PRODUCTION AND MARKETING OF MAIZE IN HASSAN DISTRICT OF KARNATAKA- AN ECONOMIC ANALYSIS

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DEPARTMENT OF AGRICULTURAL MARKETING, CO-OPERATION AND BUSINESS MANAGEMENT

UNIVERSITY OF AGRICULTURAL SCIENCES

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AFFECTIONATELY
DEDICATED TO
MY GUIDE, PARENTS,
AND FRIENDS.

DEPARTMENT OF AGRICULTURAL MARKETING, CO-OPERATION AND BUSINESS MANAGEMENT
UNIVERSITY OF AGRICULTURAL SCIENCES
BANGALORE

CERTIFICATE

This is to certify that the thesis entitled **"Production and Marketing of Maize in Hassan district of Karnataka- An Economic Analysis"** submitted by **Ms. MEGHANA, S. R.,** ID No. **PALB 9177** for the degree of **MASTER OF SCIENCE (Agriculture)** in **AGRICULTURAL MARKETING AND COOPERATION** to the University of Agricultural Sciences, Bangalore, is a record of research work done 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 other degree, diploma, associateship, fellowship or similar other titles.

Bengaluru
January, 2022

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3. _____
(H. M. JAYADEVA)

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Bengaluru
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PRODUCTION AND MARKETING OF MAIZE IN HASSAN DISTRICT OF KARNATAKA- AN ECONOMIC ANALYSIS

MEGHANA, S. R.

ABSTRACT

The present study on production and marketing of maize in Hassan district used both the secondary data (relating to area, production, productivity, arrivals and prices of maize) and primary data (60 maize growers and 30 market intermediaries). Results of the study indicated that area and production of maize decreased by 7.90 per cent and 7.10 per cent while productivity was marginally increased (0.94 %) during 2007-2017 in Karnataka. Maize arrivals and prices in Channaraypatna market showed variation during study period (2008 to 2019) with higher seasonal indices for arrivals and prices during the month of January (After harvesting) and the least during the month of August (coinciding with sowing season). The Johansen co-integration test revealed long run equilibrium between Hassan, Davangere and Bagalkot markets. Farmers incurred a total cost of Rs.37044 per acre in maize cultivation with B:C ratio of 1.20 indicating cultivation of maize is profitable. Majority (73.33 %) of the farmers preferred Channel I (Farmers→Village traders→Wholesalers→ Processing unit) compared to Channel II (16.67 %) and Channel III (10 %). However, the PSCR (31.68 %) and Acharya's marketing efficiency coefficient (0.46) were relatively higher in Channel-III compared to other channels. Scarcity of labour, high wage rate, fluctuation in price and high commission charges were the problems reported by respondents. Hence, there is a need to establish agro-processing which would benefit all the stakeholder in maize marketing *viz.*, producer-farmers by ensuring better prices, traders and processors to enjoy benefits of economies of scale.

January, 2022
Department of Agricultural Marketing,
Co-operation and Business Management,
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G. M. GADDI
(Major advisor)

ಕರ್ನಾಟಕದ ಹಾಸನ ಜಿಲ್ಲೆಯಲ್ಲಿ ಮೆಕ್ಕೆಜೋಳದ ಉತ್ಪಾದನೆ ಮತ್ತು ಮಾರುಕಟ್ಟೆಯ ಅಧ್ಯಯನ

ಮೇಘನ, ಎಸ್. ಆರ್.

ಸಾರಾಂಶ

ಮೆಕ್ಕೆಜೋಳದ ಪ್ರದೇಶ ಹಾಗೂ ಉತ್ಪಾದನೆ, ವೆಚ್ಚ ಮತ್ತು ಆದಾಯ, ಮಾರಾಟ ಮಾರ್ಗಗಳು ಹಾಗೂ ರೈತರು ಎದುರಿಸುತ್ತಿರುವ ಸಮಸ್ಯೆಗಳನ್ನು ಅಭ್ಯಸಿಸಲು ಪ್ರಸ್ತುತ ಅಧ್ಯಯನವನ್ನು ಹಾಸನ ಜಿಲ್ಲೆಯಲ್ಲಿ ನಡೆಸಲಾಯಿತು. ಈ ಅಧ್ಯಯನಕ್ಕೆ ಬೇಕಾಗಿರುವ ದ್ವಿತೀಯ (ಮೆಕ್ಕೆಜೋಳದ ಪ್ರದೇಶ ಹಾಗೂ ಉತ್ಪಾದನೆ, ಉತ್ಪಾದಕತೆ, ಚನ್ನರಾಯಪಟ್ಟಣ ಮಾರುಕಟ್ಟೆಗೆ ಮೆಕ್ಕೆಜೋಳದ ಆವಕ ಮತ್ತು ಬೆಲೆ ಮಾಹಿತಿ) ಹಾಗೂ ಪ್ರಾಥಮಿಕ ದತ್ತಾಂಶಗಳನ್ನು (60 ಮೆಕ್ಕೆಜೋಳ ಬೆಳೆಯುವ ರೈತರು ಹಾಗೂ 30 ಮೆಕ್ಕೆಜೋಳದ ಮಾರಟದಲ್ಲಿನ ಮದ್ಯವರ್ತಿಗಳಿಂದ) ಸಂಗ್ರಹಿಸಲಾಯಿತು. ಕರ್ನಾಟಕದಲ್ಲಿ 2007 ರಿಂದ 2017 ರ ಅವದಿಯಲ್ಲಿ ಮೆಕ್ಕೆಜೋಳದ ಪ್ರದೇಶ ಹಾಗೂ ಉತ್ಪಾದನೆಯ ಸಂಯುಕ್ತ ವಾರ್ಷಿಕ ಬೆಳವಣಿಗೆಯ ದರ ಕ್ರಮವಾಗಿ ಶೇ. 7.9 ಮತ್ತು ಶೇ. 7.10 ರಷ್ಟು ಇಳಿಕೆಯಾಗಿದೆ. ಉತ್ಪಾದಕತೆಯು ಶೇ. 0.94 ರಷ್ಟು ಏರಿಕೆಯಾಗಿದೆ. ಚನ್ನರಾಯಪಟ್ಟಣ ಮಾರುಕಟ್ಟೆಯಲ್ಲಿ ಮೆಕ್ಕೆಜೋಳದ ಆವಕ ಮತ್ತು ಬೆಲೆಗಳಲ್ಲಿ ಏರಿಳಿತಗಳು ಕಂಡುಬಂದಿದ್ದು, ಕಾಲೋಚಿತ ಸೂಚ್ಯಂಕವು ಜನವರಿ ತಿಂಗಳಿನಲ್ಲಿ ಅತೀ ಹೆಚ್ಚಾಗಿದ್ದು ಆಗಸ್ಟ್ ತಿಂಗಳಿನಲ್ಲಿ ಅತೀ ಕಡಿಮೆ ಇರುವುದು ತಿಳಿದುಬಂದಿದೆ. ಒಂದು ಎಕರೆ ಮೆಕ್ಕೆಜೋಳ ಸಾಗುವಳಿ ಮಾಡಲು ರೈತರು ರೂ. 37044 ರಷ್ಟು ಒಟ್ಟು ವೆಚ್ಚವನ್ನು ವ್ಯಯಿಸಿದ್ದು 1.20 ರಷ್ಟು ಲಾಭ:ವೆಚ್ಚ ಅನುಪಾತದೊಂದಿಗೆ ಮೆಕ್ಕೆಜೋಳದ ಕೃಷಿಯು ಲಾಭದಾಯಕವಾಗಿದೆ ಎಂದು ತಿಳಿದು ಬಂದಿದೆ. ಬಹುಪಾಲು (ಶೇ. 73.33 ರಷ್ಟು) ಮೆಕ್ಕೆಜೋಳ ಬೆಳೆಯುವ ರೈತರು ಮಾರಟಕ್ಕಾಗಿ ಮಾರ್ಗ– I (ರೈತರು–ಹಳ್ಳಿ ವ್ಯಾಪಾರಿ–ಸಗಟು ವ್ಯಾಪಾರಿ–ಸಂಸ್ಕರಣಾ ಘಟಕ) ಅನುಸರಿಸುತ್ತಿದ್ದು ನಂತರದಲ್ಲಿ, ಮಾರ್ಗ– II ಮತ್ತು ಮಾರ್ಗ– III ಶೇ. 16.67 ಮತ್ತು ಶೇ. 10 ರಷ್ಟು ರೈತರು, ಅನುಸರಿಸುತ್ತಿದ್ದು. ಮಾರ್ಗ– III ರಲ್ಲಿ ಗ್ರಾಹಕರ ಬೆಲೆಯಲ್ಲಿನ ಉತ್ಪಾದಕರ ಪಾಲು (31.68 %) ಹಾಗು ಆಚಾರ್ಯರವರ ಮಾರುಕಟ್ಟೆ ದಕ್ಷತೆ ಸೂಚ್ಯಂಕವು (0.46) ಸಹ ಹೆಚ್ಚಾಗಿದ್ದು ಕಂಡು ಬಂದಿದೆ. ಮೆಕ್ಕೆಜೋಳದ ಬೆಳೆಯಲ್ಲಿ ಕೂಲಿಯಾಳುಗಳ ಕೊರತೆ, ಹೆಚ್ಚಿನ ವೇತನ ದರ, ಬೆಲೆಯಲ್ಲಿ ಏರಿಳಿತ, ಹೆಚ್ಚಿನ ಆಯೋಗದ ಶುಲ್ಕ ಮುಂತಾದ ಸಮಸ್ಯೆಗಳನ್ನು ಬೆಳೆಗಾರರು ಎದುರಿಸುತ್ತಿದ್ದಾರೆ. ಆದ್ದರಿಂದ ಮೆಕ್ಕೆಜೋಳ ಉತ್ಪಾದನೆ ಮತ್ತು ಮಾರಟದಿಂದ ಹೆಚ್ಚಿನ ಲಾಭ ಗಳಿಸಲು ಕೃಷಿ ಸಂಸ್ಕರಣಾ ಉದ್ಯಮವನ್ನು ಸ್ಥಾಪಿಸುವುದು ರೈತರಿಗೆ, ವ್ಯಾಪಾರಿಗಳಿಗೆ, ಸಂಸ್ಕರಣೆ ಮಾಡುವವರಿಗೆ ಅನುಕೂಲವಾಗಲಿದೆ.

ಜನವರಿ, 2022 **ಜಿ. ಎಮ್. ಗಡ್ಡಿ**
ಕೃಷಿ ಮಾರಟ, ಸಹಕಾರ ಮತ್ತು ವ್ಯವಹಾರ ನಿರ್ವಹಣೆ ವಿಭಾಗ ಪ್ರಧಾನ ಸಲಹೆಗಾರರು
ಕೃ.ವಿ.ವಿ., ಗಾಕೃವಿಕೆ, ಬೆಂಗಳೂರು

Economic Analysis of Maize Cultivation in Hassan District of Karnataka

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Introduction

Maize (*Zea mays* L.) is known as queen of cereals because it has the highest genetic yield potential among the cereals. It is cultivated on nearly 190 m ha in about 165 countries having wider diversity of soil, climate, biodiversity and management practices that contributes (39 %) in the global grain production. The United States of America (USA) is the largest (36 %) producer of maize (APEDA, 2020).

In India, Maize is predominantly grown during *kharif* (85 %) and is the third most important cereal crop in India after rice and wheat. It accounts for around 10 per cent of total food grain production in the country. In addition to staple food for human being and quality feed for animals (APEDA, 2020). Country produced 30,250 thousand tonnes during 2020 with at an average annual growth rate of 4.67 per cent. Among Indian states, Madhya Pradesh, Karnataka, Maharashtra, Bihar, Rajasthan and Uttar Pradesh. In Karnataka it is mainly cultivated as a rainfed crop in *Kharif* season in Davangere, Belgaum, Bagalkot, Chamrajnagar, Hassan and Haveri districts. The Present study was undertaken in Hassan district which tops in southern Karnataka with the following objective.

Objective

To analyse the costs and returns in maize cultivation.

Methodology

Study Area: Hassan district, Karnataka.

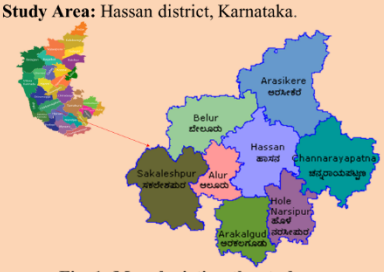


Fig. 1: Map depicting the study area

Nature and sources of data:

Secondary data:

The data on area, production and yield of maize were collected from publications of the Directorate of Economics and Statistics, District Statistical Office and other relevant sources for selection of the study area and respondents.

Primary data:

The data from 60 respondents related to socio-economic characteristics, cropping pattern, input use, output, price realized, marketing practices, constraints in production and marketing were collected with the help of pre-tested schedule designed for the purpose through personal interview method.

Analysis :Descriptive statistics.

Sample size: 60

Five villages where the maize is grown predominantly were chosen based on area dominance from each of the two taluks of Holenarasipura and Channarayapatna. Six farmers from each village cultivating maize were selected.

Results

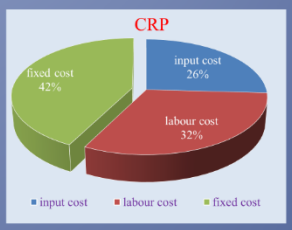
Table 1: Per acre cost of cultivation of maize in the study area

Sl. No.	Particulars	HNP		CRP		Overall area	
		Value (₹)	Per cent	Value (₹)	Per cent	Value (₹)	Per cent
1.	Material cost	9463	25.44	9179	24.88	9321	25.16
2.	Labour cost	11820	31.78	11202	30.36	11511	31.07
3.	Total Variable cost	22028	59.22	21808	59.11	21918	59.17
4.	Total Fixed cost	15165	40.77	15085	40.89	15125	40.83
5.	**Total cost of cultivation**	**37194**	-	**36894**	-	**37044**	-

Table 2: Production and returns from maize cultivation in the study area

Sl. No.	Particulars	HNP		CRP		Overall area	
		Qty	Value (₹)	Qty	Value (₹)	Qty	Value (₹)
1.	Main product (q)	23.70	40621	22.30	38222	23.00	39422
2.	By-product (Fodder-tractor load)	2.13	5325.	2.20	5060	2.17	5192
3.	Gross returns (₹)	-	45946	-	43282	-	44614
4.	**Net returns (₹)**	-	**8752**	-	**6388**	-	**7570**
5.	Returns per rupee of expenditure (₹)	-	1.24	-	1.17	-	1.20

Note: HNP- Holenarasipura and CRP-Channarayapatna



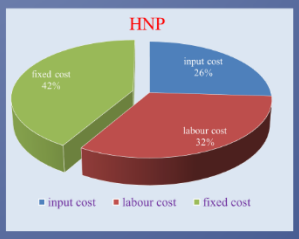


Fig. 2: Per cent share of costs incurred by maize growers in Hassan district

Note: CRP = Channarayapatna
HNP= Holenarasipura

Discussion

The results presented in table 1 revealed that the total cost of cultivation of maize was Rs. 37044.20 per acre in the overall study area without much difference between farms of Holenarasipura taluk and Channarayapatna taluk

In the total cost of cultivation of maize of Rs. 37194 per acre in Holenarasipura taluk, 59.23 per cent was the variable cost (Rs. 22028.46) and 40.77 per cent was fixed cost (Rs. 15165.87). The corresponding values for Channarayapatna taluk Rs. 36894 and Rs. 21808.91

Farmers realized maize grain yield of 23.7 quintals and by-product yield of 2.13 tonnes per acre in Holenarasipura taluk and the corresponding figures for Channarayapatna taluk were 22.3 quintals and 2.2 tonnes (Table 2). For the pooled data of both the taluks, gain yield obtained was 23 quintals and by-product was 2.17 tonnes.

The gross returns obtained was Rs. 44614.50 and net return was Rs. 7570.30 per acre. The returns realized for every rupee spent in maize cultivation was relatively higher in farms of Holenarasipura taluks (1.24) compared to sample farms of Channarayapatna (1.17) taluk.

Conclusion

Cultivation of maize was profitable and hence establishing agro-processing industries to manage the sufficient production in the study area is desirable as it would benefit all the stakeholder, *viz.,* producer-farmers, traders and processors as many poultry enterprise are coming up in the study area, which would help to fetch better price and achieve price stability.

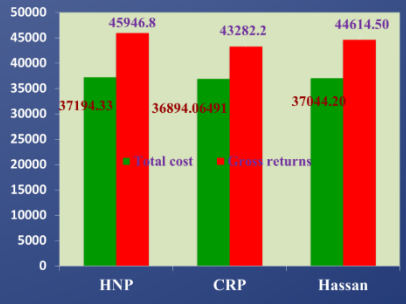


Fig. 3: Comparative Value share between total cost and gross returns in study area

Fig. 4: Glimpses of data collection from respondents in Hassan district

Advisory Committee

Chair person: Dr. G. M. GADDI
Members : Dr. M. S. GANAPATHY
Dr. SIDDAYYA
Dr. H. M. JAYADEVA

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I INTRODUCTION

Agriculture sector is the pulse of the Indian economy as it is evident from the fact that it is the only sector which witnessed a positive growth at 3.4 per cent when the India's economy slowed down by 24 per cent in the COVID-19 pandemic hit first quarter of the financial year 2020-21, giving a ray of hope towards economic revival. India contains 48 per cent and 25 per cent of the total world's arable land, which is suitable for cultivation and total number of farmers, respectively in the world.

On the other hand, the agriculture sector in India has been facing challenges which have beaten out its opportunities like inconsistent policy frameworks, chaotic land records, cropping patterns being unsustainable and unscientific, inability to adopt to newer technologies, inadequacy of irrigation facilities, bottlenecks in backward and forward linkages which in turn make farmers vulnerable to exploitation by the market intermediaries and unable to absorb the shocks posed by the changing climatic pattern.

Agriculture plays a vital role in India’s economy about 54.6 per cent of the total workforce is engaged in agricultural and allied sector activities and accounted for 17.8 per cent of the country’s Gross Value Added (GVA) for the year 2019-20 (Anon., 2021) the performance of farm sector depends upon large number of crops, livestock and many other subsidiary sectors. Hence, the assessment of performance of crops by choosing the crops of having local and international importance is crucial. Therefore, the Maize crop has been chosen for the present study to probe in different issues related to the crop.

