

**PRICE ANALYSIS OF TURMERIC FOR MAJOR
MARKETS OF MAHARASHTRA**

THESIS

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in partial fulfilment of the requirements
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**By
KADAM KALYANIRANJAN YASHWANT**

**DEPARTMENT OF AGRICULTURAL ECONOMICS
AND STATISTICS
POST GRADUATE INSTITUTE, AKOLA**

**DR. PANJABRAO DESHMUKH KRISHI VIDYAPEETH,
KRISHINAGAR PO, AKOLA (MS) 444 104**

Enrolment Number -MM/2813

2016

DECLARATION OF STUDENT

I hereby declare that the experimental work and its interpretation of the thesis entitled "**PRICE ANALYSIS OF TURMERIC FOR MAJOR MARKETS OF MAHARASHTRA**" or part thereof has neither been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis / publication of any University or Scientific Organization. The sources of material used and all assistance received during the course of investigation have been duly acknowledged.



Place: Akola

(Kadam Kalyaniranjana Yashwant)

Date: 31 / 5 / 2016

Enrolment No. MM / 2813

CERTIFICATE


This is to certify that thesis entitled "PRICE ANALYSIS OF TURMERIC FOR MAJOR MARKETS OF MAHARASHTRA" submitted in partial fulfillment of the requirement for the degree of "Master of Science in Agriculture (Agricultural Economics)" of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by Kadam Kalyaniranjn Yashwant under my guidance and supervision.

The subject of the thesis has been approved by the Student's Advisory Committee.

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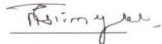




Dr. A.S. TINGRE
Chairman
Advisory Committee

Countersigned


Associate Dean
Post Graduate Institute, Akola
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE
INCLUDING EXTERNAL EXAMINER (AFTER VIVA-VOCE)

- | | |
|----------------------|--------------------|
| 1. Chairman | Dr. A. S. Tingre |
| 2. Member | Dr.S.C. Nagpure |
| 3. Member | Dr. P.P. Bhople |
| 5. External Examiner | (S.N. Suyawanshi) |

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Kadam

(KADAM KALYNIRANJAN YASHWANT)

Enroll. No.MM/2813

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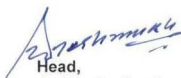
(D) Abbreviations

%	-	Per cent
/	-	Per
@	-	At the rate
Agril.	-	Agricultural
Avg.	-	Average
B:C	-	Benefit Cost
Dr. PDKV	-	Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
e.g.	-	Exempli gratia (For example)
et al.	-	Et alia (and others)
etc.	-	Et cetra
Ha	-	Hectare
i.e.	-	That is
Kg.	-	Kilo Turmeric
Kh.	-	Kharif
M.S.	-	Maharashtra State
Mha	-	Million hectare
No.	-	Number (s)
q/ha	-	Quintals per hectare
qtl.	-	Quintal
Qty.	-	Quantity
Rs./	-	Rupees
Sr. No.	-	Serial number
vis-à-vis	-	In relation to
Viz.,	-	Videlicet (namely)
w.r.t.	-	With respect to

(F)

THESIS ABSTRACT

- a) Title of the thesis : "PRICE ANALYSIS OF TURMERIC FOR MAJOR MARKETS OF MAHARASHTRA"
- b) Name of student : KALYANIRANJAN YASHWANT KADAM
- c) Name and Address of Major Advisor : Dr. A.S.Tingre
Assistant professor, Department of Agricultural Economics,
Post Graduate Institute,
Dr. PDKV, Akola (M.S.)
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- i) Signature of the student : 
- j) Signature, name and Address of forwarding Authority :


Head,
Department of Agricultural
Economics and Statistics,
Post Graduate Institute,
Dr. PDKV, Akola (M.S).

ABSTRACT

India is the largest producer, consumer and exporter of spices in the world. The global production of turmeric is about 11 lakh tons. Indian turmeric industry contributes about 78 per cent of world production and 60 per cent of the exports of Turmeric. In India Turmeric is cultivated in 8.09 ha with the production of 13.52 lakh tonnes. Total area under Turmeric in India

rose gradually from 1.10 lakh ha in 1990-91 to 1.94 lakh ha in 2009-10. Huge fluctuations in prices of farm produce were observed during past few years.

The present study aimed to study the price movement of Turmeric i.e. seasonal and cyclical variations, price volatility and co-integration among the major Turmeric markets of Maharashtra viz. Sangli, Hingoli, Basmat and Nanded.

For study purpose the data related to monthly average prices and arrivals of Turmeric were collected from major markets of Maharashtra for the period 2004-2015. Moving average method was used to estimate seasonal variations and Residual Method for cyclical variations. The econometric tools like ADF test, Johansen's Multiple Co-integration test, Pair-wise Granger Causality Test, ARCH-GARCH, Vector Error Correction models and for forecasting the future prices and arrivals ARIMA models were also used.

The prices of Turmeric were higher from the month of January to July in selected markets i.e. Sangli, Hingoli, Basmat and Nanded. The cyclical variations were observed in the prices of Turmeric in the selected markets. The higher prices recorded during the year 2004, 2009, 2010 and 2011. The peak period of arrivals of Turmeric in the selected markets was February to May. In Sangli market arrivals are higher in the month of February to May but in remaining three markets it is from April to July. The lean period of arrivals was from October November. The higher arrivals were recorded during the years 2004, 2005, 2007, 2012 and 2014. The price series of Turmeric in all selected markets were non-stationary at level with lag 1 and became stationary after 1st order.

The selected Turmeric markets having long run equilibrium relationship for the prices of Turmeric and there exists co-integration among them as indicated by the results of Johansen's Multiple Co-integration Test. There is bi-directional causality in Turmeric prices between Hingoli and Basmat, Sangli and Basmat, Sangli and Hingoli markets respectively. The prices of Nanded market exhibited unidirectional

causality and affects prices of Basmat Sangli and Hingoli markets. The results of ARCH-GARCH analysis showed that there was high variability in the prices of Turmeric. In selected markets price volatility shocks in Turmeric were quite persistent. The estimates of Vector Error Correction Model (VECM) revealed that only Nanded and Sangli market attain short run equilibrium rapidly.

The forecasted prices of Turmeric for the next season i.e. for the month of January 2017 will be 10862,10516,10888,10316 rupees per quintal for the Sangli, Hingoli, Basmat and Nanded market respectively. The forecasted arrivals for the next season i.e. for the month of January 2017 will be 26100, 13220, 16200 and 6540 quintals for the markets of Sangli, Hingoli, Basmat and Nanded respectively.

CHAPTER I

INTRODUCTION

1.1 Background Information

India is popularly known as the "Spice Bowl of the World" as a wide variety of spices with premium quality is grown in the country since ancient times. Turmeric is one of the oldest spices that's why it is called as "Indian saffron." Turmeric (*Curcuma longa*) is a important spice crop belongs to the family zingibereace .It is rhizomatous herbaceous plant originated from India. The Indian vernacular names include haldi, pasupu .It used in diversified industries as a condiment, a flavoring agent and coloured agent and a curry powder. The active constitute of Turmeric is curcumin which has a wide range of therapeutic effect. 'Kum-kum', popular with every house wife, is also a by-product of Turmeric. It finds a place in offerings on religious and ceremonial occasions. A type of starch is also being extracted from a particular type of Turmeric. Turmeric is also used in a textile industry. The increasing demand for natural products as food additives makes Turmeric as ideal produce as a food colorant.

Turmeric is grown as a kharif crop in India. Turmeric requires hot and moist climate. It thrives best on loamy or alluvial loose friable and fertile soil. It can be grown in diversified tropical condition from sea level to 1500mn above mean sea level within a temperature range 20-30⁰ C. planting is either on raised beds or on rings during May –June. There are 30 varieties grown in India among them Alleppey and Madras are of great commercial importance. Some improved varieties are CO-11983, Roma, Suroma, Sangli and Rajapuri. The main harvest season begins from end of January and extends up to March. Turmeric is harvested when leaves turn yellow and start drying up .In harvesting, the whole clump is lifted out with the dry plant, then the leafy tops are cuts off, the roots are removed, all the adhering mud particles are shaken off and rhizomes are washed well with water. The pick arrival

season is March and April. The important quality attributes of Turmeric are size, physical form, colour, curcumin content, maturity, weight, length and thickness, intensity of colour of the core and aroma.

Global scenario

India is largest producer, consumer and exporter of this spice. China is the second largest supplier of the spice and followed by a number of other countries in an Indian sub-continent, Southeast Asia, Latin American countries such as Jamaica, Peru, and Brazil. Other producers in Asia include Bangladesh, Pakistan, Sri Lanka, Taiwan, and Indonesia. The global production of Turmeric is around 11 lakh tones per annum. India dominates the world production scenario contributing 78 per cent followed by China (8%), Myanmar (4%) Nigeria and Bangala Desh together contributing (6%) of the global production. India is the global leader in value added products of Turmeric and exports. Other major exporters are Thailand, Southeast Asian countries, Central and Latin America and Taiwan. The major importer of Turmeric are the Middle East ,North East, Iran ,Japan .These importing countries represents 75 per cent of the Turmeric world trade and are mostly supplied by the Asian countries .Europe and North America represent remaining 25 per cent, and supplied by India and Central and Latin American countries. Taiwan exports mostly to Japan. The United States Imports of Turmeric from India at 97 per cent, and the rest is supplied by the island of Pacific and Thailand.

Indian scenario

Turmeric is grown in (6%) of total area under spices and condiments in India. India accounts for 78%) world production and (60%) of words exports. In India, Turmeric is cultivated in 8.09 ha with the total production of 13.52 lakh tones. The main Turmeric growing states in India are Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Orissa, and Kerala. The leading producer among the states is Andhra Pradesh with an area of 64000 ha (36%). The second

topper is Tamil Nadu with an area of 30530 ha (16%) followed by Orissa with an area of 24730 ha (13%), Karnataka with 12720 ha (8%) and Maharashtra with an area 6798 ha (4%). The production of these states to the total production of Turmeric in India is Andhra Pradesh 518,550 tons (30.25%), Tamil Nadu 143,358 (13.23%), Karnataka 26,380 (6.22%), Maharashtra 8427 (4%). The major trading centres of Turmeric in India are Nizamabad, Duggirala Kdapa in Andhra Pradesh, Dhamnapari, Erode, Coimbatore, Salem in Tamil Nadu, Sangli in Maharashtra.

The major varieties grown in India are Allepey finger (Kerala), Erode, Salem (TN), Rajapuri, Sangli (MH), and Nizamabad bulb (AP). India exports very less in its production only around (4%) but in between 1998-2001 the exports reached nearly (6%) about 56397 tonnes. Annually India consumes around 7.9 lakh tonnes of Turmeric.

Maharashtra scenario

In Maharashtra total area under Turmeric cultivation 6798 ha and the productivity is 8427 tonnes. Sangli is the Asia's biggest market. Other major markets are Basmat, Hingoli, Nanded, Barshi, and Mumbai. In Sangli district it is mainly grown in Tasgoan, Miraj, Shirala, Walva. The main area under this cultivation is 3596.39 hectares. There are two varieties of Turmeric at Sangli, viz., Jawari and Karhadi. The Jawari variety is grown mainly in the southern part of Sangli, and in Vita, Tasgoan. The Sangli Turmeric is popularly known as Rajapuri halad. In Nanded total area under Turmeric cultivation is 280 hectares and in Hingoli 1200 ha.

There are many factors affecting on demand and prices of Turmeric like weather and rainfall conditions in the country, crop situation in country and any changes in demand both domestic as well as international markets, changes in tariffs, change in external trade policies with respect to commodity.

1.2 Importance of study

Price plays a more important role in predominately agriculture countries like India. They have a profounder effect on growth, equality and stability in developing economies. Changes in agriculture prices have serious effect on the entire economy. They affect income and living standard of farmer's, rural labours and non farming population. They also affect the prices of non farm goods and foreign trades. The major factors influencing on prices of Turmeric are the arrivals in market, climatic conditions during the various growth stages, carry forward stocks, price movement over the period of time, crop condition throughout the country, export and import, global and domestic demand and supply, etc. Seasonal variations observed in prices of Turmeric. In the peak arrivals months the prices of Turmeric declined while in lean period they rises. The markets of Turmeric in Maharashtra are co-integrated and they influences on prices of each other. For better marketing of any agricultural commodity the information regarding seasonality, seasonal variations, price volatility, price movement across the state and country, etc. is necessary.

