka

The history of ajwain cultivation is more than fifty years old in Hyderabad-Karnataka region of the state. It is mainly grown in Raichur district. It is also grown in small patches in some villages of Gulbarga district, since the dryland condition of these districts is very much suitable for this crop. Another interesting fact is that Raichur district is located in the border of Andhra Pradesh and Karnataka states and thus, it is near to Kurnool which is the top-most market for quality ajwain in the entire country.

1.2 Uses of ajwain

Ajwain is an erect annual herb with striate stem. The seeds are strongly pungent and aromatic in taste. Ajwain has been proven to possess hypolipidaemic, antimicrobial, nematocidal, antifilarial, broncho-dilating, gastroprotective, diuretic, hepatoprotective, ameliorative, abortifacient, anti-inflammatory and anti-hypertensive effects. It is much valued for its antispasmodic, tonic, stimulant and carminative properties. Ajwain with its pungent taste and characteristic aromatic smell is widely used as a spice in curries. The seeds are used in small quantities for flavoring various foods, in medicine, as preservatives and for the manufacture of essential oil in perfumery industry. Ajwain seeds are known as a digestive aid and combines well with fennel to relieve gas and bloating. It also provides relief from abdominal discomfort due to indigestion and acts as an antiseptic. Seeds are also used in treatment of influenza, asthma, cough, cold, colic, diarrhea, cholera, edema, rheumatism. It also cures abdominal tumours and piles. In southern parts of India, dried and powdered ajwain seeds are soaked in milk, which is fed to babies. It is presumed that ajwain relieves colic in babies. In children it also improves digestion and appetite. Ajwain can be used as digestive mixture in large animals. In India, it is often added to heavy fried dishes to aid digestion (Bairwa *et al.*, 2012).

Table 1.1 Export of Ayush and Herbal products from India

Year	Export (US million \$)
2005-06	139.55
2006-07	160.43
2007-08	220.40
2008-09	282.12
2009-10	281.54
2010-11	289.66
2011-12	318.93
2012-13	332.12
2013-14	366.98
2014-15	352.93
2015-16	358.60
2016-17	403.59
CAGR (%)	8.80

Source: www.indiastat.com

Ajwain seed analysis has revealed that it contains 11.9 per cent of fibre, 38.6 per cent of carbohydrates, 8.9 per cent of moisture, 15.4 per cent of protein, 18.1 per cent of fat and 7.1 per cent of mineral matter containing calcium, phosphorous, iron and nicotinic acid. The seeds also contain tannins, glycosides, saponins and flavones. Ajwain fruits yield 2 to 4 per cent of brownish essential oil (Dwivedi *et al.*, 2012). The principal constituents of the essential oil are the phenols, mainly thymol (35 to 60 per cent) and some carvacrol. Their leaves and flowers are also used to extract oil. Carom oil is widely used as germicide and fungicide. Thymol is a powerful antiseptic and ingredient in a number of skin ointments, powders, deodorants, mouthwashes, toothpastes and gargles (Villapanur *et al.*, 2008).

1.3 Agronomic aspects of ajwain

The fields are prepared thoroughly by one or two ploughings and leveling. About 5 tonnes of FYM is recommended per acre even though the farmers are not usually applying any organic manures. The sowing of ajwain is done from last week of August to first fortnight of September. Seeds are sown at the rate of 2 kg per acre by using seed drill. A spacing of 45 cm is maintained between the rows. As the seeds are very small in size, they are mixed with sand and then sowing is done by using seed drill. Germination is a major problem in ajwain and thus, one should make sure that the soil is neither too dry nor it contains excess moisture during sowing. Chemical fertilizers (usually DAP, 20:20:0:13) are top dressed at about 45-50 days after sowing. Weed menace is a major problem in ajwain and thus two to three manual weedings are required at intervals of one month. The crop is harvested in January month (about 4 to 4.5 months after sowing) when the seeds turn to brownish colour. The crop is harvested manually and harvested crop is left for drying under sun for about two days. Then it is threshed manually by beating or by using thresher. The threshed seeds are cleaned by winnowing and then packed in gunny bags for marketing. An yield of 10 q is obtained per hectare.

1.4 Indian scenario

The area, production and productivity of ajwain in India is presented in Table 1.2. During 2015-16, ajwain was cultivated in an area of 24,000 ha in India, with a production of 16,000 tonnes and productivity of 660 kg ha⁻¹. According to the third advance estimates for the year 2016-17, the area under ajwain was estimated to be 29,000 ha with a production of 26,000 tonnes and productivity of 890 kg ha⁻¹. From the year 2002-03 to

2016-17, the area, production and productivity of ajwain had increased at a compound annual growth rate of 6.59 per cent, 12.94 per cent and 6 per cent respectively. This shows that the area under ajwain cultivation is significantly increasing over the years.

State-wise area, production and productivity of ajwain in India are presented in Table 1.3. In the year 2014-15, Rajasthan was having the highest area and production of ajwain, which were 12,600 ha and 9200 tonnes respectively. This constituted about 52.28 per cent of the total area and 56.09 per cent of the total production of ajwain in India. During 2014-15, Gujarat was the second largest producer of ajwain in India, with an area of 6400 ha and production of 5000 tonnes, which constituted about 26.55 per cent of the total area and 30.48 per cent of the total production in India. Gujarat was having the highest productivity of 780 kg ha⁻¹ which was more than the all India average of 680 kg ha⁻¹. Andhra Pradesh and Telangana are also major ajwain cultivating states in India with an area of 4000 ha and 1100 ha and production of 1700 tonnes and 500 tonnes respectively, during 2014-15. But the productivities of these states were low, which were 420 kg ha⁻¹ and 450 kg ha⁻¹ respectively. While in the year 2015-16, the area under ajwain cultivation was highest in Rajasthan (48.58 per cent), but the production was highest in Andhra Pradesh (41.68 per cent). Gujarat was having the highest productivity of 950 kg ha⁻¹.

1.5 Karnataka scenario

The details of the estimated area, production and productivity of ajwain in Karnataka during 2016-17 are presented in Table 1.4. It was cultivated in an area of 128 ha in Raichur district with a production of 127.04 tonnes, thus constituting 80 per cent in the total area and production of ajwain in Karnataka. The productivity of ajwain in Raichur district was 990 kg ha⁻¹.

The area under ajwain cultivation in Kalaburagi and Haveri districts was 8 ha each and the production was 7.94 tonnes in both the districts. Thus, they had a share of 5 per cent each, in the area and production of ajwain in Karnataka. The area under ajwain cultivation in other districts of Karnataka was 16 ha with a production of 15.88 tonnes. Thus, they had a share of 10 per cent in the total area and production of ajwain in Karnataka. The total area and production of ajwain in Karnataka were 160 ha and 158.80 tonnes respectively. The productivity of ajwain in Karnataka was 990 kg ha⁻¹ which was more than the all India average of 890 kg ha⁻¹.

Table 1.2 Area, production and productivity of ajwain in India

Year	Area (‘000 ha)	Production (‘000 MT)	Productivity (MT/ha)
2002-03	10.40	1.60	0.15
2003-04	10.80	10.20	0.94
2004-05	15.40	9.50	0.61
2005-06	14.50	4.40	0.30
2006-07	31.70	15.90	0.50
2007-08	23.22	11.90	0.51
2008-09	26.10	18.30	0.70
2009-10	20.60	9.00	0.43
2010-11	27.30	19.30	0.70
2011-12	35.40	26.80	0.75
2012-13	35.40	26.80	0.75
2013-14	26.70	19.20	0.71
2014-15	24.10	16.40	0.68
2015-16	24.00	16.00	0.66
2016-17*	29.00	26.00	0.89
CAGR (%)	6.59	12.94	6.00

Source: www.indiastat.com

*3rd Advance Estimates

Table 1.3 State-wise area, production and productivity of ajwain in India

State	2014-15					2015-16				
	Area ('000 ha)	%	Production ('000 MT)	%	Productivity (MT/ha)	Area ('000 ha)	%	Production ('000 MT)	%	Productivity (MT/ha)
Rajasthan	12.60	52.28	9.20	56.09	0.73	11.66	48.58	4.67	29.19	0.40
Gujarat	6.40	26.55	5.00	30.48	0.78	1.55	6.46	1.47	9.19	0.95
Andhra Pradesh	4.00	16.59	1.70	10.36	0.42	7.19	29.95	6.67	41.68	0.92
Telangana	1.10	4.56	0.50	3.04	0.45	3.60	15.00	3.19	19.93	0.88
All India	24.10	100.00	16.40	100.00	0.68	24.00	100.00	16.00	100.00	0.66

Source: www.indiastat.com

Table 1.4 Area, production and productivity of ajwain in Karnataka during 2016-17

District	Area (ha)	%	Production (MT)	%	Productivity (MT/ha)
Raichur	128.00	80.00	127.04	80.00	0.99
Kalaburagi	8.00	5.00	7.94	5.00	0.99
Haveri	8.00	5.00	7.94	5.00	0.99
Others	16.00	10.00	15.88	10.00	0.99
Karnataka	160.00	100.00	158.80	100.00	0.99

Source: Author's estimations

1.6 Need for the study

Ajwain is a dryland crop which can be grown with very less amount of water and minimum inputs. Since Hyderabad-Karnataka region is a dryland belt of Karnataka, ajwain is very much suitable for this region. In spite of this fact, the crop is grown in very less area and there is a scope for further expansion of area under cultivation of ajwain in dryland conditions. There are many problems regarding the cultivation of ajwain. Firstly, the data on the area and production of ajwain in this region is not documented. Secondly, no research on ajwain is carried out in this region and hence the economics of cultivation of this crop is not available.

This is a new and unique study on this crop which aims at analyzing the production and marketing aspects of ajwain in Hyderabad-Karnataka region. The study would attempt to find out the problems in the cultivation and marketing of ajwain, which will help to address the same by the policy makers. It would also help the agriculture functionaries to guide the farmers regarding the cultivation problems of ajwain, so that the area can be expanded in future. In addition, it would help the financial institutions to consider this crop for their financial assistance and fix the scale of finance. Hence, the present study was undertaken in Hyderabad-Karnataka region with the following specific objectives.

1.7 Objectives

1. To analyze the costs and returns of ajwain cultivation and its competing crops.
2. To examine the resource use efficiency and productivity of various factors involved in ajwain production.
3. To assess the marketing cost and margin of ajwain under different marketing channels.
4. To identify the constraints in the production and marketing of ajwain.

1.8 Hypotheses

1. Cultivation of ajwain is remunerative compared to its competing crops.
2. Resources are efficiently utilized in the production of ajwain.
3. Marketing cost and margin is more in ajwain.

1.9 Limitations of the study

The present study mainly relied on the data collected through interview using pretested schedule. Therefore, some amount of bias is bound to be associated with the collected data since the farmers did not have any record about the cultivation expenses, application of inputs and returns. However, efforts were made to minimize the bias through cross checks at the time of data collection. The data collected to the study are pertinent to the previous year production and marketing (2016-17), since enough samples are not available for the present year, which is also a limitation of the study. The study is conducted using the samples collected from Raichur district only, since the crop is cultivated in negligible area in other districts of Hyderabad-Karnataka region.

1.10 Presentation of the study

The study has been presented in six chapters as indicated below. Chapter-I deals with the nature, importance and specific objectives of the study; Chapter-II describes comprehensive review of the relevant research work done in the past related to the present study; Chapter-III outlines the features of the study area, sampling design followed, collection of relevant data and analytical tools used in the study; Chapter IV is devoted to present the main findings of the study through tables; Chapter V discusses the results of the study; Chapter VI provides the summary of the whole study and also suggests the policy implications based on the findings of the study. At the end, important references related to the present study have been listed in the Chapter VII.

Review of Literature

II. REVIEW OF LITERATURE

This chapter is intended to report the research findings conducted earlier and relevant to the present study in order to enable a better understanding of the research topic.

The reviews are classified under following head.

2.1 Cost and returns of medicinal plants cultivation

2.2 Resource use efficiency

2.3 Marketing cost and margin of medicinal plants

2.4 Constraints in production and marketing of medicinal plants

2.1 Cost and returns of medicinal plants cultivation

Benerjee (2002) worked out the cost and returns of senna cultivation in Tamil Nadu. The cost of cultivation per acre of senna leaves was ₹ 8000 and ₹ 6000 in irrigated and unirrigated area respectively and gross returns per acre were ₹ 12080 and ₹ 9970 for irrigated and unirrigated area respectively. The estimated net returns per acre were ₹ 4080 and ₹ 3970 in irrigated and unirrigated area respectively.

Patra *et al.* (2003) worked out the cost of cultivation of menthol mint per ha. It was ₹ 29,700 and ₹ 21,700 for sucker planted and transplanted menthol mint respectively. This included the cost of distillation of ₹ 6000 for sucker planted and ₹ 4500 for transplanted plants. The study has revealed that the cost of manures and fertilizers was highest in both sucker planted (₹ 62,000) and transplanted (₹ 55,000) mint. The gross returns per ha of oil produced were ₹ 60,000 and ₹ 45,000 and net returns per ha were ₹ 30,300 and ₹ 23,240 for suckers planted and transplanted respectively.

Patra *et al.* (2004 a) worked out the economics of vetiver cultivation. They found that the cost of cultivation of vetiver per ha was ₹ 57,000 including distillation cost (₹ 5000). The study revealed that the preparation of land and planting was the main component of the cost (₹ 30,000). Gross returns and net returns from vetiver oil production were ₹ 1,13,000 and ₹ 56,000 per ha respectively.

Patra *et al.* (2004 b) worked out the economics of ashwagandha cultivation and found that the cost of cultivation per ha was ₹ 5000. The study revealed that the cost of land preparation (₹ 1200), root digging and grading were the major items of cost of production. Gross returns and net returns per ha were ₹ 27,500 and ₹ 22,500 respectively.

Patra *et al.* (2004 c) worked out the cost of cultivation of kalmegh and it was ₹ 10,900 per ha. Cost of seeds (₹ 2500) and manures and fertilizer application (₹ 2000) were the two major costs incurred in the cultivation of kalmegh. Gross returns and net returns obtained per ha were ₹ 36,000 and ₹ 25,100 respectively.

Vinayak (2005) estimated the cost and returns of ashwagandha cultivation while studying contract farming in ashwagandha crop at Gadag, Raichur and Koppal districts of Karnataka. The total cost of ashwagandha production per acre was ₹ 6896 and total income was ₹ 14,820. The maximum cost was incurred on human labour (₹ 1429) followed by cost on FYM transportation and application (₹ 832), cost on seeds (₹ 484) and plant protection chemicals (₹ 40).

Raghu (2006) studied the economics of production and marketing of patchouli in Northern Karnataka. He found that the cost of establishment was ₹ 73,693.96 per ha, the average maintenance cost was ₹ 74,336.91 per ha per year. Gross returns and net returns per ha were ₹ 2,01,581.35 and ₹ 1,27,244.44 respectively for second year.

Shah *et al.* (2006) studied the cost-benefit analysis of henna cultivation in middle Gujarat and concluded that henna was a highly capital intensive crop and the average cost of cultivation was ₹ 2,02,260 per ha. Highest cost was incurred on seeds (₹ 64,129 per ha) and the net profit per ha over cost C_2 was found to be ₹ 1,80,338 with input output ratio as 1:1.97 on the basis of cost C_2 for all the farms. The overall cost of production was estimated to be ₹ 1566 per quintal, which was much lower than the market price of ₹ 2000 - ₹ 5000 per quintal during the study period. This indicated that the henna cultivation was quite remunerative in the study area even at the lowest price.

Anonymous (2007) revealed that the average total cost (cost C_2) of cultivation of isabgol per ha was ₹ 16,974 and the average gross returns was ₹ 27,267 per ha. The returns per ha over cost C_2 was ₹ 10,293. The average total cost of production (cost C_2) per quintal was ₹ 1795.21. The average farm harvest price of isabgol was estimated to be ₹ 2890.21 per quintal which was higher than the cost of production per quintal. The farm

harvest price of isabgol was found higher than the bulk line cost i.e. ₹ 2324.09 per quintal indicating the profitability of the crop. The input output ratio over cost C_2 was worked out to be 1:1.61 which showed that one rupee invested on isabgol cultivation yielded ₹ 1.61.

Mittal and Singh (2007) worked out the economics of some important aromatic plants such as lemongrass, citronella and patchouli. They found that the average total cost of herbage cultivation per ha per year at 2003-2006 prices were ₹ 40,400, ₹ 39,287 and ₹ 32,919 for lemongrass, citronella and patchouli respectively. The average total cost of oil production per ha per year were ₹ 57,230, ₹ 56,408 and ₹ 36,101 in the same order. The average net returns per ha per year from herbage cultivation was ₹ 17,320 and ₹ 48,974 and ₹ 608 for lemongrass, citronella and patchouli respectively. The average net returns per ha per year from oil production were and ₹ 45,699 and ₹ 7296 and ₹ 25,821 for lemongrass, citronella and patchouli respectively.