Maize is being cultivated by the farmers extensively since 25 to 30 years in Karnataka in general. Mostly maize has been cultivated as mono-crop. Maize is termed as “lazy man’s crop” (Oxholm and Chase, 1974) because of its less labour requirement and intercultural operations. Hence, cultivation of maize is assumed to be easy and it derives better returns and impacts on the livelihood standard of the farmers. Due to favourable climate and soil condition Hassan district is more suitable to grow maize crop.

Maize (*Zea mays* L.) is one of the most versatile crops, which thrive in a wide range of agro-climatic conditions. Maize is recognized as queen of cereals around the

world because of its highest genetic yield potential among the cereals and it contributes to food security in most of the developing countries. In India maize is emerging as third most important crop after rice and wheat. Its importance lies in the fact that it is not only used for human food and animal feed but at the same time it is also widely used for corn starch industry. The increasing use of maize as feed increasing nearest of the consumers in nutritionally enriched products and rising demand for maize seed are the core driving forces behind emerging importance of maize crop in India.

Maize can be grown in a wide range of soil types, from loamy sand to clay loam. Soils with high organic matter content, high water holding capacity, and a neutral pH, on the other hand, are thought to be more productive. Because it is a sensitive crop to moisture stress, especially excessive soil wetness and salinity stress, it is best to avoid low-lying fields with inadequate drainage.

The United States of America (USA) is the world's largest producer of maize, accounting for almost 35 per cent of global production with the highest productivity (> 9.6 t/ha) which is more than double the global average (4.92 t/ha). Whereas, the average productivity in India is 2.43 t/ha (Anon., 2020a)

World Scenario

It is the world's second most extensively farmed crop planted in tropical, subtropical, and temperate climates, and comes in varieties including field corn, sweet corn, popcorn, and baby corn. There are various sorts of field corn, including quality protein maize, waxy maize, high-oil maize, and so on. Maize is an important food, feed, and industrial raw resource for billions of people. Over 170 nations are currently producing nearly 1147.7 million metric tonnes of maize on an area of 193.7 million ha, with an average productivity of 5.75 t/ha (Anon., 2020b)

The production of maize increased at a decadal CAGR of 3.4 per cent from year 2009 to 2019. The important maize producing countries in the worldwide are The United States, China, Argentina and Brazil which together account for over 65 per cent of global production. The global acreage under maize cultivation has increased from 159 million

ha in 2009 to 197 million ha in 2019, growing at a CAGR of 2.2 per cent. The production of maize was increasing 1.3 per cent during that period. Thus, increase in production has been largely driven by improved yields (Anon., 2020b) USA has the most advanced maize creation on the planet for example around 375 million tonnes, which is 36 per cent of the absolute maize creation on the planet. The USA has the most elevated usefulness for example around 10.5 t/ha which is practically twofold of the worldwide efficiency. India ranked sixth with 2.5 per cent of the world maize production producing 27.23 million tonnes from about 9.20 million hectare with 2.95 t/ha productivity at annual growth rate of 3-4 per cent (Anon., 2018c).

Coming to the utilization of maize, 61 per cent is used for feed, 17 per cent as food 22 per cent in industry and other purposes around the world. Furthermore, around 3000 Products are produced using maize directly or indirectly, providing a completely open door to esteem expansion. It is a major driver of the global rural economy due to its diverse uses (Anon., 2020d)

Indian scenario

Among the maize-producing nations India is fourth in terms of area and seventh in terms of production, accounting for roughly (4 %) of global maize area and (2 %) of overall production. In India, the maize acreage increased to 9.2 million hectares in 2018-19 (Anon., 2020e) in 1950-51, India produced 1.73 million metric tonnes of maize, which has climbed to 27.8 million metric tonnes in 2018-19, an almost 16-fold increase in production. During this time, average productivity increased 5.42 times, from 547 kg/ha to 2965 kg/ha, while area increased nearly threefold. India's maize productivity is about half that of the world average.

Over the last few decades, maize cultivation has shifted from being grown only during the *kharif* in traditional areas such as Rajasthan, Uttar Pradesh and Bihar, primarily to be used as food, to being grown across nontraditional areas like Andhra Pradesh, Madhya Pradesh and Karnataka, across seasons and primarily for industrial use. Maize is farmed in India during two seasons: rainy (*kharif*) and winter (*rabi*). *Kharif* maize covers approximately 83 per cent of India's maize land, while *rabi* maize covers

only 17 per cent. Over 70 per cent of maize area during *kharif* is rainfed, with several biotic and abiotic stressors prevalent. The productivity of *kharif* maize is lower (2706 kg/ha) compared to *rabi* maize (4436 kg/ha).

Madhya Pradesh (15 %) and Karnataka (15 %) have the most maize-growing land, followed by Maharashtra (10 %), Rajasthan (9 %) and Uttar Pradesh (8 %). Bihar produces the most maize after Karnataka and Madhya Pradesh. The state of Andhra Pradesh has the highest productivity. The majority (> 50 %) of maize produced in India is manufacturing of chicken feed, followed by use for livestock feed and food uses (13 %), industrial purposes (12 %), in the starch sector (14 %), as processed food (7 %), and export and other purposes (6 %) (Anon., 2020b)

Maize is priced based on quality and moisture levels, but it is still selling for less than MSP across the country. The surge in exports is largely due to Bangladesh, which has imported a record two-thirds of the commodities transported out of India. Last year, domestic end-users such as the poultry and starch industries complained about supply shortages and excessive costs, prompting an increase in exports. According to APEDA data, maize exports totalled at 9.22 lakh tonnes worth (US $184.52) million in the first half of the fiscal year, up from 3.70 lakh tonnes for (US $142.78) million in the previous fiscal year.

Karnataka scenario

In Karnataka during 2017-18, maize was grown on an area of 1.31 million ha with the production and productivity of 3.853 million tonnes and 2869 kg/ha, respectively. In Karnataka, maize can be grown throughout the year in view of the favourable agro-climatic condition. However, maize is mainly cultivated as a rainfed crop in *Kharif* season in Davanagere, Belgaum, Bellary, Chitradurga, Dharwad, Hassan, Chamarajanagar and Haveri Districts. The production of maize in Karnataka state increased at 7.76 per cent per annum, largely attributable to area expansion (8.02 %). However, state has registered a marginal decrease in the maize productivity of 0.25 per cent per annum during the study period from 1990-91 to 2015-16 (Murulidhar *et al*. 2019).

Current maize utilization pattern

Maize is typically sold from October to December for *Kharif* crops and from January to May for *rabi* crops. Depending on the season, the most maize arrives in our country in Andhra Pradesh and Karnataka, followed by Bihar, Madhya Pradesh, Uttaranchal, and Uttar Pradesh. Maize is transported from assembly markets to consuming markets inside the state in most parts of the country. Maize is shipped to neighboring states from excess producers like as Andhra Pradesh, Gujarat, Karnataka to Orissa, and Uttar Pradesh. Maharashtra, West Bengal, Tamil Nadu, Rajasthan, Delhi, Bihar, Chhattisgarh, Haryana, and Assam are the largest consumers.

Maize demand has increased dramatically over the last five years. The feed sector is responsible for the majority of this increase in demand, followed by starch makers and human consumption in the form of quick and processed food. Nearly 60 per cent of the produce arriving in the mandies is purchased by poultry feed makers, 20 per cent by starch extractors, 15 per cent for human use, and five per cent for the production of alcoholic drinks. In recent years, other countries have experimented with extracting ethanol from corn for biofuel production. The domestic manufacturing of ethanol in India is still in its infancy.

Even though India has achieved cereal and grain self-sufficiency, about half of the country's youngsters are still malnourished. Because maize is a low-cost grain, it has the potential to be the first choice for the poor and downtrodden. The nutritional and clinical benefits of maize, if properly exploited through strategic interventions such as value-added maize product creation, utilization, and commercialization, can help to ensure improved Indian population's health. The availability of maize-based value-added food items on an industrial scale will improve nutritional and livelihood security. Maize-based value added products are being commercialized, promoted and adopted (Murdia *et al*. 2016).

Need for the present study

The efficient marketing channels for agriculture produce plays an important role in stimulating the production and consumption pattern and also it helps to accelerate the economic development. It ensures higher income for the farmers and broadens the markets by covering all possible areas of the country. It has been observed that when a large amount of the produce reaches the markets during peak seasons, the prices are often low, which significantly reduces the farmer's income.

The present study on production and marketing of maize in Hassan district was planned with the following specific objectives.

Objectives

1. To analyze the trends in area, production and productivity of maize in Karnataka.
2. To estimate the cost and returns in maize production.
3. To study the efficiency of different channels of marketing identified for maize.
4. To identify the constraints in production and marketing of maize.

Hypotheses

1. The increased maize production in Karnataka is area led and maize yield levels are stagnated in the state.
2. Production of maize is more stable than area under maize.
3. The cultivation of maize is economically profitable.
4. The producers' share in consumer rupee decreases with increase in number of middlemen.

Presentation of the study

The entire study has been presented in six chapters, Chapter-I presents introduction of the research topic, importance of maize in the economy, specific objectives and hypotheses of the study. Chapter II presents the review of earlier studies connected with the objectives of the present investigation. Chapter III details the methodology i.e. description of the study area, nature and sources of data, tools and techniques of analysis adopted for evaluating the objectives including terms and concepts used in the present study. Chapter IV gives results of the study consistent with the objectives and discussion on the major findings of the study. Chapter V summarizes study with policy implications based on the findings of the study and the detailed bibliography is presented in Chapter VI.

II REVIEW OF LITERATURE

Review of literature helps the researchers in knowing the previous works done in their field of research and thereby helps in identifying proper analytical and methodological issues relevant to the study. It enables the researchers to carry out research work in a proper direction and enables to draw conclusions. Therefore, the past studies were reviewed and are presented under the following headings.

2.1 Trends in area, production and productivity of crops

2.2 Cost and returns in production farm enterprises

2.3 Efficiency of marketing channels

2.4 Constraints in production and marketing of farm enterprises

2.1 Trends in area, production and productivity of crops

Saraswathi *et al.* (2012) studied the growth in area, production and productivity of major crops in Karnataka using the compound growth function. The state registered a significant increase in maize area (8.01 % per annum) during the study period. The rapid expansion in area under maize crop was mainly due to its important features like short duration, adaption to a wide range of soils and climatic conditions and high yield per hectare as compared to other cereal crops. In Karnataka, maize production increased at the rate of 8.29 per cent per annum during the study period.

Singha and Chakravorthy (2013) conducted study on crop diversification in India and revealed that maize is an important crop grown in Karnataka. Results showed that the growth of production of maize recorded the highest with an annual growth rate of 8.5 per cent in the last three decades (1980-2010). They explored that the introduction of new hybrid yield variety seed was one of the most important factor for significant growth of maize crop. Maize was suitable in the dry region and timely rainfall found to have significant on the yield level.

Ahmad *et al*. (2014) conducted a study on economic analysis of changes in cropping pattern in Karnataka. They used 30 years of time series data on area under different crop categories. Results showed that soyabean and sunflower were first in terms of growth in area with an annual growth rate of more than 8 per cent over a period from 1979-80 to 2008-09, followed by maize (7.65 %) accounting 357.73 per cent of change over the two periods, whereas the sunflower (8.31 %) and paddy (0.85 %) accounted for 473.77 per cent and 25.34 per cent change over the two periods, respectively. While, cotton and groundnut crops showed negative trend and decreased by 2.21 per cent and 0.12 per cent, respectively.

Kumar *et al*. (2014) analyzed the production performance of maize in India. The results showed that, average crop yield of 2.5 tonnes per hectare was very low as compared to the other Asian countries, such as Bangladesh (6.8 t/ha), China (5.7 t/ha), Indonesia (4.6 t/ha) and Pakistan (3.8 t/ha) in 2012. They also suggested that the demand for maize in domestic as well as international market grows faster than the production growth by creating good potential for Indian maize in near future.

Ganjeer *et al*. (2017) analyzed trends, production and productivity of wheat crop in Northern hills of Chhattisgarh in India. The results of the study revealed that the growing of wheat is not risky, as the coefficient of variation (CV) of area, production and productivity was less than 8.4 per cent. The growth rate for area, production and productivity for wheat crop are positive and instability indices are very low indicating less risk in growing this crop in future too. The production and productivity of the wheat crop have increased during the period due to the combined effects of area and productivity.

Kumar *et al*. (2017) conducted a study to examine the growth rates in area, production and productivity of major cereal crops in Sikkim, India using time series analysis. Authors revealed that area under the cultivation of wheat, rice, finger millet and barley was decreasing by 0.544, 0.37, 0.12 and 0.065 thousand hectares per year respectively. Similarly, production of barley, finger millet, wheat and rice was decreasing by 0.09, 0.069, 0.774 and 0.169 thousand tonnes per year, respectively. While maize and

buckwheat showed increasing production by 0.164 and 0.164 thousand tonnes per year, respectively. Authors concluded that shifting of farmer's focus toward the horticultural and plantation crops may be the main cause for negative trend in the production of major cereal crops.

Das *et al*. (2019) analyzed growth and instability in area, production, productivity and consumption of millets in India. Instability analysis using coefficient of variation (CV) and instability index suggested by Cuddy and Della revealed that over the years of production and productivity of both pearl millet showed higher degree of variation. Compound annual growth rates of millets production showed positive growth of 1.65 per cent and productivity of pearl millet of 3.37 per cent despite decrease in area (-1.78 %) under cultivation.

Muralidhar *et al*. (2019) conducted the study on growth performance and marketing of maize in Karnataka, India. The secondary data on maize area, production and yield were collected for fifteen years from 1990-91 and the results revealed that the production in state during study period increased at 7.76 per cent per annum. State exhibited significant growth rate of 8.02 per cent per annum area under maize. The district-wise contribution and analysis of growth performance of maize in Karnataka revealed that Davanagere, Haveri, Belagavi, Chitradurga, and Bellary together accounted for about 50 per cent of area and production of maize in Karnataka.

Shah (2019) conducted study to estimate the growth trends in area, production and productivity of apple fruit in Jammu and Kashmir. The data were analyzed through growth rate, trend analysis and co-efficient of variation techniques and results showed that CAGR of the area has increased from 2.33 per cent to 3.16 per cent and the production has increased only from 3.51 per cent to 3.83 per cent while, the yield has decreased from 1.15 per cent to 0.64 per cent. The estimated linear growth model showed that the annual growth rate of 3.16 per cent.

Parimalarangan (2020) conducted the study on trends in area, production and productivity of onion in Tamil Nadu by using compound growth rate. Growth rates

analysis was widely employed in the field of agriculture as it has important policy implications. Results showed that there was a negative growth rate of area from 2000-01 to 2015-1 i.e. (-13.88 %), whereas positive growth rate (11.25 %) in case of production. Even though there was decline in area, production was increased due to increasing productivity.

Ramesh *et al*. (2020) studied the growth rates in area, production and productivity of cotton crop in Dharwad, Ballari and Raichur districts of Karnataka. The results revealed that area, production and productivity of cotton crop marked a significant increase in growth rate. Dharwad showed growth rate in area (4.37 %), production (3.82 %) and productivity (3.01 %), Ballari also followed the same trend with little intensity of growth and the respective figures were 2.78 per cent, 3.26 per cent and 2.99 per cent. While in Raichur district there was decreasing trend in area (-5.59 %) while production (3.72 %) found to be increasing due to positive growth in productivity (3.26 %) of cotton.

2.2 Cost and returns in farm enterprises

Pagare *et al*. (2013) studied cost and profitability of *rabi* jowar cultivation in Marathwada region of Maharashtra and results revealed that in case of physical input and output there was negative relationship between human labour and farm size and there was no significant difference in the use of bullock labour and machine labour among different categories of farm and also per ha crop wise cost was Rs. 15294.21 on overall category of farmer's field. Farmers realized yield level of 15.52 q/ha and gross income of Rs. 26968 and this indicates that *rabi* jowar is quite profitable for cultivation for all categories of farmers especially for the large farmers in Marathwada region.

Sreelatha *et al.* (2013) conducted a study on grain and water productivity of rice-zero-till maize cropping system. Experiment was conducted during 2007-08 and 2008-09 at field experiment station at Hyderabad. Results revealed that transplanted rice (1.02 t/ha) recorded higher yield than aerobic rice (4.49 t/ha). However, succeeding maize grown as zero-tilled crop after aerobic rice was 0.34 tonnes per hectare more yields than that after transplanted rice (6.34 t/ha). The higher water productivity of aerobic rice (0.39 kg/m^3) and succeeding zero-tilled maize (1.17 kg/m^3) as compared to transplanted rice

and succeeding maize (0.37 and 1.09 kg/m^3) together brought higher water productivity (0.64 kg/m^3) in aerobic rice-maize system in comparison to transplanted rice-maize (0.54 kg/m^3).

Gore (2014) studied comparative economics of *rabi* sorghum and wheat in Solapur district of Maharashtra. He observed that the average cost of cultivation of jowar was Rs.8749.82 per ha and gross returns was Rs.10871 per ha. On an average, returns over Cost-A (Jowar) Cost-B (Wheat) and Cost-C (Gram) were found to be Rs. 5183, Rs. 2728 and Rs. 2122, respectively. The per quintal cost production worked out to be Rs. 566.33 while output-input ratio was 1.24 in *rabi* sorghum production.

Churpal *et al*. (2015) conducted a study on economic analysis of rice in Chattisgarh. The study revealed that the average farm size was 2.47 ha. Overall, cost of cultivation of Mahamaya rice variety was Rs. 37090.31 t/ha. Which comprised of 61.14 per cent of labour cost followed by input material cost (32.56 %) and fixed cost (6.30 %), respectively. Overall, yield of Mahamaya rice variety was 55.79 q/ha. Farmers realized gross returns of Rs. 87432.40/ha from Mahamaya rice variety with input output ratio of 1:2.36.

Kathirvel and Karthika (2015) conducted study on cost and returns of maize cultivation in Tirupur district and results showed that there was a significant difference in the total variable cost for the cultivation of maize per acre among small (Rs. 14364.85), medium (Rs. 14095.27) and large farmers (Rs. 14103.33) and no significant difference in per acre total fixed cost in the cultivation of maize among different categories of farmers. However, there was significant difference in the total cost of cultivation of maize per acre among small (Rs. 22438.39) medium (Rs. 21949.10) and large farmers (Rs. 21376.44).