Analysing the past trend in the price of commodities is also useful in understanding the present scenario and to formulate appropriate strategies to improve the marketing system. The study of seasonal variations is considered to be important as a guide to the producer to market his products and to the consumer to purchase his needs at the right time. It also serves as a guide to the Government to operate its policy measures (procurement and buffer release) at the appropriate time with this background information the present study was undertaken with the following objectives.

1.3 Objective of study

- 1) To study the seasonal and cyclical variations in prices and arrivals of Turmeric.
- 2) To assess the stationarity and volatility in prices of Turmeric of selected markets of Maharashtra.
- 3) To assess the co-integration among selected markets of Turmeric of Maharashtra.
- 4) To examine the Causality or co movement of price signals between selected markets.
- 5) To study the short run and long run equilibrium behavior of Turmeric market prices.
- 6) To forecast the prices and arrivals of Turmeric for the next season of selected markets.

1.3 Hypothesis

Agriculture commodity prices are very unstable and fluctuate violently, the prices of agricultural products fluctuates not only from year to year but during the year from month to month, day to day and even on the same day. The prices of the produce touch the lower level in the peak marketing seasons. That means, when arrival increases, prices decreases. The prices fall in the post harvest month and increase later in the year. Therefore the following hypothesis was proposed for the study.

- 1) Prices of Turmeric are volatile.
- 2) The markets of Turmeric in Maharashtra are co integrated.

1.4 Scope and Limitation

The price of agricultural commodity assumes a great significance from producer's as well as consumer's point of view. It is said that prices are mirror of economy of the country. The fluctuation in prices of agricultural commodity is a greatest obstacle in the way of agricultural development. In order to reduce the price fluctuation the knowledge of interrelations between the prices and arrivals of a farm

product is required for assessing the extent of price fluctuation over a period of time.

Agriculture sector in India has become an important component of the Indian economy and also it is said to be the biggest business of the world. But in real terms the farmers does not get proper returns from their investment. The variation in the prices of agricultural commodities has been one of the major factors affecting the income level of Indian farmers. Prices in general are volatile. They never remain constant. Price of different group of commodities never moves in same directions or with the same speed. The seasonal increase and decrease in arrival has a direct relationship with the prices. Thus price is one of the most important determinants of profit and loss in the farm business and income of the farmer.

The seasonal effect means change in price within a year. The effect of seasonality in the arrival and prices of agricultural commodities are future intensified by the year variation in production of commodity. Such seasonality is well known and deserved proper consideration while attempting marketing system. It is observed that seasonal price fluctuations mostly follow from poor storage facilities and inadequate market information. In agriculture demand for food grains is stable thus the supply plays active role in determining the prices of goods. It has been recognized that even when the farmers have produced efficiently with modern technology, he may be in loss due to marketing problems. Therefore, an assurance of a remunerative and stable price environment for the farmers has been considered as a basic foundation for increase in agricultural production and productivity.

The study is based on secondary data collected from APMC's and AGMARK NET website for four APMC's (Sangli, Hingoli Basmat and Nanded) in Maharashtra. Maximum efforts have been taken to minimize bias by proper crosschecks hence; adequate care should be taken while generalizing the results.

CHAPTER II

REVIEW OF LITERATURE

Review of literature gives the guidelines from the past researchers and provides foundation to the theoretical frame work for the present study. The review of past literature makes the researcher to get an insight in to the methods and procedures to be followed. The available literature relevant to the objectives of the present study was reviewed and presented in this chapter. This chapter deals with review of concepts used in the study as viewed by different authors and review of related studies in the past.

2.1 Trend in Arrivals and Prices

2.2 Price Behavior

2.3 Seasonal and cyclical variations in arrivals and prices

2.4 Price Volatility

2.5 Market Integration

2.6 Granger causality

2.7 Price Forecasting

2.1 Trend in arrivals and prices

Nawadkar *et al.* (1992) they observed in their study that there was an increasing trend in respect of the average price of all the cereals during the period from 1983 to 1990 excepting the average price of wheat and Jowar. They stated that the existing infrastructure facilities such as godowns, cold storage space in the market yard, supervision over the commission agents seems to be inadequate for promoting the arrival of the agricultural commodities.

Khaire *et al.* (1993) studied the trends and variability in prices and arrivals of rice in selected markets of Maharashtra State. The minimum variability was observed in price in different markets ranged between 2.94 per cent to 5.53 per cent and the maximum variability was between 9.23 per cent to 17.30 per cent. In regard to arrivals the minimum variability was from 28.21 per cent to 98.68 per cent and maximum was from 62.42 per cent to 271.79 per cent.

Brahm Prakash and Shrivastava (1994) studied the pattern of marketing arrivals and price of Gram in Uttar Pradesh for the period from 1987-88 to 1991-92 and observed that inter year variations in market arrivals of Gram varied between 86.6 and 120.0 per cent. There is a seasonality in pattern of quantum of arrivals of Gram varied between 57.3 and 218.9 per cent and inter year variations in wholesale prices varied between 65.8 and 75.5 per cent and concluded that the arrivals and prices were negatively correlated.

Sushila Srivastava and Brmhmpakash (1996) studied the trends in market arrivals and prices of Pigeon pea in Uttar Pradesh. The study was undertaken in all the 643 regulated markets of Uttar Pradesh to analyze the inter and intra-year price behaviour of Pigeon pea and studied the impact of market arrivals on it. The data on market arrivals and average wholesale prices prevailed during 1984-85 to 1991-92.

The inter-year variations in market arrivals of Pigeon pea varied between 86.37 to 127.01 per cent from the average annual arrivals from 1984-85 to 1991-92. Except 1987-88 to 1989-90, the market arrivals of Pigeon pea in the state were also most stagnant and varied between 23 and 24 lakh tones. It revealed that farmers in the state sold almost same quantity of Pigeon pea through regulated markets in the state. It is clear that about half of the total arrivals reached the markets in the month of April to June when prices were low.

Mipramawar and Gummagolmath (1998) revealed that, the trend value of arrivals was maximum in the year 1994-95 in both markets. The trend values of prices had increased up to 366.94 during 1994-95 in Belgaum market and also the trend value of price was maximum 318.09 in the year 1994-95.

The correlation coefficient (r) between trend values of arrivals and prices in both markets were positive but in Hubali market it was statistically non-significant. But in Belgaum market, it was

statistically significant. These indicated that increased arrivals lead to increase in prices, which is in contrast of law of demand.

Mishra *et al.* (1998) studied the trend analysis and prices of Gram and Soybean in two mandis of Madhya Pradesh. The total arrivals of Gram is about 52 per cent occurred during harvesting season. In case of Soybean it is 74 per cent, 15 per cent, 7 per cent and 3 per cent, respectively in each season, while price in general were the lowest during the harvesting season and increase in post harvest and pre harvest season in both the case of Gram and Soybean.

Mundinamani *et al.* (1999) studied the trend and seasonality in market arrivals and prices of groundnut in Karnataka. The trend pattern of arrivals of groundnut in the study of markets was mixed one and that of prices was almost identical. In Bijapur and Talikoti markets, arrivals of groundnut showed mild ups and downs during the initial period and considerable increase from the year 1983 - 84 onwards. In Gadag and Ranebennur markets, the arrivals pattern was almost identical whereas Raichur market showed a mild increasing trend during the study period, As far as price trend pattern was concerned, a continuous upwards movement was seen in all the markets without any exception, This was mainly caused by increase in population leading to an increase in demand for edible oils.

The seasonal indices computed for groundnut arrivals and prices are presented higher indices of market. Arrivals of groundnut were noticed immediately after harvest in almost all the study markets. The low indices were found during October to January in respect of rainfed crop and April in respect of Rabi summer crop.

Balappa *et al.* (2002) studied the trend and variation in arrivals and prices of vegetable in Northern Karnataka. The trend pattern of arrivals and prices of onion and potato shows that there was a marginal increasing trend in arrivals and prices over the years with mild ups and downs in all the selected market. However, considerable variations both in prices and arrivals were observed in onion and potato

in all the selected markets as evident from higher co-efficient of variation. The pattern of trend both in arrivals and prices of onion was observed to be similar in all the market except Hubli and Belgaum market. Similarly, there was marginal change in arrival over the period in all the market except Belgaum and Hubli wherein there was increasing trend over years with ups and downs. In case of prices, there was a marginal increase in trend over the period with mild fluctuations in the markets except Belgaum, Hubli and Dharwad wherein upward like trend was noticed from 1997 - 98.

The trend in arrivals of potato in three markets showed a different pattern. In Dharwad and Hubli markets, there was change in the trend over the period, except in Hubli market wherein ups in trend from 1984-85 and downs from 1990 were observed. On the contrary, increasing trend in arrivals over the period was observed in Belgaum market with high fluctuation. In case of prices, the pattern of trend was increasing over the period with mild fluctuations up to 1997 - 98 and thereafter sudden jump were observed in the entire market trend.

Dayatar *et al.* (2003) studied the trend in production, prices and market arrival of sorghum. They concluded that arrival at regulated market in seven states as a per centage of the all India production during the 1990's. This gives a rough approximation of the surplus marketed through regulated channels at the all India level. Market arrivals varied between 9.3 to 17.3 per cent of sorghum production in all India level. The market surplus is much lower for sorghum than wheat and rice. The declining trend prevails for sorghum over the period and the per centage of average seasonal prices variation of sorghum is not too high as compared to other commercial crops. The fluctuations in case of sorghum are mainly due to the poor grain qualities, which causes steep fall in sorghum prices.

2.2 Price Behaviour

Tyagi (1990) observed in regard with behaviour of prices that there have been instances when actual prices received by farmers

have fallen below the floor level (minimum support prices) for some commodities in some markets.

Basavaraja (1993) conducted the study on "Behaviour of prices and market arrivals of major crops in Bijapur". He studied the degree of fluctuations in prices and arrivals of major crops in Bijapur market, for the period from 1971 to 1992 and noted that the prices as well as arrivals of crops showed an increasing trend. Seasonal character was more pronounced in case of arrivals than in case of prices. The higher prices were observed during the months in which market arrivals were lower and vice-versa. In the short run prices and arrivals showed inverse relationship. Seasonal pattern of market arrivals resulted in short run price instability.

Imad (2000) viewed Price Behavior as a security analysis discipline for forecasting the future direction of prices through the study of current price movement.

Bacha and Gemeda (2001) viewed Seasonal price behavior as a regularly repeated price pattern that is completed once every twelve months. Such a regular pattern arises from seasonality in demand, supply and marketing or a combination of two.

Sable (2005) studied price behaviour of rice in four tahsils of Gadchiroli district during 2004-05 for two decades period i.e. from 1984-85 to 2003-04. The data revealed that highest arrival was observed in the month of January for APMC Armori (7.47 lakh qtls). The lowest arrival was recorded in August in APMC Chamorshi (0.03 lakh qtls). Price indices were found highest from April to September and lowest from November to June. Highest and Lowest indices recorded for Gadchiroli, Chamorshi, Armori and Aheri were 108.30 and 92.70, 110.87 and 92.81, 105.44 and 92.01, 104.49 and 94.18 respectively. An inverse relationship between arrival and price of rice was noticed.

Benke (2008) studied Arrival and Price Behaviour of Different Crops in Akola District and results indicated that compound growth rate of production and arrival were found to be positively

associated in period I (1987-96) of study and negatively associated in period II (1997-2006) of study for Akola APMC. But in case of all other APMC i.e. Akot, Telhara and Balapur it is positively associated in both period of study. Despite pronounced seasonality in arrivals there were negligible variations in seasonal prices of almost all the crops studied. The magnitude of fluctuations in arrivals were also very high, the cyclical movement in arrivals were observed in Jowar and Tur, while cyclic price fluctuations were seen in Jowar, Wheat and Soybean in all selected market. The C.V. of years prices were higher for all commodities, the highest was seen for Mung and lowest in Soybean.