Deshpande *et al.* (2008) estimated the economics of selected medicinal and aromatic crops in Karnataka, Madhya Pradesh, West Bengal, Uttaranchal and Kerala. Total cost of cultivation per acre of sweet flag, patchouli, isabgol, ashwagandha, chitramuli, leadwort and lemongrass were ₹ 44,876.58, ₹ 48,417.88, ₹ 5975.8, ₹ 26,396.75, ₹ 26,217, ₹ 1,55,350.13 and ₹ 14,412 respectively. The gross returns per acre were ₹ 77,184, ₹ 48,680, ₹ 10,688.26, ₹ 84,000, ₹ 70,500, ₹ 4,61,700 and ₹ 11,149.8 in the same order. Net returns over variable and total cost per acre were ₹ 37,026.2 and ₹ 32,308.4 respectively for sweet flag, ₹ 3180.7 and ₹ 262.12 for patchouli, ₹ 6510.64 and ₹ 4712.46 for isabgol, ₹ 60,495 and ₹ 57,603.3 for ashwagandha, ₹ 47,343 and ₹ 45,093 for chitramuli, ₹ 3,51,864.88 and ₹ 3,06,349.9 for leadwort and ₹ -832.57 and ₹ -3262.93 for lemongrass. This showed lemon grass cultivation in the study area was not profitable.

Mukerjee (2008) worked out the cost of production of *Swertia chirayita* per ha and it was ₹ 34,290. Cost of seedling/planting (₹ 5000) and cost of land rent were two major costs in production. Gross returns and net returns were ₹ 1,25,000 and ₹ 90,710 respectively with a B:C ratio of 3.64.

Powar and Hange (2008) studied the economics of production and marketing of selected medicinal and aromatic plants in western Maharashtra. They worked out cost of cultivation of safed musli, pudina and citronella per ha which were ₹ 2,28,634.32, ₹ 1,03,567.19 and ₹ 55,879.30 respectively. Further it was observed that the cost of seed material was the single largest item of expenditure in safed musli (₹ 1,05,260) whereas

for pudina, it was on human labour (₹ 30,288.540) and for citronella it was the amortization cost (₹ 17,122.26). The net returns per ha of safed musli, pudina and citronella were ₹ 35,013, ₹ 5349 and ₹ 6723 respectively. They also worked out the B:C ratio for safed musli, pudina and citronella which were 1.15, 1.05 and 1.12 respectively.

Gogoi (2009) worked out the cost of establishment of patchouli and it was ₹ 41,179 per ha. The average operational cost was ₹ 28,447.76 per ha per year and total cost per ha per year was ₹ 45,500.75. The average gross returns and net returns per ha per year were ₹ 1,23,421.33 and ₹ 77,920.58 respectively.

Mal *et al.* (2009) studied the economic analysis of cultivation of safed musli in Haryana and found that the cost of establishment per acre of safed musli was ₹ 1,82,152.30 of which ₹ 1,40,793.60 was total variable cost and ₹ 41,354.71 was total fixed cost. Cost on planting material was highest (₹ 1,01,101.30) followed by harvesting of crop (₹ 15,236.840), inter-cultivation and hoeing (₹ 7473) and chemical fertilizer (₹ 6442.10). Gross returns and net returns per acre were ₹ 2,47,052 and ₹ 64,900 respectively and the B:C ratio was 1.36.

Thanki (2009) worked out the cost and returns of ajwain in Gujarat and found that the total cost of cultivation per ha was ₹ 15204. Out of the total cost of cultivation, ₹ 6277 was incurred on labour cost itself. The average yield of ajwain was 8.96 q per ha and the farm harvest price was ₹ 4342.41 per quintal. The gross returns and net returns realized per ha were ₹ 38908 and ₹ 23704 respectively.

Ram Suresh *et al.* (2012) estimated the economics of production of three medicinal and aromatic plants, viz. menthol mint, tulsi and vetiver. The cultivation of these plant species has been found to be highly profitable. The net returns over total cost was found to be higher for vetiver (₹ 1,53,933 per ha), followed by menthol mint (₹ 53,250 per ha) and tulsi (₹ 40,094 per ha). The benefit-cost ratio however has been observed to be highest for menthol mint (3.27), followed by tulsi (3.21) and vetiver (3.04).

Ram Suresh *et al.* (2014) conducted economic analysis of palmarosa cultivation in India and had documented that the major portion of operational cost was shared by human labour, distillation charges and preparation of nursery. Total variable cost was found to be ₹ 47,926 per ha per year. The gross returns and net returns over variable cost were found to be ₹ 1,24,000 per ha and ₹ 76,074 per ha. The benefit-cost ratio was 2.59 indicating a

higher profit to the farmers. The independent variables like human labour, planting material and distillation charges were positive indicating significant impact on the returns from the crop.

2.2 Resource use efficiency

Lokesh (1999) worked out the resource productivity of sweet flag in Tumkur district of Karnataka by taking yield of the crop as dependent variable and land, labour and capital as independent variables. He found that the regression coefficients with respect to land, labour and capital were 0.45, 0.66 and 0.56 respectively and all were significant at 5 per cent level of significance. The co-efficient of multiple determination was 0.90. He also worked out the allocative efficiency for all the explanatory variables and they were 5.24, 2.23 and 2.67 with respect to land, labour and capital respectively. This meant that there was underutilization of the resources.

Dileep *et al.* (2002) employed Cobb-Douglas production function to estimate production function of tomato on sample farms and revealed that the R^2 values indicated that the independent variables explained about 96 per cent of variation in the production. Returns to scale ($\sum b_i$) was more than unity in case of overall category of non-contract farmers indicating increasing returns to scale. On the other hand, it was less than unity for both contract and non-contract farmers indicating diminishing returns to scale. The ratio of MVP to MFC in case of human labour for medium holding size contract farmers was significantly negative indicating its excessive use. A similar trend was observed in irrigation also. However, the ratio of plant protection expenditure in all the categories of contract farmers was negative and significant suggesting the need to curtail its excessive use.

Thilangavathi *et al.* (2002) in their study on resource use efficiency of rainfed chillies in southern Tamil Nadu observed that the coefficient of multiple determination (R^2) indicated that the seven variables had explained 82 per cent variation in total output of rainfed chillies. The variable, bullock labour (X_1) was found to be negatively non-significant in rainfed chillies. Machine labour (X_2) was found to be non-significant. Human labour (X_3) and manures, fertilizers and plant protection chemicals (X_5) were highly significant. Seeds (X_4) were found to be negatively significant at 5 per cent level of probability. Land (X_7) was found to be significant at 10 per cent level of significance. MVP for variables X_3 and X_5 was greater than unity (2.29 and 2.91 respectively), which

showed that there was a scope to increase the output through increased use of inputs X_3 and X_5 .

Vagdevi *et al.* (2004) studied the resource use efficiency on vegetable farms in Krishna district of Andhra Pradesh. They found that the marginal value products to opportunity cost ratios had indicated the deviation from unity, revealing inefficient use of resource of different magnitudes. This offered the scope to adjust the resources so as to derive higher returns in vegetable cultivation.

Ardesana (2005) observed that the elasticity of groundnut output with respect to area under crop and human labour has turned out to be positive and significant in all zones. Whereas, other variables were positive but they were not significant. This indicated that only human labour has contributed positively and significantly to income from groundnut in Saurashtra region.

Thanki (2009) studied the resource use efficiency in ajwain in Gujarat. He found that the regression coefficients with respect to human labour and working capital were positive and significant at 1 per cent level of significance, with values of 1.50 and 0.20 respectively. The regression coefficient with respect to nitrogen was positive and significant at 5 per level of significance, with value of 0.01. The regression coefficients with respect to area, bullock labour, manures, phosphorous and working capital were negative, indicating their excess usage. The coefficient of multiple determination (R^2) for the estimated production function was 0.86.

Saina (2011) studied the resource use efficiency in agriculture in Uttar Pradesh and Punjab state. The data used in this study were collected from sample farms each in Uttar Pradesh and Punjab through the cost of accounting method. Cobb-Douglas production function was fitted to the data to study the resource use efficiency in agriculture in which land, human labour, FYM, fertilizers and irrigation expenditure were considered as explanatory variables and gross value as dependent variable. The results revealed that the coefficient of multiple determination (R^2) in Uttar Pradesh and Punjab were 0.83 and 0.82 respectively. In Uttar Pradesh, elasticity of production with respect to land, human labour and irrigation expenditure was found significant with regression coefficients of 0.2410, 0.6504 and 0.789 respectively. Regression coefficients of manures and fertilizers were negative (-0.0174). It means that there was excess use of manures and fertilizers. In Punjab, elasticity of production with respect to land, human labour and

irrigation expenditure was found significant with regression coefficients of 0.4468, 0.8242 and 0.1082, respectively. From this, it could be inferred that there was scope to increase the land, labour and irrigation expenditure.

Jayashree (2017) worked out the resource use efficiency in chilli cultivation under contract and non-contract farming in North Karnataka. The results of the study revealed that, in case of contract farming, the regression coefficients with respect to human labour, bio fertilizer and PPC were found significant with values of 0.1955, 0.2119 and 1.0342 respectively. While in case of non-contract farming, the regression coefficients with respect to land, FYM and PPC were found significant with values of 0.0755, 0.0927 and 0.9110 respectively. Further, the coefficient of multiple determination was 0.94 in contract farming and 0.91 in non-contract farming. Returns to scale was found higher in contract farming with a value of 2.11, while in case of non-contract farming, it was 1.69.

2.3 Marketing cost and margin of medicinal plants

Datta (2001) studied the marketing of wild medicinal plants in tribal economy in India. He observed that two channels were involved in the marketing of wild medicinal plants, i.e., channel I – collection by tribal – local market – big contractors and channel II – collection by petty contractors and non-tribals – phyto medicinal drug manufacturers – consumers.

Joseph (2001) in his study on demand analysis of medicinal plants in Kerala identified four marketing channels in the trade of medicinal plants, i.e., channel I – cultivators/illegal gatherers from forest – commission agents – traders – pharmacy, channel II – gatherers from non forest areas – commission agents – traders – pharmacy, channel III – dealers outside state – commission agents – traders – pharmacy and channel IV – tribal – commission agents – traders – pharmacy.

Shailaja (2001) in her study on an economic analysis of production, processing and marketing of selected aromatic plants in and around Hyderabad identified two marketing channels i.e. channel I - producer – middle men – industry and channel II - producer – industry. In channel I, the producer's share in consumer rupee was 77.70 per cent for lemon grass and in channel II, the producer's share in consumer rupee was 98.45 per cent.

Negi *et al.* (2002) conducted a study to systematically document the collection and marketing system of important medicinal and aromatic plants in the tribal areas of Himachal Pradesh, for formulation of a suitable policy or modification exercise. It was found that *Jurinea macrocephala* and *Picrorrhiza kurroa* were the two most important species collected in that area. These were followed by *Salvia moorcroftiana*, *Viola serpens* and *Acotium spp.* The collector's net share in consumer's rupee for different products was low and ranged from approximately 14 to 23 per cent. Labour charges were the major component of collector's cost and accounted for approximately 10 to 17 per cent of the consumer's price for *Jurinea macrocephala* and *Picrorrhiza kurroa*. It was suggested that marketing of medicinal and aromatic plants need to be streamlined and cooperative efforts may be promoted for collectors to get remunerative prices.

Subal *et al.* (2002) carried out a survey in Assam, to assess the marketing system of medicinal and aromatic plants. Five marketing channels for medicinal and aromatic plants were identified. These included, channel I – forest (producing area) – collector – local market – agent – trader – consumer (industry); channel II – forest (producing area) – collector – agent – trader – consumer (industry); channel III – forest (producing area) – collector – local market – outside collector – trader – consumer (industry) ; channel IV - forest (producing area) – collector – agent – outside collector – trader – consumer (industry) and channel V – forest (producing area) – collector – local market – agent – outside collector – trader – consumer (industry).

Suneetha and Chandrakanth (2002) in their study on trade in medicinal plants in Kerala identified the marketing channels such as, channel I – gatherer/cultivator – pharmacy, channel II – gatherer/cultivator – trader – pharmacy, channel III – gatherer/cultivator – commission agent – trader – pharmacy and channel IV – gatherer – society – TRIFED – end user. It was also observed that the price spread varied from ₹ 200 per quintal in *Tinospora* to ₹ 850 per quintal in *Cuminum*.

Maikhuri *et al.* (2003) in their study on development of marketing of medicinal plants and other forest products observed one important marketing channel for higher Himalayan and central Himalayan medicinal plants *viz.*, medicinal plants growers/collectors – local collectors at village level – local traders (covering small areas) – middlemen traders (covering large areas) – wholesalers and regional traders (based at Haridwar, Dehradun and Shararpur) – retailer and industries/companies – consumers.

Gondalia and Patel (2007) reported that aonla growers sold all the quantity available for sale and did not store them for extended sale in off season due to highly perishable nature of aonla fruit. Grading in aonla was done by the farmers manually on the basis of size of fruits which helped them to get better prices for higher quality fruits in the market. The producer's share in consumer rupee was 58.26 per cent and the marketing efficiency was 1.40. This implied that aonla marketing system had been working at reasonable efficiency, looking to the perishable nature of the crop. The cost of weight loss due to damage and spoilage had the lion's share of 26 per cent in total marketing cost, which could be minimized by using appropriate packing and handling technology.

2.4 Constraints in production and marketing of medicinal plants

Dhanakumar and Nendran (2003) identified problems in production of medicinal and aromatic plants within industrial utilization perspective. They were poor agricultural practices, poor harvest and post harvest treatment practices, lack of research on development of high yielding varieties and domestication, inefficient processing techniques leading to low yield and poor quality, high energy losses during processing, lack of research and development on product and process development, difficulties in marketing, lack of trained personnel and equipment, lack of facilities to lubricate equipment locally and lack of access to latest technological information.

Ganapathy (2004) studied the major constraints in selected commercial and endangered medicinal plants of Bangalore rural district and reported that farmers' major problem were lack of proper yardstick to measure quality of the produce, poor technical guidance in the cultivation of medicinal plants and high rate of rejection by contract firm if farmers do not maintain quality. Low contract price and irregular payment for produce influenced the farmers to cultivate next crop.

Venugopal *et al.* (2004) in his study on the potentials and problems of patchouli cultivation in North Karnataka found that the non-availability of genuine planting material, soil fertility status, post-harvest handling, lack of market information and frequent irrigation were the major problems.

Sriram (2005) in his study on present status and emerging trends in medicinal plant cultivation, noticed some of the main problems in the sector. They were unavailability of demand and supply statistics, secretive industry about its consumption,

lack of organized marketing facility, lack of standardized quality parameters, meager agricultural research on medicinal plants and inadequate inputs for medicinal plants research.

Raghu *et al.* (2006) studied economics of production and marketing of patchouli in North Karnataka. Problems identified were water logging in rainy seasons, frequent irrigation, nematode attack, lack of proper package of practice, non availability of method/instrument to assess the quality of patchouli herbage at farm level.

Rajesh (2006) studied the economic evaluation of vanilla cultivation in Uttara Kannada district of Karnataka. He identified problems in production, processing and marketing of vanilla. Non availability of genuine planting material, non availability of organic manures, incidence of pest and diseases, non availability of credit facility were major production problems. Lack of knowledge to process the bean, non availability of skilled labour for processing, occurrence of pest and diseases after processing, low price for poor quality processed bean were major processing problems. Price fluctuation and lack of marketing facilities were major problems in marketing.

Deebasouaghanayaki and Sundaravaradarajan (2007) studied the economic analysis of aloe vera cultivation in Tamil Nadu. They found that lack of technical guidance, lack of knowledge about cultivation, poor quality of suckers, untimely availability of suckers, high cost of suckers, absence of high yielding suckers, poor drainage facilities and non availability of required quantity of organic manures were the main constraints in the cultivation of aloe vera.

Mittal and Singh (2007) identified problems in production and processing of aromatic plants. They found that high initial cost of production, poor quality of inputs and delay in their supply, lack of awareness about loan facility, incentives and procedural delays in obtaining loan, price fluctuations, inadequate market information, lack of trained labour for cultivation, high rate of interest, lack of training programmes on cultivation methods and their awareness to farmers and prevalence of pests and diseases were major production problems. Other problems were lack of basic infrastructure and organized marketing system, lack of processing facilities, high processing cost, improper handling of herbage and longer distances between farms and distillation units.

Ajjan *et al.* (2008) studied the economic analysis of cultivation and marketing of *Gloriosa superba* in Tamil Nadu. They identified problems such as labour problem, high cost of cultivation, pest and disease problem and weed problem with respect to production. Fluctuation in price, non availability of market information and selling only to registered contractors were the marketing problems.

Powar and Hange (2008) studied the economics of production and marketing of selected medicinal and aromatic plants in Western Maharashtra. The general problems identified by them were unawareness about agro-techniques, high price for seed material, non availability of sufficient irrigation water, lack of sufficient loan in time, lack of market intelligence and market information and low demand in local market. Lack of information about storage of produce resulting in discolorations and lack of nearby markets were the major problems in safed musli. Unawareness about processing for value addition and high incidence of diseases like wilt and anthracnose were major problems in pudina. Lack of guidance for increasing oil content, cheating by agents and price variation were major problems in citronella.

Osemeobo (2009) investigated the demand and supply of medicinal plants in rainforest of Nigeria. Results of the survey indicated that the medicinal plant trade was subsistence and dominated the sale of reproductive propagules and vegetative structures. Out of the 45 medicinal plants identified for market, 22 were scarce due to loss of habitats. Therefore, the domestication of indigenous species was required.