Zalkuwi *et al*. (2015) analyzed and compared the cost and return of sorghum production in India and Nigeria using data collected from respondents using simple random sampling techniques. The result of the CACP cost concept revealed that average output of the respondents 17.68 and 18.14 quintals per hectare for India and Nigeria sorghum production systems respectively. Also, the revenue generated were Rs. 17354.30

and Rs. 20642.10 per hectare for India and Nigeria sorghum production respectively. The sorghum production had a gross margin and net farm income of Rs. 28281.90 and Rs. 17354.30 per hectare, respectively while Nigeria sorghum producer had a gross margin and net farm income of Rs. 29810 and Rs. 20642 per hectare, respectively.

Chendrashekhar and Lokesh (2018) conducted study on cost and returns of paddy crop under different residue management practices in Tunga Bhadra command area of Karnataka. It was observed that the total variable cost per acre was higher in incorporation of straw and stubbles (Rs. 30029.25) compared to removal of straw and burning stubbles (Rs. 29345.33) and burning of straw and stubbles (Rs. 26616.61). The highest total cost per acre was recorded in incorporation of straw and stubbles (Rs. 41845.65) than burning of straw and stubbles (Rs. 38411.33). The highest yield per acre was recorded in the incorporation of straw and stubbles (29.75 q/acre) than removal of straw and stubbles (29.15 q/acre).

Abera *et al*. (2019) conducted study to estimate cost of production of rice and assessing its profitability under smallholder farmers in lowland agro ecologies of Fogera plain, Ethiopia. Descriptive statistics and enterprise budgeting were used to analyze data collected from selected farmers. The study revealed that the average productivity of rice was 3.6 ton per hectare. The enterprise budget analysis indicated that sampled farmers obtained a profit margin of 49.51 per cent per hectare with B:C ratio of 1.98, and breakeven price and yield of 4.66 ETB per kg and 2064 kg per hectare. Rice production is a profitable enterprise and the study suggests that research institution should focus on developing and promoting productivity by improving and labor saving technologies.

Jain *et al*. (2019) conducted study on cost, returns and profitability of *kharif* maize in Solapur district of Maharashtra. The district with high area under maize crop Malshiras, Pandharpur and Sangola tehsils were selected. The information collected with respect to expenditures and returns were analyzed using cost concept like Cost –A (Variable cost) Cost- B (Fixed cost) and Cost – C (Cost B+ Family human labour). Results revealed Cost – A was Rs. 49631.66 in which Cost –B was Rs. 65483.72 while

that of Cost – C was Rs. 71276.94. Gross returns were found to be Rs. 92475.42 and thus farmers realized net profit of Rs. 21198.48 with B: C ratio of Rs. 1.29.

Pathok and Deka (2019) conducted a study on cost, returns and prices of paddy in Assam and results found that the growth rate of yield per annum was low compared to cost of production and cost of cultivation. Value of correlation coefficient (0.63) between yield and cost of production indicated that with increase in cost of production yield increases and vice versa. The value of correlation coefficient between yield and net income was found to be (-0.54) which was due to increase in cost of cultivation. The relation between yield and MSP was found to be highly positive (0.93). Cost of production and net income had negative relation which is common phenomena revealing inverse relationship between cost and return.

2.3 Efficiency of different marketing

Kumar (2009) studied marketing aspects of wheat in U.P. He selected marketing channels randomly and concluded that the marketing charges paid by producer in Channel-I (Producer-Wholesaler-Retailer-Consumer) were higher than that of Channel-II (Producer-Trader-Wholesaler-Retailer-Consumer). The marketing charges born by wholesaler were highest in both the channels. The sale price of producer in Channel-I was Rs. 560 per quintal and Rs. 542.00 per quintal in Channel-II. The purchase price for consumer in Channel-I was Rs. 646.50 and Rs. 661.50 per quintal of wheat. The producer's share in consumer price was 84.49 percent and 40.49 percent respectively in Channel-I and Channel-II.

Taj *et al*. (2013) made a detailed analysis of price spread and marketing margin of cut rose in Punjab and Pakistan and marketing channels were identified as Channel-I (producers-wholesalers-cum-commission agents-retailers–consumer) and Channel-II (producers-retailers). In Channel-I the highest consumer's price of Rs. 444.78 per 100 pieces of cut roses indicated that consumers have to pay more there. The price spread was greater in Channel-I which was Rs. 243.36 per 100 pieces of cut roses. In Channel-II where producers were directly linked with retailers, producer's share was maximized up to (46.86 %) which increases the marketing efficiency of Channel-II as compared to

Channel-I. The study revealed that as the number of marketing intermediaries in the marketing channel increases the producers and consumers were least benefitted. Therefore there was need for more vertical integration in the cut roses market.

Richard *et al*. (2013) conducted study on identifying and quantifying costs and their impact on maize market participation for small holder farmers in Zambia. The logit results showed that ownership of assets (radio) having access to alternative marketing channels increased the likelihood of market participation, while the heckit results showed that ownership of OX-carts, increased family size and experience in maize marketing. The study recommended that provision of market information, improving accessibility to markets, as well as increasing access to productive assets as means of alleviating impact of transaction costs.

Ranganath *et al*. (2013) made an attempt to analyze the structure and competitiveness of the maize market in Davangere district of Karnataka. The Lorenz coefficient of inequality was found to be 0.20 which revealed that there existed a higher degree of competitiveness for maize in Davangere, as market concentration was less. The maize traders from Davangere established linkage with the poultry feed manufacturers of the district. Among the three poultry feed units in the study area, Feeds India private limited stood first for price and procurement reasons and Pragathi feeds was preferred for payment reasons.

Kausar and Aslam (2016) made a study of marketing efficiency of maize in Bangladesh and indentified channels as (i) Farmers-Farias-wholesalers-Aratdars-feed mills (ii) Farmers-wholesalers-Aratdars-feed mills (iii) Farmers-Aratdars-feed mills (iv) Farmers-wholesalers-feed mills, and (v) Farmers-Farias-Aratdars-feed mills among the identified channels, Channel III was the most efficient channel. Channel IV was the next best alternative of Channel III. The study explained the plausible reasons why Channel III was most efficient one. The study suggested reducing the number of intermediaries by developing a system of direct buying from farmers and selling directly to Aratdars or feed mills.

Kumar *et al*. (2017) selected Uttar Pradesh to identify marketing channels of Marketing costs, margins and producer's share in consumer rupee with the help of available data and information and the channels are (i) Producer-Govt. Procurement Agency-Rice miller- Govt. Agency - Fair price shop dealers -Consumers (ii) Producer-Village traders -Primary wholesaler-Rice miller-Secondary wholesaler–Retailer-Consumer (iii) Producer-Primary wholesaler-Rice miller-Secondary wholesaler-Retailer-Consumer (iv) Producer-Rice miller-wholesaler Consumer and the marketing margins obtained by different agencies were Rs. 158.00, 133.00 and 113.00 in case of Channel-II, III and IV respectively. The marketing charges, margins were highest in Channel-II followed by Channel-III and Channel-IV and it is because of higher number of intermediaries involved in Channel-II. The marketing efficiency index of Channel-IV was highest as compared to the Channel-III and Channel-II. The producer's share was found to be highest in case of Channel-IV, where as the number of intermediaries are lesser. The Channel-IV found to be most efficient and suitable to the farmers.

Singh *et al*. (2019) studied marketing aspects in Auraiya district of Uttar pradesh. Three marketing channels were identified for disposal of maize in the study area i.e. 1-Producer-Consumer, 2- Producer-Retailer-Consumer and 3- Producer-Wholesaler-Retailer-Consumer. Net price received by producer was observed higher in Channel -1, followed by Channel -2 and Channel-3 which revealed inverse relationship between net price received by producer and number of intermediaries. Producers share in consumer's rupees was found (95.8 %) in Channel –1 followed by Channel -2 i.e. (92.04 %) and Channel -3 (79.42 %) respectively. It revealed that Channel -1 was most efficient for producers as well as consumers followed by Channel -2 and Channel-3 in study area.

Ranathilaka *et al*. (2019) conducted study to determine the relative profitability of banana in Srilanka and result showed that there is a wide range in cultivating practices and sales channels which all are linked together into the supply chain in the country. Total cost, profit and benefit cost ratio for indifferent marketing channels such as banana producers, wholesalers and retailers were investigated. The results showed that, the profit margin of the retailer is greater than that of the farmers and wholesalers. It is also found

that average benefit cost ratio of the producer was highest, however the retailer has the largest impact on determining the price of banana in the intermediate chain.

Cariappa and Sinha (2020) studied about marketing channels of paddy and used data from a nationally representative survey to identify the factors that determine farm households' choice of paddy marketing channels and the impact of the choice on the price realized. Small landholders sell their produce predominantly in informal or traditional value chains. Multinomial treatment effect estimates with endogenous market channels indicate that small landholders are less aware of the government-set floor price (minimum support price) and they realized lower prices and earn lower incomes than farmers selling in mandis (regulated markets).

Agbongiarhuoyi *et al*. (2020) studied marketing channels about cashew in Nigeria. The most frequent channel farmers used in selling cashew nuts was village buying traders (71.7 %). Most (70 %) of the farmers have no idea of market information before selling their produce. The major constraints encountered by farmers were low price (95 %), dishonesty of middlemen (87.5 %) and lack of government regulation on cashew price (86.7 %). Significant relationship existed between how often farmers get cashew market information and their marketing channels $r = -0.194$ and $p = 0.033$.

2.4 To identify the constraints in production and marketing of crops

Singh *et al*. (2010) studied about production and marketing constrains of Papaya production in north-eastern states of India and the constrains faced by them are low productivity, climatic circumstances, water logged condition and heavy winds, substantial frost bite during blooming stage, soil erosion and attack of insects during monsoons. Also lack of know-how related to cultivation practices, nutrient management, plant protection, measures also have been seen as a problem of growers.

Peer *et al*. (2014) studied constraints faced by the potato growers in Jammu and Kashmir through random sampling method. The study revealed that potato growers faced constraints through seed treatment technique (100.00 %), non-availability of fertilizers at proper time (76 %), financial problem (72.89 %), non-availability of insecticides at

proper time (64.64 %), high cost of fertilizers (61.77 %), high cost of seed (60.04 %), high cost of fungicides (57.78 %) and labour problem (54.66 %).

Lakra *et al*. (2017) studied to examine cost, returns, marketing pattern and constraints of paddy in Dantewada district of Chhattisgarh. Major constraints pertaining to cultivation of these crops were lack of soil testing facility (82 %) and scarcity of labour during peak season (81.25 %). Long distance of regulated market from the crop growing area (81.25 %) and lack of transportation facilities (77.80 %) were some of the major constraints which were faced by the produce. Farmers engaged in organic farming should be linked to niche markets where they will obtain a premium price, in order to compensate for any loss in yield.

Singh *et al*. (2017) conducted study in Uttar Pradesh by random sampling technique, 100 sample farmers were selected and interviewed for collection of data, average land holding size corresponding 0.44 marginal, 1.57 small and 3.24 medium size group of farm. In various problems, technical problem ranked first followed by marketing availability of inputs in time, other problems (Blue Bull, Natural calamity and canal problem) agro- climatic problem and miscellaneous problem. Henry Garrett's ranking methods HG technique is used to evaluate the reason for switching over from LIC to other private company.

Ansari and Khan (2018) studied marketing constraints of wheat and rice in Aligarh district. The study revealed that lack of road and transport, storage and market information are the major infrastructural constraints. Lack of proper regulated markets and excessive involvement of middlemen adversely affected the marketing of wheat and rice. Low price of produce, price fluctuation and ineffective government procurement system are the major pricing constraints. Lack of grading facilities, non-availability of scientific weighting and measurement equipments and lack of bargaining power farmers faced in marketing. The results also revealed that marginal farmers face significantly more problem compared to small and medium farmers.

Gohain and Singh (2018) studied the problems faced by the farmers in the marketing of paddy, wheat, maize and cotton in Punjab. The results indicated that the most important problem identified by the farmers in the marketing of paddy and wheat was the delay in procurement of paddy in the markets followed by the deduction of payments by commission agents due to higher moisture content in the grains. However, the major problem during marketing of basmati was the exploitative practices by the intermediaries followed by lack of public procurement. The problem faced by majority of farmers in the marketing of maize and cotton was the lack of public procurement of the produce and lack of remunerative price of the crop respectively.

Kumar *et al*. (2018) conducted study in Haryana about constraints faced by farmers and middlemen in production and marketing of major vegetables. Major production related constraints expressed by vegetable growers were lack of information about cultivation of vegetables, higher cost of fertilizers, seeds and labour, lack of suitable cold storage facilities, high cost of storage, costly weedicide and lack of credit. Major marketing related constraints expressed in marketing of vegetables were lack of market information, higher price fluctuation, higher amount of price spread, malpractices in weighing and storing of vegetables, problem of storage facilities, lack of processing industries, high cost of labour, high transportation cost and delay in payments.

Kumari *et al*. (2018) studied Problems and constraints in banana cultivation in Bihar and concluded perishability is one of the important constraints in banana production and marketing. The non-availability of credit was important to the extent of 88.0, 77.0 and 33.0 per cent for semi-medium, marginal &small and medium and large category of banana growers, respectively. The non-availability of proper market and dominance of pre-harvest contractors was considered the limiting factor in the order of 100, 64 and 44 per cent by three categories of growers, respectively with overall mean average as 77 per cent. All sample growers were of the opinion that the soil of the area is suitable for banana cultivation as well as its profitable nature.

Basavaraj *et al*. (2020) studied about the constraints faced by farmers in production and marketing of maize in Haveri district of Karnataka through Garrett's

ranking techniques and results showed that frequent occurrence of drought ranked I, which recorded a Garrett mean score of 73.38 while in the case of marketing of maize, location of markets at for off places ranked I, which recorded a Garrett mean score of 72.23.

Kumar *et al*. (2020) conducted study in Haryana on the basis of highest production of onion. The results of the study revealed that the major problems faced by the onion farmers in production were high cost of pesticide (93.33 %), lack of knowledge about recommended fertilizer doses (86.67 %), difficulty in identifying the pests and diseases (80 %) and lack of knowledge about seed treatment (76.67 %). As for as marketing of onion is concerned, (83.33 %) of respondents opined that high cost of transportation, absence of minimum support prices (83.33 %), existence of large number of intermediaries in marketing process (83.33 %) and too much fluctuation in prices (80 %).

III METHODOLOGY

Designing of proper methodology is very important to carry out a systematic analysis of any research problem. This chapter deals with the methodology followed in the present study, which includes the nature and sources of data, techniques employed and statistical procedures followed. These are detailed under the following sub-headings.

3.1 Selection and description of study area

3.2 Nature and sources of data

3.3 Sampling procedure

3.4 Analytical tools and techniques employed

3.5 Definition of the terms and concepts

3.1 Description and selection of study area

Karnataka is the largest state in South India and it is in the south western region of India. The state covers an area of 191,976 square kilometers (74,122 sq m.) or 5.83 per cent of the total geographical area of India. It is the sixth largest Indian state by area comprising of 31districts and the eighth largest state by population. According to the 2011 census of India, the total population of Karnataka was 61,095,297. The literacy rate of the state was 75.36 per cent. Relatively higher proportions of males were literates (82.47 %) than females (68.08 %) in the state.

Salient features of Hassan district

The present study was conducted in Hassan district of Karnataka, which is the leading district in maize cultivation in Southern Karnataka. Hassan is lying between 12° 13´ and 13° 33´ North latitudes and 75° 33´ and 76°38´ East longitude and stands around 3,084 feet above the sea level. The geography is mixed with the malnad or mountainous region to the west and south west called Bisle Ghat and the maidan or plains regions in the north, south and east. The District has eight taluks, 38 hoblies and 2574 villages. The geographic area of the district of Hassan is 6814 square kilometers. The general level of

Hassan district is it slopes with the course of Hemavathi river from the western ghat ranges towards the bed of the Kaveri river near Hampapura in the south east. The district is surrounded by Chikmagalur District to the northwest, Tumkur District to the east, Mandya District to the south east, Mysore to the south, Kodagu District to the south west and Dakshina Kannada district to the west. According to the 2011 census Hassan district has a population of 1,776,421. Literacy rate was found to be 76.07 per cent. Relatively higher proportions of males were literates (83.64 %) than females (68.60 %).

Climate

The climate of the district is moderate to cool as the district is situated in the hilly terrain. The average temperature is 22.1° C. The humidity is very high in the monsoon generally exceeding 90 per cent. Fog occurs on many days in the cold season in the western parts of the district in the monsoon and post monsoon season. The hilly areas are often enveloped in cloud or mist. The rainfall received in the district is around 1208 mm and about 79 per cent of it is received during the southwest monsoon months of June to September.

Soil type

The soils of the Hassan district are predominantly red and sandy soils. They vary from red to brownish in colour, shallow to fairly deep and loamy to sandy loam in texture. They are well drained but poor in bases, water holding capacity and available phosphorus. About 42 per cent of the soils are poor in organic matter. The soils are favorable for growing of crops like paddy, sugarcane, potato and vegetables under irrigated condition, while coffee, potato, ragi, maize, pulses, groundnut, cotton etc. can be grown in rainfed conditions.

3.2 Sampling procedure

Selection of taluks

Hassan district comprises of eight taluks *viz.,* Hassan, Channarayapatna, Belur, Alur, Arasikere, Holenarasipura, Arkalgud and Sakaleshpura. For the purpose of achieving the objectives of the study, to collect the needed information from the

Fig. 3.1 Map showing Karnataka state and Hassan district

Plate 3.1: Glimpses of primary data collection in the study area

respondents, two taluks *viz.,* Channarayapatna and Holenarasipura which lies in the eastern part of the district were selected based on the highest area under maize.

Selection of villages and respondents

From each of the taluk, five villages were selected based on the area under maize, in consultation with the Department of Agriculture and extension workers. From each of the selected village, six farmers were chosen randomly. Thus, a total of 60 sample farmers were selected at the rate of 30 from each taluk.