Salave (2011) studied the Price Behaviour of Selected Agricultural Commodities in Akola District and the study revealed that, there was inverse relation between arrival and prices of selected agricultural commodities. There were wide seasonal variations in arrival and prices of agricultural commodities. In case of Wheat peak arrival was in month of April in all APMCs. Over a period of 10 years maximum mean arrival of Wheat was 18187.92 quintals in 2004-05. Per quintal price of Wheat in Akola market steadily increased from Rs.730.17 per quintal in 2001-02 up to Rs. 1209.58 per quintal in 2008-09. Over a period of 10 years maximum mean arrival of Jowar 7147.91 quintals in 2001-02. The compound growth rates of area, production and productivity of all crops increased significantly over a period of time. In respect of area, production and productivity, the highest instability was observed in Wheat and Soybean. Seasonal indices of arrival of all crops were observed at highest level in the month just after harvesting of Soybean, Tur, Wheat and Jowar crops with lowest price indices while it was highest during the months just before harvesting of crops showing lowest arrival in the market. The inverse relationship between arrival and prices was recorded for all crops in all selected markets.

Selvaraj (2011) explained that the price behavior of the agricultural commodities is based on the traditional theory of supply and demand conditions. Due to seasonal behavior of agriculture, it is

viewed that during peak arrivals, the prices would be low and vice versa. However the demand is spread throughout the year.

Virkar (2012) analyzed the Price Behaviour of Wheat in Selected APMC's in Nagpur district and the results indicated that in Nagpur district, over 20 years period, APMC Kalmana was found highest arrival of wheat i.e. 24611.33 qtls by comparing all APMCs of Nagpur district, over 20 year's period. Average price of Wheat in Nagpur district was increased from Saoner market was Rs. 1161.85/qlts in 2009-10 to Kalmana market was Rs. 1399.01/qlts 2010-11. In selected APMCs in Nagpur district, highest arrival was found in month of March, April and May i.e. post harvesting period and lowest was in October, November and January due to lean period. The highest prices were found in the month of January, March, July and September in all APMCs of Nagpur district due to less arrival except in Kalmana market. In inter-market price behavior of Wheat in Nagpur district, Kalmana market was found highest mean price i.e. Rs1399.01/qlts in 2010-11 over 20 year period. Inter-year, APMC Umrer was found highest arrival index number i.e. 1894.98 per cent in 2010-11 by comparing all APMCs in Nagpur district and mean price index number i.e. 1178.02 per cent in 1997-98. In the inter and intra year market variability was higher in APMC Kalmana and Saoner as compare to all five APMCs in Nagpur district.

2.3 Seasonal and cyclical variations in arrivals and prices

Gill and Joshi (1970) studied Gram price structure in Punjab during 1955 to 1966 and observed that prices generally moved opposite to production trend. The prices tend to move continuously upward due to a general shortage of food-grains which showed the inflationary trend of the economy for the period under study. The violet seasonal price fluctuations affect the producers incomes as the major portion of their produce (about 70 per cent) was sold during post harvest period when the prices generally observed the lowest. This occurred due to glut situation in the market. The glut situation occurred in the market as result of distress sale or forced sale by the producers.

The seasonal fluctuations in prices can be reduced if the producers avoid immediate post-harvest sales so called distress sale. They should avail the warehousing facilities and spread their sale throughout the year rationally. This calls for effective minimum support policy to be adopted by the government for price stabilization. Only an integrated policy of control and regulation of movement and prices of all the allied and competing commodities simultaneously, can ensure efficacy of restriction on arrivals movement in the market.

Aulakh and Singh (1971) stated that the total arrival of wheat in 63-64 at Amritsar market was 11,74,384 quintals. Where as in 69-70 it had reached the level of 6,05,553 quintals. The arrival of wheat in Amritsar market in the peak season varied from 54.13 per cent to 87.21 per cent, in mid season from 7.33 per cent to 28.98 per cent and in lean season from 5.46 per cent to 21.4 per cent of the total annual arrivals during 63-64 to 69-70.

In case of Gram, arrival decreased from 30,643 quintals in 63-64 to 22,126 quintals in 69-70. The arrival of Gram in peak season varied from about 41 per cent to 65 per cent, in the mid season from 20.63 per cent to 32.07 per cent and in lean season from 6.35 per cent to 26.96 per cent of the total annual arrivals during 63-64 to 69-70 where as in case of paddy in 63-64 total arrival was 3,90,943 quintals which has significantly increased in 69-70 to 9,83,407 quintals. The arrival in peak season varied from 79.49 per cent to 96.73 per cent, in mid season from 2.06 per cent to 15.60 per cent and in lean season from 0.27 per cent to 4.92 per cent of the total annual arrival during 63-64 and 69-70.

Chauhan *et al.* (1971) studied the price structure of wheat in Jaipur market and observed that the index of wheat arrivals start rising from February onwards to April. After May the arrivals decline month by month till they almost dry up in February. The result of the study indicated that the price index decreases with the arrivals of new crop in the month of May when the arrivals index reaches at its peak

from the month of May. The price start rising again till July. The prices again start decreasing from August onwards till October.

Mandavawalla (1979) studied seasonal variations in prices of food grains with special reference to wheat and rice during 1970 -71 to 1977-78 and noted that difference between the highest or lowest normal levels of seasonally adjusted price index number was 9.6 per cent for rice and wheat and 7.7 per cent for all food grains. Whereas on the basis of unadjusted price index, the lowest level of rice price index has shifted from December to March since 1975-76; in case of wheat it was generally located in March-June. No such uniformity was noticed in respect of highest level to rice while for growth rates in area, production and productivity.

Awasthi *et al.* (1985) studied the seasonal fluctuations in the groundnut prices in Indore, Khargone and Sanwad markets, for the period of 1972-82. The study has highlighted, that there is an abrupt and sudden decline in the prices of groundnut just after the harvesting period. While the price increases moderately up to the month of February. The price after this period increases substantially till August. The high degree of positive correlation in the selected market indicated that the price of groundnut is positively correlated.

Verma (1985) studied the seasonal fluctuations in the prices of groundnut in district Unnoo (U.P.) and stated that the adjusted seasonal index arrivals of groundnut in Bangarman market for a period of 1981-1982 to 1983-84 was the highest in the month of December (400.54) and lowest in the month of September (2.14). It was observed that the market arrivals of groundnut gradually increased from the month of October (21.27) to November (222.90) and reached its peak by December (400.54) and there after gradually decreased in January (280.55) February (4.62) and March (45.84). The adjusted seasonal index of prices of groundnut reached to its peak in the month of August (199.52). The adjusted seasonal index was observed as minimum in the month of October (75.93) followed by November (82.87) and December (85.21).

Bhatt and Shiyani (1989) studied the changes in behaviour of market arrivals and prices of groundnut in Amreli regulated market of Gujrat for the period 1970-71 to 1987 -88. They showed that the seasonal indices of arrivals varied from 25.28 per cent in August to 28.86 per cent in the month of December indicating vary wide range in flow of groundnut while those of prices were found to be in the range of 96.87 to 107.75 per cent. They further concluded that the seasonal variability in arrivals was much higher than those of prices indicating that the price is not the only factor, which determines the quality of market arrivals.

Barah and Dutta (1991) stated that monthly seasonal indices for rape and mustards were the lowest in post-harvest period i.e. in the month of March and the highest in pre-harvest months of October and November. The seasonal price index of mustard decreases from December to February. The seasonal indices of market prices of rape and mustard in five major markets in Assam revealed lowest in the month of March and highest in month of November.

Pushpavali (1993) studied the pattern of arrivals and prices of groundnut in Tiruvannamalai regulated market in Tamilnadu. The findings resulted that, the peak season for arrival in the market was October and minimum arrivals were in February. The maximum prices of groundnut prevailed in the month of July and the minimum in the month of April. The seasonal indices of arrivals varied from 34.72 per cent to 171.38 per cent while that of prices from 93.57 per cent to 107.57 per cent.

Raja (1997) undertaken the study on the seasonal variations in prices of Tapioca products for the period of 1983-84 to 1994-95. The variations in the prices of tapioca products were increased from the minimum of 45.16 per cent in February to the maximum of 136.53 per cent in the month of December. It is also observed that the percentage of variation in the prices of tapioca products showed a mixed trend, as the variations in the prices over these periods were not uniform. The seasonal index observed to the

minimum of 97.01 per cent in the first quarter and the maximum of 102-58 per cent recorded during the third quarter. The range of differences between the two was worked out to 5.67 per cent.

Vitonde *et al.* (2000) studied arrivals and prices of major commodities of A.P.M.C. Amravati in Maharashtra. They showed that, the seasonal variation were more in case of arrivals than in case of prices of selected commodities. The higher prices were observed during the months in which the market arrivals were lower and vice-versa. The cyclical fluctuations were found to be more in prices than seasonal variations. The correlation studies revealed that, the arrivals falls and vice-versa.

Bawaskar (2002) in her study on economic analysis of market arrivals and prices of selected food grains in Parbhani District analysed seasonal indices of arrivals and prices of Pigeon pea and chickpea for the period 1980-81 to 1999-2000. The study revealed that the highest indices of arrival in Pigeon pea were in the month of April-February, January and April in Parbhani, Manwat, Selu, and Jintur markets respectively while the lowest indices of arrivals were registered in the month of September in all the four markets selected for study the monthly seasonal indices in prices of Pigeon pea were highest in the month of April, June and November, on the contrary the lowest seasonal indices in prices were observed in the month of September and November.

Kadu (2002) examined the seasonal fluctuation in arrivals and prices of major food grains. He reported that the arrivals of almost all the selected major food grains have shown variation in particular season i.e. the arrivals were highest in post harvest months and lowest in pre-harvest months. The seasonal fluctuation in arrivals were mainly arrived due to seasonal nature of production of forced sale by farmer. A bulk of market arrivals were arrived in peak immediate post harvest months which causes fall in prices. The seasonal fluctuation in arrivals was much higher than those of price, indicating that the price is not the only factor which determines the quantity of arrivals.

Lavleen Kaur *et al.* (2005) studied seasonal indices of arrivals and prices of tomato in Punjab markets, 1989-2001 observed the lowest indices for prices were recorded during May in both the periods when there was a glut in the market with produce i.e. 51.32 in period I (1980-90) and 60.47 in period II (1991-01). Price increases in period II due to the increased demand by the processing units in this period.

Pawar and Jadhav (2007) showed that the highest mean arrival were in the month of October i.e. 18,887.60.qt followed by September i.e.7827.20 qt. These months having overall highest arrivals in the month due to the harvest of black Gram is the month of September and the average mean prices per quintal were highest in the month October i. e Rs.2087.60 followed by November i. e Rs.2060. The highest indices of market arrivals were in the month of October, i. e 398.96 per cent followed by September i. e 372.91 per cent and the highest seasonal indices of market prices were observed in the month February i. e 116.22 per cent followed by January i. e 115.55 per cent. It was observed that seasonal indices of arrival and prices exhibited inverse relationship indicating that there by when arrival indices were less price indices more and vice-versa.

Inderpal Singh and Rangji (2008) showed that there was significant increase in the arrivals of potato during the study period in both the markets. In Punjab market the lean period existed from April to October in arrivals. During the period of November to March, the arrival were the highest, creating glut like situation in the market consequently the prices reached at their lowest level during these month. During April the prices started recovery and reached the highest levels during the period July to September. The seasonal indices of arrivals in both the market were the highest in the month of December (190.11 and 374.80) and lowest in September (51.60 and 7.26) respectively. The price fall and was the lowest in January (83.15 and 84.85) and the highest in the month of August (118.53 and 118.88) respectively in both the market. During the peak period of November to March the

seasonal indices of potato arrival ranged between 106.30 to 190.11 per cent in the Jalandhar market while during the lean period (April to October) the seasonal indices of market arrival ranged between 51.66 to 103.15 per cent.