Mallik *et al.* (2011) concluded that the wild population of medicinal plants of north Kashmir Himalayas was under severe pressure of over-harvesting coupled with over grazing. The study also depicted the market chain of medicinal plant trade in the region which was highly unregulated and lacked equitable share of benefits. Keeping all these issues in mind, an appropriate strategy for the conservation and sustainable utilization of medicinal plants of the region was suggested to be formulated and implemented effectively.

Methodology

III. METHODOLOGY

This chapter reveals the methodology adopted for the study. To achieve various objectives of the study, appropriate methodology describing sampling design, method of data collection and tools and techniques employed for data analysis are hereby explained under the following headings.

3.1 Locale of the study

3.2 Description of the study area

3.3 Sampling procedure

3.4 Nature and sources of data

3.5 Analytical techniques and tools employed

3.6 Definition of terms and concepts

3.1 Locale of the study

The study was conducted in Karnataka state with a focus on Hyderabad-Karnataka region in the jurisdiction of University of Agricultural Sciences, Raichur. However, the study area was confined to Raichur district of H-K region as it is the major ajwain growing area in this region.

3.2 Description of the study area

Raichur district lies between 15⁰ 09' and 16⁰ 34' North latitude and 75⁰ 46' and 77⁰ 35' East longitude. The general slope of the district is from the north-west towards the south-east and its average height above the Mean Sea-Level is 1,311 feet. As per 2011 census, total geographical area of the district is 8442 sq.kms and total population is 19.28 lakh. The climate of the district is characterized by dryness for the major part of the year and a very hot summer. The average rainfall of the district is about 621 mm. The low and highly variable rainfall renders the district liable to drought. Two types of soil can be found in this area, the black cotton soil in the west and red rocky soil in the rest of the places.

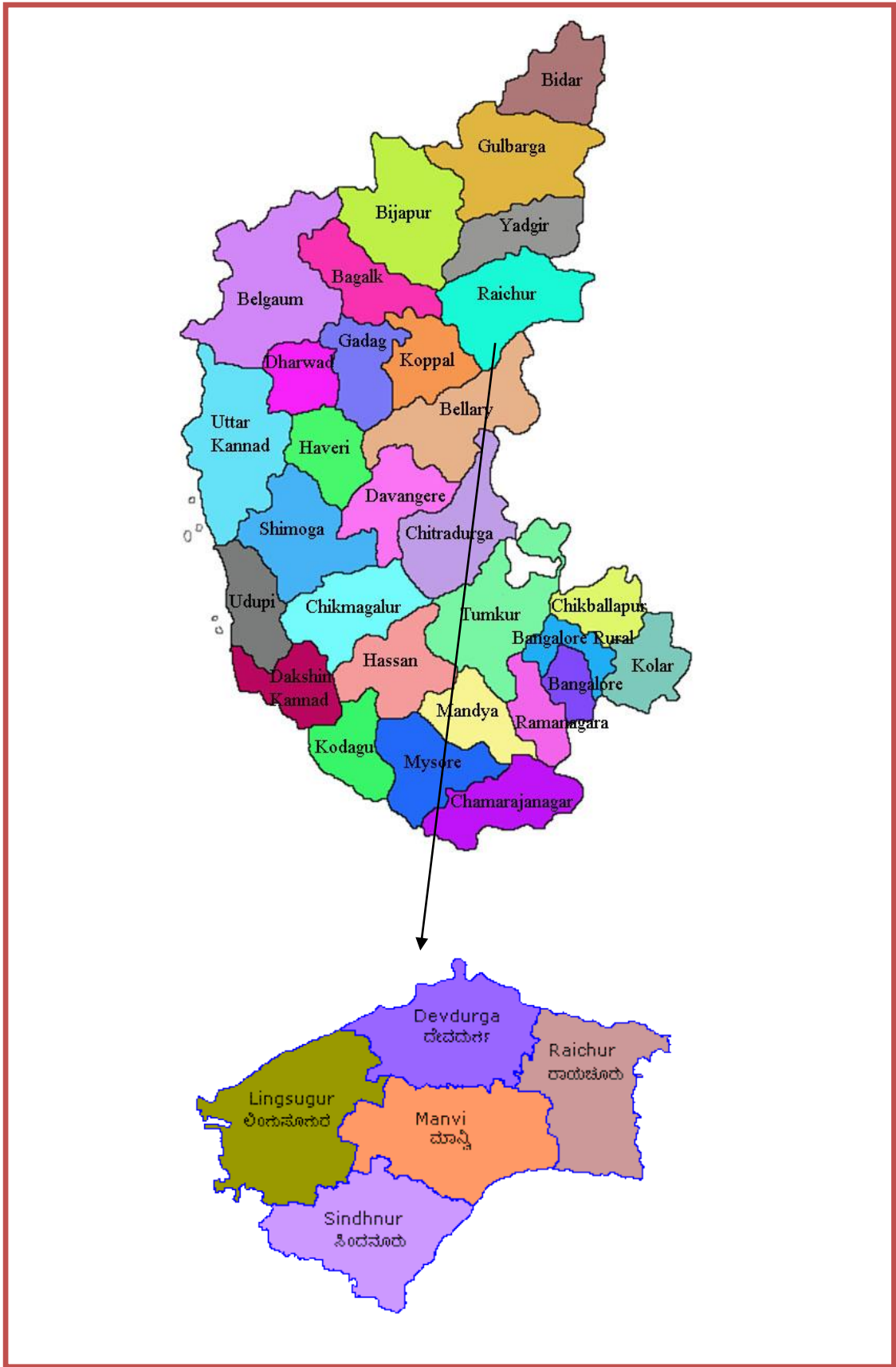


Fig.1 Map showing the study area

3.3 Sampling procedure

The sampling design adopted in the study is represented in Table 3.1. Four villages in Raichur taluk and district were selected for data collection namely, Idapnuru, Ganadhal, Shakavadi and Kudluru based on formal interaction with the officers of State Department of Horticulture. From each village, 10 ajwain growing and 10 non-ajwain growing farmers were selected by a purposive sampling method. Thus, the total sample size of the study was 40 ajwain growers and 40 non-ajwain growers.

Data related to marketing of ajwain was also collected from 10 wholesale traders in Kurnool APMC where ajwain is sold by the sample farmers (since there is no wholesale market in Raichur) and 10 retailers in Raichur city.

Table 3.1 Sample design of the study

A. Farmers		
Village	Ajwain growers	Non-ajwain growers
i) Idapnuru	10	10
ii) Ganadhal	10	10
iii) Shakavadi	10	10
iv) Kudluru	10	10
Total	40	40
B. Traders		
Place	Wholesalers	Retailers
i) Kurnool	10	-
ii) Raichur	-	10
Total	10	10

3.4 Nature and sources of data

The study involves both primary and secondary data for evaluating and analyzing the specific objectives of the study.

3.4.1 Primary data

The primary data were collected by interviewing the farmers and market intermediaries. For this purpose, a pre-tested and well structured schedule was used to obtain required information. The data collected from the respondents included some general information about the farmers, socio-economic status of the farmers, cropping pattern, area under ajwain cultivation, cost of cultivation of ajwain and competing crops, cost of marketing etc. The intermediaries involved in the marketing of ajwain were also interviewed individually to enumerate the detailed information about cost and margin in ajwain marketing.

3.4.2 Secondary data

The data pertaining to area, production and productivity of ajwain, pattern of arrivals and prices of ajwain was collected from the websites of Ministry of Statistics and Programme Implementation and Agricultural Marketing Information Network.

3.5 Analytical tools employed

For the purpose of fulfilling the specific objectives of the study, the data collected were subjected to the statistical analysis. For this purpose, the data were analyzed by using following techniques.

3.5.1 Descriptive analysis

3.5.2 Functional analysis

3.5.3 Garrett's ranking technique

3.5.1 Descriptive analysis

The technique of descriptive statistical analysis was employed to study the general characteristics of farmers, cropping pattern, cost of cultivation, returns and profit from the cultivation of ajwain and competing crops. Different marketing channels of ajwain were identified and marketing cost and marketing margin under each channel was also calculated using descriptive analytical tools like percentage, averages etc. to draw meaningful inferences.

3.5.2 Functional analysis

3.5.2.1 Resource Use Efficiency

In functional analysis, it is essential to choose an appropriate form of production function with the consideration of data to be analyzed and objectives which are to be achieved. With this perspective, in order to analyze the resource use efficiency, Cobb-Douglas type of production function was fitted to the farm level data in order to know the efficiency of various inputs used in the cultivation of ajwain.

The Cobb-Douglas production function being homogenous provides a scale factor enabling one to measure the returns to scale. The following form of Cobb-Douglas production function was used for analysis.

$$Y = a X_1^{b_1} \cdot X_2^{b_2} \cdot X_3^{b_3} \cdot X_4^{b_4} \cdot X_5^{b_5} \cdot e^u$$

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

$$\text{Log } Y = \text{Log } a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + u \log e$$

Where,

Y = Gross returns (₹)

X₁ = Land (acre)

X₂ = Expenditure on human labour (₹)

X₃ = Expenditure on seeds (₹)

X₄ = Expenditure on chemical fertilizers (₹)

X₅ = Expenditure on bullock and machine labour (₹)

a = Constant / intercept term

u = Random variable

e = 2.718

b₁ to b₅ are the elasticity coefficients of respective factor inputs.

The regression coefficients were tested using 't' test at chosen level of significance. While the function as a whole was tested using F- test.

$$t = \frac{b_i}{SE(b_i)}$$

Where,

b_i = Regression co-efficient of i^{th} input

SE (b_i) = Standard error of i^{th} input

The overall goodness of fit of the model was tested by using 'F' test by using the following formula,

$$F = \frac{R^2 / (K-1)}{(1-R^2) / (n-K)}$$

Where,

R^2 = Co-efficient of multiple determination (unadjusted)

K = Number of parameters in the sample

n = Number of observations in the sample

The co-efficient of multiple determination (R^2) was worked out in order to test the goodness of fit of the estimated function.

3.5.2.2 Allocative Efficiency

Given the technology, allocative efficiency exists when resources are allocated within the farm according to market prices and it implies the proper level of input use in production. Marginal value product for each input is computed in order to decide whether a particular input is used rationally or irrationally on the criteria of coverage of its acquisition cost by the respective input.

Marginal value product for each input was calculated by using the elasticity coefficient of each input obtained from the production function of respective input and the geometric mean levels of each variable by using the formula,

$$\text{MVP of } i^{\text{th}} \text{ input} = b_i P_y (\bar{Y}/\bar{X}_i)$$

Where,

\bar{Y} = Geometric mean of output

\bar{X}_i = Geometric mean of i^{th} input

b_i = Regression co-efficient of i^{th} input

P_y = Average price per unit of output

The allocative efficiency in the use of each resource was estimated by calculating the ratio of marginal value product (MVP) to the marginal factor cost (MFC). Based on the ratio of value of marginal products to their factor prices, the decision whether particular input was used rationally or irrationally was decided based on the following criteria.

If MVP to MFC ratio was

>1, then resources were under utilized

=1, then resources were optimally utilized

<1, then resources were over utilized

3.6 Garrett's ranking technique

In this study, Garrett's ranking technique was used to compute the important constraints in the production and marketing of ajwain. Farmers were asked to rank the constraints based on the problems faced by them. The order of the merit given by the respondent was converted into per cent position using the formula:

$$\text{Percent position} = 100*(R_{ij} - 0.50)/N_j$$

Where,

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

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

The percent position of each rank was converted to scores by referring to tables given by the Garrett and Woodworth (1969). Then for each factor, the scores of individual respondents were summed up and divided by the total number of respondents from whom scores were gathered. The mean scores for all the factors were ranked, following the decision criterion that higher the value, the more important is the order of preference by the respondents.

3.7 Definitions of terms and concepts

Variable costs: The variable costs included cost on seeds, organic manures, biofertilizers, chemical fertilizers, plant protection chemicals and wages of human labour, bullock labour and machine labour.

Human labour: The human labour included labour put forth by men and women for taking up different cultivation operations. Human labour was estimated in terms of eight hours of work per day. Men labour was measured in terms of man days. Women days were converted into man days on the basis of wage differentials between men and women labour.

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

Machine labour: The machine labour included the use of tractor, harvester, thresher etc. to carry out various operations. The cost of machine labour in hours was calculated for different farm operations which vary with the selected crop.

Farm yard manure (FYM): FYM is the traditional organic manure and is most readily available to the farmers. It is produced by decomposing locally available agricultural wastes, dung and urine. The quantity of FYM used in the cultivation of all selected crops was measured in terms of tonnes and the cost was computed considering the actual price paid by the farmers.

Chemical fertilizers: These are the synthetic fertilizers and include urea, DAP, MOP and complex fertilizers, etc. used for supply of nutrients in crop production. The cost of chemical fertilizers was based on the actual price paid by the sample farmers.

Plant protection chemicals: Plant protection chemicals included different insecticides, fungicides and herbicides used in controlling pests, diseases and weeds. The cost of plant

protection chemicals was calculated based on the actual price paid by the farmers towards these chemicals.

Interest on working capital: The working capital consists of the expenditure on labour, seeds, organic manures, fertilizers, plant protection chemicals and also marketing cost incurred by the farmers. The interest on working capital was calculated at the rate of 9 per cent per annum (the rate at which nationalized bank provide short term loans).

Fixed costs: These included depreciation on farm implements and machinery, land revenue, rental value of land and interest on fixed capital.

Depreciation: Depreciation on each capital equipment and machinery owned by the farmers was calculated by the straight line method by using the following formula.

$$\text{Annual depreciation} = \frac{\text{Purchase value} - \text{Junk value}}{\text{Economic life of the asset}}$$

Land rent: Land rent is the consideration for using leased - in land which was paid in the form of kind.

Land revenue: Land revenue was charged at the rate imposed by the government.

Interest on fixed capital: Interest on fixed capital was calculated at the rate of 11.5 per cent per annum.

Total cost of cultivation: Cost of cultivation included variable costs and fixed costs. Variable costs included the cost of human labour, bullock labour, machine labour, seeds, farmyard manure, chemical fertilizers, plant protection chemicals, marketing cost and interest on working capital. Fixed costs comprised depreciation, land revenue, rental value of land and interest on fixed capital.

Gross returns: The gross returns were computed by multiplying the quantity of main product and byproduct obtained with respective prices received.

Net returns: Net returns were computed by deducting the total costs incurred by the farmers from the gross returns obtained.

Returns per rupee spent: Returns per rupee of expenditure were obtained by dividing gross returns by the total cost of cultivation.

Marketing channels: These were the routes through which the producer seller sold their produce at the village level and market level.

Marketing cost: It was computed by adding all the costs incurred by the market intermediaries in the marketing of the produce.

Marketing margin: It was obtained by adding the profit of all market intermediaries.

Price spread: It was worked out by computing the difference between the selling price of the retailers and net price received by the producer.

Producer's share in consumer rupee: This is the percentage of the net price received by the producers from the price paid by the consumers.



Plate 1: Ajwain crop at the flowering stage



Plate 2: Researcher visiting the farmer's field



Plate 3: Ajwain plant



Plate 4: Researcher interviewing the farmer



Plate 5: Ajwain flower



Plate 6: Ajwain seeds



Plate 7: Ajwain crop ready for harvesting



Plate 8: Harvested ajwain crop kept for sun drying

Results

IV. RESULTS

The results of the analysis carried out for fulfilling the objectives of the study are presented under the following heads.

4.1 Socio-economic characteristics of sample respondents

4.2 Cropping pattern followed by the respondents

4.3 Comparative economics of ajwain and its competing crops

4.3.1 Material input use pattern in the cultivation of ajwain and its competing crops

4.3.2 Comparative labour use pattern in the cultivation of ajwain and its competing crops

4.3.3 Comparative cost of cultivation of ajwain and its competing crops

4.3.4 Comparative cost and returns of ajwain and its competing crops

4.4 Resource use efficiency in the cultivation of ajwain

4.4.1 Technical efficiency of different resources in the cultivation of ajwain

4.4.2 Allocative efficiency of different resources in the cultivation of ajwain

4.5 Marketing cost and margin under different marketing channels of ajwain

4.5.1 Channels identified in ajwain marketing

4.5.2 Marketing cost incurred by sample respondents

4.5.3 Marketing cost incurred by traders

4.5.4 Marketing cost, margin and price spread of ajwain

4.5.5 Pattern of arrivals and price trend of ajwain in Kurnool market

4.5.6 Major destinations for ajwain in India from Kurnool market

4.6 Constraints faced by the sample farmers in the cultivation of ajwain

4.1 Socio-economic characteristics of sample respondents

An understanding of socio-economic characteristics provides a bird's eye view of the general features of farmers cultivating ajwain and its competing crops in the study area. Therefore, an attempt has been made to analyze some of the important characteristics of sample farmers. The socio-economic characteristics of the respondents are presented in Table 4.1. It could be seen from the table that the average age of the farmers in case of non-ajwain growers was 46.56 years which was slightly higher than that of ajwain growers (43.42 years). On the whole, the farmers were having an average age of 44.99 years.

With respect to average size of the family, it was observed from the table that, it was slightly higher in case of non-ajwain growers (6.20) than that of ajwain growers (5.90). On the whole, the farmers were having an average family size of 6.05.