Table 3.1: General features of the study area

Sl. No.	Particulars	Holenarasipura taluk	Channarayapatna taluk	Hassan district
1.	Geographical area (sq. km)	595	1044	6814
2.	Villages (No.)	249	384	2574
a)	Inhabited	211	375	2418
b)	Un-inhabited	38	9	156
3.	Density of population (per sq.km)	306	268	261
4.	Population (No.)	1,82,187	2,79,798	17,76,421
a)	Rural	1,52,213	2,32,896	13,99,658
b)	Urban	29,974	46,902	3,76,763
5.	Literacy rate (%)	67.52	75.64	76.07
a)	Male	77.2	84.52	83.64
b)	Female	57.76	67.02	68.6
6.	Sex ratio (Male: Female)	990	1023	1010
7.	Decadal growth of population (%)	3.96	0.61	3.18
8.	Net sown area (ha)	2,74,90	5,7805	3,45,441
9.	Average rainfall (mm)	677	553	1208
10.	Net area irrigated (ha)	9560	15257	51102
12.	Barren land (ha)	2535	5319	30365

Source: District at a Glance, Hassan, 2021

In addition, to assess the efficiency of different marketing channel, data from wholesalers (5), Village trader (5), processor (5) and users of the animal feed manufactured from maize (15) were chosen using a pre-tested schedule designed for the purpose. Thus, the total respondents were 90, comprising of 60 farmers and 30 participants in the marketing channel.

3.3 Nature and sources of data

Both the secondary and primary data were used in the present study to achieve the specific objectives.

Table 3.2: Sample framework of the study

Sl. No.	Taluks	Village	Sample size
1.	Holenarasipura	Ulivala	6
		Hosur	6
		Mudlepe	6
		Valambige	6
		Gannikada	6
2.	Channarayapatna	Bagur	6
		Yaliyur	6
		Srinivaspura	6
		Kumbenalli	6
		Nugehalli	6
	2	**10**	**60**

The primary data from farmers (60) and participants in marketing channel (30) on various aspects like demographic features of the respondents, cropping pattern, input use pattern, yield realized, selling price, quantity marketed, marketing channels followed and constraints faced by the them in production and marketing were collected through personal interviews conducted during April, 2021.

The secondary data on area, production and productivity of maize in Karnataka were collected from the reports of the Directorate of Economics and Statistics. Further, data on arrivals and prices of maize were sourced from the records of the three chosen Agricultural Produce Market Committees (APMC's) and krishimaratavahini.

3.4 Analytical tools and techniques employed

For the purpose of achieving the objectives of the study, the data collected were subjected to various analytical tools as detailed below.

3.4.1. Compound Annual Growth Rate

The Compound Annual Growth Rate (CAGR) is a useful measure of growth over multiple time periods. In the present study, the CAGR was used to analyse the trends in area, production and productivity of maize in major maize growing districts and Karnataka. The compound growth rate (CAGR) was estimated by fitting a semi-log trend equation of the following form:

$$Y_t = AB^t u_t \qquad \text{……..(1)}$$

Where,

Y_t = Area / production / productivity during time t

A = Constant / intercept

t = Time period

u_t = Error term

B = (1+g), where g = growth rate

The above equation would become linear by taking the logarithm on both the sides.

$$\text{Log } Y_t = \text{Log } A + t\,(\text{Log } B) + \text{Log } u_t \qquad \text{…….. (2)}$$

Where, log A and log B were the parameters of the function obtained by ordinary least square (OLS) method. Once the above equation is estimated, g can be computed as:

$$g = [\text{Antilog } (b)-1] \times 100 \qquad \text{…….. (3)}$$

3.4.2. Time series analysis

Time arrangement examination was done to think about the variations in month to month arrivals and prices of maize for the time of 12 years in Channarayapatna taluk. A period arrangement is an unpredictable blend of four parts *viz.,* Trend, Seasonal, Cyclical and Irregular variations. These components were isolated, first by estimated the trend value and then other components were isolated using the multiplicative model.

$$Y=TSCI \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where,

Y - Time series data on arrivals/prices

T - Trend

S - Seasonal variation

C - Cyclical variation and

I – Irregular variations

Trend

Trend is a pattern in data that shows the movement of a series to relatively higher or lower values over a long period of time.

The following polynomial equation of degree 2 was fitted to the data on arrivals and prices, which gave the good fit to the data, as revealed by the value of R^2.

$$\mathbf{Y_t=a+bX_t+cX_t^2+U_t}$$

Where, Y_t is the price /arrival during the year 't', X_t is the serial number assigned to the t^{th} year, U_t is the random disturbance term with usual assumptions, N is number of year in the price/arrival series.

The estimated parameters can be used to predict the trend values of both the arrivals and prices by substituting the serial number of year (X) for each year.

Seasonal indices

The variation within a year is called as regular variation. The fundamental drivers of occasional varieties are generation periods, traditions, atmospheres, transportation, etc. Such regular segments can be broke down through consonant examination.

Cyclical

The cyclical component of a time series refers to (regular or periodic) fluctuations around the trend, excluding the irregular component, revealing a succession of phases of expansion and contraction.

Irregular

The irregular component (residual) is what remains after the seasonal and trend components of a time series have been estimated and removed. It results from short term fluctuations in the series which are neither systematic nor predictable.

3.4.3. Marketing efficiency

Efficiency of the marketing system was normally analysed using the standard formula developed by Acharya and Agarwal (2001).

$$ME=NP_F \div [MC+MM]$$

Where,

ME = Marketing efficiency index

NP_F = Farmer's net price

MC=Marketing cost

MM=Marketing margin

$$NP_F = GP_F - \{C_F\}$$

Where,

NP_F = Net price received by the farmer (₹/q)

GP_F = Gross price received by the farmer (₹/q)

C_F = Cost incurred by the farmer during marketing (₹/q)

$$MC = C_F + C_W + C_P$$

Where,

MC = Marketing cost of the intermediaries

C_F = Cost of the farmer in marketing (₹/q)

C_W = Cost of the wholesaler in marketing (₹/q)

C_P = Cost of the Processor in marketing (₹/q)

$$MM = MM_W + MM_P + MM_{VT}$$

Where,

MM = Marketing margin of the intermediaries

MM_W = Marketing margin of the wholesaler

MM_P = Marketing margin of the Processor

MM_{VT} = Marketing margin of the village trader

3.4.4. Garrett's ranking technique

To find out the most significant constraint faced by the respondents in production and marketing, Garrett's ranking technique was used. As per this method, respondents have been asked to assign the rank for all constraints and the outcome of such ranking has been converted into score value with the help of the following formula:

$$\text{Percent position} = 100\ (R_{ij} - 0.5) \div (N_j) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ (5)$$

Where,

R_{ij} = Rank given for the i^{th} variable by j^{th} respondents

N_j = Number of variable ranked by j^{th} respondents

The percent position of each rank was converted to scores by referring to tables given by Garret and Woodworth (1969). Then for each constraint, the scores of individual respondents were summed up and divided by the total number of respondents for whom scores were gathered. The mean scores for all the constraints were ranked, following the decision criterion that higher the value the more important it will be in order of preference given by respondents.

3.5 Definition of the terms and concepts

Variable costs

The variable costs include cost of seed, FYM, fertilizers, wages of human, bullock and machine labour, plant protection chemicals and interest on working capital at the rate of seven per cent per annum.

Human labour

Human labour was estimated in terms of eight hours of work per day measured in man days. The prevailing average wage rates were Rs. 500 for male and Rs. 400 for female labour in the study area.

Machine labour

The cost of machine labour both owned and hired was calculated at prevailing rates on hourly base for the different type of operations prevailed in the study area.

Bullock labour

Bullock labour is measured in bullock pair days, both owned and hired were charged at the prevailing rate paid per day (8 hours) in the study area.

Farm Yard Manure (FYM)

The quantity of FYM used in the cultivation of maize was measured in terms of tractor load that has been converted into tonnes as mentioned by the majority of respondent farmers that one tractor load approximately weights 4 to 5 tonnes and the cost was imputed at the price prevailing in the village including cost of transportation.

Fertilizers and plant protection chemicals

Cost of fertilizers and plant protection chemicals were taken at the actual prices paid by the sample farmers including the cost transportation and other incidental charges, if any.

Seeds

The cost of seed was calculated at the market price.

Interest on working capital

This was calculated on the entire working cost of maize cultivation at the interest rate of seven per cent per annum and was considered for six months period only since within that period farmers would realize the produce from maize cultivation.

Fixed cost

These include expenditure towards land revenue, rental value of land, depreciation on farm implements and machinery and interest on fixed capital (10 %).

Land revenue

Land revenue was taken at Rs.28 as levied by the government.

Rental value of land

It was imputed by taking the prevailing rents 20 per cent of the gross returns, as used by the CACP in estimation of cost of cultivation while announcing MSP policy.

Depreciation

The depreciation was calculated by the straight line method. The charges on account of minor repairs of implements and machinery during the year were added to the depreciation charges. It was apportioned on the basis of area of land under each crop grown during the year.

Annual depreciation = (Purchase value – Junk value) /Economic life of the asset

Total cost of cultivation

Cost of cultivation included variable cost and fixed cost. Variable cost included the cost of human labour, bullock labour, machine labour, seeds, farm yard manure, plant

protection chemicals, irrigation charge and interest on working capital. Fixed cost comprised depreciation, land revenue, rental value of land and interest on fixed capital.

Returns per rupee of expenditure

It is calculated by dividing gross income with total cost of cultivation.

Marketing channels

The marketing channels are the routes consisting of various agencies through which the produce moves from producer to the ultimate consumer.

Maize produce after leaving farm gate it has to reach to the consumer through different pathways. In the present study, efforts were made to find out different marketing channels.

Channel-I: Farmers →Village traders→ Wholesalers→ Processing unit

Channel-II: Farmers →Wholesalers→ Processing unit

Channel-III: Farmers→ Government Procurement Centre

Market intermediaries:

Village trader

Village level traders play an important role in the marketing process. They are the first agency to receive the produce once produce leaves the first participant in the marketing channel (producer-farmer). Village level trader purchase the produce at a certain agreed price from the farmer at farm or village only and sell to the wholesaler.

Wholesalers

Wholesalers are professional traders, who purchase from the producers or village traders in large quantities and sell it to the processors.

Processors

Industrial processing employed for transforming maize into products for human and animal consumption. They are known as dry and wet milling. In the wet milling process, maize is separated into relatively pure chemical compound classes of starch, protein, oil, and fiber. The products and co-products obtained from wet maize milling are not typically directly used by the consumer and often require further industrial processing before consumption.

Final users

Final users are consumers, who purchase the feed either from processors or wholesalers or retailer to feed poultry and cattle manufactured from maize.

APMC

Organized marketing of agricultural commodities has been promoted in the country through a network of regulated markets. These regulated markets were established as per the provisions of the Marketing of Agricultural Produce Acts' of State Governments. The main function is to setting up of a network for physical markets and structure to ensure remunerative prices for the producer for fair play of supply and demand forces and narrow down the price spread. They aim at regulating market practices and transparency in transactions.

Net farm price

The net farm price received by the farmers is the difference between gross price received by him and marketing costs incurred (packing, loading, grading, transportation, etc.).

Marketing margin

It is the difference between purchase price and selling price of agency in the distribution channel.

Intermediaries margin= ((sale price – purchase price) – cost of marketing)

Marketing cost

The cost incurred by intermediaries (Wholesaler, Village trader and Processors) in flow of goods from producers to end users. Lower marketing cost indicates higher efficiency of the marketing channel.

Gross returns

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

Net returns

Return obtained by subtracting the total cost from gross returns.

Price spread

The price spread is the difference between the price paid by the ultimate consumer and the net price received by the farmers for an equivalent amount of the farm commodity.

Producer's share in consumer rupee

It is the percentage of the net price received by the producer to price paid by the consumer. Higher value of producer's share in consumer rupee indicates more the efficiency of the channel.

IV RESULTS AND DISCUSSION

The present study conducted in Hassan district to analyze the production and marketing of maize using both the primary and secondary data analyzed using the suitable tools to draw the meaningful conclusions. The results of the present study are presented in this chapter under the following headings.

4.1 Trends in area, production and productivity of maize in Karnataka

4.2 Time series analysis of arrivals and prices of maize in Channarayapatna market

4.3 Co-integration of maize in selected markets of Karnataka

4.4 Demographic features of the respondents

4.5 Cropping pattern on the sample farms

4.6 Cost of cultivation of maize cultivation

4.7 Production and returns from maize cultivation

4.8 Marketing channels and price spread of maize in the study area

4.9 Constraints in production and marketing of maize

4.1 Area, production and productivity of maize in Karnataka

4.1.1. District-wise share of area, production and productivity of maize in Karnataka

The information on area, production and productivity of maize for the Triennium ending 2017-18 in important districts is presented in Table 4.1. It could be observed from the table that among the different districts in Karnataka, Davangere district leads with respect to area under maize with 182704 ha which accounted for 14.06 per cent of total state area followed by Haveri (181778 ha and 13.99 %) and Belgaum (145987 ha and 11 %). The top three districts *viz.*, Davangere, Haveri and Belgaum together account for about 39 per cent of both the area and production of maize in the state. However, the productivity of maize in these districts was not so encouraging, which ranged from 3108 kg/ha in Haveri to 3401 kg/ha in Belgaum. The top three districts with respect to

productivity included Shimoga (4341 kg/ha), Bagalkot (4148 kg/ha) and Hassan (4153 kg/ha) compared to average productivity for the state of 3277 kg/ha for the Triennium ending 2017-18.

In Southern Karnataka, Hassan district is the leading district with 84018 ha and account for 6.47 per cent of total state area of 1.30 lakh ha and account for about eight per cent of production with annual production of 3.29 lakh tonnes with about eight per cent share in the total 40.79 lakh production of maize of the state during the period of Triennium ending 2017-18 was chosen for in depth analysis in the present study.

Table 4.1: Area, Production and Productivity of maize in important districts of Karnataka for the Triennium ending 2017-18

Sl. No.	District	Area		Production		Productivity	
		ha	%	t	%	Kg/ha	Rank
1.	Davanagere	182704	14.06	566864	13.90	3255	7
2.	Haveri	181778	13.99	538965	13.21	3108	10
3.	Belgaum	145987	11.24	474482	11.63	3401	5
4.	Bellary	97553	7.51	296820	7.28	3202	8
5.	Chitradurga	93536	7.20	247072	6.06	2928	12
6.	Hassan	84018	6.47	328476	8.05	4153	3
7.	Shimoga	58431	4.50	246701	6.05	4341	1
8.	Bagalkote	57688	4.44	231613	5.68	4181	2
9.	Koppal	57432	4.42	123174	3.02	2166	15
10.	Chickballapur	57293	4.41	183713	4.50	3315	6
11.	Bijapur	51182	3.94	158259	3.88	3114	9
12.	Mysore	44033	3.39	130246	3.19	3097	11
13.	Gadag	40916	3.15	96087	2.36	2479	14
14.	Dharwad	31694	2.44	77852	1.91	2606	13
15.	Chamarajanagar	28486	2.19	112528	2.76	3841	4
16.	Others	86437	6.65	265623	6.51	3242	
	Total	**1299167**	**100**	**4078475**	**100**	**3277**	

The analysis of maize production in major districts revealed that again the Davangere district was the largest producer (5.67 lakh tonnes) in the state with 13.90 per cent contribution followed by Haveri (5.39 lakh tonnes) with 13.21 per cent contribution and Belgaum (4.75 lakh tonnes) contributing 11.63 per cent in state's production.

The district-wise productivity performance of maize in Karnataka revealed that Shimoga registered the highest productivity of 4341 kg/ha followed by Bagalkot (4181 kg/ha) and Hassan district (4153 kg/ha). The productivity of maize for the state as a whole during the study period of Triennium ending 2017-18 was 3277 kg/ha. Even though, Hassan district, account for only about six per cent of the state's area (6^{th}), but due to its higher productivity district (3^{rd}), it accounted for about eight per cent (4^{th}) of the state's production.

4.1.2. District-wise growth rates in area, production and productivity of maize in Karnataka

The data for the period from 2007 to 2017 on area (ha), production (t) and productivity (Kg/ha) of maize in major growing districts were collected from the publications of the Directorate of Economics and Statistics and the Compound Annual Growth Rates (CAGR) were calculated and results are presented in the Table 4.2.

In Karnataka, the cultivation of maize found to be nearly stabilized, even though there was decrease in area by 7.90 per cent and production by 7.10 per cent annually but these growth rates were non-significant. Interestingly, the productivity of maize increased by about one per cent (0.94 %) but that growth rate was not statistically significant during the study period. The district-wise analysis of growth performance revealed that Koppal district registered the highest growth rate (8.23 %) followed by Hassan (6.73 %) and Chickballapur (6.23 %) with respect to maize area. While, with respect to production, growth rate was found to be the highest in Hassan (8.11 %) followed by Chickballapur (7.03 %) and Koppal (6.12 %) districts. With respect to productivity growth rate, Chamarajanagar (4.26 %) registered the highest CAGR followed by Shimoga (3.63 %) and Bijapur (2.98 %). The top three districts showed positive growth rates for area, production and productivity of maize except Belgaum district, which showed a marginal

decrease in the maize area (-0.43 %). However, the growth rates were found to be significant only in the case of Hassan and Mysore with respect to area and for rest of districts and for the state as a whole the growth rates of area, production and productivity of maize were non-significant.

Table 4.2: Growth rates in area, production and productivity of maize in important districts of Karnataka during 2007-08 to 2017-18

(Per cent)

Sl. No.	Districts	Area (ha)	Production (t)	Productivity (kg/ha)
1.	Davanagere	0.79***	1.08	0.29
2.	Haveri	3.96***	5.92*	1.89
3.	Belgaum	-0.43	1.56	1.99
4.	Bellary	0.30	2.05	1.75
5.	Chitradurga	2.58	5.58	2.93
6.	Hassan	6.73***	8.11***	1.29
7.	Shimoga	-0.08	3.55	3.63*
8.	Bagalkote	-2.59	-0.59	2.06
9.	Koppal	8.23***	6.12	-1.95
10.	Chickballapur	6.23***	7.03*	0.76
11.	Bijapur	-0.83	2.13	2.98
12.	Mysore	5.64***	4.64**	-1.49
13.	Gadag	0.82	-0.36	-1.17
14.	Dharwad	-4.23**	-3.02**	1.26
15.	Chamarajanagar	-3.83*	0.27	4.26
16.	Others	-3.35	12.53	15.72
	Karnataka	**-7.90**	**-7.10**	**0.94**

Note: ***, ** and * indicates significant at one per cent, five per cent and ten per cent probability level, respectively.