Vijaykumar (2009) revealed that highest seasonal indices of Maize prices during August month in both karimnager (110.76) and Nijamabad (106.11) market followed by July month (110.61) and (106.10) for respective markets less arrival and more demand for the product during the above month may response for highest seasonal indices suggesting the farming community to go for early sowing and harvesting of the crop for getting highest profit however ,the lowest seasonal indices of Maize prices during October month in both the market reflect the real fact i.e. sharp fall in prices during peak post harvest handling period or immediately after harvesting of the crop. Further the result of analysis of variance indicated that the four month period from May to August is most suitable for marketing the Maize produce as the average prices during this period are higher as compared to other in this four month of July (Rs.615.32) followed by June (Rs.604.61) fetched highest average prices less arrival and more demand for the product.

2.4 Price Volatility

Crain and Lee (1996) explore how wheat spot and future market volatility has been impacted by government farm programme during the 1950-53 periods. They found that changing volatility in both markets was highly associated with changing farm programme at both 1950 and early 1960 were associated with low volatility while the voluntary programmes initiated in the mid 1960 seem to have induced high volatility. They examine seasonality and causality in conjunction with farm programmes.

Hudson and Coble (1999) examined the Durbin-Watson statistics resulting from the initial estimation of equation showed signs of significant auto correlation. Equation was thus corrected for autocorrelation. The model R^2 was 0.3692 which indicates that the

model only explained 36.92 per cent of the variation in cotton price volatility models of this type in other commodities. It was important to note that the model is attempting to explain price variability not price level, so explanatory power is expected to be lower.

Richerter and Sorenson (2000) had estimated "Stochastic volatility Model using panel data of Soybean futures and options on Soybean futures." He revealed that the model of commodity price dynamics was within the exponential affine class and option prices are determined using the inversions of characteristics function approach suggest by Heston (1993) the estimation method is based on a state space formulation of the model and quasi maximum likelihood estimation results are presented based on weekly observation of Soybean future prices and option prices from Chicago board of trade in the period Oct 1984 to March 1999.

Kelly Bryant *et al.* (2004) tomatoes, like all fresh fruits and vegetables, were perishable and cannot be stored for long periods of time. This means that price was highly dependent on the current supply and demand. Supply and demand could change in a matter of days, thus making tomato prices quite volatile. While the demand for tomatoes was increasing over time, much of the volatility in tomato prices comes from changes in supply. A bumper crop or crop disaster in a major production region could change tomato prices quickly. According to USDA's weekly report on tomato shipments dated May 4, Florida had shipped almost 7.5 million more boxes of tomatoes as of May 1 than at that same time last year (an 19 per cent increase). Mexico, on the other hand, had shipped over 3 million boxes less than one year ago at this time (an 11 per cent decrease).

Selcuk Caner, Zeynep ander (2005) in this study, the short term fluctuations in monthly returns on composite index of 17 emerging markets affected by the financial crises in the late 1990's and 2000 were decomposed with vector autoregressive estimates. The results were compared to the behaviour of variation in returns in developed markets. Three different models were estimated for each

market. Due to first order autocorrelation, lagged returns contribute significantly to return volatility in emerging markets. Decomposition of variances indicates that dividend yield and interest rate are determining factor of volatility, but a varying degrees in different emerging markets. However, the role of dividend was not as strong as it was in the developed markets as efficient market hypothesis would imply. In some cases, exchange rates significantly influence market volatility.

Jayakar (2006) the growing Chilli production could see the Chinese dragon devour India's strong oleoresin industry, according to P. Jayakar of China-based Paprika Oleo's. With India already losing out its market to Vietnam and Guatemala in pepper and cardamom produce respectively, there was need to devise strategies like value-addition, curry powders and sauces, better marketing of its oleoresins and selling packaged Chilli and its products to retain its hold on the Chilli market.

Volatility appeared to be the norm rather than exception in international trade due to its structure, climatic conditions and the rapidity with which producers responded to price changes. An interesting feature was that compared to China, India did not have a price advantage in the global market.

Naseem Taleb (2006) there was plenty of nonsense in the discussions about volatility as an "asset class". Volatility was not a tangible object like a tomato; it was abstract and far more complicated than a stock. He can buy a chair or a stock for a price p and sell it at $p + \text{something}$. Volatility was not tangible outside explicit volatility contracts. He gave last night's lecture at Courant on why anyone "reifying" volatility was causing trouble. There were four problems with the measurement of volatility.

Kelvin (2008) quoted that the volatility of the price series may be interpreted as its tendency to have large changes in its values from period to period.

Bharadwaj and Vasisht (2009) examined the price volatility and integration in spot and futures market of Gram. In this

univariate ARCH-Type model has been used to empirically examine persistence and asymmetry in volatility of price of Gram crop. Maximum likelihood estimation results of the models explain the best statistical fit, lending support for hypothesis of persistence, symmetry and variability in volatility. ARCH relates the error variance to the square of a previous period's error. It is employed commonly in modeling financial time series that exhibit time varying volatility clustering i.e. periods of swings, followed by periods of relative calm. An ARCH (9) model can be estimated using ordinary least squares.

Sangeetha (2010) the exports had been lower during the April-December period in terms of volumes, compared with the same period last year. During 2009 period, the country exported Rs 139,000 tones of Chilli, against 146,000 tonnes shipped during April- December 2008. Exports were 5 per cent lower in volumes than the previous year. At an average price of Rs 6,473, the unit-value realization was higher at Rs 899.68 crores. In April-December 2008, the average price was Rs 5,671 and the exports earned Rs 827.98 crores during the nine-month period. As for Chilli, the country had attained 70 per cent of the export target of 200,000 tones and 94 per cent of the target value of Rs 960 crores for the financial year, "The off take by Malaysia dipped during the period. The Telangana protests had been delaying the arrival of the crop in the markets during December. On many days, the markets did not open. Inadequate availability of top quality Chilli from Andhra Pradesh led to lower exports," said Kannan. Higher volatility of prices also had been affecting exports, said Mehul Agrawal, research analyst of agri. commodities with SfaareKhan Commodities.

Caracalla (2011) defined price volatility as a one which indicates how much and how quickly a value of price changes over time.

Elodie and Tristan (2011) defined price volatility as the unanticipated component of price instability, i.e., the conditional variance, while instability could be defined as the unconditional variance in food prices over a time period.

In the present study upward and downward movement of Maize price over the months in a year was considered as price volatility and its presence was tested statistically.

2.5 Market Integration

Cummings (1967) opined that market integration implied the association of prices between markets. Association of prices over time show seasonal integration of prices and association of prices between markets show spatial integration of prices.

Farooq (1970) studied on market and performance of rice marketing system in East Pakistan. In order to know the relationship, he computed correlation coefficients between secondary markets between terminal and secondary markets and between terminal markets and found them to be 0.90, 0.86 and 0.80, respectively. Thus, it indicated that lesser the distance higher was the correlation and greater the degree of market integration.

According to Lele (1971) market integration was the interrelationship between price movements in the two markets. The degree of correlation can be taken as an indicator to which the markets were integrated.

Byln (1973) estimated the market integration by computing the correlation coefficients for the de-trended and de-seasoned data for eight markets in Punjab. The author pointed out that the average V was equal to V between Delhi and other markets indicating the dependence of Delhi prices on the prices of all other collecting markets. The study also showed for lower V prices were lower and vice-versa.

Singh and Arora (1975) examined the extent of market integration of groundnut prices in some important markets of Punjab for the periods 1962-63 to 1967-68 and 1962-63 to 1972-73 by calculating correlation coefficients. The authors found higher variation in groundnut prices during earlier period (1962-63 and 1967-68) than during the later period (1972-73). Their analysis yielded higher 'r' between Khanna and Malerkotta (0.872) and lower 'r' between Khanna and Sangrus and

Ludhiana and Mathura markets (0.67). The study further reported that during later period i.e., 1972-73, the value of 'r' was higher than the earlier two in all markets.

Rao and Subbarao (1976) considered that the markets were integrated over space when the territorial price differences do not exceed the transport costs plus the remuneration for the services of the trader.

According to Goletti and Babu (1994) spatial market integration refers to co-movements of prices and more generally, to smooth transmission of price signals and information across spatially separated markets.

Jayesh (2001) studied market integration for spices using correlation coefficient. The zero order correlation matrix of prices showed a strong integration among the selected markets of Kerala, Karnataka and Tamil Nadu for both pepper and cardamom.

Bessler and Kergna (2003) studied monthly millet prices in 12 markets in Bamako, Mali. They used an error correction model to consider whether the prices from these markets were integrated. They used directed acyclic graphs to study contemporaneous correlation among markets. They found that prices were discovered in the primary wholesale market, where farmers meet retailers and other middle persons. The retail markets did not serve well as points of price discovery.

Amit *et al.* (2004) indicated that Chennai, Delhi and Bombay markets were well integrated indicating the existence of price dependency among various markets. It was pointed out that the values of ADF test were all significant at 10 per cent level of significance.

Dalawi (2004) analyzed the relationship between the prices in major six domestic cotton markets and also at international market (New York) using the co-integration technique. The results clearly indicated that all the price series in major four DCH cotton markets and two Jayadhar cotton markets in the state were assumed to be stationary at order of integration one. The DF test statistics

obtained for all the markets including international market were found to be more than the asymptotic critical value even at 10 per cent level. Thus, the major cotton markets in the state were found to be integrated and hence quite competitive pricing behaviour.

Van (2007) proposed a threshold autoregressive model to measure market integration to better capture the dynamics of the arbitrage process underlying the interconnected markets.

Philip (2008) analyzed market integration hypothesis for rubber cultivation of Kerala. The Augmented Dickey-Fuller and Error Correction Model were used as the statistical tools for analyzing market co integration and causal nexus between two rubber market prices. This paper also argued that time series analysis can be helpful to provide insight into the market integration and price transmission if an appropriate testing framework is employed and the results are interpreted correctly.

Saran and Gangwar (2008) analyzed the spatial co integration amongst major wholesale egg markets in India through measurement of oneness in the egg markets or which, the Engle-Granger co integration test procedure was applied to egg price series for major wholesale egg markets in the country. The study indicated that the major markets were co integrated apparently due to performance of market intelligence functions by National Egg Coordination Committee (NECC) which helped in transmitting price signals across length and breadth of the country through print media on day-to-day basis. The high degree of co integration amongst various markets indicated that the markets were competitive and efficient at the wholesale levels.

Yadav (2008) in his study on Co-integration, Causality, Money and Income in India using annual data over 1950-51 to 2006-07 established that money supply and national income (both real and nominal) were found to be co-integrated which suggested the existence of long-run relationship.

Hossain and Ismail (2010) has made an attempt to examine whether the regional/divisional rice markets have become spatially integrated following the liberalization of the rice market for which they used co-integration analysis and a vector error correction model (VECM) to test the degree of market integration in Bangladesh. The Johansen co-integration test indicated that there are at least three co-integrating vectors implying that rice markets in Bangladesh during the study period were moderately linked together and therefore the long-run equilibrium is stable. The short-run market integration as measured by the magnitude of market interdependence and the speed of price transmission between the divisional markets has been weak.

Babar *et al.* (2010) analyzed the regional market integration in many agricultural commodities in Pakistan to provide information on the dynamics of price adjustment and to know whether there exists market imperfection. This study used the monthly wholesale price data from January 1991 to December 2006 of Gram and estimated the degree of integration in Gram markets of Pakistan using co-integration analysis. The results showed that all Gram markets were highly integrated in the long run.

Line and Helene (2010) has made an attempt to investigate price transmission for agricultural commodities between world markets and the Ugandan market to determine the impact of world market prices on the Ugandan market. The prices of Robusta coffee and sorghum were examined. The analysis focused on the spatial price relations i.e. the price variations between geographically separated markets in Uganda and the world markets and a dynamic vector autoregressive (VAR) model was used. The results indicated that food markets in Uganda, based on the study of sorghum price transmission, were not integrated into world markets, and it was found different for the cash crop, Robusta coffee. In the period in the 1990's with high coffee prices on the world market, prices in Uganda were strongly connected to world prices. The empirical analysis thus

indicates that rising food prices (of little-traded crops) on world markets will not have a direct effect on food prices in Uganda.