With respect to educational status, majority of the sample farmers were illiterates. In case of ajwain growers, the respondents who were illiterates and who had studied primary school, high school, college and above college were 29, 7, 2, 1 and 1 respectively. In case of non-ajwain growers, it was 25, 11, 3, 1 in the same order and none of them had studied above college. On the whole, 54 respondents were illiterates and the respondents who had studied primary school, high school, college and above college were 18, 5, 2 and 1 respectively.

The average size of operational holding among ajwain growers (9.24 acres) was higher than that of non-ajwain growers (8.75 acres). On the whole, the average size of the operational holding among the sample respondents was 8.99 acres. The average size of the owned land in case of ajwain growers, non-ajwain growers and on the whole were 7.63 acres, 7.21 acres and 7.42 acres respectively. The average size of the leased-in land was 1.61 acres, 1.54 acres and 1.57 acres in the same order.

4.2 Cropping pattern followed by the respondents

The cropping pattern of the sample respondents across the study area is presented in Table 4.2. It can be observed from the table that, in case of ajwain-growers, major portion of the net cropped area was occupied by cotton which was grown in an area of 150.50 acres that constituted 40.67 per cent of the net cropped area. Ajwain was grown in an area of 93.50 acres that occupied second highest share of 25.27 per cent in the net

cropped area. Tur, bengal gram and paddy occupied 16.62 per cent, 12.02 per cent and 5.40 per cent of the net cropped area, respectively.

In case of non-ajwain growers also, major portion of the net cropped area (51.78 per cent) was occupied by cotton which was grown in an area of 181.50 acres. Tur and bengal gram were grown in an area of 83.50 acres (23.82 per cent) and 57.50 acres (16.40 per cent), respectively. Paddy was also grown in a small area of about 28 acres by non-ajwain growers that constituted 7.98 per cent of the net cropped area.

Table 4.1 Socio-economic features of the sample respondents

Sl. No.	Particulars	Unit	Ajwain growers (n=40)	Non-ajwain growers (n=40)	All (n=80)
1	Average age of the farmer	Years	43.42	46.56	44.99
2	Average size of the family	Number	5.90	6.20	6.05
3	Educational status				
	i) Illiterate	Number	29.00	25.00	54.00
	ii) Primary school	Number	7.00	11.00	18.00
	iii) High school	Number	2.00	3.00	5.00
	iv) College	Number	1.00	1.00	2.00
	v) Above college	Number	1.00	-	1.00
4	Land holding				
	i) Average size of operational holding	Acre	9.24	8.75	8.99
	ii) Average size of owned land	Acre	7.63	7.21	7.42
	iii) Average size of leased in land	Acre	1.61	1.54	1.57

Table 4.2 Cropping pattern of sample respondents

Sl. No.	Crops	Ajwain growers (n=40)				Non-ajwain growers (n=40)			
		Area (acres)				Area (acres)			
		Kharif	Rabi/Summer	Total	%	Kharif	Rabi/Summer	Total	%
A	Cereals								
1	Paddy	20.00	-	20.00	5.40	28.00	-	28.00	7.98
B	Pulses								
1	Tur	61.50	-	61.50	16.62	83.50	-	83.50	23.82
2	Bengal gram	-	44.50	44.50	12.02	-	57.50	57.50	16.40
C	Commercial crops								
1	Cotton	150.50	-	150.50	40.67	181.50	-	181.50	51.78
D	Horticulture crops								
1	Ajwain	-	93.50	93.50	25.27	-	-	-	-
Total		232.00	138.00	370.00	100.00	293.00	57.50	350.50	100.00

4.3 Comparative economics of ajwain and its competing crops

4.3.1 Material input use pattern in the cultivation of ajwain and its competing crops

The pattern and extent of input usage per acre in the cultivation of ajwain, bengal gram and cotton is presented in Table 4.3. Results of the study revealed that the usage of seeds in case of ajwain, bengal gram and cotton were 2.45 kg, 29.25 kg and 1.86 kg, respectively. The quantum of FYM applied was very less in case of ajwain (0.22 tonnes), whereas in case of bengal gram and cotton it was 1.86 and 1.81 tonnes respectively. With respect to the usage of chemical fertilizers, ajwain growers had applied least quantity of nitrogen (13.55 kg). Whereas in case of bengal gram and cotton, the respondents had applied 20.50 kg and 119.32 kg of nitrogen, respectively. The application of P_2O_5 was highest in case of ajwain (28.45 kg) followed by 23 kg in bengal gram and 15.68 kg in cotton. The application of K_2O in case of ajwain was almost negligible (2.60 kg). But, it was very high in case of cotton (91.38 kg), when compared to ajwain. In case of bengal gram, K_2O was not applied by the sample respondents. The application of plant protection chemicals was 1.11 litre in ajwain, 0.96 litre in bengal gram and 3.64 litre in cotton.

4.3.2 Comparative labour use pattern in the cultivation of ajwain and its competing crops

The labour use pattern in the cultivation of ajwain, bengal gram and cotton per acre is presented in Table 4.4. The results revealed that, with respect to field preparation, ajwain, bengal gram and cotton required almost same units of human labour which were 1.4, 1.18 and 1.92 man days respectively. With respect to FYM application, ajwain required less man days (0.4) when compared to bengal gram (1.36 man days) and cotton (1.34 man days). With respect to sowing, ajwain required more man days (2.02) than that of bengal gram (1.28 man days) and less than that of cotton (3.42 man days). With respect to fertilizer application, ajwain required almost same man days (0.45) as that of bengal gram (0.39 man days) but less than cotton (3.68 man days). The ajwain growers required more man days for weeding (9.85), harvesting (10.04) and threshing (10.70) when compared to bengal gram growers who required only 3.94 and 4.92 man days for weeding and harvesting, respectively. Bengal gram growers did not use any human labour for threshing. The human labour requirement for weeding was higher in ajwain (9.85 man days) when compared to cotton (5.59 man days). But, for harvesting, ajwain growers required less man days (10.04) than for picking of cotton (19.68 man days). The

application of plant protection chemicals required almost same man days in ajwain (0.98) and bengal gram (1.21), which was less than the requirement of cotton (4.73 man days).

The usage of bullock labour for field preparation and sowing was almost similar in ajwain and bengal gram. For field preparation, ajwain and bengal gram required 0.61 and 0.72 bullock days respectively, whereas cotton required a higher bullock day (1.21) than that of ajwain. The usage of same for sowing was 0.38 and 0.22 bullock days in ajwain and bengal gram respectively. Inter cultivation was not done in ajwain, hence no bullock labour was used. But, in case of bengal gram and cotton, 0.26 and 1.17 bullock days were used for inter cultivation, respectively.

Table 4.4 also revealed that the requirement of machine labour for field preparation was slightly less in ajwain (0.75 machine hours) than that of bengal gram (0.82 machine hours) and cotton (1.87 machine hours). Machine harvesting and threshing of ajwain was done by only few farmers of the study area and thus it required only 0.1 and 0.15 machine hours for harvesting and threshing respectively. Whereas, bengal gram required a higher machine hour (1.08) for threshing than that of ajwain (0.15 machine hours).

The total labour cost for field preparation was almost same in case of ajwain (₹ 1517.50) and bengal gram (₹ 1607), but it was almost half of that of cotton (₹ 3001.50). The total labour cost for FYM application was lower in ajwain (₹ 120) than bengal gram (₹ 408) and cotton (₹ 402). The labour cost incurred on sowing operation was ₹ 986, ₹ 727.50 and ₹ 1026 in ajwain, bengal gram and cotton respectively. The total labour cost for fertilizer application was highest in cotton (₹ 1104) followed by ajwain (₹ 135) and bengal gram (₹ 117). More labour cost was incurred on weeding, harvesting and threshing in ajwain (₹ 2955, ₹ 3102 and ₹ 3345, respectively) than bengal gram (₹ 1182, ₹ 1476, ₹ 972 respectively). In cotton, less labour cost was incurred on weeding (₹ 1677) than that of ajwain (₹ 2955), but more labour cost was incurred on harvesting (₹ 5904) than that of ajwain (₹ 3102). The total labour cost incurred in ajwain cultivation (₹ 12454.50) was higher than that of bengal gram (₹ 7262.50), but lower than that of cotton (₹ 15976.50).

Table 4.3 Material input use pattern in the cultivation of ajwain and its competing crops

(Per acre)

Sl. No.	Inputs	Unit	Ajwain	Bengal gram	Cotton
1	Seeds	kg	2.45	29.25	1.86
2	FYM	tonne	0.22	1.86	1.81
3	Fertilizers				
a)	N	kg	13.55	20.50	119.32
b)	P ₂ O ₅	kg	28.45	23.00	15.68
c)	K ₂ O	kg	2.60	-	91.38
d)	Micronutrients	kg	-	-	4.61
4	PPC	litre	1.11	0.96	3.64

Table 4.4 Labour use pattern in the cultivation of ajwain and its competing crops

(Per acre)

Sl. No.	Operation	Ajwain				Bengal gram				Cotton			
		HL	BL	ML	Total cost (₹)	HL	BL	ML	Total cost (₹)	HL	BL	ML	Total cost (₹)
1	Field preparation	1.40	0.61	0.75	1517.50	1.18	0.72	0.82	1607.00	1.92	1.21	1.87	3001.50
2	FYM application	0.40	-	-	120.00	1.36	-	-	408.00	1.34	-	-	402.00
3	Sowing	2.02	0.38	-	986.00	1.28	0.22	0.19	727.50	3.42	-	-	1026.00
4	Fertilizer application	0.45	-	-	135.00	0.39	-	-	117.00	3.68	-	-	1104.00
5	Weeding	9.85	-	-	2955.00	3.94	-	-	1182.00	5.59	-	-	1677.00
6	Inter cultivation	-	-	-	-	0.50	0.26	-	410.00	0.91	1.17	-	1443.00
7	Application of PPC	0.98	-	-	294.00	1.21	-	-	363.00	4.73	-	-	1419.00
8	Harvesting	10.04	-	0.10	3102.00	4.92	-	-	1476.00	19.68	-	-	5904.00
9	Threshing	10.70	-	0.15	3345.00	-	-	1.08	972.00	-	-	-	-
Total		35.84	0.99	1.00	12454.50	14.78	1.20	2.09	7262.50	41.27	2.38	1.87	15976.50

HL= Human labour (man days), BL= Bullock labour (bullock days), ML=Machine labour (machine hours)

Wage rate: ₹ 300 for man day, ₹ 200 for woman day, ₹ 1000 for bullock day, ₹ 650 for machine hour

4.3.4 Comparative cost of cultivation of ajwain and its competing crops

The details of the cost incurred per acre, on both variable and fixed inputs in the cultivation of ajwain, bengal gram and cotton are presented in Table 4.5. It can be observed from the table that the total cost of cultivation per acre in ajwain (₹ 25628.41) was higher than that of bengal gram (₹ 18932.79) and lower than that of cotton (₹ 40056.52). Out of the total cost of cultivation, the share of material inputs like seeds (3.75 per cent), FYM (0.68 per cent), chemical fertilizers (7.13 per cent) and plant protection chemicals (4.27 per cent) were lower in ajwain when compared to bengal gram and cotton. Thus, the material inputs had a least share of 15.84 per cent in the total cost of cultivation of ajwain, when compared to bengal gram (28.87 per cent) and cotton (39.88 per cent). The total expenditure on material inputs amounted to ₹ 4060.25, ₹ 5466.62 and ₹ 12609.63 in ajwain, bengal gram and cotton, respectively.

The Table 4.5 also revealed that the share of labour cost in the total cost of cultivation was highest in ajwain (48.60 per cent) followed by cotton (42.11) and bengal gram (38.36 per cent). The share of marketing cost in the total cost of cultivation was also higher in ajwain (11.31 per cent) than both bengal gram (7.80 per cent) and cotton (6.14 per cent). It was also clear that the variable cost had a share of about 81 to 85 per cent in the total cost of cultivation of all the three crops. In absolute figures, the variable cost in case of ajwain, bengal gram and cotton were ₹ 21162.47, ₹ 15484.49 and ₹ 33838.64 respectively.

The share of fixed cost in the total cost of cultivation of ajwain, bengal gram and cotton were almost similar which were 17.42 per cent, 18.21 per cent and 15.52 per cent respectively. In case of fixed components, land rent had the highest share in the total cost of cultivation of all the three crops which amounted to ₹ 3333.33, ₹ 2500 and ₹ 5000 in absolute figures, in ajwain, bengal gram and cotton respectively. The share of land revenue in the total of cost of cultivation of ajwain, bengal gram were 0.70 per cent, 0.95 per cent and 0.45 per cent, respectively. The shares of depreciation in the total cost were 1.92 per cent, 2.18 per cent and 0.99 per cent in the same order. The total fixed cost summed up to ₹ 4465.94 in ajwain, ₹ 3448.30 in bengal gram and ₹ 6217.88 in cotton.

4.3.4 Comparative cost and returns of ajwain and its competing crops

The per acre cost and returns structure of ajwain, bengal gram and cotton are represented in Table 4.6. It is evident from the table that the total cost of cultivation of ajwain was ₹ 25628.41 and it was higher than bengal gram (₹ 18,932.79) and lower than cotton (₹ 40,056.52). The average yield in ajwain, bengal gram and cotton were 3.97q, 6.23q and 11.18q, respectively and the respective gross returns realized were ₹ 49,287.55, ₹ 26,166 and ₹ 54,782. But, it could be seen from the table that the highest net returns was realized in ajwain (₹ 23659.14), when compared to both bengal gram (₹ 7233.21) and cotton (₹ 14,725.48). Returns per rupee spent was higher in ajwain (1.86) than bengal gram and cotton which yielded 1.38 and 1.36 rupees of returns per rupee spent, respectively.

It can also be observed from the table that the total cost incurred per quintal of produce was highest in ajwain (₹ 6455.52) followed by cotton (₹ 3582.87) and bengal gram (₹ 3038.97). The gross returns and net returns per quintal also followed the similar trend with respective values of ₹ 12415 and ₹ 5959.48 in ajwain, ₹ 4200 and ₹ 1161.02 in bengal gram and ₹ 4900 and ₹ 1317.13 in cotton.

Table 4.5 Comparative cost of cultivation of ajwain and its competing crops

(Per acre)

Sl. No.	Particulars	Ajwain		Bengal gram		Cotton	
		Cost (₹)	%	Cost (₹)	%	Cost (₹)	%
A.	Material input costs						
	a. Seeds	961.25	3.75	1755.00	9.27	1968.00	4.91
	b. FYM	176.00	0.68	1488.00	7.86	1448.00	3.61
	c. Fertilizers	1827.50	7.13	1400.00	7.39	4374.00	12.03
	d. PPC	1095.50	4.27	823.62	4.35	4819.63	31.48
	Subtotal	4060.25	15.84	5466.62	28.87	12609.63	39.88
B.	Labour cost	12454.50	48.60	7262.50	38.36	15976.50	42.11
C.	Marketing cost	2900.36	11.31	1476.84	7.80	2458.50	6.14
D.	Interest on working capital @ 9%	1747.36	6.82	1278.53	6.75	2794.01	6.97
E.	Total variable cost (A+B+C+D)	21162.47	82.57	15484.49	81.78	33838.64	84.48
1	Land revenue	180.00	0.70	180.00	0.95	180.00	0.45
2	Land rent	3333.33	13.00	2500.00	13.20	5000.00	12.48
3	Depreciation on farm implements/ machinery	492.00	1.92	412.65	2.18	396.58	0.99
4	Interest on fixed capital @ 11.5%	460.61	1.80	355.65	1.88	641.30	1.60
F.	Total fixed cost(1+2+3+4)	4465.94	17.42	3448.30	18.21	6217.88	15.52
III.	Total cost (E+F)	25628.41	100.00	18932.79	100.00	40056.52	100.00

Table 4.6 Cost and returns of ajwain and competing crops**(Per acre)**

Sl. No.	Particulars	Ajwain	Bengal gram	Cotton
1	Total variable cost (₹)	21162.47	15484.49	33838.64
2	Total fixed cost (₹)	4465.94	3448.30	6217.88
3	Total cost (₹)	25628.41	18932.79	40056.52
4	Yield (q)	3.97	6.23	11.18
5	Gross returns (₹)	49287.55	26166.00	54782.00
6	Net returns (₹)	23659.14	7233.21	14725.48
7	Returns per rupee spent (₹)	1.86	1.38	1.36
8	Total cost per quintal (₹)	6455.52	3038.97	3582.87
9	Gross returns per quintal (₹)	12415.00	4200.00	4900.00
10	Net returns per quintal (₹)	5959.48	1161.02	1317.13