The growth rates for maize area found to be highly significant at one per cent in the case of Davanagere (0.79 %), Haveri (3.96 %), Hassan (6.73 %), Koppal (8.23 %), Chikkaballapur (6.23 %) and Mysore (5.64 %) districts, while maize area in Dharwad

(-4.23 %) found to be decreasing and coefficient found to be significant at five per cent probability level. In the case of rest of the district's the CAGR whether positive or negative but found to be non-significant.

With respect to production, Hassan was the only district which showed highly significant growth rate (8.11 %) at one per cent probability level, while growth rates were significant at five per cent in the case of Mysore (4.64 %) and Dharwad (-3.02 %) and were found to be positive and negative, respectively. Growth rates of maize production in Chikkaballapur (7.03 %) and Haveri (5.92 %) were significant at ten per cent. Except Shimoga district (3.63 %, significant at 10 %), the productivity growth was found to be non-significant.

In the case of other districts, inspite of decrease in the area (3.35 %), but due to relatively higher growth rate in productivity (15.72 %), production of maize found to be increasing (12.53 %), however, growth rates were non-significant.

4.2 Time series analysis of maize

4.2.1. Trends in maize arrivals and prices in Channarayapatna market

The data on arrivals and prices were collected for 12 Year period from 2009 to 2020 from the records of the APMC, Channarayapatna. The actual and forecasted arrivals of maize are presented in Table-4.3. It could be observed from the table that the arrivals of maize in Channarayapatna market were found to be increasing during the initial years of study, reached peak in 2014, and then there was a decreasing trend during the later part of the study period from 2015 to 2020. However, for the overall study period, the arrivals shown decreasing trend as revealed by the negative slope coefficients. The actual and estimated arrivals are also presented in graph (Fig.4.1) for better understanding.

Like arrivals, the prices of maize have shown wider fluctuations over the years, however, unlike arrivals, there was an increasing trend in maize prices as revealed by the positive slope coefficient. The actual and estimated prices along with the estimated trend equation for prices of maize in Channarayapatna market are given Fig. 4.2. The prices of maize in Channarayapatna market were found to be the highest during 2019.

Table 4.3: Trend in arrivals and prices of maize in Channarayapatna market

Sl. No.	Year	Actual Arrivals (q)	Trend in Arrivals (q)	Actual Prices (Rs./q)	Trend in prices (Rs./q)
1.	2008-09	18756	11271	835.91	791.79
2.	2009-10	8396	17069	880.45	912.95
3.	2010-11	20758	22971	971.60	1024.49
4.	2011-12	16320	27474	1094.79	1126.41
5.	2012-13	36151	29202	1344.42	1218.70
6.	2013-14	63392	27584	1245.40	1301.37
7.	2014-15	59084	23156	1425.80	1374.41
8.	2015-16	10361	17275	1507.50	1437.83
9.	2016-17	5847	11453	1220.00	1491.63
10.	2017-18	2285	6748	1500.00	1535.80
11.	2018-19	6126	3533	1966.67	1570.35
12.	2019-20	1879	1644	1393.75	1595.27
Estimated equations		**$Y = -1121t^2 + 12941t - 2576$ $R^2 = 0.417$**		**$Y = -4.812t^2 + 135.6t + 661.0$ $R^2 = 0.722$**	

4.2.2. Seasonal indices for maize arrivals and prices in Channarayapatna market

The seasonal indices for arrivals and prices of maize crop were worked out using the monthly data for the period from January 2009 to December 2020 and results are presented Table-4.4 and graphically presented in Fig. 4.3. It can be inferred from the graph that arrivals of maize in Channarayapatna market showed a great variation and were found to be the higher during the months of January (334.73) and started increasing and the lowest index was seen during August (1.70) with respect to prices of maize same trend was observed in the market with one month lag. It is very much clear that the indices for maize arrivals in the market have chased the price prevailed during the previous month. In other words, the highest index of arrivals observed during January may be attributable to the highest index of prices during the month of December (123.95) observed in Table-4.4.

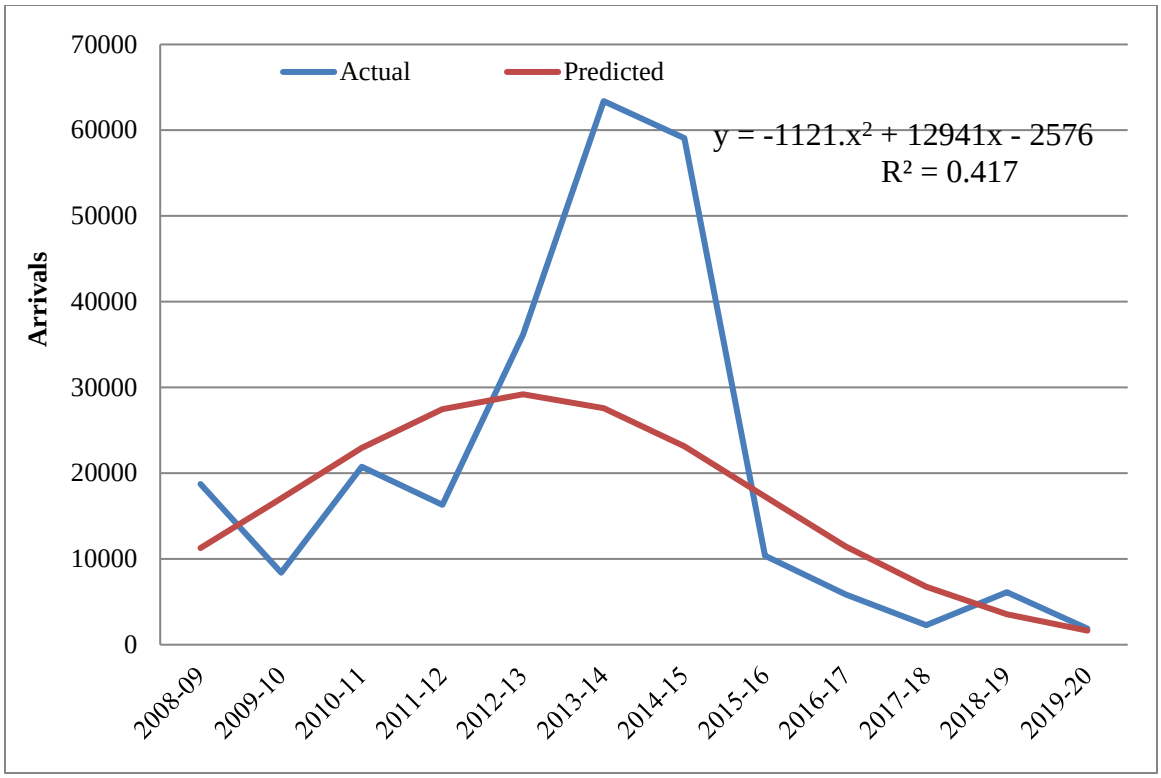

Fig. 4.1: Trend analysis of maize arrivals for the period from 2008-09 to 2019-20

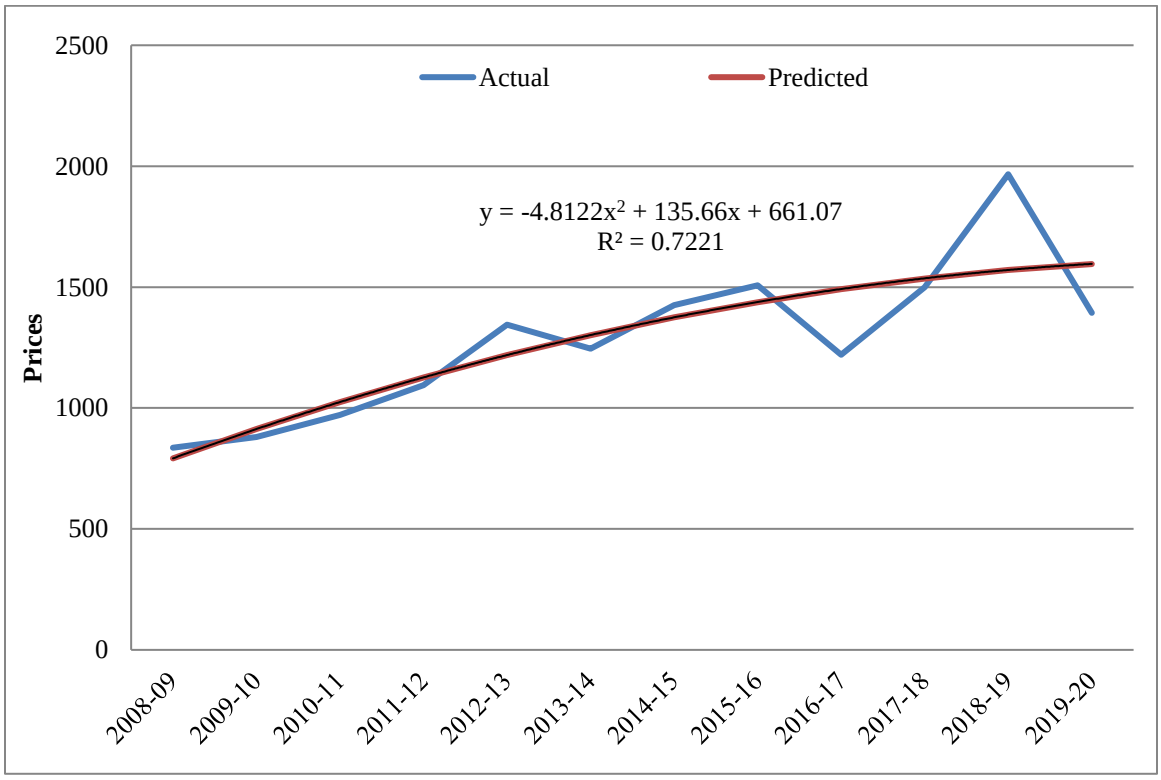

Fig. 4.2: Trend analysis of maize prices for the period from 2008-09 to 2019-20

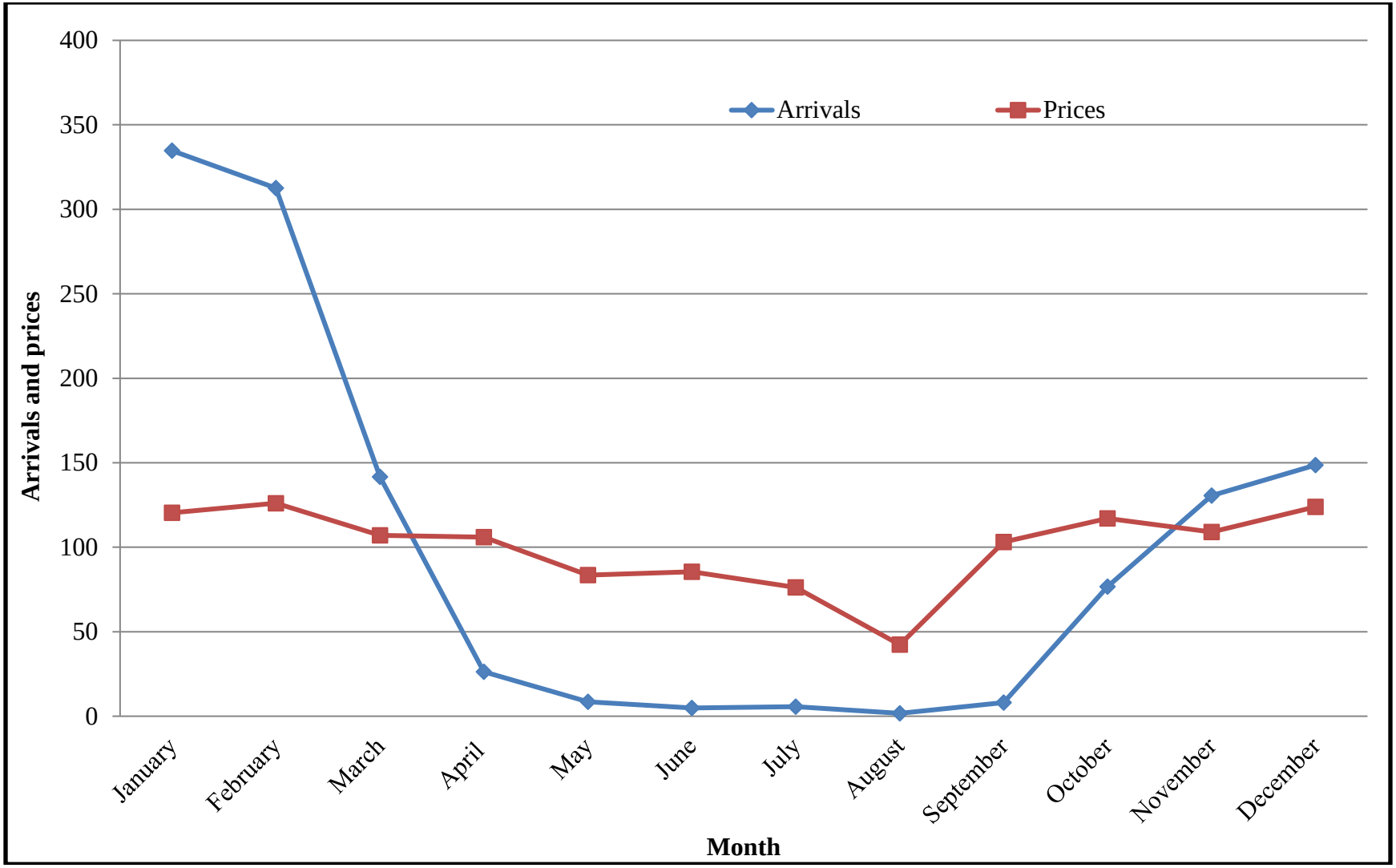

Fig. 4.3: Seasonal indices of maize arrivals and prices in Channarayapatna market for the period from 2008-09 to 2019-20

Table 4.4: Seasonal indices of maize in Channarayapatna market

(Per cent)

Sl. No.	Months	Arrivals	Prices
1.	January	334.73	120.35
2.	February	312.60	126.07
3.	March	141.66	107.11
4.	April	26.31	105.92
5.	May	8.48	83.52
6.	June	4.90	85.53
7.	July	5.71	76.24
8.	August	1.70	42.30
9.	September	8.09	103.01
10.	October	76.66	116.98
11.	November	130.58	108.96
12.	December	148.57	123.95

4.2.3. Cyclical variations in maize arrivals and prices in Channarayapatna market

The cyclical component in the time series data was isolated using the multiplicative model using the values of trend isolated using the OLS method. The cyclical variations of maize arrivals in market are presented in Fig.4.4. It is very much clear from the figure that the arrivals of maize in Channarayapatna market were found to be the highest in 2017-18 and the lowest in 2013-14, the arrivals of maize have shown cycle period of 4 years of increase and four years of decrease and totally eight years cycle.

Similarly, it was also attempted to analyze maize prices during the study period in the study market (Fig.4.5). The cyclical variations of maize prices showed changes over the study period. Again there existed a clear cut cyclical behavior in the arrivals of maize, which was mainly attributable to price changes. It is very much clear from the above two figures that the arrivals of any year followed the prices. In other words, there existed a

clear relationship between arrivals and prices of maize, as the lowest cyclical index for price during 2018-19 resulted in the lowest arrival index during the succeeding year (2014-15).

Table 4.5: Cyclical variations in arrivals and prices of maize in Channaraypatna market

(Per cent)

Sl. No.	Year	Arrivals (q)	Prices (Rs./q)
1.	2008-09	-	-
2.	2009-10	111.66	126.87
3.	2010-11	86.69	119.14
4.	2011-12	57.95	107.24
5.	2012-13	36.74	98.15
6.	2013-14	19.38	95.98
7.	2014-15	32.47	92.48
8.	2015-16	78.42	94.30
9.	2016-17	163.85	100.63
10.	2017-18	212.19	92.09
11.	2018-19	200.64	85.28
12.	2019-20	-	-

4.2.4. Irregular variations in maize arrivals and prices in Channarayapatna market

In the present study it was also attempted to isolate the irregular component of the time series data on arrivals and prices for maize. A look at the Table-4.6 and Fig. 4.6 gives information on the irregular variations in arrivals of maize in Channarayapatna market. After isolating the trend, cyclical and seasonal components in the times data, the residual irregular component has not shown any definite movement over the time period. However, the results on irregular components for arrivals of maize in Channarayapatna market have not shown any definite pattern as we can observe no relation between arrivals of any year with either the preceding or succeeding year.