In the present study the technique of co-integration was applied to test the integration between prices of selected markets.

2.6 Granger Causality

Granger (1969) proposed a time-series data based approach in order to determine causality. In the Granger-sense x is a cause of y if it is useful in forecasting y . In this framework "useful" means that x is able to increase the accuracy of the prediction of y with respect to a forecast, considering only past values of y .

Bharadwaj and Vasisht (2009) estimated that a large number of empirical studies have shown that most economic variables exhibit an asymmetric adjustment process. The results of Granger test detect unidirectional Granger causality from futures to Spot markets. The means of the spot market are greater than those for the futures market.

Keppler and Maria (2009) explained granger causality as the test that analyses the extent to which the past variations of one variable explain subsequent variations of the other and added that Granger causality tests habitually come in pairs, testing whether variable x_t Granger-causes variable y_t , and vice versa.

Manuel and Maximo (2010) viewed that the linear Granger causality test examines whether past values of one variable can help to explain current values of a second variable, conditional on past values of the second variable.

Seyoum (2010) explained granger causality in a way that if there is an integration between the two markets, the price in one market, p_1 , would commonly be found to Granger-cause the price in the other market, p_2 and/or vice versa and thus, Granger Causality gives us additional evidence whether or in which direction price-transmission is occurring between two series.

Lavanya (2011) revealed that the results of the GARCH model showed that there was no persistent volatility in prices of

turmeric in- the selected markets. The results of co-integration test revealed that spot and futures market of turmeric were integrated. Granger causality test confirmed that futures price influence spot prices in Erode and Nizamabad markets, while in Sangli market there is a bidirectional influence.

In the present study Granger causality test was applied to know the direction of relationship between prices of selected markets.

2.7 Prices and Arrivals Forecasting

Purna Chandra (2012) conducted the study on forecasting of annual productivity of selected agricultural products. For this 34 different agricultural product was selected on annual data from 1950-1957 to 2010. In this for turmeric ARIMA (2, 1, 2,) model with adjusted R^2 being equal to 0.26 are most suitable. The forecasted value for turmeric in 2011 is 867.49, in 2012 is 940.17, in 2013 is 968.54, in 2014 is 947.47 and in 2015 is 910.68.

Chaudhari and Tingre (2013) conducted the study on forecasting milk production in India, an application of ARIMA model. They studied the milk production data for the period from 1979-80 to 2010-11. The aim of the study was to forecast milk production, various forecasting techniques were considered for use. ARIMA model, introduced by Box and Jenkins (1970) was frequently used for discovering the pattern and predicting the future values of the time series data. Based on the fitted model, milk production in the country was forecasted for the period from 2011-12 to 2020-21. The results showed that the forecasted milk production for the period from 2011-12 to 2020-21 were 126.43, 130.54, 134.29, 137.81, 141.15, 144.38, 147.54, 150.64, 153.71 and 156.75 million tons, respectively. It means milk production in India will increase from 126.43 to 156.75 million tones.

Chaudhari and Tingre (2014) conducted the study on forecasting the Green Gram prices for Maharashtra. For this they have used the time series data of monthly average prices for the period from January 2001 to September 2012 of Akola market. In the present study

the best fitted model was ARIMA (0, 1, 0). The forecasted values of Green Gram prices increasing from Rs 4646 pr quintal during October 2012 to Rs 4729 per quintal during February 2013.

Chaudhari *et al.* (2014) examine the Cotton production in India by using the time series data for the period from 1950-1951 to 2010-2011. They have observed that the value of normalized BIC was lowest and worked out 254 for the ARIMA (0, 1, 0) it indicates that the ARIMA (0, 1, 0) was suitable. It is showed that the Cotton production will increase from 33.93 million bales during 2011-2012 to 37.98 million bales during 2019-2020.

CHAPTER III

METHODOLOGY

The present study "Price analysis of Turmeric for major markets of Maharashtra" was carried out at the Department of Agricultural Economics and Statistics, Dr. PDKV, Akola during the year 2015-16. In the present study, an attempt has been made to analyze the market prices of Turmeric critically so that it will be helpful to the farmers, consumers, traders and policy makers to take more informed marketing decisions.

This chapter explains the methodological framework used in the study. More specifically, this chapter deals with the methods of data collection and the analytical tools used.

Source of Data

The study was based on secondary data. Hence, a reliable source of data is very important to get the real picture. Secondary data consisting of monthly prices and arrivals of Turmeric were collected from four Agriculture Produce Market Committee (APMC)'s namely Sangli, Hingoli, Basmat and Nanded. The website www.agmarknet.nic.in was also used for the purpose. The data thus collected were tabulated, analyzed and subjected to statistical and econometric analysis to study the price behaviour and integration of markets.

Selection of Crop

For the present study, Turmeric was selected, as it is one of the major crop grown in Maharashtra which holds economic importance in the life of farmers of the Maharashtra.

Selection of Markets

The study has been confined to the Maharashtra state. Four APMC markets at four district places of Maharashtra namely Sangli, Hingoli, Basmat and Nanded were selected purposively for the study.

Period of the Study

For the study, monthly time series data on the prices and arrivals of Turmeric were collected for the period from January 2004 to December 2015.

Method of Analysis

The collected data were analyzed and the results were presented in the tables in order to bring out generalization of facts from which meaningful inference could be drawn.

Tools of Analysis

The choice of the statistical and econometric tools of analysis was decided with reference to the objectives of the study and the nature of data collected. The analytical techniques used in the study are presented below.

3.1 Seasonal and Cyclical variations in prices and arrivals of Turmeric

3.1.1 Estimation of seasonal indices of monthly data

Most widely used method of measuring seasonal fluctuations i.e. method of moving average was used to calculate seasonal indices. To measure the seasonal variations in prices and arrivals, seasonal indices were calculated employing twelve months ratio to moving average method. The seasonal indices were calculated by adopting the following steps.

1. Generate a series of 12 months moving totals.
2. Generate a series of 12 months moving averages: A series of 12 months moving averages is generated by dividing 12 months moving totals by 12.
3. Generate a series of centered 12 months moving averages. This step involves taking averages of pairs of two subsequent 12 months moving averages and entering between each pair. There are no corresponding moving averages for the first six and last six months.

4. Express each original value as a percentage of corresponding centered moving average. The percentage of moving average represents indices of seasonal and irregular components combined.
5. The next step involves removing the irregular component.
6. Arrange the percentages of moving averages in the form of monthly arrays.
7. Next, the average index for each month is calculated.
8. These averages are to be adjusted in such a way that their sum becomes 1200. This can be done by working out of correction factor and multiplying the average for each month by this correction factor. The correction factor (K) is worked out as follows:

$$K = \frac{1200}{S}$$

Where, K is correction factor and S is sum of averages indices for 12 months, multiply K with the percentage of moving average for each month to obtain the seasonal indices.

3.1.2 Estimation of cyclical indices

The residual method of estimating cyclical movement in time series was used for estimating cyclical indices, after eliminating the seasonal variation and trend components. This is accomplished by dividing (Y_t) by corresponding (S) for time 't' symbolically. These deseasonalized data contain cyclical and irregular components.

3.2 Stationarity and Volatility in prices of Turmeric of selected markets of Maharashtra

3.2.1 Testing of Stationarity in Price Series of Turmeric

Before analysing any time series data testing for stationarity is per-requisite. The stationarity of time series data on Turmeric prices was tested by applying the Augmented Dickey-Fuller test (ADF). The (ADF) test is the test for the unit root in a time series sample. A stationary series is one whose parameters are independent of time, exhibiting constant mean and variance and having

autocorrelations that are invariant through time. If the series is found to be non-stationary, the first differences of the series are tested for stationarity. The number of times (d) a series is differenced to make it stationary is referred to as the order of integration, I(d).

ADF unit root test are based on the following three regression forms:

- 1) Without constant and trend $\Delta Y_t = \delta Y_{t-1} + u_t$
- 2) With constant $\Delta Y_t = \alpha + \beta T + \Delta Y_{t-1} + u_t$
- 3) With constant and trend

The hypothesis is: $H_0: \delta = 0$ (Unit root)

$$H_1: \delta \neq 0$$

If $t^* >$ ADF critical value then accept the null hypothesis, i.e. unit root exists and

If $t^* <$ ADF critical value then reject the null hypothesis, i.e. unit root does not exist.

3.2.2 Presence of Price Volatility

To access the presence of price volatility the ARCH-GARCH analysis was carried out. Auto Regressive Conditional Heteroscedasticity (ARCH) models are specifically designed to forecast conditional variances. ARCH model introduced by Engel (1982) and generalized as GARCH by Bollersllev (1986). These models are widely used in various branches of econometrics, especially in financial time series analysis. The ARCH model has two distinct specifications one for the conditional variance and the standard GARCH (1, 1) specification is presented below:

$$Y_t = \gamma_0 + \gamma_1 X_{1t} + \dots + \gamma_k X_{kt} + e \quad \text{.....1}$$

$$\sigma^2_t = \omega + \alpha e^2_{t-1} + \beta \sigma^2_{t-1} \quad \text{.....2}$$

Equation (1) is the mean equation and equation (2) is the conditional variance equation. The ARCH component (α) indicate the lag of the squared residual from the mean equation and the GARCH term (β) the last period's forecast variance and the resultant sum of

these co-efficient ($\alpha + \beta$) are presented. The sum of co-efficient very close to 1 would indicate that the volatility shocks are quite persistent in the series.

3.3 Co-integration among the selected markets of Turmeric in Maharashtra

Johansen's Multiple Co-integration test was employed to determine the long run relationship between the price series of selected markets. The test shows whether the selected Turmeric markets are integrated or not. Johansen (1988) has developed a multivariate system of equations approach, which allows for simultaneous adjustment of both or even more than two variables. The multivariate system of equations approach is more efficient than single equation approach since it allows estimating the co-integration vector with smaller variance. The second advantage of the multivariate approach is that in the simultaneous estimation it is not necessary to presuppose ergogeneity of either of the variables.

3.4 Causality or Co movement of price signals between selected markets

The Granger causality test was applied to study the price interaction and to know the direction of causation between the selected markets. It is named after the first causality tests performed by Clive Granger (1969). It analyses the extent to which the past variations of one variable explain (or precede) subsequent variations of the other. When a co-integration relationship is present for two variables, a Granger Causality Test can be used to analyze the direction of this co-movement relationship. Granger causality tests come in pairs, testing whether variable x_t Granger-causes variable y_t and vice versa. All permutations are possible:

- 1) Univariate Granger causality from x_t to y_t or from y_t to x_t ,
- 2) Bivariate causality or absence of causality.

Formally, the Granger causality test analyses whether the unrestricted equation:

$$y_t = \alpha_0 + \sum_{i=1}^T \alpha_{1i} y_{t-i} + \sum_{j=1}^T \alpha_{2j} x_{t-j} + \varepsilon_t \text{ with } 0 \leq i, j \leq T$$

Yield better results than the restricted equation:

$$y_t = \beta_0 + \sum_{i=1}^T \beta_{1i} y_{t-i} + \varepsilon_t \text{ with } \sum_{j=1}^T \alpha_{2j} x_{t-j} = 0 \text{ (The null hypothesis)}$$

i.e. if H_0 , in which $\alpha_{21} = \alpha_{22} = \dots = \alpha_{2T} = 0$, is rejected then one can state "variable x_t Granger causes variable y_t "

Theoretically, a variable is said to Granger-cause another variable, if the current value is conditional on the past value.