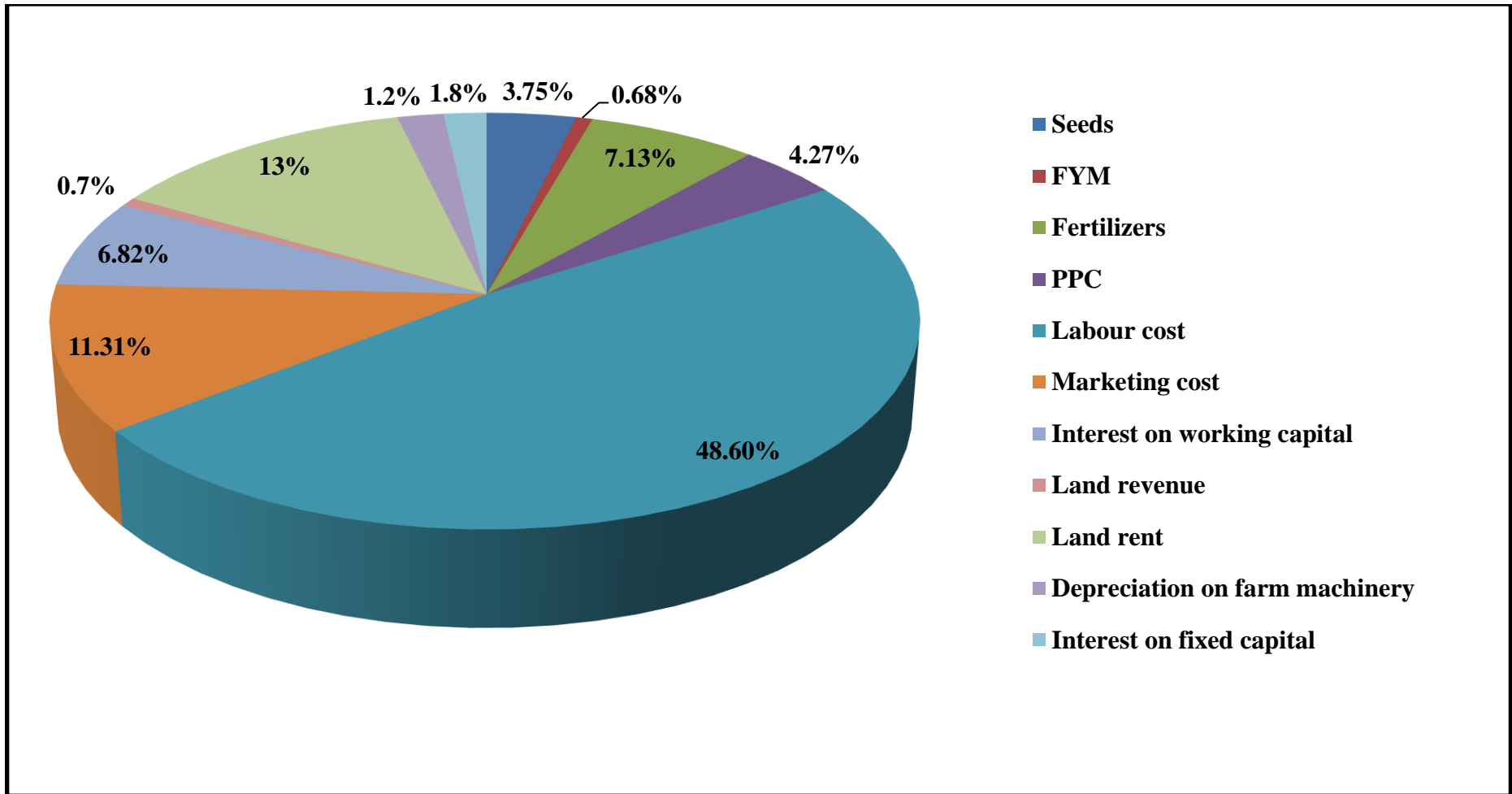


Fig.2 Share of different components in the total cost of cultivation of ajwain per acre

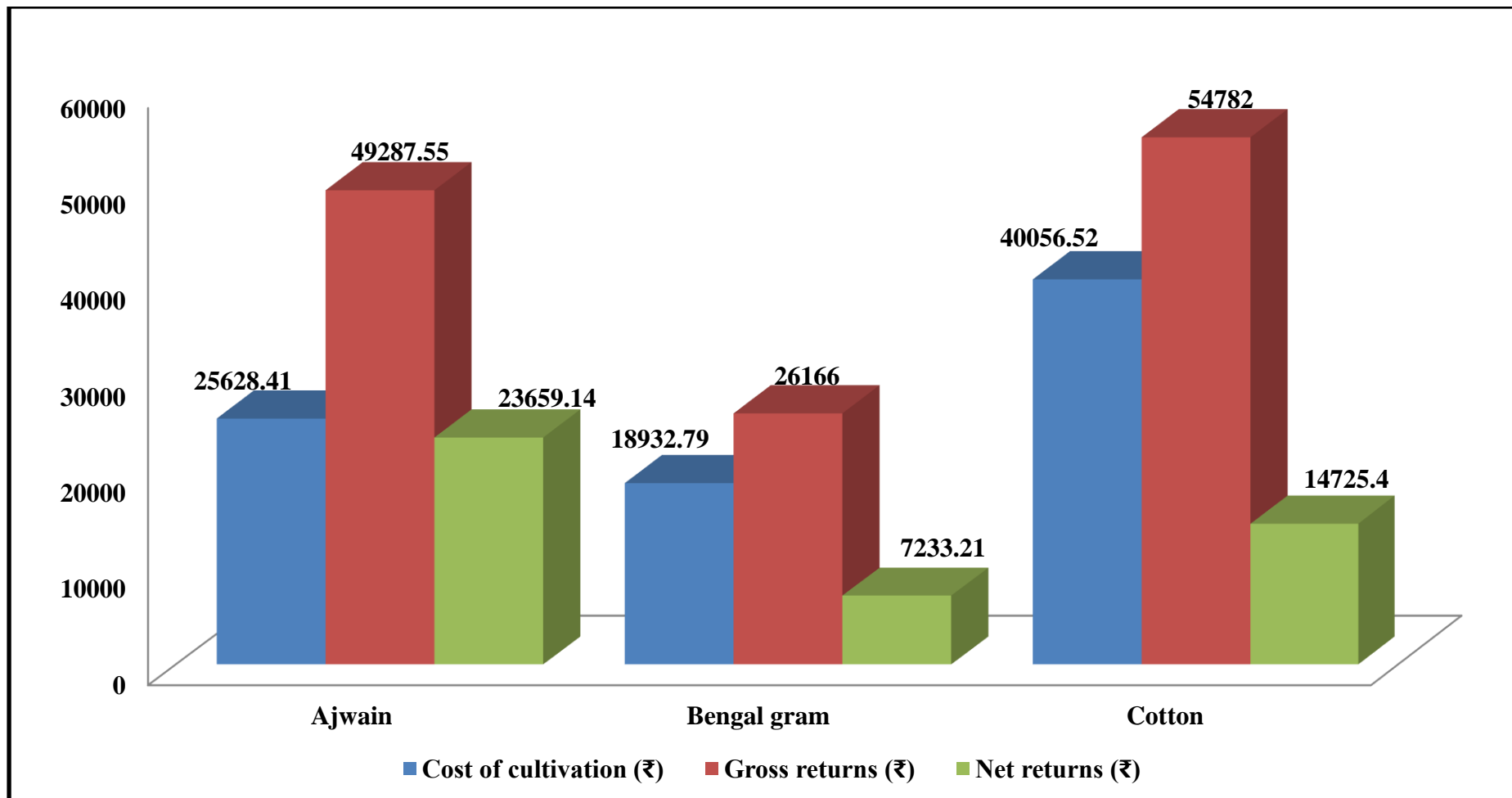


Fig.3 Comparative economics of ajwain, bengal gram and cotton per acre

4.4 Resource use efficiency in the cultivation of ajwain

4.4.1 Technical efficiency of different resources in the cultivation of ajwain

An attempt has been made to analyze the productivity of various resources in the cultivation of ajwain in order to meet the objectives of the study.

Technical efficiency of each resource is indicated by the respective elasticity coefficients. In order to get the clear picture about the technical efficiency, the Cobb-Douglas production function was fitted to the farm level data. The details of the production parameters estimated by taking gross returns(Y) as dependent variable and other inputs like land (X_1), human labour (X_2), seeds (X_3), chemical fertilizers (X_4) and bullock and machine labour (X_5) as independent variables are presented in Table 4.7.

The results of the study revealed that the co-efficient of multiple determination (R^2) was 0.86 in case of ajwain cultivation. This indicated that the variables included in the production function had explained 86 per cent of variation in gross returns of ajwain. The high and significant F value indicated that the Cobb-Douglas production function was adequate in explaining 86 per cent variation in output due to variations in all the resources included in the model. An increasing returns to scale was noticed with a value of 1.17.

The gross returns in ajwain was positively and significantly conditioned by human labour (0.39) and bullock and machine labour (0.31). The other variables in the production function like land (0.31), seeds (0.02) and chemical fertilizers (0.14) contributed positively to the output, but they were not statistically significant.

4.4.2 Allocative efficiency of different resources in the cultivation of ajwain

To analyze the allocative efficiency of various resources employed in the cultivation of ajwain, the MVP of the resources were compared with the respective MFC values and the results obtained were presented in Table 4.8. The MVP to MFC ratios were worked out to be more than unity for all the resources included in the analysis i.e., land (1.39), human labour (1.75), seeds (1.10), chemical fertilizers (3.61) and bullock and machine labour (4.66).

Table 4.7: Technical efficiency in the cultivation of ajwain

Dependent variable = Gross returns (₹)

Sl. No.	Particulars	Parameters	Regression coefficients	t value
1	Intercept	a	5.47	2.81
2	Land (acre.)	b ₁	0.31	1.03
3	Expenditure on human labour (₹)	b ₂	0.39**	2.38
4	Expenditure on seeds (₹)	b ₃	0.02	0.19
5	Expenditure on chemical fertilizers (₹)	b ₄	0.14	0.73
6	Expenditure on bullock and machine labour (₹)	b ₅	0.31**	2.30
7	Co-efficient of multiple determination (R ²)		0.86	
8	F value		49.06	
9	Returns to scale ($\sum b_i$)		1.17	

* Significant at 10% level, **Significant at 5% level, ***Significant at 1% level

Table 4.8 Allocative efficiency in the cultivation of ajwain

Sl. No.	Input	Geometric Mean	MVP	MFC	MVP/MFC
1	Land (acre.)	2.00	13914.14	10000.00	1.39
2	Expenditure on human labour (₹)	19971.88	1.75	1.00	1.75
3	Expenditure on seeds (₹)	1600.56	1.10	1.00	1.10
4	Expenditure on chemical fertilizers (₹)	3431.06	3.61	1.00	3.61
5	Expenditure on bullock and machine labour (₹)	5914.96	4.66	1.00	4.66

4.5 Marketing cost and margin under different marketing channels of ajwain

4.5.1 Channels identified in ajwain marketing

Marketing channels through which ajwain was marketed in the study area from producers to the ultimate consumers is presented here under. Two channels were identified in the marketing of ajwain *viz.*

Channel I : Producer – Wholesaler (APMC) – Retailer – Consumer

Channel II : Producer – Village trader – Wholesaler (APMC) – Retailer – Consumer

In channel-I, producer marketed the produce to the wholesalers at Kurnool APMC in Andhra Pradesh. As per the information collected from the respondents, about 95 per cent of the producers marketed their produce through this channel. Further, these wholesalers marketed the produce to retailers in different parts of the country and ultimately it reached the consumers.

In channel-II, village trader himself purchased the produce from the producer, which he further sold to wholesalers. In the study area, only about 5 per cent of the total producers marketed their produce through this channel.

4.5.2 Marketing cost incurred by sample respondents

The producers of ajwain had incurred a considerable amount of expenditure towards the cost of cleaning, packing material, weighing and packing, loading and unloading, transportation, middlemen's commission etc. All these expenses are accounted to arrive at the total marketing cost of ajwain per acre which are represented in Table 4.9. All the costs were worked out for channel-I since the village traders were not available for the collection of information, to work out the costs for channel-II.

Out of the total marketing cost, the expenditure incurred on middlemen's commission was highest (50.98 per cent) with ₹ 1478.62, followed by transportation charges (20.79 per cent) with ₹ 602.92. The costs on gunny bag, cleaning, weighing and packaging, loading and unloading were ₹ 322.56, ₹ 277.91, ₹ 119.10 and ₹ 99.25 respectively. The total marketing cost of ajwain was found to be ₹ 2900.36 per acre which worked out to ₹ 730.57 per quintal.

4.5.3 Marketing cost incurred by traders

The detailed information on various costs incurred by traders per quintal, in the marketing of ajwain is presented in Table 4.10. Out of the total marketing cost (₹ 1095.15), the expenditure on variable and fixed cost amounted to ₹ 1022.15 and ₹ 73 respectively. Out of the total variable cost, transportation charges was having highest share (21 per cent) that amounted to ₹ 230 per quintal, followed by cost on storage (19.97 per cent), cleaning (18.26 per cent) and packing material (16.20 per cent) which amounted to ₹ 218.75, ₹ 200 and ₹ 177.50 respectively. The cost incurred on market fee, grading, loading and unloading, weighing and packing were ₹ 124.15, ₹ 32, ₹ 24.25 and ₹ 15.50 respectively.

Out of the total fixed cost, the expenditure incurred on rent was highest with ₹ 32, followed by electricity charges, telephone charges and license fee with values of ₹ 28, ₹ 12 and ₹ 1, respectively. The total cost of marketing incurred by the traders amounted to ₹ 1095.15 per quintal. The average volume of ajwain purchased by the trader per year was 1500 quintals and the average quantity sold was 1350 quintals. The purchase and selling price of ajwain stood at ₹ 12,415 and ₹ 20,000 per quintal. Thus, the annual net turnover of the traders was ₹ 67.34 lakh. The gross margin of the trader was ₹ 7585 and net profit was ₹ 6489.85 per quintal.

4.5.4 Marketing cost, margin and price spread of ajwain

The marketing cost, margin and price spread per quintal, in marketing of ajwain are presented in Table 4.11.

The total marketing cost incurred by producer was ₹ 730.57. The net price received by the producer was ₹ 11,684.43. The price spread amounted to ₹17,585. Out of the total marketing cost, the cost incurred by the wholesaler and retailer amounted to ₹ 1095.15 and ₹ 800, respectively. The profit realized by the retailers was highest with ₹ 9200 followed by wholesalers with ₹ 6489.85. The total marketing cost incurred by all the intermediaries was ₹ 1895.15 per quintal. The producer's share in consumer rupee was 41.38 per cent and the total marketing margin amounted to ₹ 15,689.85 (52.30 per cent).

Table 4.9 Marketing cost of ajwain by sample respondents**(Per acre)**

Sl. No.	Particulars	Cost (₹)	Percentage (%)
1	Gunny bags	322.56	11.12
2	Cleaning	277.91	9.58
3	Weighing and Packaging	119.10	4.10
4	Loading and Unloading	99.25	3.42
5	Transportation charges	602.92	20.79
6	Middlemen's commission	1478.62	50.98
	Total	2900.36	100.00
	Marketing cost per quintal	730.57	-

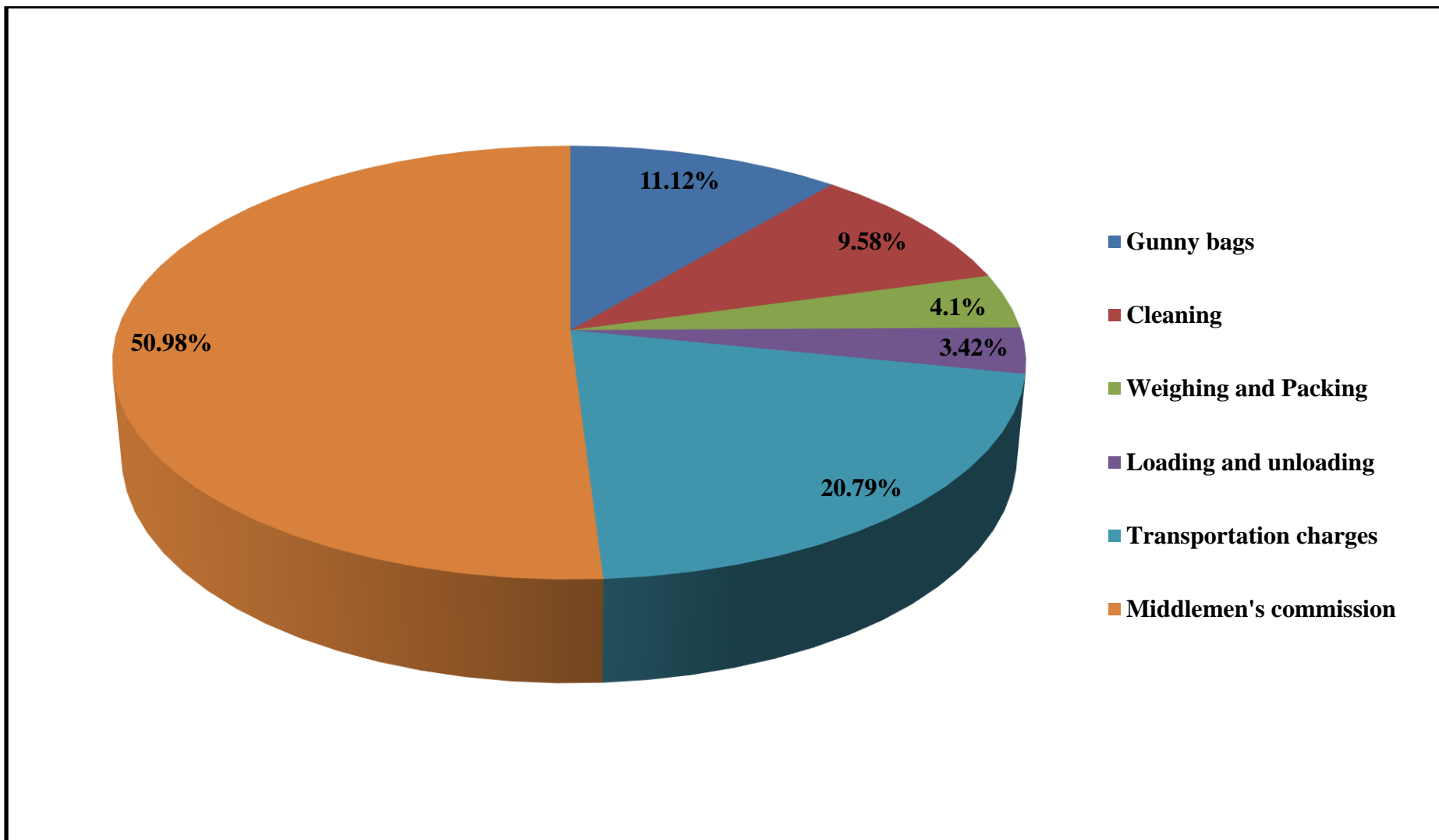


Fig.4 Share of different components in the marketing cost of ajwain per acre by the farmers