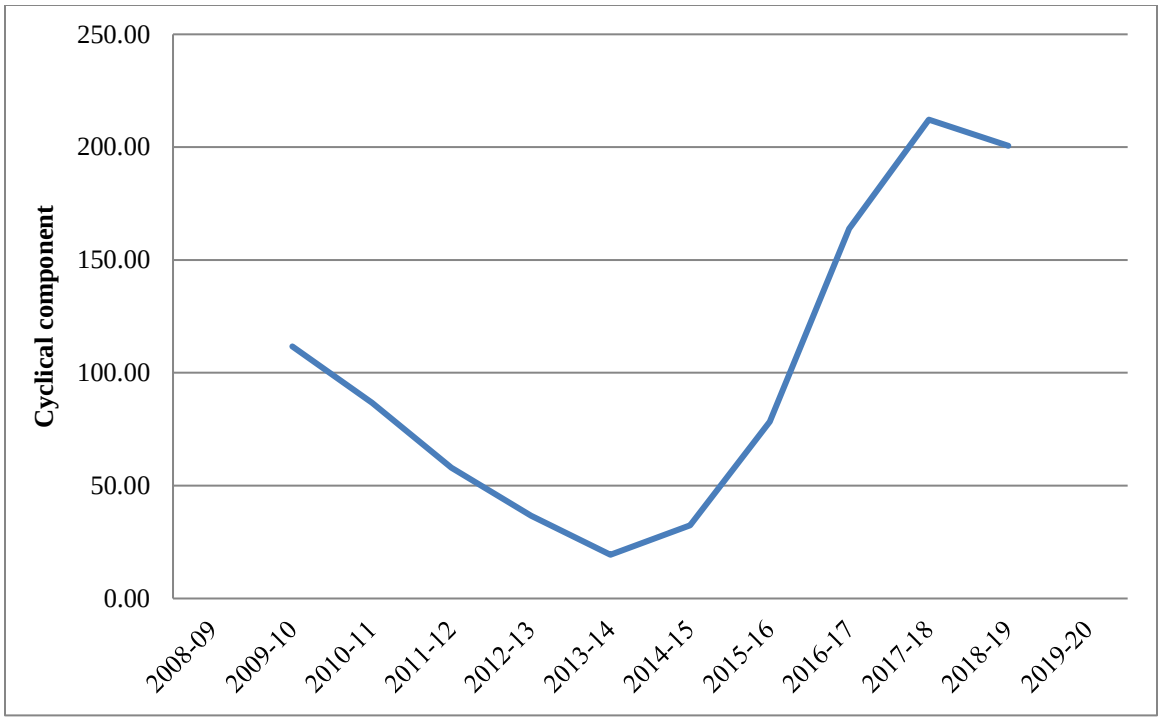

Fig. 4.4: Cyclical variations in arrivals of maize in Channarayapatna market for the period from 2008-09 to 2019-20

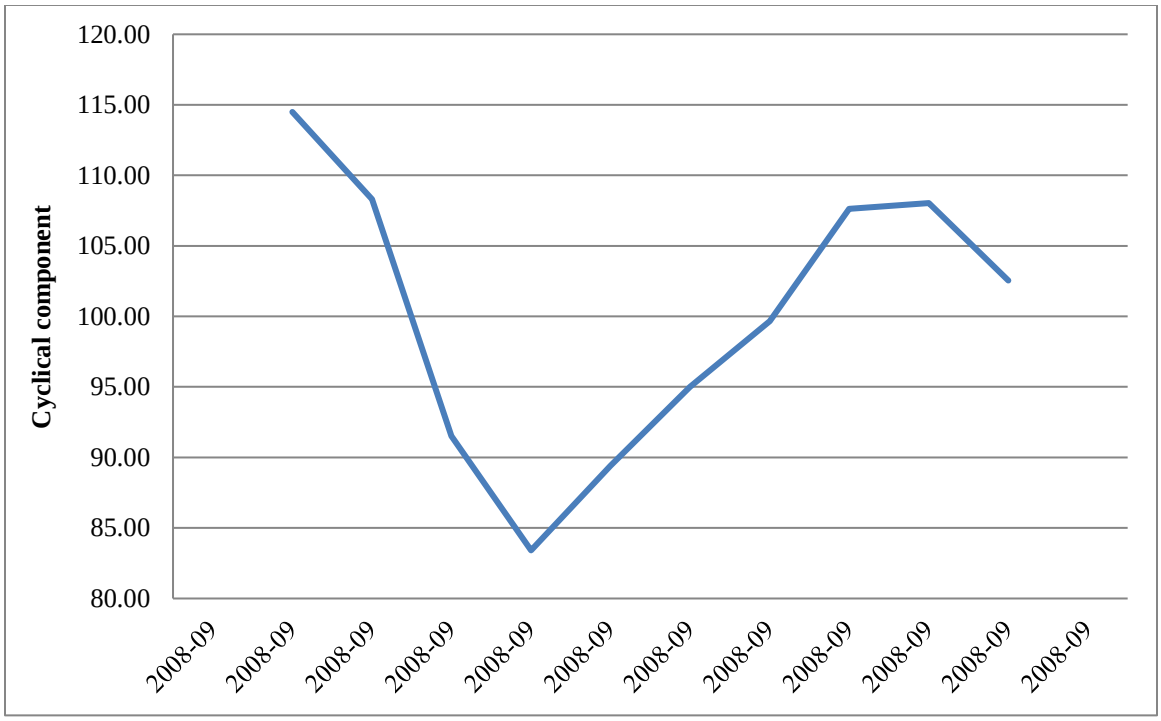

Fig. 4.5: Cyclical variations of maize prices in Channarayapatna market for the period from 2008-09 to 2019-20

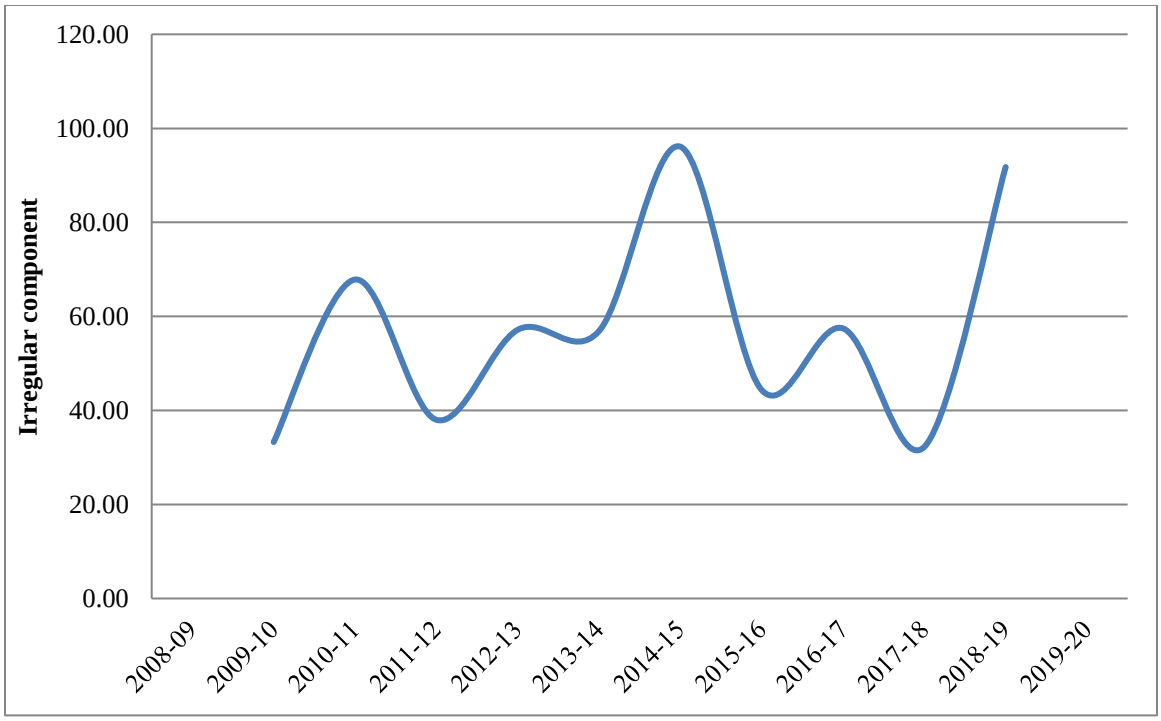

Fig. 4.6: Irregular variations of maize arrivals in Channarayapatna market for the period from 2008-09 to 2019-20

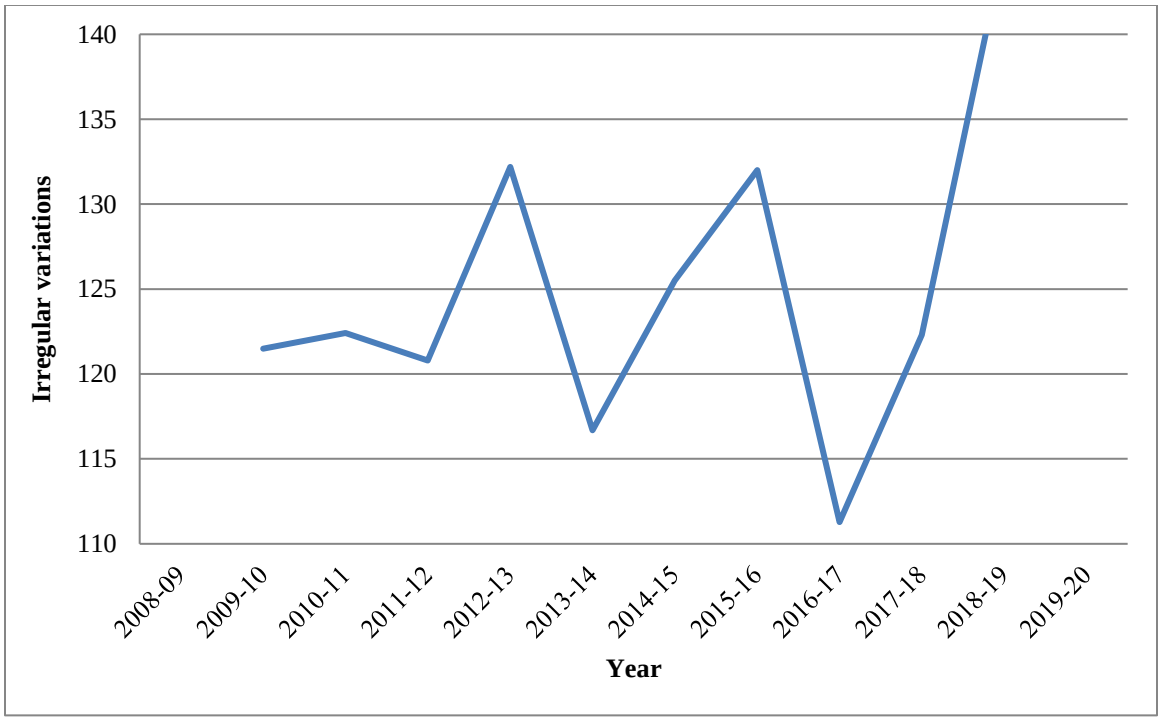

Fig. 4.6: Irregular variations of maize arrivals in Channarayapatna market for the period from 2008-09 to 2019-20

Table 4.6: Irregular variations in arrivals and prices of maize in Channaraypatna market

(Per cent)

Sl. No.	Year	Arrivals (q)	Prices (Rs./q)
1.	2009-10	33.29	121.49
2.	2010-11	67.85	122.40
3.	2011-12	38.01	120.80
4.	2012-13	57.15	132.19
5.	2013-14	56.88	116.67
6.	2014-15	96.11	125.50
7.	2015-16	44.36	132.00
8.	2016-17	57.45	111.27
9.	2017-18	32.25	122.29
10.	2018-19	91.77	145.12

The analysis of irregular component in the time series data of maize prices in market was carried out using the same methodology followed for arrivals mentioned above and results are given in Table-4.6 and graphically indicated in Fig. 7. The similar pattern was observed for prices of maize in Channarayapatna market with the highest in 2018-19.

4.3 Co-integration analysis for selected maize markets in Karnataka

Co-integration technique was used to analyse the integration between the selected major maize markets of Karnataka using monthly data for fifteen years from 2010-11 to 2019-20.

The Augmented Dicker Fuller Unit Root Test (ADF test) was conducted to check the data for its stationary, as the first step in Co-integration analysis. The chosen markets for the study included Davangere, Bagalkot and Hassan districts based on the magnitude of arrivals. On conducting ADF test for these chosen maize markets, Bagalkot and Hassan were found to be at stationary level, while data for Davangere market were made stationary by taking First difference (Table 4.7).

Table 4.7: ADF Unit root test for maize in selected markets of Karnataka

Variable	Level	P-value	First difference	P-value
Bagalkot	-9.309**	0.0000	-	-
Davangere	-2.422	-0.1371	-12.623**	0.0000
Hassan	-8.154**	0.0000	-	-

Note: ** indicates significance at one per cent probability level

Since, the price series for Bagalkot and Hassan were found stationary at one per cent probability level, while the price series for Davangere market were found to be non-stationary. However, the price series for Davangere market were found stationary at first difference level. Then the Johansen co integration test was applied to analyze the long run equilibrium among the maize markets. The results of the analysis showed that there exist at least three co integrations, out of which two equations were significant at one per cent level remaining was significant at five per cent level (Table 4.8). Hence, it is concluded that long run equilibrium exists among the three major markets. Any shocks in any one of these markets would affect the prices of the other markets.

Table 4.8: Johansen's multiple co-integration analysis for maize in selected markets unrestricted co-integration rank test (Trace)

Trace statistics of Series for Bagalkot, Davangere and Hassan markets				
No. of CE(s)	**Eigen value**	**Statistic**	**Critical value**	**Probability**
None **	0.2317	50.081	29.797	0.0001
At most 1 **	0.1326	19.767	15.494	0.0107
At most 2	0.0291	3.4035	3.841	0.0651

Note: Critical values based on MacKinnon (1999); LR test indicated 2 co-integrating equation **Significant at one per cent probability level.

As a part of co-integration analysis, Granger causality test was used to know if co-integration exists between two markets or not. The causal relationship among the price of major maize markets in Karnataka were approached through above technique and results are presented in Table 4.9. It could be seen from the results that mostly unidirectional causality existed among the selected maize markets. The unidirectional relationship found for the pair of Davangere market with other two markets indicated that price of Davangere market influence the price of Bagalkot and Hassan market. Similarly, Hassan market prices also exerted unidirectional causality on Bagalkot (Fig. 8). Thus results of the study confirms a strong integration among the major maize markets of Karnataka chosen for the study. The test for causality is based on F statistics.

Table 4.9: Pair-wise Granger causality test for maize markets in Karnataka.

Null hypothesis	F – statistic	P –value
DAVANGERE does not Granger Cause BAGALKOT	5.3006**	0.0063
BAGALKOT does not Granger Cause DAVANGERE	0.2205	0.8025
HASSAN does not Granger Cause BAGALKOT	130.7000**	4.E-30
BAGALKOT does not Granger Cause HASSAN	0.3460	0.7082
HASSAN does not Granger Cause DAVANGERE	0.2210	0.8021
DAVANGERE does not Granger Cause HASSAN	5.1514**	0.0072

Note: ** and * indicates significant at one and five percent probability level, respectively.

In order to know the Co-integration between the major maize markets Karnataka considered under study, the Vector Error Correction Mechanism was also conducted and the results of the same are presented in Table 4.10. The Co-integration coefficients were tested for their significance by comparing the t value at the chosen level of probability to know their significance. The Co-integration coefficients were found to be significant only with Bagalkot and Davangere, while it was non-significant for Hassan market.

Table 4.10: Reduced form vector error correction estimates for maize markets

Error Correction	D (Bagalkot)	D (Davangere)	D (Hassan)
ECM	**-0.8825****	-0.0077	0.3205
	(0.1397)	(0.1049)	(0.2029)
	[-6.3198]	[-0.0738]	[1.5796]
D(BAGALKOT(-1))	-0.1494	0.0479	-0.2677
	(0.1088)	(0.0817)	(0.1580)
	[-1.3740]	[0.5867]	[-1.6941]
D(BAGALKOT(-2))	-0.0538	0.0238	**-0.1799***
	(0.0499)	(0.0375)	(0.0725)
	[-1.0778]	[0.6364]	[-2.4808]
D(DAVANGERE(-1))	-0.0150	**-0.5744****	0.0366
	(0.1828	(0.1374)	(0.2656)
	[-0.0821]	[-4.1801]	[0.1380]
D(DAVANGERE(-2))	0.1107	-0.1822	0.0997
	(0.1819)	(0.1367)	(0.2644)
	[0.6086]	[-1.3326]	[0.3773]
D(HASSAN(-1))	0.0230	0.0085	-0.2271
	(0.1734)	(0.1303)	(0.2521)
	[0.1329]	[-0.0653]	[-0.9901]
D(HASSAN (-2))	0.0046	-0.0330	-0.1096
	(0.1279)	(0.0961)	(0.1859)
	[0.0360]	[-0.3438]	[-0.5894]
C	31.82	23.91	46.23
R-squared	0.8294	0.1436	0.3029
AIC	14.5851	14.0140	15.3325

Note: ** indicates significant at one per cent probability level, Figures in round bracket indicates standard errors & figures in square bracket indicates t-statistics

Two month previous prices of Bagalkot market will have an impact on the present prices in Hassan market to an extent of 17.99 per cent in opposite direction. One month previous prices in Davangere market have no impact on present prices in any of the other

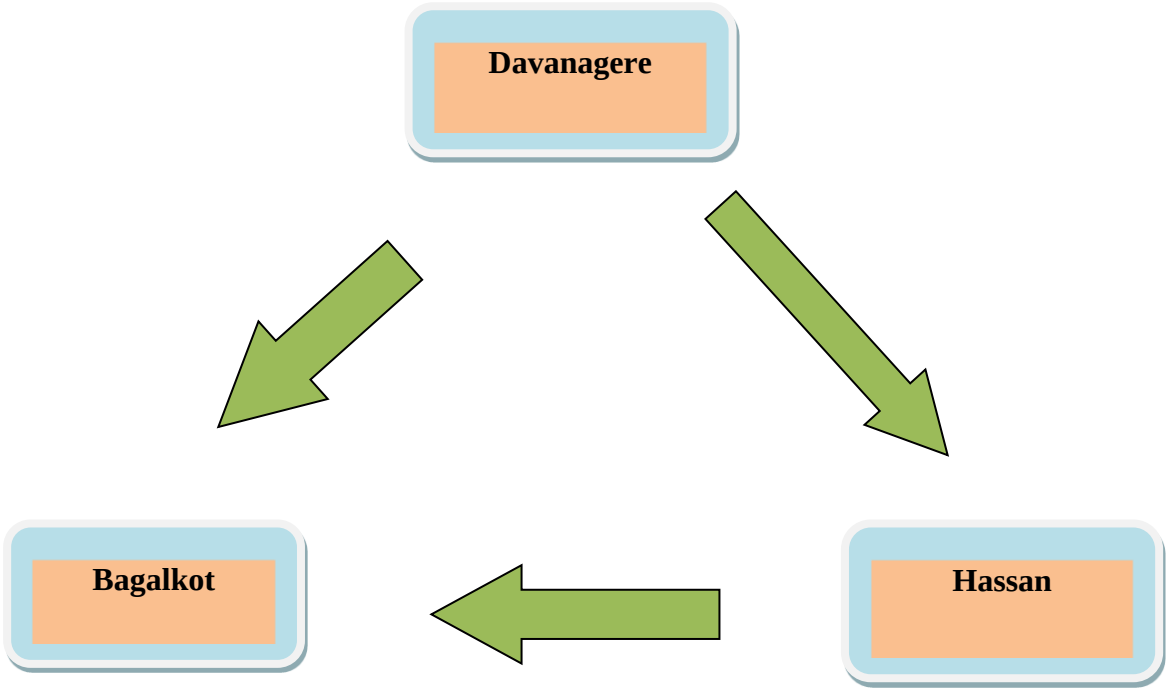

Fig. 4.8: Pair-wise granger causality test for maize market

markets considered for the study, but any variations in the prices in the Davangere will get corrected by itself within 57.44 percent of time. Though there exists Co-integration between the prices between and within the given market but coefficients were not significant.