3.5 Short-run and Long-run equilibrium behaviour of Turmeric market prices

Vector Error Correction Model (VECM) was used to test the short run and long run behaviour of Turmeric markets prices. Even if one demonstrates market integration through co-integration, there should be disequilibrium in the short run i.e. price adjustment across markets may not happen instantaneously. It may take some time for the spatial price adjustments. Error correction model can incorporate such short-run and long-run changes in price movement. A generalized VECM formulation to understand both the short-run and long-run behaviour of prices can be considered by first taking the autoregressive distributed lag (ADL). The generalized form of this equation for k lags and an intercept term is as follows.

$$\Delta Y_t = a_0 + \sum_{i=1}^k a_i \Delta X_{t-i} + m_0 [m_1 X_{t-k} - Y_{t-k}] + \varepsilon_t$$

$$\text{Where } m_0 = (1 - \sum_{i=1}^k a_i)$$

The parameter m_0 measures the rate of adjustment of the short-run deviations towards the long run equilibrium. Theoretically, this parameter lies between 0 and 1 the value 0 denotes no adjustment and 1 indicate an instantaneous adjustment. A value between 0 and 1 indicate that any deviations will have gradual adjustment to the long-run equilibrium values.

3.4.6 Forecasting of the prices and arrivals of Turmeric for the next season of selected markets

In order to forecast the prices and arrivals of Turmeric for the next season, univariate time series model such as ARIMA (Autoregressive Integrated Moving Average models) was used. Among the class of ARIMA models the best fit model was selected on the basis of lowest AIC (Akaie Information Criteria) values and the residual was in confidence limit.

CHAPTER IV

SOCIO-ECONOMIC STATUS OF THE STUDY AREA

The present chapter is devoted to discuss, in brief, some of the agro-economic features of Sangli, Hingoli, Basmat and Nanded just to facilitate comparison and to get better idea of the economy of these markets.

4.1 Socio-economic status of Sangli district

4.1.1 Location

The Sangli district is one of the most district of Maharashtra state. It is lies between the latitudes 16°45' North and 17°33' North and longitudinal of 73°41' East and 75°41' East. The district is bounded by Satara district on the North western side. Southern is boarded by Belgam and Bijapur district of Karnataka State. At the Centers and East Kolhapur district and the Ratnagiri district lies on West of Sangli district. The total area of the district about 8601.5 Sq.km.

4.1.2 Administrative set up

The Sangli district is divided in to five administrative sub-division mainly Khanapur, Walwa, Miraj, Tasgon, Palus. The Shirala and Walwa Taluka were included in Walwa sub-division. The Miraj sub-division Comprises of Jath, Kavthe Mhanal and Miraj. The khanapur sub-division includes Atpadi and Khanapur and Palus sub-division include Kadegaon and Palus.

4.1.3 Agro-climatic conditions

4.1.3.1 Topography and soil

Central portion of the district i.e. Walwa, western part of Tasgaon and Miraj tahsils is formed by plains. The western portion of the district consists of high hills which forms the branches of Sahyadri running towards East from the northern side of the district. These hills are covered by tall trees and ample greenery and vegetation. Another range of hills starting from Mahadeo hills runs towards South and

covers northern portion of the eastern part of the district. Naturally the district is sloping from North to South.

The soils of the region are derived from the deccan trap. The characteristic and distribution of soils in the region are influenced by essentially by nature and intensity of weathering, mode and rapidity of fluvial transport.

The district possesses the following three soil types

i. Medium soils

It occupies 27 per cent of the village area and located in west, South and Eastern parts.

ii. Deep black soils

This soil covers 8 per cent of total village area and located in Southern part of village.

iii. Coarse shallow soils

An extensive tract 65 per cent has been occupied by this soil which is not fertile and mostly devoted to grasslands but now used for pomegranate and grape wine cultivation.

4.1.3.2 Climate and rainfall

Climatically, Sangli region falls under the great monsoon and associated with the rain shadow region of the Sahyadri Mountain. The four months of rainy season followed by eight months of relatively dry period of winter and summer.

The general distribution of rainfall in the Sangli district is very uneven. The rainfall decreases from West to East. Above 600mm in the central tahsils such as Palus, Tasgaon and Miraj tahsils and above 800 to 1000 mm in walwa and Shirala Tahsil. The Sangli district receives the rainfall of below 500mm. Therefore, rainfall is not sufficient to agricultural development and farming without irrigation is not possible.

4.1.4 Demographic features

Table 4.1 Population

District	Population in thousand			Density (person/km)	Sex Ratio No of female/1000 male	Literacy (%)	Population growth since 2001-2011
	Rural	Urban	Total				
Sangli	2103	720	2822	329	966	81.5	9.2

Source: Directorate of census operations in Maharashtra, 2011

4.1.4.2 Land Utilization Pattern

Table 4.2. Land utilization pattern of Sangli

Sr. No.	Particular	Area (Thousand Ha)	% to total area
1.	Total geographical area	861	
2.	Area under forest	48	6
3.	Barren and uncultivable land	78	9.05
4.	Land under miscellaneous tree crops	16	1.86
5.	Cultivable waste land	25	2.90
6.	Land put under non-agricultural use	40	4.64
7.	Current fallow	9	1.05
8.	Other Fallow	72	8.36
9.	Gross cropped area	712	89.70

Source: District Socio-economic Review, 2014

4.1.5 Cropping pattern

The information relating to the cropping pattern of Sangli district is presented in table 4.3 along with cropping pattern of Sangli district as a whole. The study of cropping pattern focuses on the economic conditions of the farmers.

It could be revealed from table that cereals are the important crops in the district having occupied 47.62 per cent of the gross cropped area. The area under total nonfood crops, total pulses, sugarcane and fruits and vegetables was 21.38, 5.73, 12.51 and 12.76 per cent of the gross cropped area respectively. The area under total food crops was 76.62 per cent of gross cropped area in Sangli respectively. The area under Jowar (*kharif+Rabi*) in Sangli was 31.43 per cent respectively.

Table 4.3. Cropping pattern of the Sangli

Sr.No.	Crop	Area (ha)	Percentage to total
I	Cereals		
1.	Rice	17500	2.91
2.	Wheat	17700	2.94
3.	Jowar (<i>kharif+Rabi</i>)	189200	31.43
4.	Maize	24100	4.00
5.	Other cereals	2200	0.37
	Total cereals	286600	47.62
II	Pulses		
1.	Gram	6500	1.08
2.	Other pulses	10500	1.74
	Total pulses	34500	5.73
III	Total food-grains	321100	53.35
IV	Sugarcane	75300	12.51
.	Fruits and vegetables	76800	12.76
V	Total food crops	473200	76.62
VI	Total non-food crops	128700	21.38
14.	Total gross cropped area	601900	100.00

Source: District Socio-economic Review, 2014

4.2 Socio-economic status of Nanded District.

4.2.1 Location of Nanded District

The district of Nanded is between 18^o.15' and 19^o.55' North latitude and 77^o.7' to 78.15' East longitude. The district has a geographical area of 10528 Sq. Kms. The Nanded is surrounded in the North by Yevatmal district, in the West by Parbhani, Latur and Osmanabad districts, in the South by Bidur district of Karnataka state and in the East by Nizamabad and Adilabad districts of Andhra Pradesh.

4.2.2 Administrative setup

For the convenience of administration the district is divided in three revenue subdivisions namely: Nanded, Deglur and Kinvat. The district has 16 talukas or Blocks. Initially the district consisted of eight talukas namely Nanded, Kandhar, Mukhed, Kinvat, Deglur, Biloli and Bhokar. Eight talukas namely Mahur, Himayatnagar, Umari, Dharmabad, Mudkhed, Loha, Ardhapur and Naygaon were newly formed on 26/6/1999. The district headquarters is located at Nanded. Other administrative information about the district is as follows.

Table 4.4. Administrative information of Nanded district

Particulars	Number
Total Villages	1687
Number of Gram Panchayats	1311
Independent Gram Panchayats	1132
Group Gram Panchayats	181
Number of Circle villages	59
Urban Municipal Corporations	12

Source: Directorate of census operations in Maharashtra, 2011

4.2.3 Agro climatic Condition

4.2.3.1 Soil

There are three kinds of soil in Nanded district namely deep black (90 cm depth), medium black (20-90 cm) and shallow (less than 20 cm). The Nanded is situated on the Godavari river basin. The

Godavari itself drains the Southern Portion of the region and is forming fertile valley. The soil of Marathwada region varies both in texture and depth on Northern portion of region it is shallow and relatively poor in south. It becomes deep and fertile and fairly rich in Godavari valley especially along the bank of Godavari river.

4.2.3.2 Climate and Rainfall

In general climate is dry throughout the year except during the South-West monsoon season. During hot season, maximum temperature recorded is 45°C (high level) in the month of May and minimum temperature during cool dry season was 21°C - 31°C. Temperature of district normally varies between 41.5°C and 14.6°C during the year. Hot dry winds prevail in month of April and May. The district gets bulk of rainfall from the South-West monsoon. Generally, the monsoon starts in the month of June and last up to mid October. The district also receives rainfall from mid October to December through the North East monsoon. All the parts of district do not receive uniform rains. The normal rainfall of the district is 827 mm.

4.2.4 Demographic Feature

Table 4.5. Population and literacy status

District	Population in thousand			Density (person/km)	Sex Ratio No of female/ 1000 male	Literacy (%)	Population growth since 2001-2011
	Male	female	Total				
Nanded	1730075	1631217	3361292	319	943	75.45	16.8

Source: Directorate of census operations in Maharashtra, 2011

Table 4 .6.Land Details Land use pattern (Year 2012-2013)

Type	Hectors (Lakh)
Total land (district)	10.33
Forest	0.92
Area not available for cultivation	0.57
Cultivable and other waste	1.27
Grazing land	0.38
Area under cultivation	7.11

Source: Agriculture Statistical Information Maharashtra State 2010

Table 4.7. Distribution of landholders according to size of landholding

Land holding in ha.	Total Landholders	Percent	Total land owned in ha.	Percent
0.00-1.00	100489	26.48	61275	7.62
1.00-2.00	132988	35.04	195186	24.29
2.00-5.00	119740	31.55	358063	44.56
5.00-10.00	23672	6.24	154799	19.29
10.00-20.00	2488	0.66	30819	3.84
20.00 plus	128	0.03	3465	0.43
Total	379505	100	803607	100.00

Source: District Socio-economic Review, 2014

Landholding in range of 1.00 to 2.00 ha are highest at 35 percent followed by those having 2.00 to 5.00 ha of land at 31 per cent. Only 6 percent landholders own approximately 20 percent of land. Marginal farmers are 26 percent and land owned by them is just 7 percent.

Table 4.8. Cropping pattern 2012-2013

Crop	Area as percent to total land cultivated
Jowar	30.15
Wheat	2.01
Paddy	4.75
Bajra	0.08
Cereals	37.09
Pulses	17.66
Food grains	58.20
Cotton	37.46

Source: Socio-economic abstract of Nanded district

Kharif and rabbi are the two agricultural seasons in the district Sugarcane and Cotton are the cash crops taken. Groundnut and Sunflower is cultivated in summer wherever irrigation facility is available.

Table 4.9. Per hectare yield of various crops (2003-04)

Crop	Per Hector production in Kg.
Paddy	575
Wheat	1361
Jawar	2310
Bajra	548
Barli	632
Maize	2262
Other Grains	833
Arhar	687
Cow Pea	799
Black gram	753
Horse gram	740
Other Cereal	286
Jawas	261
Ground nut	226
Mustard	300
Sesame	322
Sugarcane	65
Cotton	160 (Bale)
Potato	6310 (Tonnes)
Turmeric	1156 (Tonnes)

Source: Agriculture Statistical Information Maharashtra State 2010)

4.3 Physical features of Hingoli district

4.3.1 General characteristics of the district

Hingoli district has been separated from Parbhani district and existed as a independent district from 01.05.1999. It is one of the eight districts of Marathwada. It is located at eastern site of Maharashtra State. The geographical area of the district is 4526 Sq. kms. which occupies is 1.47% of area of the Maharashtra state. It comprises of five talukas viz. Hingoli, Basmat, Aundha Nagnath,

Kalamnuri and Sengaoon. Majority of districts population is engaged in agricultural activities and there is little industrialization in the district. Majority of its population lives in rural areas. The literacy rate of Hingoli district is 66.86 per cent as compared to 76.9 per cent of Maharashtra. Out of 12 main Jyotirling in the country, one of the Aundha Naganath Jyotirling situated in the district.