Table 4.10 Marketing cost incurred by traders at Kurnool market, 2016-17

Sl. No.	Particulars	Cost	Percentage to the total
I	Variable costs		
1	Packing material (₹/q)	177.50	16.20
2	Cleaning (₹/q)	200.00	18.26
3	Grading (₹/q)	32.00	2.92
4	Weighing and packing (₹/q)	15.50	1.41
5	Loading and unloading (₹/q)	24.25	2.21
6	Storage (₹/q)	218.75	19.97
7	Transportation (₹/q)	230.00	21.00
8	Market fee @ 1% (₹/q)	124.15	11.33
	Subtotal (₹/q)	1022.15	93.33
II	Fixed cost		
1	License fee (₹/q)	1.00	0.09
2	Rent (₹/q)	32.00	2.92
3	Electricity charges (₹/q)	28.00	2.55
4	Telephone charges (₹/q)	12.00	1.09
	Subtotal (₹/q)	73.00	6.66
III	Total marketing cost (I+II)	1095.15	100.00
IV	Average quantity purchased (q/year)	1500	-
V	Purchase price (₹/q)	12415.00	-
VI	Average quantity sold (q/year)	1350	-
VII	Sale price (₹/q)	20000.00	-
VIII	Annual net turn over (lakh ₹)	67.34	-
IX	Gross margin (₹/q)	7585.00	-
X	Net profit (₹/q)	6489.85	-

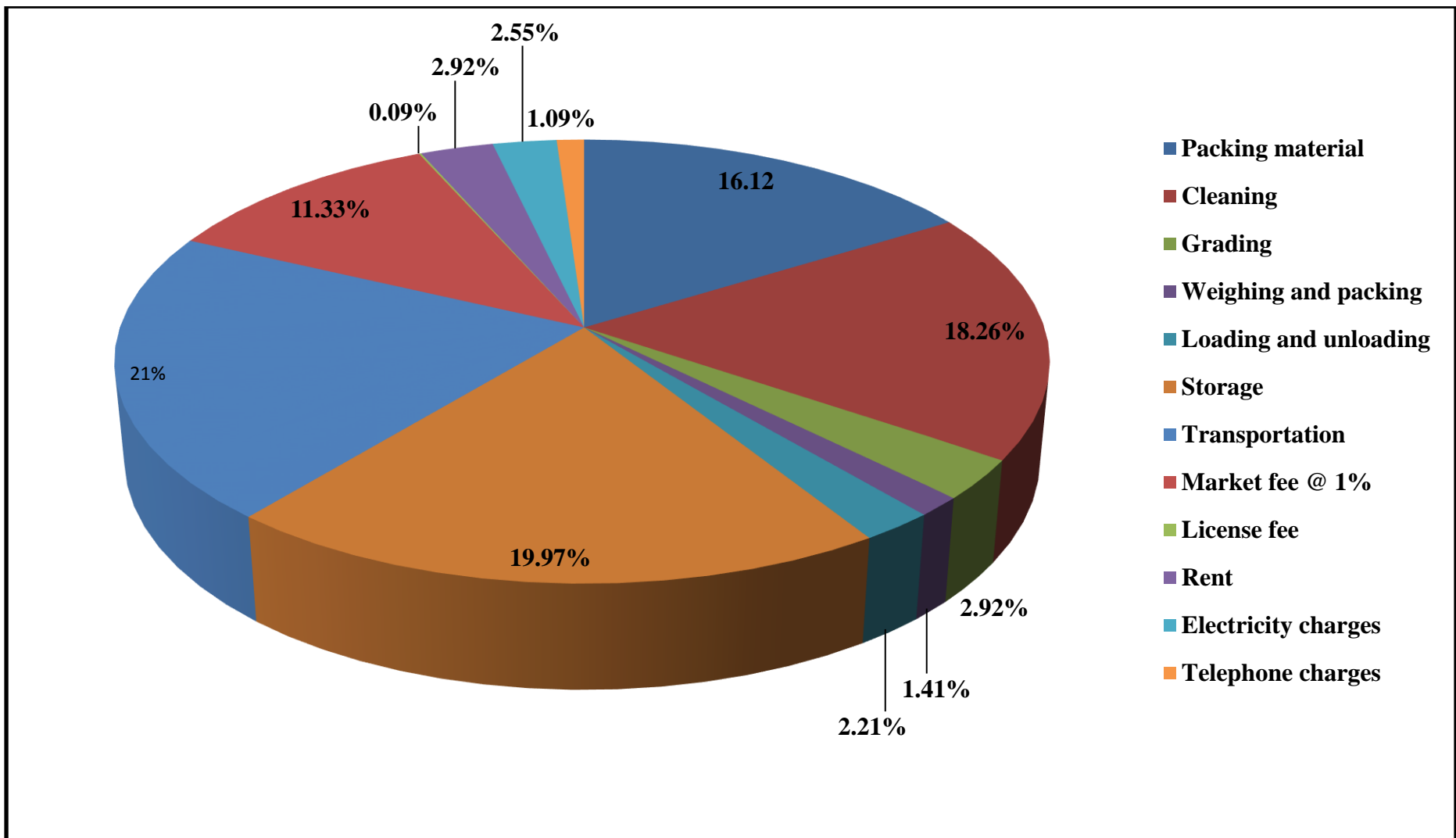


Fig.5 Share of different components in the marketing cost of ajwain per quintal by the traders

Table 4.11 Marketing cost, margin and price spread in the marketing of ajwain

Sl. No.	Particulars	Amount (₹/q)
1	Producer sale price	12415.00
2	Marketing cost incurred by the producer	730.57
3	Net price received by the producer	11684.43
4	Wholesaler purchase price	12415.00
5	Marketing cost incurred by wholesaler	1095.15
6	Wholesaler selling price	20000.00
7	Profit of wholesaler	6489.85
8	Retailers purchase price	20000.00
9	Marketing cost incurred by retailer	800.00
10	Retailer sale price	30000.00
11	Profit of retailer	9200.00
I.	Total marketing cost (5+9)	1895.15
II.	Total marketing margin	15689.85
III.	Total marketing margin (%)	52.30
IV.	Price spread	17585.00
V.	Producer's share in consumer rupee (%)	41.38

4.5.5 Pattern of arrivals and price trend of ajwain in Kurnool market

The month-wise arrival pattern of ajwain at Kurnool market is presented in Table 4.12. From the table we can observe that the total arrival of ajwain was least during 2008 with 574 quintals and it was highest during 2010 with an arrival of 1,39,547 quintals. We can also observe from the table that the arrival of ajwain is significantly increasing over the years with a compound annual growth rate (CAGR) of 27.90 per cent. The major months for the marketing were from January to April. During 2017, highest arrival was recorded in the month of February (20880 quintals), followed by March (19929 quintals), April (16409 quintals) and January (12322 quintals). The total arrival for the year 2017 was 103982 quintals.

The monthly average price of ajwain from 2008 to 2017 is presented in Table 4.13. We can observe from the table that the average price was least during 2008 with ₹ 4214 per quintal and the prices had reached the highest during 2016 with ₹ 12,438 per quintal. During 2017, highest price was realized in the month of February which was ₹ 13570 per quintal. Figure 4.5 depicts that the price of ajwain was showing an increasing trend from 2008 to 2011 and after that it was fluctuating over the years but it was above ₹ 8000 per quintal.

4.5.6 Major destinations for ajwain in India from Kurnool market

The major destinations for ajwain in India are represented in Table 4.14. It is estimated that the major portion of 30 per cent (31,194.60 quintal) goes to Rajasthan followed by 25 per cent (25,995.50 quintals) to Gujarat followed by 15 per cent (15,597.30 quintals) to Madhya Pradesh. About 5 per cent (5199.10 quintals) goes to West Bengal, Karnataka and Tamil Nadu each. About 15 per cent (15597.30 quintals) goes to other states of the country depending upon demand.

Table 4.12 Pattern of arrivals of ajwain in Kurnool market (in quintals)

	Jan	Feb	March	April	May	June	July	August	Sep	Oct	Nov	Dec	Total
2008	14	13	8	6	3	3	1	-	-	120	-	406	574
2009	10189	9214	3913	3349	2186	831	1126	508	189	245	97	88	31935
2010	2235	77352	23160	80	6500	4310	1230	1540	500	2150	10730	9760	139547
2011	10870	14368	5843	4931	10577	2778	1675	767	1204	4596	593	207	58409
2012	8688	10732	6853	1674	5430	3435	2743	1981	1275	1146	1247	584	45788
2013	14427	14674	4821	-	-	1495	1524	2171	494	1494	714	1031	42845
2014	10838	15535	8135	2394	1242	368	134	760	431	227	283	623	40970
2015	6448	19209	9004	5335	1476	1666	97	44	2	179	524	75	44059
2016	3603	16866	6550	3074	1783	1056	1024	351	46	273	221	593	35440
2017	12322	20880	19929	16409	9482	6795	5839	3489	4071	1508	1437	1821	103982
CAGR (%)													27.90

Source: www.agmark.net

Table 4.13 Average prices of ajwain at Kurnool market (₹/q)

	Jan	Feb	March	April	May	June	July	August	Sep	Oct	Nov	Dec	Average
2008	3716	4040	3920	4120	4306	5070	4613	4591	4519	3873	-	3588	4214
2009	5098	5140	5304	5138	4804	5171	5544	5865	5279	6346	7764	6035	5624
2010	10637	7525	9276	8406	11742	13515	13677	12423	9694	10171	6411	12658	10511
2011	12613	13778	14040	14338	12493	13077	11871	12082	11918	11667	11358	8215	12287
2012	9980	8433	7298	8050	5995	6902	8584	8711	8111	7893	8051	7054	7922
2013	9346	8174	8163	8366	7775	8497	8227	8036	7597	8175	8778	7963	8258
2014	10541	11311	10242	7890	11159	11866	9529	9877	9603	9694	9049	9007	9981
2015	10221	10626	10540	11017	11006	11861	12959	8350	7669	10595	7274	832	9412
2016	14407	12360	8977	12884	13409	14347	12735	15589	14107	12369	9831	8244	12438
2017	10476	13570	11274	12420	12104	9165	10235	8799	9896	12187	8562	8012	10558

Source: www.agmark.net

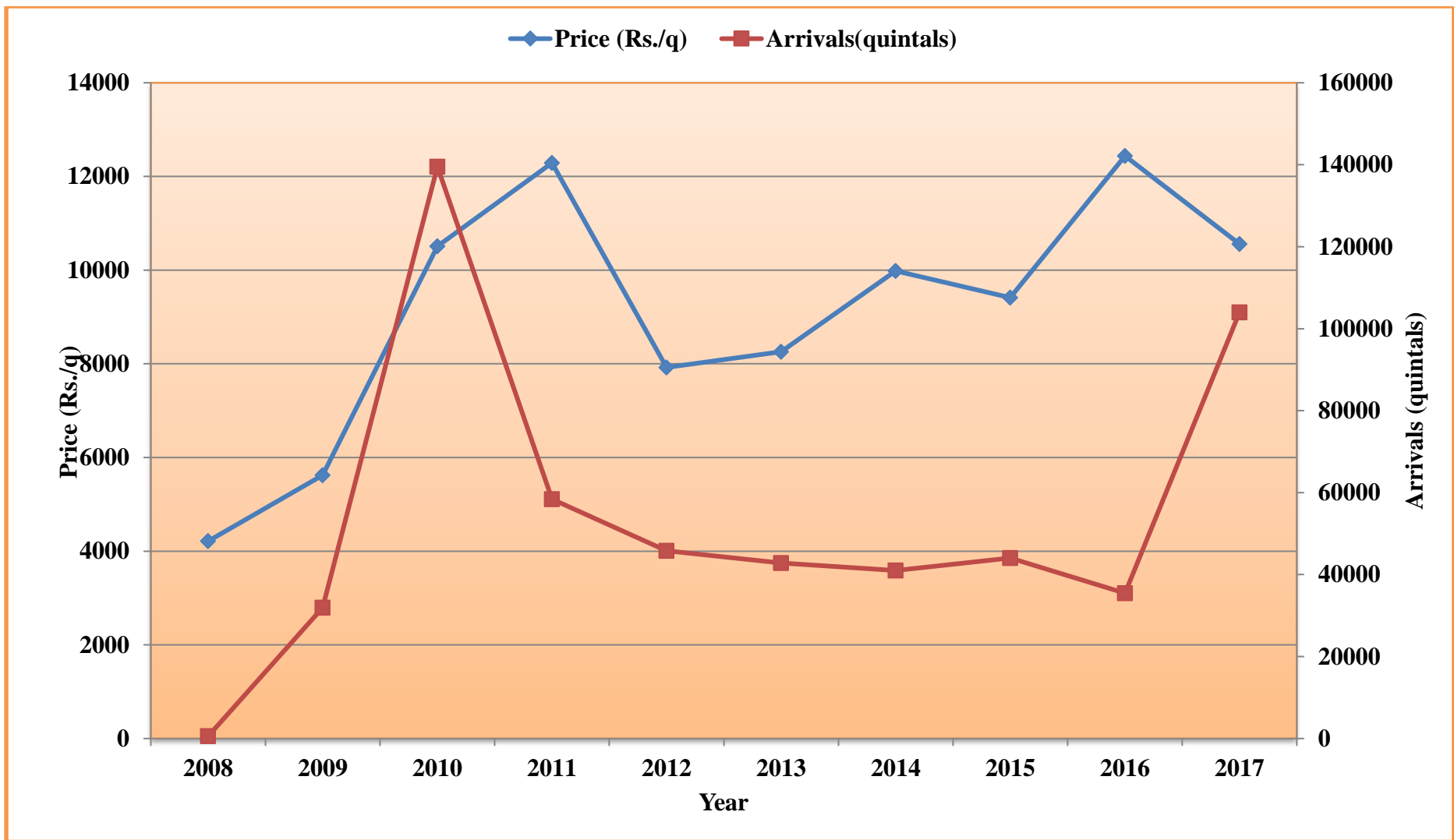


Fig.6 Trend of annual average prices and arrivals of ajwain at Kurnool market

Table 4.14 Major destinations for ajwain in India (2017)

Sl. No.	State	Quantity (q)	Percent
1	Rajasthan	31194.60	30.00
2	Gujarat	25995.50	25.00
3	Madhya Pradesh	15597.30	15.00
4	West Bengal	5199.10	5.00
5	Tamil Nadu	5199.10	5.00
6	Karnataka	5199.10	5.00
6	Others	15597.30	15.00
Total		103982.00	100.00

Source: Author's estimation based on discussion with traders

4.6 Constraints faced by the sample farmers in the cultivation of ajwain

In order to identify the constraints in the cultivation of ajwain, Garrett's ranking was done and the results are presented in Table 4.15. The constraints were subdivided into production constraints and marketing constraints.

The major production constraints in the study area were that the crop was more prone to germination failure followed by non availability of improved varieties. There was also shortage of labour and non availability of good quality seeds for sowing in the study area. Many farmers were not having much knowledge about the pest and disease control in ajwain and it was also contributing to the list of production constraints. Lastly, there was limited technical knowledge about the improved cultivation practices of ajwain to the farmers and it was ranked in the last position in the list of production constraints.

No nearby markets and non availability of latest market information were stated as important marketing constraints. Thirdly, there was high price fluctuation and fourthly, the commission charged by the commission agents was more. Lastly, there was an inconsistency in the purchase of produce.

Table 4.15 Constraints faced by the farmers in the cultivation of ajwain

Sl. No.	Constraints	Garret score	Rank
A	Production constraints		
1	Crop is more prone to germination failure	46.67	I
2	Non availability of improved varieties	28.37	II
3	Shortage of labour	57.25	III
4	Non availability of good quality seeds	55.37	IV
5	Limited knowledge about the pest and disease control	35.02	V
6	Limited technical knowledge about the improved cultivation practices	72.47	VI
B.	Marketing constraints		
1	No nearby markets	67.85	I
2	Non availability of latest market information	28.80	II
3	High price fluctuation	64.30	III
4	Higher commission charged by the trader/commission agent	59.35	IV
5	Inconsistency in purchase	31.77	V

Discussion

V. DISCUSSION

In this chapter, the results presented in the previous chapter are discussed under the following headings.

