AN ANALYSIS OF PRICE BEHAVIOUR OF TURMERIC IN GUNTUR DISTRICT OF ANDHRA PRADESH

By

MANJUNATH ULLAGADDI

B.Sc. (Ag.)

THESIS SUBMITTED TO
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DECLARATION

I, Mr MANJUNATH ULLAGADDI., here by declare that the thesis entitled **"An Analysis of Price Behaviour of Turmeric in Guntur District of Andhra Pradesh"** submitted to the Acharya N.G.Ranga Agricultural University for the degree of Master of Science in Agriculture in the major field of **Agricultural Economics** is the result of original research work done by me. I also declare that any material contained in the thesis has not been published earlier.

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CERTIFICATE

Mr. MANJUNATH ULLAGADDI has satisfactorily prosecuted the course of research and that the thesis entitled **"An Analysis of Price Behaviour of Turmeric in Guntur District of Andhra Pradesh"** submitted is the result of original research work and of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by him for a degree of any University.

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Place :

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CERTIFICATE

This is to certify that the thesis entitled **"An Analysis of Price Behaviour of Turmeric in Guntur District of Andhra Pradesh"** submitted in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURE** in the major field of **AGRICULTURAL ECONOMICS** of the Acharya N. G. Ranga Agricultural University, Hyderabad is a record of the bonafide research work carried out by **Mr. MANJUNATH ULLAGADDI** under our guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.

No part of the thesis has been submitted by the student for any other degree or diploma. The published part has been fully acknowledged. All the assistance and help received during the course of investigations have been duly acknowledged by the author of the thesis.

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Date : **(Manjunath Ullagaddi)**

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ABSTRACT

Name of the Author	:	**MANJUNATH ULLAGADDI**
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The present study entitled "An Analysis of Price Behaviour of Turmeric in Guntur District of Andhra Pradesh" was conducted with the specific objectives (1) To study the trends, seasonal, cyclical and irregular variations in market prices and arrivals of turmeric in Duggirala market in Andhra Pradesh. 2) To analyze the impact of arrivals on prices of turmeric in Duggirala market of Andhra Pradesh. 3) To study the export and domestic competitiveness of turmeric. 4) To forecast the future prices of turmeric in Duggirala market of Andhra Pradesh.

Analytical tools employed in the study were: Multiplicative model has been used to estimate the trend, seasonal, cyclical and irregular movements in market prices and arrivals and 12 months moving average method was used to construct the seasonal indices. Regression analysis was used to study the impact of arrivals on prices of turmeric. Nominal Protection Coefficient (NPC) was used to estimate the export competitiveness of turmeric. Domestic resource cost (DRC) was used to analysis domestic competitiveness of turmeric. Box-Jenkins model (ARIMA) was used to forecast the future prices.

The trends in arrivals were fitted by cubic model and market arrivals were recorded as highest in the year 2014 and lowest during the year 2002. The trends in prices were fitted by cubic model and prices were recorded as highest in the year 2011 and lowest during the year 2004. The month wise seasonal arrivals revealed that the highest arrivals were found in the month of June and May and lowest in the month of November and February respectively.The highest seasonal

price index was found in December, January and lowest in the month of April and July respectively. Thus, the farmers can get benefited if they sell their produce in the month of January, December and August. The cyclical variations in market arrivals showed one cycle from 2002-2009 and prices of turmeric showed one cycle from 2004-2010. The irregular component in the market arrivals were highest in the year 2005 and were found lowest in the year 2013 and in the prices were recorded highest in the year 2010 and lowest during the year 2012.The impact of turmeric arrivals on prices in the Duggirala market revealed that arrivals were showing a negative impact on price of turmeric. The export competitiveness of turmeric showed highly export competitive. The Domestic Resource Cost(DRC) of turmeric indicated that the input is used efficiently and it is export competitive. The forecasts of turmeric prices were found to be fairly accurate when compared to real prices at market and observed less than five percent variation between the both the prices.