Similar results were reported by Muralidhara *et al*. while studying market dynamics of maize in Karnataka during 2019 they reported that (Davanagere, Hassan and Haveri) have a strong association between them with respect to maize prices, as revealed by co-integration analysis.

Vector Error Correction test revealed that a change of one rupee in Bagalkot market in present month would decrease maize prices in succeeding month of Hassan market by 17 paisa. One month lagged prices of vector error correction test revealed that a change in price by one rupee in Davangere market in present month would be responsible for decrease in price by 57 paisa in succeeding month in the same market. If there is occurrence of any changes in the prices of maize in market it would to be due to other factors.

4.4 Demographic features of the respondents

4.4.1. Socio-economic characteristics of respondents

An understanding of general characteristics of sample farmers pertaining to the age, family size, average number of animals, average value of farm inventory, income and education level having bearing upon the profitability of the crops cultivated would provides a bird's eye view of the general features prevailing in the study area and are presented in Table 4.11. It could be observed from the table that most of the respondents were male in both the Holenarasipura (80 %) taluk and Channarayapatna taluk (83.33 %). It is heartening to note that still about 30 per cent of the respondents are illiterates. Among the literates, little more than one-fourth (26.67 %) have completed high school education followed by 23.33 per cent of the respondents possessed primary school education and 20 per cent completed college education. Whereas in Channarayapatna taluk still higher per cent (43.33 %) of them were illiterates, 6.67 per cent did primary

education, 26.67 per cent studied up to high school and 23.33 per cent completed college level education.

Table 4.11: Demographic features of sample farmers

Sl. No.	Characteristics	Holenarasipura (n_1=30)		Channarayapatna (n_2=30)		Pooled (n=60)	
		Nos.	%	Nos.	%	Nos.*	%
1.	Respondent						
	Male	24	80.00	25	83.33	24	81.67
	Female	6	20.00	5	16.67	6	18.33
2.	Educational status						
	a. Illiterate	9	30.00	13	43.33	11	36.67
	b. Primary school	7	23.33	2	6.67	4	15.00
	c. High school	8	26.67	8	26.67	8	26.67
	d. College	6	20.00	7	23.33	7	21.67
3.	Average age (Years)	48	-	43	-	45	-
4.	Family size (No.)						
	a. Male	2	40.00	2	50	2	44.44
	b. Female	2	40.00	1	25	2	33.33
	c. Children	1	20.00	1	25	1	22.22
	Total	5	100.00	4	100.00	5	100.00
5.	Average No. of animals	5		4		5	
	a. Cow	2	-	2	-	2	-
	b. Buffalo	1	-	1	-	1	-
	c. Others	2	-	1	-	2	-
6.	Average value of farm inventory (₹ lakhs)	2.46	-	2.39	-	2.43	-
7.	Average family income (₹ lakhs)	2.83	-	2.79	-	2.81	-

Note: * rounded-off averages

The average age of sample farmers was 48 years and 43 years in Holenarasipura and Channarayapatna taluks of Hassan district, respectively. Respondents had a family size of about 5 and 4, respectively in Holenarasipura and Channarayapatna taluks. The numbers of animals possessed by respondents in these taluks was 5 and 4, respectively with corresponding value of farm inventory of Rs. 2.46 lakhs and Rs. 2.39 lakhs. Average family income of farmers in two taluks was Rs. 2.83 lakhs and 2.79 lakhs respectively and it worked out to be Rs. 2.81 lakhs for the pooled data of both the taluks. The Hassan district is known for its diversity as it falls under four agro-climatic zone of the state and most suitable to grow number of crops and maize crop enjoys it as it is also got the wider adaptability to the diverse climate prevailing. In addition, farmers are also interested in cultivation of maize due to its short duration, lower cost of cultivation and assured market for the crop, as its demand is increasing in present days due to its huge demand in feed industry, as more and more commercial poultry farms are exited in the study area.

4.4.2. Details of land operated by the respondents

The results presented in Table 4.12 related to land owned by the respondents revealed that in Holenarasipura taluk the total area operated was 3.23 acres out of 2.70 acres was irrigated and it accounted for 83.51 per cent of the area operated and remaining was rainfed (16.49 %). Similarly, in Channarayapatna taluk respondent operated 3.07 acres of land and again majority (91.30 %) of it as irrigated (2.80 acres) land and only 0.27 acres (8.70 %) was rainfed. For the respondents of overall study area, respondents operated 3.15 acres comprising of 2.75 acres of irrigated land (87.30 %) and 0.40 acres of dry land (12.70 %). The results are comparable with the district average size of land holding of 2.05 acres of Hassan which was dominated by the marginal and small holdings accounting for about 91 per cent.

Table 4.12 Details of land operated by the respondents

Sl. No.	Particulars	Holenarasipura		Channarayapatna		Pooled	
		Area (acres)	%	Area (acres)	%	Area (acres)	%
1.	Dry land	0.53	16.49	0.27	8.70	0.40	12.70
2.	Irrigated land	2.70	83.51	2.80	91.30	2.75	87.30
3.	Total land	3.23	100.00	3.07	100.00	3.15	100.00

4.5 Cropping pattern on sample farms

Details pertaining to cropping pattern followed on the sample farmers' field are given in Table 4.13. It could be observed from the table that the average gross cropped area worked out to be 5.83 acres and 5.57 acres in Holenarasipura and Channarayapatna taluks, while the net sown area was relatively more in Holenarasipura taluk (3.23 acres) than in Channarayapatna taluk (3.07 acres). The cropping intensity on sample farms was 180.41 per cent and 181.52 per cent, respectively in Holenarasipura and Channarayapatna taluk. The season-wise analysis of cropping pattern revealed that out of the gross cropped area, 2.4 acres was the *kharif* season area in Holenarasipura taluk and it was 1.77 acres in Channarayapatna. Farmers followed diversified cropping pattern in the study area. The major crops grown during *Kharif* season in Holenarasipura taluk include Maize (52.78 %) followed by Paddy, Vegetables, Potato and Ragi. The similar trend was observed for Channarayapatna taluk with maize as the leading crop. For the pooled data of both the taluks, *kharif* season area was 2.15 acres. The respective figures for *rabi* and perennials were 2.15 and 1.07 acres.

The results reported by Spandana *et al*. while studying cropping pattern of marigold in Hassan district during 2019 using the data from 80 sample respondents, were contradicting to the findings of the present study. Where as she reported lower cropping intensity of 120.44 per cent and there existed vast changes in the irrigation practices in the area during *rabi* season.

Table 4.13 Cropping pattern of sample farmers in the study area

Sl. No.	Season	Holenarasipura		Channarayapatna		Pooled	
		Area (acres)	%	Area (acres)	%	Area (acres)	%
1.	**Kharif**						
	a. Maize	1.27	52.78	0.93	52.83	1.10	52.80
	b. Paddy	0.33	13.89	0.23	13.21	0.28	13.60
	c. Ragi	0.13	5.56	0.17	9.43	0.15	7.20
	d. Vegetables	0.30	12.50	0.20	11.32	0.25	12.00
	e. Potato	0.27	11.11	0.17	9.43	0.22	10.40
	f. Others	0.1	4.17	0.07	3.77	0.08	4.00
	Sub total	**2.4**	100.00	**1.77**	100.00	**2.08**	100.00
2.	**Rabi**						
	a. Maize	1.10	45.83	0.67	35.09	0.88	41.09
	b. Paddy	0.33	13.89	0.27	14.04	0.30	13.95
	c. Vegetables	0.43	18.06	0.33	17.54	0.38	17.83
	d. Others	0.53	22.22	0.63	33.33	0.58	27.13
	Sub total	**2.40**	100.00	**1.90**	100.00	**2.15**	100.00
3.	**Annuals/Perennials**						
	a. Ginger	0.20	24.00	0.13	10.26	0.17	15.63
	b. Sugarcane	0.17	20.00	0.33	25.64	0.25	23.44
	c. Coconut	0.47	56.00	0.83	64.10	0.65	60.94
	Sub total	**0.83**	100.00	**1.30**	100.00	**1.07**	100.00
4.	Gross cropped area	5.83	-	5.57	-	5.70	-
5.	Net sown area	3.23	-	3.07	-	3.15	-
6.	Crop intensity	180.41	-	181.52	-	180.97	-

4.6 Cost and returns structure in maize cultivation

The cost of cultivation of maize on per acre basis has been worked out using standard cost concepts and results are presented in Table 4.14.

4.6.1. Cost structure in maize cultivation in Holenarasipura taluk

The results presented in table revealed that the total cost of cultivation of maize was Rs. 37194 per acre in Holenarasipura taluk, out of which about 59.23 per cent was the variable cost (Rs. 22028.46), while fixed cost (Rs. 15165.87) accounted for 40.77 per cent of total cost. Among the different items of variable cost, the cost of human labour (Rs. 8640) was the highest with 23.23 per cent share in the total cost and other variable costs like machine hour cost (Rs. 2880) accounted for (7.74 %), seed cost (Rs. 2092.30) for 5.63 per cent. The fertilizer cost, which included Rs. 741.30 on Nitrogen, Rs. 1519.93 on Phosphorous and Rs. 1078 on Potassium and all these three major nutrients' cost together accounted for 8.98 per cent in the total cost of cultivation. Since, majority of the maize area sampled was irrigated, irrigation charge (Rs. 2945) accounted for 7.92 per cent. The rest of the items of expenditure like cost of plant protection chemicals (Rs. 555), farm yard manure (Rs. 532) and bullock labour (Rs. 300) ranged from about one to two per cent each in the total cost of cultivation.

Among various items of fixed cost, rental value of land (Rs. 9189.36), which was arrived at by taking 20 per cent of the gross returns, accounted for the major chunk of fixed cost and accounted for 24.71per cent of total cost. The other items of fixed costs included managerial cost (Rs. 2128.35) accounted for (5.72 %), depreciation cost (Rs. 2875) for 7.73 per cent, insurance premium (Rs. 340.54) for about one per cent. The land revenue paid by the farmers was Rs. 28 per acre.

4.6.2. Cost structure in maize cultivation in Channarayapatna taluk

Similarly, per acre cost of cultivation of maize in Channarayapatna was worked for comparison and results are also presented in Table 4.14 Not much difference was observed with respect to cost of cultivation and the composition of total cost. The total cost of cultivation of maize was Rs. 36894.1 per acre, of which variable cost (Rs.

218080.9) accounted for 59.11 per cent of total cost while fixed cost (Rs. 15085.2) accounted for 40.89 per cent of the total cost of cultivation. Among the different items of variable cost, the cost of human labour was the highest (Rs. 8393) which accounted for about one-fourth of total cost of cultivation. The other variable costs items included machine hour cost (Rs. 2560 and 6.94 %), seeds costs (Rs. 2040.85 and 5.53 %), Fertilizer cost (Rs. 3188) which comprised of Rs. 735.33 on Nitrogen, Rs. 1472.43 on Phosphorous and Rs. 980 on Potassium and these three nutrients together accounted little less than ten per cent. The cost of irrigation comprising of amortized drilling and commencement charges including depreciation of various irrigation machineries and equipments worked out to be Rs. 2880 and accounted for about 7.81 per cent. The other items of variable cost included expenses on Plant Protection chemicals (Rs. 540), farm yard manure (Rs. 456) and bullock pair (Rs. 250) together accounted for about five per cent. Nowadays farmers are using more of machines for farm operations like ploughing, spraying and harvesting, hence the usage of bullock labour found to be very less. In addition, due to uneconomical holding size, farmer likes to hire machineries instead of owning a pair bullock due to higher prices of bullock pair (Rs. one lakh) and their high maintenance cost.

Among the fixed items of costs, the rental value of land accounted for the major (Rs. 8656.44) share which accounted for 23.46 per cent of total cost. The other item of fixed costs was returns to the owner (managerial cost-Rs. 2038.21) accounted for about six per cent. This was obtained by taking ten per cent of the total variable cost incurred by the farmers. The depreciation charges (Rs. 2880), insurance premium (Rs. 326.11) and land revenue (Rs. 28) were the items of minor importance.

Similar results were reported by Swami *et al*. while studying cost and returns structure of maize in north eastern district during 2019 using data from 160 respondents. Where in TVC accounted for 79.25 per cent (Rs. 14750) and TFC accounted for 11.18 per cent (Rs. 2220) of the total cost of cultivation.

Table 4.14 Cost of cultivation of maize per acre in the study area

Sl. No.	Particulars	Holenarasipura			Channarayapatna			Pooled		
		Qty	Value (₹)	Per cent	Qty	Value (₹)	Per cent	Qty	Value (₹)	Per cent
I	**Variable Costs**									
1.	Seeds (kg.)	6.10	2092.30	5.63	5.95	2040.85	5.53	6.03	2066.58	5.58
2.	FYM (Tractor load)	0.14	532.00	1.43	0.12	456	1.24	0.13	494.00	1.33
3.	Fertilizer (kg.)									
	Nitrogen	62.00	741.30	1.99	61.5	735.32	1.99	61.75	738.32	1.99
	Phosphorous	32.00	1519.93	4.09	31	1472.43	3.99	31.50	1496.18	4.04
	Potassium	33.00	1078.00	2.90	30	980	2.66	31.50	1029.00	2.78
4.	PPC (kg.)	1.85	555.00	1.49	1.8	540	1.46	1.83	547.50	1.48
5.	Human labour (Mandays)	19.20	8640.00	23.23	18.65	8392.50	22.75	18.93	8516.25	22.99
6.	Bullock pair (Pair days)	0.30	300.00	0.81	0.25	250	0.68	0.28	275.00	0.74
7.	Machine hour (hr.)	3.60	2880.00	7.74	3.2	2560	6.94	3.40	2720.00	7.34
8.	Irrigation charges (Rs.)		2945.00	7.92		2955	8.01		2950.00	7.96
9.	Interest on working capital @ 7 %		744.92	2.00		1426.75	3.87		1085.84	2.93
	Total Variable Cost	**-**	**22028.46**	**59.23**	**-**	**21808.90**	**59.11**	**-**	**21918.66**	**59.17**
II	**Fixed Costs**									
1.	Land revenue	-	28	0.08	-	28	0.08	-	28.00	0.08
2.	Depreciation cost	-	2875.00	7.73	-	2880	7.81	-	2877.50	7.77
3.	Rental value of land#	-	9189.36	24.71	-	8656.44	23.46	-	8922.90	24.09
4.	Managerial cost	-	2128.35	5.72	-	2038.21	5.52	-	2083.28	5.62
5.	Insurance premium	-	340.54	0.92	-	326.114	0.88	-	333.33	0.90
6.	Interest on fixed capital @ 10 %	-	604.62	1.63	-	1156.44	3.13	-	880.53	2.38
	Total Fixed Costs	**-**	**15165.87**	**40.77**	**-**	**15085.20**	**40.89**	**-**	**15125.54**	**40.83**
III	**Total cost of cultivation**	**-**	**37194.33**	**100.00**	**-**	**36894.10**	**100.00**	**-**	**37044.20**	**100.00**

Note: #Rental value of the land was considered at 20 per cent of the gross returns

4.7 Production and returns from maize cultivation

4.7.1. Production and returns from maize cultivation in Holenarasipura

The details of output and returns per acre were presented in Table 4.15. It could be observed that the average grain yield of the maize was 23.7 quintals and that of by-product obtained was 2.13 tonnes per acre. Farmers realized a gross return of Rs. 45946.8 by selling at an average price of Rs. 1714 per quintal. After deducting the total cost from gross returns, the net return realized was Rs. 8752.47 and resulted in returns per rupee of expenditure of 1.24 for maize cultivators in the study area. This implies for every one rupee of expenditure on maize cultivation, farmers would get 24 paisa net profit, indicating viability of maize cultivation in the study area.

Table 4.15: Production and returns from maize in study area

(₹/acre)

Sl. No.	Particulars	Holenarasipura		Channarayapatna		Pooled	
		Qty	Value (₹)	Qty	Value (₹)	Qty	Value (₹)
1.	Main product (q)	23.70	40621.80	22.30	38222.20	23.00	39422.00
2.	By-product (Fodder-tractor load)	2.13	5325.00	2.20	5060.00	2.17	5192.50
3.	Gross returns (₹)		45946.80		43282.20		44614.50
4.	Net returns (₹)		**8752.47**		**6388.14**		**7570.30**
5.	Returns per rupee of expenditure		1.24		1.17		1.20

4.7.2 Production and returns from maize cultivation in Channarayapatna

The details of output and returns per acre were presented in the Table 4.15 it could be observed that the average grain yield of the maize was 22.3 quintals and that of by-product obtained was 2.2 tonnes per acre. Farmers realized a gross return of Rs. 43282.20 by selling at an average price of Rs. 1714 per quintal. After deducting the total cost from gross returns, the net return realized was Rs. 6388.14 and resulted in returns per rupee of expenditure of 1.17 for maize cultivators in the study area. This implies for

every one rupee of expenditure on maize cultivation, farmers would get 17 paisa net profit, indicating viability of maize cultivation in the study area.

For the pooled data of both the taluks, the respondents indicated a total cost of Rs. 37044.20. Average yield obtained was 23 quintals and by-product was 2.17 tonnes and Gross returns obtained was Rs. 44614.50 and net return was Rs. 7570.30.

4.7 Efficiency of marketing channels for maize

4.7.1. Identification of marketing channels for maize

Study of marketing channels consists of analyzing the multiple functions performed by various agencies in a sequence in the movement of produce from the producer to ultimate consumers. In the study area three marketing channels were identified for maize.

Channel-I:

Farmers →Village traders→ Wholesalers→ Processing unit

In Channel-I, farmers sold their produce at farm gate to local village traders, where in farmers have not incurred any cost towards transportation except cost of cleaning and packaging. In turn these village traders sold produce to the wholesaler in the regulated market and from whom the produce reached the processors.

Channel-II:

Farmers →Wholesalers→Processor

In channel –II, produce of farmers moved to the processing unit through wholesaler. These wholesalers also sourced their supply to processing unit from the village traders.

Channel-III:

Farmers→ Government Procurement Centre

In this channel farmers directly sold their produce to the government procurement centres at the prevailing Minimum Support Price (MSP).

4.7.2. Efficiency of major marketing channels identified for maize

It could be seen from the results presented in Table 4.11 that farmer's sold maize through different marketing channels. The quantity marketed through these three channels identified differed. The convenience, personal preference and commitments of farmers with traders and availability of the procurement centres were the major factors determining choice of a particular channel by the respondents.