5.1 Socio-economic characteristics of sample respondents

5.2 Cropping pattern followed by the respondents

5.3 Comparative economics of ajwain and its competing crops

5.3.1 Material inputs use pattern in the cultivation of ajwain and its competing crops

5.3.2 Comparative labour use pattern in the cultivation of ajwain and its competing crops

5.3.3 Comparative cost of cultivation of ajwain and its competing crops

5.3.4 Comparative cost and returns of ajwain and its competing crops

5.4 Resource use efficiency in the cultivation of ajwain

5.4.1 Technical efficiency of different resources in the cultivation of ajwain

5.4.2 Allocative efficiency of different resources in the cultivation of ajwain

5.5 Marketing cost and margin under different marketing channels of ajwain

5.5.1 Channels identified in ajwain marketing

5.5.2 Marketing cost incurred by sample respondents

5.5.3 Marketing cost incurred by traders

5.5.4 Marketing cost, margin and price spread of ajwain

5.5.5 Pattern of arrivals and price trend of ajwain in Kurnool market

5.5.6 Major destinations for ajwain in India from Kurnool market

5.6 Constraints faced by the sample farmers in the cultivation of ajwain

The global projections of trade in medicinal plants indicates a steep rise in the demand for different types of medicinal plants and according to WHO estimates, it is expected to grow to US \$5 trillion by the end of 2050. But, the concerning fact is that about 90 per cent of the demand for medicinal plants is being met by the wild sources which has been resulting in large scale destruction of bio-diversity. Thus, it is the need of the hour to conserve important medicinal flora of our country by bringing them under commercial cultivation (Anon., 2006).

Keeping the above key issues in mind, the results of the investigation carried out are discussed here under.

5.1 Socio-economic characteristics of sample respondents

It is evident from the Table 4.1 that the average age of the ajwain growers was slightly less (43.42 years) when compared to non-ajwain growers (46.56 years). Thus, they were able to perceive ajwain as a better alternative crop and as a more remunerative crop. This enabled the respondents to allocate a manageable portion of the total land under ajwain cultivation to get higher returns. These findings are in line with the study conducted by Raghu (2006) in patchouli in North Karnataka.

With respect to the average size of the family, it was slightly higher in case of non-ajwain growers (6.20) than in ajwain growers (5.90). This revealed the fact that ajwain growers were able to engage less family labours in the farming activities because of slightly lower family size.

Education level of the sample farmers which was reported in Table 4.1 indicated that the majority of the respondents were illiterates both in case of ajwain growers (29) and non-ajwain growers (25). This indicated that the ajwain growers were able to perceive ajwain as a more remunerative crop irrespective of their educational status. This was mainly due to their farming experience with respect to ajwain cultivation which was more than 50 years old in the study area.

The average size of the operational holding in case of ajwain growers (9.24 acres) was more than that of non-ajwain growers (8.75 acres). This implied that medium farmers dominated the cultivation of ajwain in the study area. The average size of leased-in land was higher in case of ajwain growers (1.61 acres) than non-ajwain growers (1.54 acres).

This was because, many respondents expanded the ajwain cultivation in a larger area by leasing in, due to its profitability.

5.2 Cropping pattern followed by the respondents

The cropping pattern adopted by the sample farmers in the study area was presented in Table 4.2. It revealed that cotton, tur and paddy were major *kharif* crops and bengal gram and ajwain were major *rabi* crop in the study area. The results indicated the prominence for cotton both by ajwain growers (40.67 per cent) and non-ajwain growers (51.78 per cent) in the net cropped area. This was due to the perception of cotton as a commercial crop. But interestingly, ajwain was grown in 93.50 acres out of the net cropped area of 370 acres of ajwain growers and thus occupied the second highest share of 25.27 per cent of the net cropped area. This was higher than the share of bengal gram (12.02 per cent) which was also an important *rabi* crop in the study area. This was mainly due to the relative price advantage they reap when compared to bengal gram. In addition, ajwain served as a catch crop, in the situation of insufficient rains in which cotton crop couldn't be taken up. This was because, ajwain was a late *kharif* and early *rabi* crop. This clearly indicated that, with respect to land, cotton and bengal gram were the major competing crops for ajwain in the study area.

5.3 Comparative economics of ajwain and its competing crops

5.3.1 Material inputs use pattern in the cultivation of ajwain and its competing crops

Material input use pattern in the cultivation of ajwain, bengal gram and cotton per acre was presented in Table 4.3. The findings of the study clearly indicated that the seed requirement in ajwain (2.45 kg) was more than recommended (2.00 kg). This was mainly because, ajwain seeds were small and they were sown through seed drills by mixing with sand. While sowing, no spacing was maintained between the plants, thus accommodating more number of plants per acre. Therefore, it required slightly higher seed rate than recommended.

The quantum of FYM applied was very less in case of ajwain (0.22 tonnes) than that of bengal gram (1.86 tonnes) and cotton (1.81 tonnes). In case of chemical fertilizers also, the usage of nitrogen (13.55 kg) and K₂O (2.60 kg) in ajwain cultivation was less when compared to bengal gram and cotton. This was also less than the recommended dose of 40 kg of N and 20 kg of K. But the usage of P₂O₅ (28.45 kg) was more than the

recommended dosage of 20 kg. All these factors clearly indicated that the ajwain growers were not aware of the recommended nutrient management practices in the study area. The application of plant protection chemicals was almost same in ajwain (1.11 litre) and bengal gram (0.96 litre). But, it was considerably less than that of cotton (3.64 litre). This revealed that ajwain was comparatively less prone to pest and diseases than cotton.

5.3.2 Comparative labour use pattern in the cultivation of ajwain and its competing crops

It was evident from Table 4.4 that ajwain required more human labour with respect to operations like weeding (9.85 man days) and threshing (10.70 man days) when compared to bengal gram and cotton. But for harvesting, it required more human labour (10.04 man days) than bengal gram (4.92 man days) and less human labour than cotton (19.68 man days). This implied that weed menace was a major problem in the cultivation of ajwain when compared to bengal gram and cotton. Since the seeds of ajwain were small, which required careful handling, more number of human labour were required for harvesting and threshing also.

In case of field preparation, ajwain, bengal gram and cotton required almost same units of human labour. But, for sowing, ajwain required (2.02 man days) slightly more human labour than that of bengal gram (1.28 man days) and less human labour than that of cotton (3.42 man days). This was also due to small size of ajwain seeds than bengal gram, which required mixing them with sand during sowing. But, the labour requirement was less than cotton, because cotton was sown through dibbling that required more labour. With respect to operations like FYM application, ajwain required less human labour (0.4 man days) than that of bengal gram (1.36 man days) and cotton (1.34 man days). This was obviously because of lower quantity of application of FYM in ajwain. Application of PPC required almost same units of human labour in ajwain (0.98 man days) and bengal gram (1.21 man days), but it was less than cotton (4.73 man days). Because, comparatively less plant protection chemicals were used in ajwain since it was less prone to pest and diseases. With respect to fertilizer application, ajwain required (0.45 man days) almost same units of human labour as that of bengal gram (0.39 man days), but it was lower than cotton (3.68 man days). This was because, almost same quantity of fertilizers was applied in both the crops, whereas it was higher in cotton.

The usage of bullock labour for field preparation and sowing was almost same in ajwain and bengal gram. But, cotton required higher bullock labour (1.21 bullock days) for field preparation because of additional operation harrowing which was absent in ajwain cultivation. In addition, there was a labour saving in ajwain with respect to intercultural operation. With respect to the use of machine labour, it was observed that few farmers in the study area had used machines for harvesting (0.1 machine hours) and threshing (0.15 machine hours) which meant that they were gradually shifting towards the mechanical means of harvesting and threshing because of labour shortage.

The Table 4.4 also revealed that the total labour cost was higher in ajwain (₹ 12545.50) than bengal gram (₹ 7262.50) clearly indicating that ajwain was more labour intensive than bengal gram. But, it was less labour intensive than cotton in which ₹ 15976.50 was incurred on labour cost. This was mainly because of lesser duration of ajwain than cotton. Further, in case of ajwain, the labour cost incurred on weeding (₹ 2955), harvesting (₹ 3102) and threshing (₹ 3345) were more, indicating that these were the major labour intensive operations in ajwain.

5.3.3 Comparative cost of cultivation of ajwain and its competing crops

It was clearly indicated from Table 4.5 that the cost of cultivation of ajwain per acre (₹25,628.41) was higher than bengal gram (₹18,932.79) and lower than cotton (₹40,056.52). Material inputs had a least share (15.84 per cent) in the total cost of cultivation of ajwain when compared to both bengal gram (28.87 per cent) and cotton (39.88 per cent). Thus, it could be concluded that ajwain was grown with lesser inputs than both the competing crops in the study area. The share of cost on seeds (3.75 per cent) was lower in ajwain compared to bengal gram (9.27 per cent) and cotton (4.91 per cent). This was because, ajwain seeds were available at a lower price of ₹ 300 per kg. The cost incurred on FYM (₹ 176) was almost negligible in ajwain. This indicated that the ajwain growers were not following the proper nutrient management practices. The share of cost on fertilizers (7.13 per cent) and PPC (4.27 percent) in ajwain was similar to bengal gram but it was lower than cotton.

The share of labour cost in the total cost of cultivation was much higher in ajwain (48.60 per cent) than both bengal gram (38.36 per cent) and cotton (42.11 percent). Thus, it could be clearly noted that ajwain was more labour intensive with almost 50 per cent of the total cost of cultivation incurred on labour cost. These findings are in agreement with

the findings of Thanki (2009) who had reported that the cost on human labour had the highest share of 29.55 per cent in the total cost of cultivation of ajwain and the cost on human and bullock labour together constituted about 41.28 per cent of the total cost of cultivation of ajwain.

Marketing cost also had a major share of 11.31 per cent in the total cost of cultivation of ajwain. This was because, the villages were located almost 115 km away from Kurnool city where the respondents had sold their produce. This caused them to incur about ₹ 2900.36 on marketing cost itself.

In case of fixed components, land rent had the major share (13 per cent) in the total cost of cultivation of ajwain. This indicated that the ajwain growers had allocated their leased-in land majorly for ajwain cultivation. The depreciation cost was more in ajwain (₹ 492) than bengal gram (₹ 412.65) and cotton (₹ 396.58) indicating that ajwain growers had owned more number of equipments and machineries as compared to non-ajwain growers.

5.3.4 Comparative cost and returns of ajwain and its competing crops

The profit from the cultivation of ajwain, bengal gram and cotton has been examined by computing per acre cost of cultivation and net returns realized. It was evident from the Table 4.6 that the average yield was lower in ajwain (3.97q / acre) than both bengal gram (6.23q / acre) and cotton (11.18q / acre). But interestingly, the net returns realized per acre ajwain cultivation was ₹ 23,659.14 and it was almost three times higher than bengal gram (₹ 7233.21) and one and a half times higher than cotton (₹ 14,725.48). This was because of higher market price of ajwain of about ₹ 12,415 per quintal because of its importance as a spice and medicinal crop. Whereas, bengal gram and cotton were having an average market price of ₹ 4200 and ₹ 4900 per quintal respectively. Hence the hypothesis, cultivation of ajwain is remunerative compared to its competing crops was accepted.

The cost of production per quintal of ajwain was higher (₹ 6455.52) than bengal gram (₹ 3038.97) and cotton (₹ 3582.87) because of lower yield of ajwain. But, the net returns realized per quintal was highest in ajwain (₹ 5959.48) attributed to higher market price. The returns per rupee spent was higher in ajwain (1.86) than its competing crops like bengal gram (1.38) and cotton (1.36). This was because, in case of ajwain, higher

market price was realized and lower cost of cultivation was incurred in contradictory to cotton, in which lower market price was realized and higher cost of cultivation was incurred. Whereas in case of bengal gram, yield was only slightly higher than ajwain, but market price per quintal was almost one third of that of ajwain. This resulted in lower returns per rupee spent in case of bengal gram (1.38) when compared to ajwain (1.86). These findings are in agreement with the study conducted by Sarawgi and Agrawal (2006) who reported a higher benefit cost ratio of 1.84 in safed musli.

It was evident that the area and production of ajwain in India is significantly increasing over the years (Table 1.2). Another interesting fact is that the productivity of ajwain in Karnataka is 990 kg ha⁻¹ which is 11.23 per cent higher than the all India average of 890 kg ha⁻¹. This clearly indicates that the crop is very much suitable for the study area and yields greater returns per hectare than other parts of the country.

5.4 Resource use efficiency in the cultivation of ajwain

5.4.1 Technical efficiency of different resources in the cultivation of ajwain

To analyze the technical efficiency of various resources employed in the cultivation of ajwain, their respective elasticity coefficients were estimated by fitting Cobb-Douglas production function. It was clear from the results presented in Table 4.7 that the adjusted Co-efficient of Multiple Determination (R^2) was 0.86 which indicated that the variables included in the model had explained 86 per cent of variation in the gross returns of ajwain and thereby good fit of the model. Similar results were reported by Thanki (2009), wherein R^2 value of 0.86 was observed while working out the resource use efficiency of ajwain.

Inputs like human labour (X_2) and bullock and machine labour (X_5) were found to influence the gross returns significantly and positively with coefficient values of 0.39 and 0.31 respectively. This indicated that the gross returns can be significantly enhanced by increasing the expenditure on human, machine and bullock labour. Land (0.31) and chemical fertilizers (0.14) were also positively influencing the gross returns but, they were not statistically significant. The influence of seeds (X_3) was marginally positive with co-efficient value of 0.02 but not statistically significant. This meant that the opportunity to increase the use of seeds was almost negligible.

The sum of output elasticities was found to be more than one (1.17) indicating increasing returns to scale i.e., one per cent increase in all the inputs simultaneously, would result in increase in the yield of ajwain by 1.17 per cent. This was because, all the coefficients included in the model were positive.

5.4.2 Allocative efficiency of different resources in the cultivation of ajwain

The allocative efficiency of resources was examined by comparing the marginal value product of each input with the respective marginal factor cost. In case of land, the prevailing rental value of land was taken as opportunity cost or marginal factor cost. It was evident from Table 4.8 that MVP to MFC ratio was 1.39 for land. That means, for one rupee of additional cost, an additional return of 1.39 could be realized at the geometric mean level of use of land and other inputs. Similarly the MVP to MFC ratio more than unity for other resources like human labour (1.75), chemical fertilizers (3.61) and bullock and machine labour (4.66) which indicated that all these resources were under utilized in the production of ajwain. Thus, the farmers can still increase the use of these inputs to reap the economic benefits from the cultivation of ajwain. These findings are similar to the results reported by Thanki (2009) wherein MVP to MFC ratio was estimated to be more than one, with respect to human labour (1.47) and bullock labour (1.16) in the cultivation of isabgol.

The MVP to MFC ratio was 1.10 for seeds which indicated that even though it was more than one, there was only a little opportunity to increase its use. Since the MVP to MFC ratio was more than unity for land, area under cultivation of ajwain can be increased by the farmers in order to achieve the economically optimum output. This is yet to be realized as the farmers were still in the first stage of production function with respect to land, human labour, chemical fertilizers and bullock and machine labour. Hence the hypothesis, resources are efficiently utilized in the production of ajwain, was rejected.

5.5 Marketing cost and margin under different marketing channels of ajwain

5.5.1 Channels identified in ajwain marketing

The major marketing channel identified in the marketing of ajwain was channel I: Producer - Wholesaler (APMC) – Retailer – Consumer. About 95 per cent of the farmers had sold their produce through this channel. Remaining 5 per cent of the farmers had sold

their produce through channel II: Producer –Village trader – Wholesaler (APMC) – Retailer – Consumer. This was mainly because, the village traders were not available as and when the farmers' produce came to harvest and the farmers had to incur comparatively higher marketing cost while selling their produce through village trader, than selling to the wholesaler. Thus, majority of the respondents had sold their produce through channel I. About 70 per cent of the end use of ajwain is for the use as a spice. Only 30 per cent goes for the manufacture of medicinal formulations.

5.5.2 Marketing cost incurred by sample respondents

Marketing cost incurred by the sample respondents per acre was presented in Table 4.9. The highest portion of the total marketing cost of ajwain (50.98 per cent) was incurred on middlemen's commission (₹ 1478.62), followed by transportation charges (20.79 per cent) of ₹ 602.92. This was mainly because, a higher commission of 3 per cent was charged by the commission agents and Kurnool is located at a distance of almost 115 km from these villages which resulted in high transportation cost. Similar results were reported in the study conducted by Verma *et al.* (2016) in coriander wherein the producers were disposing off their produce through two marketing channels and the marketing cost incurred in channel-I and channel-II were estimated to be ₹ 1616.04 and ₹ 1513.69 per quintal respectively. The higher marketing cost in channel-I was due to the involvement of more number of middlemen as compared to channel-II.