Chapter I

INTRODUCTION

Agricultural marketing in our country has not received as much attention as that of agricultural production. For the farmer, disposal of his produce has become as important as the adoption of modern production technology in improving yield levels. The journey of each product from the farm to the ultimate consumer plays a crucial role in determining the price for the farmer. The evolution of new production technology cannot be sustained without the improvement in agricultural marketing system unless simultaneous efforts are effected. Incentives to expand production through high yielding varieties will not attract the farmers, unless marketing system improves only stability in income of farmers that could be brought about by stable yields, and more than this, the stable prices will induce the cultivators to expand production and increase their marketed surplus. The instability in yield and prices is more in the case of commercial crops, has posed a serious problem in obtaining stability in income of the farmers. If the sustained breakthrough in agricultural sector has to be achieved, the farmers are to be relieved of the risks and uncertanities involved in agricultural production and marketing. Therefore, equal attention has to be focused on the diversified production activities as well as diversified marketing aspects of agricultural commodities.

Prices play an important role in a predominantly agricultural country like India. Prices have profound effect on growth, equity and stability in a developing economy. The pricing mechanism provides the signal to the producers in deciding what and how much is to be produced with the available resources for maximization of income. Due to heavy dependence on natural factors the prices of the farm products fluctuates or instability in prices has been affecting the income levels of farmers and tempo of agriculture. The inter-year (trend), cyclical and seasonal variations in prices are more important in the context of policy instruments that are brought to bear on prices in order to minimize the fluctuations.

Commodity price behavior has been the subject of numerous studies over the years. These investigations have focused mainly on the question of price instability and their effects in both developed and developing economies. Studies on speculation-induced instability, commodity export instability, and commodity stabilization programs have widely addressed the question of price instability (Labys, Badillo, and Lesourd, 1998).

There are over 50 types of spices produced in India among them pepper, cardamom, ginger and turmeric, clove, nutmeg, vanilla and certain varieties of chilies are important. A number of varieties are grown for vegetables, spices, condiments, sauce and pickles.

Turmeric is grown as a Kharif crop in India. The crop-harvesting season starts between end of January and March in India. The country is the leading producer, consumer and exporter of turmeric in the world. It has near monopoly in this commodity. Indian turmeric has been known to the world since ancient times. India accounts for 78% of world turmeric production and it contributes 60% to the world market. Major turmeric growing states are Andhra Pradesh (57%), Tamil Nadu (23%), Karnataka (6%) and Orissa (4%) in production. Indian turmeric is considered as the best in the world because of its high curcumin content.

India holds the top position in the list of world's leading exporters of turmeric. During 2013-14, India exported 65000 tons of turmeric, compared to 60442 tons in 2012-13. The target for 2014-15 is 80000 tons. The major turmeric producing countries are India, China, Bangladesh, Pakistan, Sri Lanka and Taiwan. The major turmeric exporting countries are India, Thailand and other Southeast Asian countries and Central and Latin American countries. UAE is the major importer from India buying over 18 per cent of the total exports from India followed by the US with eight per cent.

Andhra Pradesh, Tamil Nadu, Orissa, West Bengal, and Karnataka are the top producing States. Andhra Pradesh contributes roughly around 47 per cent of the total production. Turmeric is mainly used to flavor and colour foodstuffs and an ingredient in cosmetics and medicines. The production of turmeric is concentrated in the southern part of the country mainly in the peninsular area. The

warm climatic conditions and consistent rainfall in those areas support the growth of turmeric and many other spices also. As per the trade sources, area under turmeric has reduced by about 20 per cent in 2012-13 in India.

Turmeric is being exported to foreign countries like USA, Dubai, Japan, Singapore, and Bangladesh by shipment through the agencies from Bombay. The local turmeric traders export turmeric to the agencies outside the state like Bombay, Jabalpur, Amrithsar, Kolkatta, Delhi, Guwhati, Raypur, Sharpur, Jaipur, Agarthala, Lucknow, Kanpur and Nagpur.