4.3.2 Location

Hingoli is situated at the northern part of Marathwada in Maharashtra. Borders of Hingoli are surrounded by Akola and Yavatmal in northern side, Parbhani in Western side and Nanded at South-Eastern side. The district came into existence by division of Parbhani district on 1st May, 1999. Latitude of Hingoli district is $19^{\circ} 43$ N and Longitude is $77^{\circ} 11$ E.

4.3.3 Agro climatic Condition

4.3.3.1 Climate and Rainfall

In Hingoli district, monsoon starts from the month of June and ends in September. In the remaining period the weather is dry. The average rainfall in the district is 895 mm. The maximum temperature of the district is 42.6° C and minimum temperatures are 10.6° C

4.3.3.2 Area and Topography

The district has a geographical area of 4526 sq.kms. which forms 1.47% of the total geographical area of Maharashtra State. The Sengaoon, Hingoli and Aundha naganath tahsils of the district are surrounded by small hills. The district is 600 meters high from sea level.

Soil

The soil of the district is Black and very fertile for cultivation of crops.

Rivers

Purna, Penganga & Kayadhu rivers are in the district.

A) Painganga River

Painganga river is the main river in the district. It flows in the northern region of the district. The river passes through Sengaoon and Kalamnuri talukas.

B) Purna River

Purna river flows from Southern part of Sengaoon. It flows further south from Aundha and Basmat talukas.

C) Kayadhu River

This is also main river and flows through Sengaoon, Hingoli, Aundha, Nagnath and Kalamnuri. It meets further to Painganga river in Nanded district.

4.3.4 Socio-economic features of the study area.

Table 4.10. Population and literacy status

District	Population in thousand			Density (person/km)	Sex Ratio No of female/1000 male	Literacy (%)	Population growth since 2001-2011
	male	female	Total				
Hingoli	606294	571051	1177345	244	942	78.17	19.27

Source: Directorate of census operations in Maharashtra, 2011

Table 4.11. Land use pattern of the District (Year 2010)

Geographical area (000 ha)	466.1
Cultivable area	441.7
Forest area	28.4
Land under non-agricultural use	10.5
Permanent pastures	17.8
Cultivable waste land	11.3
Land under Mics.tree crops and groves	0.3
Barren and uncultivable land	8.7
Current fallows	43.7
Other fallows	15.9

(Source: Agriculture Statistical Information Maharashtra State 2010)

Table 4.12. Area under major field crops

Major field crops	Area (000 ha)								
	Kharif			Rabi			Summer		
	Irrigated	Rained	Total	Irrigated	Rained	Total	Irrigated	Rained	Total
Soybean	-	126.3	126.3	-	-	-	-	-	126.3
Cotton	-	67.0	67.0	-	-	-	-	-	67.0
Sorghum	-	60.3	60.3	-	21.7	21.7	-	-	82.0
Pigeon pea	-	25.2	25.2	-	-	-	-	-	25.2
Green gram	-	20.4	20.4	-	-	-	-	-	20.4
Black gram	-	17.4	17.4	-	-	-	-	-	17.4
Wheat	-	-	-	35.4	-	35.4	-	-	35.4
Gram	-	-	-	-	33.0	33.0	-	-	33.0
Safflower	-	-	-	-	26.4	26.4	-	-	26.4
Sunflower	-	-	-	6.8	-	6.8	-	-	6.8
Groundnut	-	-	-	-	-	-	4.8	-	4.8
Sugarcane	-	-	-	12.3	-	12.3	-	-	12.3

(Source: JDAs ZREAC Report, Kharif and Rabi, 2010)



Fig. 4.1 Map of Maharashtra

CHAPTER V

RESULTS AND DISCUSSION

The data collected were analyzed in relation to each of the specific objective of the study and results have been tabulated. In this chapter, the results of the analysis are presented and discussed in the following sections.

1. Seasonal and cyclical variations in arrivals and prices
2. Price Volatility
3. Market Co-integration
4. Causality of price signals between selected markets
5. Short run and long run behavior of market prices
6. Prices and Arrivals of forecasting

5.1 Seasonal and Cyclical variations in prices and arrivals of Turmeric

5.1.1. Seasonal index for Turmeric prices

The arrivals of Turmeric in Maharashtra start hitting in the market from the end of January to February. The peak period of arrivals is February to May. The lean period of arrivals of Turmeric in markets is October - November. Most of the traders release the stored stock of Turmeric during this period in anticipation of making the profit. The price variations are observed in Turmeric in selected markets due to the varieties grown in particular areas and their Curcumin content. The high Curcumin content varieties are more costlier than other. The seasonal indices of monthly average prices of Turmeric in Sangli, Hingoli, Basmat and Nanded markets were worked out, which are presented in Table 5.1.

Table 5.1. Seasonal index for Turmeric prices in selected markets of Maharashtra for the period 2004-2015

Month	Sangli	Hingoli	Basmat	Nanded
Jan	100.73	100.80	97.75	97.83
Feb	104.20	75.73	92.11	89.18
Mar	111.59	96.59	82.70	91.93
Apr	105.15	103.08	102.62	103.53
May	109.93	103.09	99.17	98.71
Jun	96.33	99.65	96.32	97.64
Jul	96.81	101.78	102.26	103.17
Aug	92.50	101.59	103.13	102.82
Sep	91.17	96.50	98.38	98.71
Oct	92.35	105.56	102.30	99.00
Nov	97.93	104.79	108.39	107.17
Dec	101.31	110.85	114.89	110.32

From Table 5.1 it is observed that the prices of Turmeric were higher from April to July in the Hingoli, Basmat and Nanded market. While in Sangli market prices are higher in December to May. As it is national market arrivals as well as prices remains high throughout the year. All the markets recorded lower prices in the month of September.

5.1.2. Cyclical index for Turmeric prices

The cyclical indices for Turmeric prices were worked out for the period 2004-2015 and are presented in Table 5.2.

Table 5.2. Cyclical index for Turmeric prices in selected markets of Maharashtra for the period 2004-2015

Year	Sangli	Hingoli	Basmat	Nanded
2004	114.71	114.19	107.25	107.48
2005	79.10	80.80	76.91	78.69
2006	66.49	65.93	62.67	61.01
2007	49.23	50.35	50.09	49.63
2008	71.30	75.86	76.14	74.16
2009	120.58	126.93	134.13	128.71
2010	212.40	228.17	237.20	244.66
2011	137.30	118.75	110.36	122.34
2012	68.69	63.97	65.60	63.60
2013	80.20	75.06	79.64	69.72
2014	77.50	82.47	82.19	77.66
2015	98.46	105.11	99.65	104.25

The cyclical variations were observed in the prices of Turmeric in the selected markets. The higher prices were recorded during the year 2004, 2009, 2010 and 2011 in all four markets.

5.1.3 Seasonal index for Turmeric arrivals

The seasonal indices for monthly arrivals of Turmeric in Sangli, Hingoli, Basmat, Nanded markets were worked out, which are presented in Table 5.3.

Table 5.3. Seasonal index for Turmeric arrivals in selected markets of Maharashtra for the period 2004-2015

Month	Sangli	Hingoli	Basmat	Nanded
Jan	31.82	30.53	108.73	21.24
Feb	145.74	30.37	19.08	13.46
Mar	232.39	49.99	38.21	26.09
Apr	285.18	177.77	175.64	186.99
May	215.47	207.46	267.57	221.70
Jun	87.05	154.60	176.98	205.65
Jul	74.17	168.85	114.45	132.20
Aug	35.01	83.61	57.06	95.92
Sep	29.45	106.15	68.68	174.09
Oct	19.31	99.31	64.02	42.14
Nov	16.21	27.65	57.88	48.07
Dec	28.21	63.71	51.69	32.46

The arrivals of Turmeric start hitting in the market from the month of February and continued for next three to four months. The peak period of arrivals is February to May. In Sangli market arrivals are higher in the month of February to May but in remaining three markets it is from April to July. The lean period of arrivals is October - November.

5.1.4 Cyclical index for Turmeric arrivals

Table 5.4. Cyclical index for Turmeric arrivals in selected markets of Maharashtra for the period 2004-2015

Year	Sangli	Hingoli	Basmat	Nanded
2004	127.46	192.89	101.82	190.17
2005	130.59	113.79	111.19	173.56
2006	85.77	125.01	91.74	82.46
2007	104.75	121.02	136.20	134.96
2008	47.22	64.61	112.76	24.17
2009	80.23	73.76	91.95	53.97
2010	77.13	96.84	78.19	39.03
2011	119.33	44.40	88.31	101.85
2012	131.73	112.09	113.12	182.89
2013	95.79	95.61	118.71	16.92
2014	111.08	142.58	146.18	108.93
2015	75.90	81.87	66.68	179.97

Table 5.6. Results of ARCH-GARCH analysis for Turmeric prices in selected markets of Maharashtra for the period 2004-2015

Parameter	Sangli	Hingoli	Basmat	Nanded
Alpha (α)	0.789	0.697	0.720	0.890
Beta (β)	0.199	0.337	0.321	0.142
Sum ($\alpha+\beta$)	0.988	1.035	1.041	1.032

The sum of Alpha and Beta ($\alpha+\beta$), indicated ARCH and GARCH effect for the given market. It was observed that among the markets, the sum of Alpha and Beta is nearer to 1 i.e. 0.988, 1.035, 1.041, 1.032 for Sangli, Hingoli, Basmat and Nanded markets, respectively, indicated that the volatility shocks in the prices of Turmeric are quite persistent in these markets. Hence the hypothesis proposed for present study is accepted.

5.3 Market Co-integration

Johansen's Multiple Co-integration test is employed to determine the long run relationship between the price series of Turmeric. Co-integration is used instead of regular regression method because of its capacity in dealing with non-stationary series. The most popular co-integration method, developed by Johansen (1988) is applied. The test shows whether the selected Turmeric markets are integrated or not. The results of the test were presented in Table 5.7.

Table 5.7. Results of multiple co-integration analysis for Turmeric prices in selected markets of Maharashtra for the period 2004-2015

Hypothesized No. of CE (s)	Eigen Value	Trace Statistic	Critical Value (5%)	Prob.**	Number of Co-integrating Equation CE (s)
None	0.295	119.218	63.876	0	Three
At most 1*	0.280	71.892	42.915	0	
At most 2*	0.160	27.414	25.872	0.031	
At most 3	0.027	3.809	12.517	0.769	

Trace test indicates 3 co-integrating equations at the 0.05 level

Presence of at least one co-integration equation at 5 per cent level of significance confirms that there exists long run equilibrium relation in the markets. The results of Co-integration test showed three co-integration equations were significant at 5% level of significance. It indicated that the selected Turmeric markets having long run equilibrium relationship and there exists co-integration between them. Hence the hypothesis framed regarding the markets of Turmeric in Maharashtra are co-integrated is accepted.

5.4 Causality of price signals between selected markets

In order to know the direction of causation between the markets Granger Causality test was employed. When a co-integration relationship is present for two price series, a Granger Causality Test (Granger, 1969) is used to analyse the direction of this co-movement relationship. Theoretically, a variable is said to Granger-cause another variable, if the current value is conditional on the past value. The results of pair-wise Granger Causality test applied to the selected Turmeric markets were presented in Table 5.8.

It was observed that there is bidirectional causality in Turmeric prices between Hingoli and Basmat, Sangli and Basmat, Sangli and Hingoli markets respectively. The prices of Nanded market exhibited unidirectional causality and affects prices of Basmat, Hingoli and Sangli markets respectively. From the above analysis it can be concluded that Sangli and Nanded markets can be considered as a Lead market of Turmeric and influencing the prices of the remaining markets. Thus a strong market integration of the four markets Sangli, Hingoli, Nanded, and Basmat are established through the results of the analysis. Similar results found by Ajjan et.al (2009).