The costs on gunny bags, cleaning, weighing and packaging, loading and unloading were ₹ 322.56, ₹ 277.91, ₹ 119.10 and ₹ 99.25 respectively in ajwain marketing. The total marketing was ₹ 2900.36 per acre which indicated that marketing cost has a major contribution to the total variable cost of ajwain. The total marketing cost per quintal of ajwain was ₹ 730.57.

5.5.3 Marketing cost incurred by traders

The marketing cost incurred by traders (wholesalers) per quintal of ajwain was presented in Table 4.10. Out of the total cost, the expenditure on variable and fixed cost amounted to ₹1022.15 and ₹ 73 per quintal, respectively. Out of the total variable cost, transportation charges was having highest share (21 per cent) that amounted to ₹ 230 per quintal. This was mainly because, ajwain was sold to different states like Rajasthan, Gujarat and Madhya Pradesh *etc.* that had resulted in higher transportation cost. Similar

results were reported by Guleria (2012) in the marketing of *Aloe vera* and lemon grass in the mid hills of Himalaya.

Storage (19.97 per cent), cleaning (18.26 per cent) and packing material (16.20 per cent) also had a significant share in the total cost, which amounted to ₹ 218.75, ₹ 200 and ₹ 177.50 respectively. This was because, the traders were cleaning and storing ajwain for almost 5 to 6 months and selling it as and when the demand arises. Thus, higher cost was incurred on cleaning and storage. The share of cost on market fee, grading, loading and unloading and weighing and packing were 11.33 per cent, 2.92 per cent, 2.21 per cent and 1.41 per cent respectively.

The average quantity of ajwain seeds purchased per year by the traders was 1500 quintals at average price of ₹ 12415 per quintal. But there was almost 10 cent loss of the produce during handling and storage. This was mainly due to impurities like husk, sand particles, wastage during machine cleaning, improper storage, pests etc. Thus, the total quantity of ajwain sold was 1350 quintal at the price of ₹ 20,000 per quintal. The annual net turnover of the trader was ₹ 67.34 lakh. The gross margin and net profit of the traders were ₹ 7585 and ₹ 6489.85 respectively.

5.5.4 Marketing cost, margin and price spread of ajwain

In this section an attempt has been made to throw light on the marketing cost, margin and price spread of ajwain which were presented in Table 4.11. Out of the total marketing cost, the cost incurred by the wholesaler and retailer amounted to ₹ 1095.15 and ₹ 800 per quintal respectively. This was because, the wholesalers were cleaning and storing the produce and selling it to distant places that had resulted in higher marketing cost. Whereas, retailers were purchasing and selling the produce in small quantities without much cost incurred. Therefore, cost incurred by them was a meager amount considering the high price of ajwain.

The farmers were selling their produce at ₹ 12415 per quintal and it was reaching the consumer at ₹ 30000 per quintal. Thus, a very high price spread of ₹ 17585 was observed in ajwain. The profit realized by the retailers was highest with ₹ 9200 per quintal followed by wholesalers with ₹ 6489.85 per quintal, thus registering an effective market margin of 52.30 per cent together. But the producer's price in consumer rupee was 41.38 per cent which was lower than the market margin of 52.30 per cent. Hence the

hypothesis, marketing margin is high in ajwain was accepted. This clearly indicated that ajwain trade was highly secretive and there was a high degree of market imperfection yielding a greater profit to the market intermediaries than the producer. However, since the quantity of ajwain purchased by the ultimate consumer is small, they will not feel this imperfection in the margin.

5.5.5 Pattern of arrivals and price trend of ajwain in Kurnool market

The month-wise arrival pattern of ajwain in Kurnool market which was presented in Table 4.12 indicated that the arrivals are increasing over the years with a very high compound annual growth rate of 27.90 per cent. This clearly implied that the demand for ajwain is tremendously increasing over the years because of its unique uses both as a spice and as a medicinal plant. In addition, Kurnool ajwain is given the name as the top quality ajwain in the entire country. Because of this region specific tag and high price of the produce, its arrival is increasing over the years in Kurnool market. The peak season for the marketing of ajwain was from January to April, since the farmers were selling the produce immediately after the harvest in January or February. During 2017, highest arrival was in the month of February (20,880 quintals), followed by March (19,929 quintals), April (16,409 quintals) and January (12,322 quintals).

Ajwain is a notified commodity in Kurnool APMC. About 1300 quintal of ajwain from Raichur is being marketed at Kurnool APMC every year, which is worth about ₹ 1.61 crores at the market price of ₹ 12415 per quintal. Thus, the government of Karnataka is forgoing an estimated revenue of ₹ 2,42,000 (by considering 1.5 per cent market fee) every year since it is not a notified commodity in Raichur APMC.

Price trend of ajwain which was depicted in Fig.4.5 indicated that the price of ajwain had shown an increasing trend from 2008 to 2011. After 2011, the prices were fluctuating but, essentially above ₹ 8000 per quintal. This fluctuating trend was mainly attributed to the variations in production and demand over the years. But, because of its importance as a spice and medicinal crop the average price was above ₹ 8000 per quintal. It could also be observed from Table 4.13 that the average price had reached maximum of ₹ 12438 per quintal during 2016. During 2017, highest price was realized in the month of February with ₹ 13570 per quintal. This higher price is one of the factors which is attracting the farmers towards this crop.

5.5.6 Major destinations for ajwain in India from Kurnool market

The major destinations for ajwain in India were represented in Table 4.14. The quantity of ajwain traded and the places to which it is transported has not varied substantially over the years. According to the discussion held with ajwain traders in Kurnool market by researcher, the major portion of 30 per cent (31,194.60 quintal) goes to Rajasthan followed by 25 per cent (25,995.50 quintals) to Gujarat followed by 15 per cent (15,597.30 quintals) to Madhya Pradesh. This is mainly because, these are the major ajwain growing states in India and thus they are purchasing the produce from Kurnool market and further together to export to different countries or distribute to different parts of the country. From Kurnool market, a sizeable portion of about 5199.10 quintals (5 per cent) goes to West Bengal, Karnataka and Tamil Nadu each. Because, Tamil Nadu and Karnataka are the neighboring states to Andhra Pradesh and thus, it is easier to sell ajwain to these states. About 15597.30 quintals (15 per cent) is reaching other states of the country depending upon demand.

5.6 Constraints faced by the sample farmers in the cultivation of ajwain

Constraints faced by the farmers in the production and marketing of ajwain were presented in Table 4.15. The major production constraint in the study area was that the crop was more prone to germination failure followed by non availability of improved varieties. Since the ajwain seeds were very much sensitive to excess moisture, even a single rain during germination period had resulted in the germination failure of ajwain. Secondly, since the research institutions had not undertaken enough research on ajwain, there was a non-availability of improved varieties. Local varieties which yield only 3.97 q/ acre on an average, were making the farmers to perceive it as a low yield crop.

There was also shortage of labour in the study area. Since ajwain was a labour intensive crop, there was much need of labour for different operations like weeding, harvesting and threshing. In addition, there was non-availability of quality seeds. Since ajwain seeds were very much sensitive to excess moisture, it was very much essential to use quality seeds for sowing so that the minimum germination percentage could be ensured. But, quality seeds were not distributed to respondents by any means of agriculture functionaries. These findings are in line with the study conducted by Mounika (2015) who reported that the labour shortage and non-availability of quality planting material were the major production problems in the cultivation of palmarosa.

The respondents were not aware of the proper pest and disease control measures in ajwain which was also a production constraint. Lastly, there was limited technical knowledge about the improved cultivation practices like proper nutrient management in ajwain. Thus, the farmers should be educated about the improved cultivation practices of ajwain.

In case of marketing constraints, no nearby market was stated as an important constraint. Since the Kurnool market was located almost 115 km away from villages, it was difficult for the respondents to properly dispose off their produce. Secondly, there was a non-availability of latest market information like market demand, prices etc. These findings are in agreement with the results reported by Raghu (2006) that the lack of market information was a major problem in the marketing of Patchouli.

There was also a price fluctuation as explained previously. In addition, the commission charged by the middlemen was high (in some cases it was even 5 per cent) which increased the marketing cost incurred by the respondents. Lastly, there was an inconsistency in the purchase because of the fluctuating demand of the produce. Since per capita consumption of ajwain is too low, it takes comparatively longer period to dispose off the produce by retailers. This created an inconsistency in demand and ultimately in the purchase of the produce by the traders.

*Summary and Policy
implications*

VI. SUMMARY AND POLICY IMPLICATIONS

Herbal medicines and their preparations have been widely used traditionally, for thousands of years in developing and developed countries owing to its natural origin and lesser side effects. While the demand for herbal medicines is growing in developing countries, there are indications that consumers in developed countries are becoming disillusioned with modern healthcare and are seeking alternatives in traditional medicines. Therefore, there is an increasing consumer demand for herbal medicines in developed countries.

Ajwain is a highly valued medicinally important seed spice grown in arid and semi arid regions of the world. It is a native of Egypt and mainly grown in arid regions of India like Rajasthan, Gujarat, Madhya Pradesh, Andhra Pradesh, Telangana, Maharashtra, Uttar Pradesh, Bihar, West Bengal and some parts of Northern Karnataka. The seeds possess stimulant, carminative and antispasmodic properties and are used traditionally as an important remedial agent for flatulence, atonic dyspepsia, abdominal tumors, diarrhea, bronchial problems, abdominal pains, lack of appetite, galactagogue, piles and asthma. Ajwain seeds also contain 2–4% brown colored oil known as ajwain oil that contains thymol, which is a strong germicide, anti-spasmodic and fungicide. Thymol is also used in toothpaste and perfumery industry. Ajwain seeds are strongly pungent and aromatic in its taste and widely used as a spice in curries.

During 2016-17, ajwain was cultivated in an area of 29,000 ha in India, with a production of 26,000 tonnes and productivity of 890 kg ha⁻¹. From 2002-03 to 2016-17, the area, production and productivity of ajwain had been increased at a compound annual growth rate of 6.59 per cent, 12.94 per cent and 6 per cent respectively. This shows that the area under ajwain cultivation is significantly increasing over the years.

The history of ajwain cultivation is more than 50 years old in Hyderabad-Karnataka region. But the data regarding the area and production of ajwain in this region is nowhere documented and no attempt has been made to work out the economics of ajwain. Keeping the above issues in mind, the present investigation was carried out with following specific objectives.

Specific objectives of investigation

1. To analyze the costs and returns of ajwain cultivation and its competing crops.
2. To examine the resource use efficiency and productivity of various factors involved in ajwain production.
3. To assess the marketing cost and margin of ajwain under different marketing channels.
4. To identify the constraints in the production and marketing of ajwain.

The selection of samples for the study was based on purposive sampling method. Four villages in Raichur taluk and district were selected for the study. From each village, 10 ajwain growers and 10 non-ajwain growers were selected. Thus, the total sample size of the study was 40 ajwain growers and 40 non-ajwain growers. Data related to marketing of ajwain was also collected from 10 wholesale traders in Kurnool APMC where ajwain was sold by the sample farmers (since there is no wholesale market in Raichur) and 10 retailers in Raichur city. Primary data were obtained from the selected farmers using pre-tested schedule through personal interview for evaluating the objectives of the study. In addition, secondary data was also collected with respect to area, production, productivity, arrival pattern and average prices of ajwain, in order to understand the status of ajwain production and marketing.

The data were analyzed using descriptive statistical analysis, functional analysis, Garrett's ranking technique and other economic tools to arrive at meaningful conclusions.

Major findings of the study

1. Ajwain farmers have used lower quantity of FYM (0.22 tonnes), N (13.55 kg) and K₂O (2.60 kg) per acre, than the recommended dose. But, the usage of P₂O₅ (28.45 kg per acre) is more than the recommended dose.
2. Ajwain is a labour intensive crop, mainly with respect to operations like weeding (₹ 2955), harvesting (₹ 3102) and threshing (₹ 3345).
3. The per acre cost of cultivation of ajwain (₹ 25628.41) is higher than bengal gram (₹ 18932.79) and lower than cotton (₹ 40056.52).

4. The cost incurred on material inputs is lower in ajwain (₹ 4060.25) than both bengal gram (₹ 5466.62) and cotton (₹ 12609.63). Thus, ajwain is a low input crop compared to its competing crops.
5. Ajwain is a labour intensive crop with 48.60 per cent of the total cost of cultivation incurred on labour cost.
6. The average yield is lower in ajwain (3.97 q / acre) than both bengal gram (6.23 q / acre) and cotton (11.18 q / acre). But the net returns realized per acre in ajwain (₹ 23659.14) is almost three times higher than bengal gram (₹ 7233.21) and one and a half times higher than cotton (₹ 14725.48), because of higher market price of ajwain of about ₹ 12415 per quintal.
7. Returns per rupee spent is higher in ajwain (1.86) than both the competing crops bengal gram (1.38) and cotton (1.36).
8. The Coefficient of Multiple Determination (R^2) is 0.86 for estimated production function of ajwain and an increasing returns to scale is observed with a value of 1.17.
9. MVP to MFC ratio is more than one for all the resources included in the production function indicating the underutilization of all the resources.
10. The major marketing channel identified in the marketing of ajwain is channel I: Producer – Wholesaler (APMC) – Retailer – Consumer, through which 95 per cent of the farmers have sold their produce.
11. The total marketing cost incurred by farmers, per acre of ajwain grown is ₹ 2900.36 in which middlemen commission (50.98 per cent) and transportation charges (20.79 per cent) formed the major component.
12. The total marketing cost incurred by traders, per quintal of ajwain is ₹ 1095.15, out of which, the cost on transportation (21 per cent), storage (19.97 per cent), cleaning (18.26 per cent) and packing material (16.20 per cent) have a major share.
13. The profit earned by wholesalers and retailers in ajwain marketing are ₹ 6489.85 and ₹ 9200 per quintal, thus registering an effective market margin of 52.30 per cent.
14. Price spread is ₹17,585 and producer's share in consumer rupee is 41.38 per cent in ajwain marketing.

15. January to April is the major trading season of ajwain. Arrivals of ajwain at Kurnool market is increasing at a compound annual growth rate of 27.90 per cent and the prices are showing a fluctuating trend after 2011. But, they are essentially above ₹ 8000 per quintal.
16. Rajasthan (30 per cent), Gujarat (25 per cent) and Madhya Pradesh (15 per cent) are the major destinations for ajwain in India.
17. The major production constraints in the study area are that the crop is more prone to germination failure, non availability of improved varieties and shortage of skilled labour.
18. The major marketing constraints in the study area are lack of nearby markets, non-availability of latest market information and price fluctuation.

Policy implications

Based on the findings of the study the following policy measures are suggested.

1. The declaration of Ajwain as a notified commodity in Raichur regulated market is crucial. It will help the farmers in easy marketing of the produce and also prevent a revenue loss in the form of market fee (1.5 per cent) to the extent of 2.42 lakh per annum to Karnataka government.
2. Labour cost accounts for 48.60 per cent of the total cost of cultivation of ajwain. Therefore, awareness should be created about the use of machine for harvesting and threshing of ajwain, through trainings and demonstrations in the farmers' field, to reduce the labour cost.
3. Farmers in the study area do not possess much knowledge about the improved cultivation practices of ajwain. Thus, package of practice on ajwain should be standardized, so that the farmers can grow the crop scientifically.
4. Productivity of ajwain in Karnataka is higher (11.23 percent) than the all India average. In addition, ajwain is more profitable and labour intensive crop. Thus, it is recommended especially to small and marginal farmers to increase their area under the cultivation of ajwain, by providing suitable incentives.

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**AN ECONOMIC ANALYSIS OF PRODUCTION AND MARKETING OF AJWAIN
(*Trachyspermum ammi* L.) IN HYDERABAD-KARNATAKA REGION**

MANASA D.J

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**DR. LOKESH G.B
(MAJOR ADVISOR)**

ABSTRACT

Ajwain (*Trachyspermum ammi* L.) is a highly valued medicinally important seed spice grown in arid and semi-arid regions of India. The seeds are used in small quantities for flavoring various foods, in medicine and as preservatives. The study used both primary and secondary data to fulfill the objectives of the study. Primary data relating to socio-economic characteristics of farmers, economics of ajwain and its competing crops, marketing cost, margin and price spread of ajwain *etc.*, was collected from 80 farmers in Raichur district, among which 40 were ajwain growers and 40 were non-ajwain growers and 10 wholesalers in Kurnool market and 10 retailers in Raichur city. The data were collected through personal interview method with the help of pre-tested structured schedule.

The results revealed that the per acre cost of cultivation of ajwain is ₹ 25628 and it is higher than bengal gram (₹ 18933) and lower than cotton (₹ 40057). Ajwain is a labour intensive crop with 48.60 per cent of the total cost of cultivation incurred on labour cost. The net returns realized per acre of ajwain (₹ 23659) is higher than both bengal gram (₹ 7233) and cotton (₹ 14725), attributed to a higher market price of ajwain of about ₹ 12415 per quintal. The major marketing channel identified in the marketing of ajwain is channel I: Producer - Wholesaler (APMC) – Retailer – Consumer, through which 95 per cent of the farmers have sold their produce. Total market margin is 52.30 per cent. Price spread is ₹ 17,585 per quintal and producer's share in consumer rupee is 41.38 per cent in ajwain marketing. The major constraints in ajwain cultivation are: crop is more prone to germination failure and lack of nearby markets. There is an urgent need for declaration of ajwain as notified commodity in Raichur regulated market area.