Problem statement

Agricultural price policy is a method of influencing the allocation of resources for achieving the societies objectives of growth and equitable distribution of income. The main objective of agricultural price policy is to augment production of agricultural commodities by assuring better prices to the farmers and to provide agricultural commodities, including food grains, to the consumers at reasonable prices.

Inter and intra-year price behavior help in formulating both long and short term policy measures to regulate the price movements within the moderate limits. The preference for high quality, low prices and regular supply of commodities coupled with stiff competition from other countries in the international market has imposed serious challenges to the Indian agricultural exports. Therefore, the situation calls for timely information of the changing global as well as domestic market for agricultural commodities. So there is a need to study the effectiveness of price policy and the extent of variation in prices at micro level which helps the farmer to get sufficient profits to promote investment, technology and productivity there by to increase the export of the country.

Turmeric marketing takes place through out the year but the peak season of marketing starts from February to June.Average daily arrivals of turmeric is 35-75 metric tonnes with minimum of 30mt and maximum of 225mt. The total annual arrivals for the year 2013-14 is 15986mt as compared to 16995mt in 2012-13 and 21594 mt in 2011-12 respectively. There are intra and inter year variations in arrivals and prices effecting the farmers income. The present study has been carried out with the following specific objectives.

Objectives of Investigation

1. To study the trends, seasonal, cyclical and irregular variations in market prices and arrivals of turmeric in Duggirala market in Andhra Pradesh.
2. To analyze the impact of arrivals on prices of turmeric in Duggirala market of Andhra Pradesh.
3. To study the export and domestic competitiveness of turmeric.
4. To forecast the future prices of turmeric in Duggirala market of Andhra Pradesh.

Importance of the study

Agricultural marketing plays an important role not only in stimulating production and consumption, but in accelerating the pace of economic development. An efficient marketing system ensures higher levels of income for the farmers and widen the market for the products by taking them to remote corners of the country and the world wide.

Analysis of price and market arrivals over time is important for formulating a sound agricultural price policy. Fluctuations in market arrivals largely contribute to the price instability of the produce. In order to device appropriate ways and means for reducing price fluctuations of agricultural commodities, there is a need to have a thorough understanding of price behaviour over time and over space.This information is further strengthened through forecasts of prices in future markets. It gives information regarding the competitiveness of Indian turmeric in international market. Such an analysis is also useful to farmers in order to decide the optimum time for disposing their produce to their best advantage. Proper planning in disposing of the produce by the farmer alone can considerably increase their income without incurring much additional cost.The conclusions of the study and recommendations would be helpful for farmers, researchers and policy makers for effective implementation of price policy, price behaviour of turmeric in Duggirala market and competitiveness of turmeric in international market.

Limitations of the study

Constraint on time and availability of data has forced the researcher to take restricted area for the study. Hence the results are confined to one market.The analysis of the data has been carried out by using secondary data available for the period 2002 to 2014.Only three years data was obtained to the objective of domestic competitiveness of turmeric. The export competitiveness objective was confined to the USA country which imports the Indian turmeric at a greater amount. Hence the results may have limitations in their interpretation and application.

Presentation of the study

The entire study has been presented in five chapters.

Chapter -I	:	Introduction, problem statement, objectives, scope and limitations of the study.
Chapter – II	:	The review of earlier studies connected with present investigation.
Chapter –III	:	Describes the material and methods used in the study.
Chapter – IV	:	The results of the study were discussed in this chapter.
Chapter –V	:	The chapter concludes with the summary and conclusions

Chapter II

REVIEW OF LITERATURE

In this chapter, an attempt has been made to critically review the literature of the past research work in relevance to the present study. The review of earlier studies is very much helpful in providing guidelines to the present researchers to develop a comprehensive knowledge on the objectives and enable to formulate concepts for use in the study and draw meaningful conclusions and also helps in identifying the conceptual and methodological issues relevant to the study. Some important studies which may provide basis for the present study are grouped under the following sub headings.