Table 5.8. Results of pair wise Granger causality test for Turmeric prices in selected markets of Maharashtra for the period 2004-2015

Null Hypothesis	Observations	F-Statistic	Probability
HINGOLI does not Granger Cause BASMAT	142	67.3052*	4.00E-21
BASMAT does not Granger Cause HINGOLI		9.18727*	0.0002
NANDED does not Granger Cause BASMAT	142	24.2742*	9.00E-10
BASMAT does not Granger Cause NANDED		0.47936	0.6202
SANGLI does not Granger Cause BASMAT	139	3.76645*	0.0256
BASMAT does not Granger Cause SANGLI		21.4521*	8.00E-09
NANDED does not Granger Cause HINGOLI	142	21.2865*	9.00E-09
HINGOLI does not Granger Cause NANDED		0.9021	0.4081
SANGLI does not Granger Cause HINGOLI	139	3.63871*	0.0289
HINGOLI does not Granger Cause SANGLI		11.7579*	2.00E-05
SANGLI does not Granger Cause NANDED	139	0.1013	0.9037
NANDED does not Granger Cause SANGLI		16.3304*	4.00E-07

5.5 Short-run and long-run behaviour of market prices

Since the Johansen's Multiple Co-integration test results showed that the selected Turmeric markets having long run equilibrium relationship and there exists co-integration between them. Hence the Vector Error Correction Model (VECM) among the selected markets of Turmeric is employed to know the speed of adjustments for the prices of Turmeric among various markets, for short run and long run equilibrium of prices. The results of VECM showed in Table 5.9.

Table 5.9. Results of Vector Error Correction Model for Turmeric prices in selected markets of Maharashtra for the period 2004-2015

Error Correction:	D(BASMAT)	D(HINGOLI)	D(NANDED)	D(SANGLI)
CointEq1	0.068945	-0.09158	0.091404	0.26635
	-0.07068	-0.0761	-0.05776	-0.0569
	[0.97541]	[-1.20339]	[1.58262]	[4.68100]
D(BASMAT(-1))	-0.40528	0.369577	0.042006	-0.02973
	-0.15675	-0.16876	-0.12808	-0.12618
	[-2.58554]	[2.18990]	[0.32797]	[-0.23560]
D(BASMAT(-2))	-0.15352	-0.65223	-0.12185	-0.63244
	-0.16772	-0.18057	-0.13704	-0.13501
	[-0.91532]	[-3.61198]	[-0.88915]	[-4.68424]
D(BASMAT(-3))	-0.14855	-0.23925	0.014176	-0.11835
	-0.13469	-0.14502	-0.11006	-0.10843
	[-1.10287]	[-1.64984]	[0.12880]	[-1.09153]
D(HINGOLI(-1))	0.51274	-0.89755	-0.02099	-0.33078
	-0.13171	-0.1418	-0.10762	-0.10602
	[3.89309]	[-6.32964]	[-0.19504]	[-3.11990]
D(HINGOLI(-2))	0.072175	-0.88015	-0.06836	-0.30298
	-0.17754	-0.19115	-0.14507	-0.14292
	[0.40652]	[-4.60443]	[-0.47120]	[-2.11988]
D(HINGOLI(-3))	0.072922	0.239645	0.146285	-0.04568
	-0.16037	-0.17267	-0.13104	-0.1291
	[0.45470]	[1.38790]	[1.11633]	[-0.35385]
D(NANDED(-1))	0.113121	0.712447	-0.1157	0.159589
	-0.20247	-0.21798	-0.16543	-0.16299
	[0.55872]	[3.26833]	[-0.69939]	[0.97916]
D(NANDED(-2))	-0.04944	1.191358	-0.04709	0.642223
	-0.2126	-0.22889	-0.17371	-0.17114
	[-0.23257]	[5.20492]	[-0.27108]	[3.75261]
D(NANDED(-3))	-0.08014	0.147856	-0.21021	-0.00467
	-0.23794	-0.25618	-0.19442	-0.19154
	[-0.33680]	[0.57716]	[-1.08121]	[-0.02440]
D(SANGLI(-1))	-0.00826	-0.15097	0.094974	0.138988
	-0.12808	-0.1379	-0.10465	-0.1031
	[-0.06450]	[-1.09481]	[0.90752]	[1.34804]
D(SANGLI(-2))	0.173837	0.05649	0.183792	0.241453
	-0.1179	-0.12694	-0.09634	-0.09491
	[1.47442]	[0.44501]	[1.90779]	[2.54398]
D(SANGLI(-3))	-0.01982	0.037265	0.067327	0.141842
	-0.0995	-0.10713	-0.0813	-0.0801
	[-0.19919]	[0.34786]	[0.82811]	[1.77084]
C	51.36614	61.20924	58.14826	59.58551
	-91.2177	-98.2095	-74.5338	-73.4307
	[0.56312]	[0.62325]	[0.78016]	[0.81145]

The estimates of Vector Error Correction Model revealed that Nanded and Sangli markets attain short run equilibrium rapidly.

Basmat market one month lag price is affecting current prices of Hingoli market and same market. Basmat market two month lag price is affecting current prices of the Hingoli and Sangli market. Basmat market three month lag price is affecting the current price of Hingoli market.

One month lag price of Hingoli market is affecting current prices of Basmat, Sangli and same market while two month lag price of Hingoli market is affecting current price of Sangli market.

One month lag price of Nanded market is affecting the current price of Hingoli market as well as two month lag price of Nanded market are affecting current prices of Hingoli and Sangli market.

Current prices of Nanded and Sangli markets are affected by two month lag prices of Sangli market as well as three month lag price also affecting the current price of same market.

5.6 Prices and Arrivals of forecasting

In order to forecast the prices and arrivals of Turmeric for the next season of selected markets ARIMA model was used. Among the class of ARIMA models the best fit model was selected on the basis of lowest AIC (Akaie Information Criteria) values and the residuals should be in confidence limit.

Table 5.10. Forecasted prices and arrivals of turmeric for next season of selected markets of Maharashtra for the period 2004-2015

Months	Sangli		Hingoli		Basmat		Nanded	
	Prices	Arrivals	Prices	Arrivals	Prices	Arrivals	Prices	Arrivals
Jan 2017	10862	26100	105160	13220	108880	16200	10316	6540
Feb 2017	10910	24850	105650	10500	109400	12000	10364	5110
March 2017	10958	18630	106150	9210	109920	10500	10408	3900
April 2017	11005	16000	106640	9260	110430	9820	10456	3920
May 2017	11053	12450	107140	9310	110950	9500	10500	2860
AIC	2403.21	2740.89	2485.53	225093.	2405.92	2274.87	2471.94	2136.85
Models	(1,1,1)	(1,1,0)	(1,1,1)	(1,1,1)	(1,1,1)	(1,1,1)	(2,1,1)	(1,1,1)

The forecasted prices and arrivals of Turmeric are represented in Table 5.10.

Generally the arrival of turmeric is started in month of February and continued for next three to four months. The forecasted prices for the next season i.e. month of January 2017 will be 10862, 10516, 10888, 10316 rupees per quintal for the Sangli, Hingoli, and Basmat and Nanded market respectively.

In respect of arrivals for the next season i.e. month January of 2017 will be 26100, 13220, 16200 and 6540 quintals respectively for the markets of Sangli, Hingoli, Basmat and Nanded.

CHAPTER VI

SUMMARY AND CONCLUSIONS

India is the largest producer, consumer and exporter of spices in the world. The global production of turmeric is about 11 lakh tons. Indian turmeric industry contributes about 78 per cent of world production and 60 per cent of the exports of Turmeric. Asian countries consume much of their own turmeric production nearly 90 per cent.

In India larger share of Turmeric production is utilized for domestic consumption. In India Turmeric is cultivated in 8.09 ha with the production of 13.52 lakh tonnes. Total area under Turmeric in India rose gradually from 1.10 lakh ha in 1990-91 to 1.94 lakh ha in 2009-10. At the same time production has also rise from 3.42 lakh tonnes in 1990-91 to 8.92 lakh tonnes in 2009-10. The production was maximum in Andhra Pradesh in India.

Huge fluctuations in prices of farm produce were observed during past few years. The present study aimed to study the price movement of Turmeric i.e. seasonal and cyclical variations, price volatility and co-integration among the major Turmeric markets of Maharashtra.

For study purpose the data related to monthly average prices and arrivals of Turmeric were collected for major markets of Maharashtra viz. Sangli, Hingoli, Basmat and Nanded for the period January 2004 to December 2015. Moving average method was used to estimate seasonal variations and Residual Method for cyclical variations. The econometric tools like ADF test, Johansen's Multiple Co-integration test, Pair-wise Granger Causality Test, ARCH-GARCH, Vector Error Correction model and ARIMA models was used for the forecasting. The following conclusions were emerged from the present study.

Conclusions

- 1) The prices of Turmeric were higher from the month of January to July in selected markets i.e. Sangli, Hingoli, Basmat and Nanded.
- 2) The cyclical variations were observed in the prices of Turmeric in the selected markets. The higher prices recorded during the year 2004, 2009, 2010 and 2011.
- 3) The peak period of arrivals of Turmeric in the selected markets was February to May. In Sangli market arrivals are higher in the month of February to May but in remaining three markets it is from April to July. The lean period of arrivals was from October November.
- 4) The cyclical variations were observed in the arrivals of Turmeric in the selected markets. The higher arrivals were recorded during the years 2004, 2005, 2007, 2012 and 2014.
- 5) The price series of Turmeric in all selected markets were non-stationary at level with lag 1 and became stationary after 1st order.
- 6) The selected Turmeric markets having long run equilibrium relationship for the prices of Turmeric and there exists co-integration among them as indicated by the results of Johansen's Multiple Co-integration Test.
- 7) There is bi-directional causality in Turmeric prices between i) Hingoli and Basmat ii) Sangli and Basmat iii) Sangli and Hingoli markets respectively.
- 8) The prices of Nanded market exhibited unidirectional causality and affects prices of Basmat Sangli and Hingoli markets. .
- 9) The results of ARCH-GARCH analysis showed that there was high variability in the prices of Turmeric. In selected markets price volatility shocks in Turmeric were quite persistent.

- 10) The estimates of Vector Error Correction Model (VECM) revealed that only Nanded and Sangli market attain short run equilibrium rapidly.
- 11) The forecasted prices of Turmeric for the next season i.e. for the month of January 2017 will be 10862,10516,10888,10316 rupees per quintal for the Sangli, Hingoli, Basmat and Nanded market respectively.
- 12) The forecasted arrivals for the next season i.e. for the month of January 2017 will be 26100, 13220, 16200 and 6540 quintals respectively for the markets of Sangli, Hingoli, Basmat and Nanded.

Policy Implications

In order to minimise the price risk and to protect the price security of farming community and also to stabilise the acreage under Turmeric of Maharashtra state which is the volatile commodity in terms of market prices, it is suggested that long term procurement policy should be adopted to maintain price stability throughout the year at least for major markets of the state. So that the prime objectives of Agricultural Price Policy i.e. a) Stabilisation of Agriculture Commodity Prices and b) Enhancement of Agricultural Market Efficiency will be achieved.

CHAPTER VII

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www.agmarknet.nic.in

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VITA

1. Name of student : Kalyaniranjn Yashwant Kadam
2. Date of birth : 27th June 1992.
3. Name of college : Department of Agricultural
Economics and Statistics,
Post Graduate Institute,
Dr. P.D.K.V, Akola.
4. Residential address : A/P Darphal (gawdi)
Tq. –North Solapur
Dist. – Solapur Pin Code- 413222
Emailid:kalyaniranjn27 @gmail.com

5. Academic qualification

Sr. No.	Name of degree awarded	Year in which obtained	Division/ Class	Name of awarding university	Subjects
11	B.Sc. (Agri.)	2014	First	MPKV, Rahuri	Agriculture and Allied Science

6. Research paper published : Nil
7. Field of interest : Agriculture, Administration

Place: Akola

Date: 31 / 5 /2016

Kalyaniranjn

Signature of student

(Kalyaniranjn Yashwant Kadam)