Channel-I found to be the most preferred channel for sale of commodity as 73.33 per cent of them sold within the village, followed by Channel- II where 16.67 per cent of farmers sold their produce to the wholesalers and Channel- III accounts 10 per cent of farmers. The analysis of volume of produce sold revealed that 73.98 per cent of the maize quantity sold in Channel-1 and 16.46 per cent of quantity sold in Channel-II and remaining 9.56 per cent of quantity sold by the farmers through in Channel-III.

Marketing cost and market margin analysis

The marketing costs, marketing margins, profit margin, total market margin and producer's share in consumer rupee on per quintal basis have been worked out and presented in table 4.11.

Marketing Channel-I

In this channel, farmers received a net price of Rs. 1,666 per quintal of maize after the deduction of the marketing cost of Rs. 34 per quintal. The purchase price of village trader was Rs. 1700 and the marketing cost incurred by him was Rs. 51 per quintal and he sold the produce to the wholesaler by keeping the margin of Rs. 55. After village trader the wholesaler was the next agency who purchased at Rs. 1806 and incurred a marketing cost of Rs. 48 then he sold the produce to processor at Rs. 1934, which included his margin of Rs. 80.

Up to this point of reaching produce to processor, the total marketing margin was Rs. 268 which comprises of almost equal proportion of total marketing cost (Rs. 133) and total profit margin (Rs. 135) of different marketing agencies. The Producers' Share in

Consumer Rupee was 86.14 per cent. In other words, farmers realized Rs. 86.14 from every Rs. 100 worth of maize sold.

From this point onwards, the produce altogether changes its form, livestock feed, so we can treat this as new channel, and the efforts were made to estimate the cost and returns from processing. In manufacturing of feed, the total processing cost incurred was Rs. 2450, this comprised of cost of maize grain, additives, electricity, labour, depreciation of machineries, amortized establishment cost. Further processor incurred Rs. 516 towards marketing and earned about Rs. 700 as profit margin for a quintal of feed.

In per cent terms, processing cost, marketing cost and profit margins account for 43.75 per cent, 9.21 per cent and 12.50 per cent in the total marketing margin of Rs. 3934 in the case of feed. The selling price of processor or purchase price of consumer was Rs. 5600.

Channel-II

Similar analysis with respect to marketing Channel-II for maize revealed a total marketing margin of Rs. 166 comprising of Rs. 81 marketing cost and Rs. 85 as the profit margin of market intermediaries. Thus, the producer share in consumer rupee in maize marketing was more than ninety per cent (90.98 %) and hence it was little more efficient than previous Channel-I. The analysis with respect to feed showed Producers' share in consumer rupee of about 30 per cent. The total marketing cost formed 78.97 per cent of the marketing margin and remaining 21 per cent was profit margin of intermediaries.

Channel-III

The producers share in consumer rupee was 96.25 per cent and 31.68 per cent in the case of maize grain and livestock feed marketing. In this channel the total marketing margin consist of only marketing cost of Rs.65 as it was direct marketing to processing unit. With respect to feed manufacturing and marketing the total marketing cost was Rs.2885 and profit margin was Rs.710, which account for 80.25 per cent 19.75 per cent of the total marketing margin.

Table 4.16: Marketing of maize by the sample farmers through different marketing channels

(a)

Sl. No.	Market functionaries	Channel I		Channel II		Channel III	
		Quantity	Per cent	Quantity	Per cent	Quantity	Per cent
I	**Channel-wise quantity marketed**						
1.	No. of farmers	44	73.33	10	16.67	6	10
2.	Produce sold **(q)**	1039	81.43	235	18.42	142	11.13

(b) ***(Rs./q)***

Sl. No.	Market functionaries	Channel I			Channel II			Channel III		
		Amount	Per cent		Amount	Per cent		Amount	Per cent	
			Grain	Feed		Grain	Feed		Grain	Feed
II	**Details of marketing**									
1.	**Producer**									
A	Sale price	1700	87.90	30.36	1710	92.88	30.59	1732	100.00	32.92
B	Total cost incurred	34	1.76	0.61	35	1.90	0.63	65	3.75	1.24
C	Net price received	1666	86.14	29.75	1675	90.98	29.96	1667	96.25	31.68
2.	**Village trader**									
A	Purchase price of village traders	1700	87.90	30.36	-	-	-	-	-	-
B	Cost incurred by village trader	51	2.64	0.91	-	-	-	-	-	-
C	Marketing margin of village trader	55	2.84	0.98	-	-	-	-	-	-
3.	**Wholesaler**									
A	Wholesaler purchase price	1806	93.38	32.25	1710	92.88	30.59	-	-	-
B	Cost incurred by wholesaler	48	2.48	0.86	46	2.50	0.82	-	-	-

Sl. No.	Market functionaries	Channel I			Channel II			Channel III		
		Amount	Per cent		Amount	Per cent		Amount	Per cent	
			Grain	Feed		Grain	Feed		Grain	Feed
C	Marketing margin of wholesaler	80	4.14	1.43	85	4.62	1.52	-	-	-
D	Selling price	1934	100.00	34.54	1841	100.00	32.93	-	-	-
E	Total marketing cost	133	49.63	-	81	48.8	-	65	100	-
F	Total profit margin	135	50.37	-	85	51.2	-	-	-	-
G	Marketing margin	268	100	-	166	100	-	-	-	-
	Producer's share in consumer rupee (%) for grain	86.14	-	-	90.98	-	-	96.25	-	-
4.	**Processor**									
A	Purchase price	1934	-	-	1841	-	-	1732	-	-
B	Processing cost	2450	62.28	43.75	2480	62.28	44.36	2300	62.28	43.71
C	Marketing cost	516	13.12	9.21	500	13.12	8.94	520	13.12	9.88
D	Profit margin	700	17.79	12.50	730	17.79	13.06	710	17.79	13.49
	Selling price of feed	5600		100.00	5590		100.00	5262		100.00
5.	Total MC	3099	78.77	-	3061	78.97	-	2885	80.25	-
6.	Total Profit margins (PM)	835	21.23	-	815	21.03	-	710	19.75	-
7.	Marketing margin (MC+PM)	3934	100	-	3876	100	-	3595	100	-
8.	**Producer's share in consumer rupee (%) for Feed**	**29.75**	**0.76**	**-**	**29.96**	**0.76**	**-**	**31.68**	**0.76**	-
9.	**Acharya method**	0.42	-	-	0.43	-	-	0.46	-	-
10.	**Shepherd method**	1.42	-	-	1.44	-	-	1.46	-	-

Thus the channel with less number of middlemen found to be more efficient (Channel-III) followed by Channel-II and Channel-I.

Acharya and shephered's approach was calculated to know the marketing efficiency of channels and here also channel III was found to be more efficient than other two channels, due to less number of intermediaries.

4.8 Constraints in maize production and marketing

The major limitations associated with cultivation of maize in Hassan district expressed by the farmers were collected and analysed using garret ranking technique. The results on production constraints are presented in Table 4.12 and constraints reported by respondents in marketing are presented in Table 4.13.

Among the production constraints, shortage of labour was the major constraint with garret mean score of 71.08 followed by high wages of labour with garret score 54.35, attack of insects and pests (garret score 46.35), costlier of input (garret score 45.31) and high pesticide cost (garret score 32.77).

Similarly, there were five major marketing constraints reported by the respondents (Table 4.13) which comprises of fluctuation in price of maize cultivation (59.15), followed by high commission charges (55.67), delayed payment (49.42), high transportation cost (48.58) and inadequate storage facility (41.56).

Similar results were reported by Basavaraj *et al*. while studying constraints faced by maize growers in Haveri district during 2020.

Table 4.17: Production constraints faced by the farmers

Sl. No.	Constraints	Garret score	Rank
1.	Labour shortage	71.08	**I**
2.	High wages of labour	54.35	**II**
3.	Insects and pests attack	46.35	**III**
4.	Costly input (Seeds and fertilisers)	45.31	**IV**
5.	High pesticide cost	32.77	**V**

Table 4.18: Marketing constraints faced by the farmers

Sl. No.	Constraints	Garret score	Rank
1.	Fluctuation in price	59.15	**I**
2.	High commission charges	55.67	**II**
3.	Delayed payment	49.42	**III**
4.	High transportation cost	48.58	**IV**
5.	Inadequate storage facility	41.56	**V**

V SUMMARY AND CONCLUSION

A crisp summary of the research findings along with brief information study area, data sources and analytical tools employed is presented in this chapter. Policy recommendations based on the results of the present study are also proposed for planners and administrators to consider while framing policies.

5.1 Introduction

Maize is one of the most versatile emerging crops able to thrive in a wide range of agro-climatic conditions. Maize is recognized as queen of cereals around the world because of its highest genetic yield potential among the cereals. Maize starch is an excellent source of carbohydrates and a highly versatile industrial raw material that finds extensive application in the textile, food, pharmaceutical and paper industries. Maize is preferred as poultry feed because of its easy availability. It also discovers application in food holders, plastic food bundling, medication, nutrient tablets, material items, confections, etc. Globally, maize has been prepared to deliver bio ethanol incredibly for mixing with auto fills. Indeed, maize is the solitary grain that has different employments.

It is the world's second most extensively farmed crop planted in tropical, subtropical, and temperate climates, and comes in varieties including field corn, sweet corn, popcorn, and baby corn. Over 170 nations are currently producing nearly 1147.7 million metric tonnes of maize on an area of 193.7 million ha, with an average productivity of 5.75 t/ha (FAOSTAT, 2020).

Maize is used for feed (61 %), food (17 %) and in industries (22 %) around the world. India with 9.2 million ha ranks fourth in area and seventh in production with roughly four per cent area and two per cent production of maize in the globe.

Karnataka rank first with 10 per cent share of India’s maize production, as it is being grown throughout the year in view of the favourable agro-climatic condition. Karnataka produced 3.853 million tonnes from an area of 1.31 million ha with productivity of 2869 kg/ha maize during 2017-18. The present study was conducted in

Hassan district, the leading producer of maize in Southern Karnataka with the following specific objectives.

Objectives of the study

1. To analyze the trends in area, production and productivity of maize in Karnataka
2. To estimate the cost and returns in maize production
3. To study the efficiency of different channels of marketing identified for maize
4. To identify the constraints in production and marketing of maize

5.2 Methodology

The present study was taken-up in Holenarasipura and Channarayapatna taluks of Hassan district in Karnataka chosen based on the dominance of maize area. Farmers were chosen randomly from the predominantly maize villages in consultation with the officers of the Department of Agriculture and extension workers.

To accomplish the objectives of the study, the both the primary and secondary data were collected. The primary data from farmers (60) on demographic features of the respondents, cropping pattern, net returns, marketing channels and constraints faced by them were collected through survey method during April, 2021. In addition, data were also collection from Processors (5), Wholesalers (5) and Village traders (5) and users of the animal feed manufactured from maize (15).

The secondary data on area, production and productivity of maize in Karnataka were collected from the reports of the Directorate of Economics and Statistics. Further, data on arrivals and prices of maize were sourced from the records of the three chosen Agricultural Produce Market Committees (APMC's) and krishimaratavahini.

5.3 Analytical aids and approaches employed

The primary data collected from respondents were analysed using the measures of central tendency and standard costs and returns concepts. Frequency distribution and percentages were used for meaningful comparison and interpretation of the results. The

performance of maize in area, production and productivity in different districts and state was studied by estimating the growth rates. The different components of time series data on arrivals and prices were isolated for selected markets. The Co-integration analysis was performed to know the integration between selected major maize markets of Karnataka. Acharya method and Shephered's methods were used to assess the efficiency of different marketing channels followed by the respondents.

5.4 Major findings of the study

1. In Karnataka, the area and production of maize found to be decreasing by 7.90 per cent and 7.10 per cent, respectively but the productivity of maize registered about one per cent (0.94 %) growth. However, growth rates were found to be non-significant.

2. Hassan district is the leading district with 84018 ha and account for 6.47 per cent of total state area of 1.30 lakh ha and account for about eight per cent of production with annual production of 3.29 lakh tonnes with about eight per cent share in the total production of maize of the state of 40.79 lakh tonnes during the period TE 2017-18.

3. The growth rates for maize area found to be highly significant at one per cent in the case of Davanagere (0.79 %), Haveri (3.96 %), Hassan (6.73 %), Koppal (8.23 %), Chikkaballapur (6.23 %) and Mysore (5.64 %) districts, while maize area in Dharwad (-4.23 %) found to be decreasing and coefficient found to be significant at five per cent probability level.

4. With respect to production, Hassan was the only district which showed growth rate of 8.11 per cent and was significant at one per cent probability level, while growth rates were significant at five per cent in the case of Mysore (4.64 %) and Dharwad (-3.02 %).

5. The arrivals of maize in Channarayapatna market were found to be increasing during the initial years of study, reached peak in 2014, and then there was a decreasing trend during the latter part of the study period from 2015 to 2020. For the overall study period arrivals shown decreasing trend as revealed by the negative coefficients. The

prices of maize have shown wider fluctuations over the years and have increased by over the years.

6. Seasonal indices for arrivals of maize in Channarayapatna market showed a greater variation and were found to be the higher during the months of January (334.73) and started increasing and the lowest index was seen during August (1.70) and with respect to prices of maize also, the same trend was observed in the market with one-month lag.

7. The arrivals of maize have shown cycle period of 4 years of increase and four years of decrease and totally eight years of cycle there existed a clear relationship between arrivals and prices of maize.

8. After isolating the trend, cyclical and seasonal components in the times data, the residual irregular component has not shown any definite movement over the time period. However, the results on irregular components for arrivals of maize in Channarayapatna market have not shown any definite pattern so there was no relation between arrivals of any year with either the preceding or succeeding year.

9. The results on Johansen co-integration test showed long run equilibrium among the three markets (Hassan, Davangere and Bagalkot) chosen for the study. The results of Granger causality test showed unidirectional relationship for Davangere market with other two markets, i.e., prices in Davangere market influence the price of Bagalkot and Hassan market. Similarly, Hassan market prices exerted unidirectional causality on Bagalkot. The Co-integration coefficients were found to be significant only with Bagalkot and Davangere, while it was non-significant for Hassan market.

10. Most of the respondents were male (80 %) in Holenarasipura taluk and about 30 per cent of the respondents were illiterates. Among the literates, 26.67 per cent have completed high school education followed by 23.33 per cent of the respondents possessed primary school education and 20 per cent completed college education.

11. In Channarayapatna taluk, more than 80 per cent were male respondents. More than forty per cent (43.33 %) of the respondents were illiterates, 6.67 per cent did primary education, 26.67 per cent studied up to high school and 23.33 per cent completed college level education.

12. Respondents had a family size of about 5 and 4, respectively in Holenarasipura and Channarayapatna taluks. The respondents in these taluks possessed 5 and 4 animals, respectively with farm inventory worth of Rs.1.46 lakhs and Rs.1.39 lakhs. Average family income of farmers in two taluks was Rs.1.83 lakhs and 1.80 lakhs, respectively.

13. In Holenarasipura taluk the total area operated was 3.23 acres out of 2.70 acres (83.51 %) was irrigated and remaining was rainfed (16.49 %). Similarly, in Channarayapatna taluk respondent operated 3.07 acres of land with majority (91.30 %) of it as irrigated (2.80 acres) land.

14. During *kharif* season the main crops cultivated were maize, paddy, vegetables, potato and ragi and during *rabi* season maize, paddy and vegetables were grown and sugarcane, ginger and coconut were the other crops grown by the respondents.

15. The season-wise analysis of cropping pattern revealed that in the gross cropped area, about 36 per cent (72 acres) was the kharif season area in Holenarasipura taluk and it was 25.73 per cent (53 acres) in Channarayapatna. Gross cropped area worked out to be 200 acres and 206 acres in Holenarasipura and Channarayapatna taluks, while the net sown area was relatively more in Holenarasipura taluk (97 acres) than in Channarayapatna taluk (92 acres). The cropping intensity on sample farms was 206.19 per cent and 223.91 per cent, respectively in Holenarasipura and Channarayapatna taluk.

16. The total cost of cultivation of maize was Rs. 37194 per acre in Holenarasipura taluk, of which 59.23 per cent was the variable cost (Rs. 22028.46), while fixed cost (Rs. 15165.87) accounted for 40.77 per cent of total cost.

17. With respect to cost of cultivation and the composition of total cost in Channarayapatna taluk, the total cost of cultivation was Rs.36894 per acre, of which variable cost (Rs.218080.9) accounted for 59.11per cent of total cost while fixed cost (Rs.15085.2) accounted for 40.89 per cent of the total cost of cultivation.

18. Farmers realized grain yield of 23.7 quintals and by-product of 2.13 tonnes per acre in Holenarasipura taluk. Farmers received Rs. 1714 per quintal of maize. The gross returns (Rs. 45946.8) and net returns (Rs. 8752.47) appears to be sufficiently high to cover total cost and realized Rs. 1.24 of returns for every rupee spent in maize cultivation.

19. Similarly, in Channarayapatna taluk farmers realized grain yield of 22.3 quintals and 2.2 tonnes of fodder per acre. Farmers earned net returns of Rs. 6388.14 per acre and profit of Rs. 0.17 from every rupee spent on maize.

20. Three marketing channels were identified for maize in the study area and with increase in the number of middlemen, the price spread increased and producer share in consumer rupee shrinks. The channel with less number of middlemen found to be more efficient.

21. Among the production constraints, shortage of labour was the major constraint followed by prevalence of high wages rates, attack of insects and pests, high cost of input and pesticides.

22. The major marketing constraints reported by the respondents comprised of high price fluctuation followed by high commission charges, delayed payment, high transportation cost and lack of storage facility.

Policy recommendations

Findings of the present study have provided basis for following policy implications.

1. Intensive efforts are needed to create awareness among farmers about benefits of regulated markets, which help to get higher share and Producers' share in consumer rupee compared to other channels existed in the study area.

2. The information dissemination mechanism of APMCs on current, comprehensive and up to date information on arrivals and prices of agricultural commodities would help suitable marketing plan and in turn would help achieve price stability.

3. There is need to give more emphasis on strengthening and the effective functioning of regulated markets in terms of upgrading good storage, grading and packaging infrastructure.

4. Establishing agro-processing industries to absorb maize and manufacture maize based products is desirable as it would benefit the entire stakeholder, *viz.,* producer-farmers by ensuring better prices, traders and processors to enjoy benefits of economies of scale.

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