2.1 Studies on the trends, seasonal, cyclic and irregular variations in market prices and arrivals.

2.2 Studies on analyzing the impact of arrivals on prices.

2.3 Studies on the export and domestic competitiveness.

2.4 Studies on forecasting the future prices.

2.1 STUDIES ON TRENDS, SEASONAL, CYCLICAL AND IRREGULAR VARIATIONS IN MARKET PRICES AND ARRIVALS

Mundinamani *et al.* (1991) used the monthly time series data on market arrivals and prices of groundnuts for the period 1960-61 to 1983-84 collected from the regulated markets of Gadag and Hubli to estimate indices, trend equations and coefficients of variation. The pattern of market arrivals of groundnut indicates a seasonal character. The prices of groundnuts were found to be a function of market arrivals only in the short- run. The seasonal pattern of market arrivals and the resulting short-run instability in groundnut prices could be eliminated by using a package of measures. In the long-run, prices are influenced not only by market arrivals but also by other factors such as the general rise in prices and the steady rise in demand for groundnut products.

Prakash and Srivastav (1996) revealed that inter year variation in market arrivals of lentil was between 37.1% and 146.4% of average annual arrivals during the period 1984-85 to 1993-94.

Kasar *et al.* (1996) studied behaviour of price and arrivals of red chillies in Maharashtra seasonal indices of arrivals of red wet chillies begin in October and end in April, where as that of red dry chillies start in May and end in September. The arrivals of red wet chillies were maximum during December to March when the corresponding prices were relatively low. The arrivals of red wet chillies were low during October, November and April when the prices were relatively at higher level. By and large, it appears that when the seasonal index of arrivals of red wet chillies was more during December to March, the seasonal index of prices was at a low level. On the other hand, when the seasonal index of arrivals of red dry chillies was low (May to September) the price index of chillies was at a very high level.

Babu and Sebastain (1996) found that the seasonal price behaviour of coconut was being influenced by seasonality in copra and coconut oil prices. The seasonal peak in coconut production was coupled with seasonal trough in coconut prices and vice versa, thereby indicating the prevalence of a distorted market in state to the disadvantage of coconut growers.

Singh *et al.* (2000) adopted linear equation and moving average methods to examine the trend as well as seasonal variation of arrivals and price of rapeseed-mustard in Haryana from 1985-86 to 1995-96. The findings of the study showed general tendency of rising, while the arrivals indicated greater fluctuations from year to year in all markets.

Ravikumar *et al*. (2001) concluded that in general, arrivals showed mixed trend, whereas, prices showed an increasing trend for the selected commodities in Anakapalle regulated market of Andhra Pradesh. There exists an inverse relationship between seasonal indices of arrivals and prices of selected commodities. Therefore, the policy implication lies in encouraging the farmers to dispose their produce at the opportune time to get good remunerative prices. It

requires providing finance to farmers and better storage facilities either at village level or at market level so as to spread the arrivals reasonably in the lean months of the year.

Rajashekar (2005) studied the cyclic trend in arrivals and prices of vegetables for Mysore and K.R. Market. K.R. Market cycle was smoothening with maximum cycle effects in case of 156 months. The slump was observed with 35 months indicating that the high arrivals observed in every 30 months. The cyclical components were observed only in weekly prices for K.R. Market.

Garg and Bhakar (2006) concluded that the annual price of the wheat increased significantly whereas arrivals in the market, though increased, were not significant. The seasonal indices revealed that the consumers can be advised to purchase wheat at Bikaner in August, at Nokha in October, at Loonkaransar in April and at Khajuwala in June. November and December was the perfect time for sale of wheat by the farmers.

Khunt *et al.* (2006) made a study on the price behaviour of major vegetables in Gujarath state, and the major vegetables considered for the study were onion, brinjal, potato, chillies, tomato and cluster bean. A number of regulated markets were selected by considering the major vegetable growing areas and data availability about the prices and arrivals of vegetables. The study revealed that there is seasonality in arrivals and price of all the major vegetables produced in the state which indicates the need for storage facilities. The inverse relationship was observed between prices and arrivals of most of the vegetables. Arrivals and prices of major vegetables have increased over the period in most of the regulated markets showing the scope for expansion of vegetable cultivation.

Punitha (2007) studied the seasonal indices and trend in arrivals and prices of maize and ground nut in Davengere market and Hubli market. In case of maize, Davangere market showed increasing trend in arrivals but Hubli market showed stagnant trend and both the markets showed an increasing trend in prices. In Davangere market significant and positive relationship between arrivals and prices was observed for maize. Whereas, in Hubli market non-significant and negative relationship was observed.

Yogisha *et al.* (2007) computed trend in arrivals and prices of potato in Chikkaballapur, Chintamani, Kolar and Srinivaspur during 1994-95 to 2004-05. The results show that in the initial years potato arrivals were at increasing path and in the mid period it started decling while in the later period the arrivals again increased in all markets except Srinivaspur. In case of price, a decreasing trend in prices of potato in later period except Bangalore and Chintamani may be because of increased arrivals of potato to these markets.

Goudra (2010) analysed the price behavior of chilli in Hubli and Byadgi markets for the period 1993-94 to 2008-09 and found that the highest arrivals of seasonal indices in Hubli market were observed in February (287.4) and the lowest, in August (6.6). With regard to price indices of chilli, the highest price was recorded in January (110.23). In case Byadagi market, the highest arrivals of seasonal indices were observed in February (211.7) and the least arrivals in August and September (18.9). The highest price indices were noticed in January (121.6) and lowest price indices in August (84.1). The critical analysis showed a gradual increasing trend in arrivals in both the markets but the price of chilli in both the markets exhibited mild ups and downs.

Singh *et al.* (2010) time series analysis shows that arrivals of chilli increases over a period of time in Amritsar market where as in Patiala market it shows declining trend. It has been found that seasonal nature of chilli creates glut in the market during post harvest season which leads to sharp fall in prices and effects the producer adversely in both the Amritsar and Patiala market

Singh *et al.* (2010) revealed that the prices of chilli in Amritsar market exhibited an increasing trend where as in Patiala market it showed the declining trend for the period 1994-95 to 2005-06. The seasonal nature of chilli crop creates glut in the market during the post harvest season which leads to sharp fall in prices and affects the produce adversely in both the Amritsar and Patiala market.

Meena *et al.* (2011) studied the trends of arrivals of rapeseed-mustard that showed significant increase over a period of time. In Alwar market, the trend of arrivals of rapeseed-mustard showed a non-significant increase over a period of

time. With regard to trend in prices, a general rise in prices of rapeseed-mustard in all the selected markets *viz.* Alwar, Khairthal, Sri Ganganagar and Raisinghnagar markets was witnessed.

Raviachandran and Bhanumathy (2011) reported that linear trend in chilli arrivals and prices was observed which had inferred that there is decreasing trend in arrivals and increasing trend in prices. The average price index was high (109.35) lean season and it was less in peak season which was 97.

Saravana *et al.* (2011) conducted a study to analyze the trend, seasonal and spatial variations in wholesale prices of egg for the period from August 2000 to July 2009. The results revealed that the wholesale egg price hiked at rate of four to fifth of paise per month. The monthly egg price index was observed to be the minimum during the months of March and April and started increasing to reach peak during the month of June. Further, it started decreasing and reached lower value during the months of August and September. The monthly price index was found to increased higher in the months of November to January.

Singh *et al*. (2011) reported that the correlation matrix for the trend of slaughtering in sheep, goat and buffalo deduced that all of them were positively correlated. The seasonal indices show that different type of animals exhibit different seasonal pattern in slaughtering, and was maximum in the month of December and January indicating high demand for meat in these months while it was lowest in the months of August and September. The number of animals slaughtered varied over the years. In all the animals a long cycle of 13 years was found. In all types of animals uneven cycles were observed.

Mahendran (2012) analyzed the trends and seasonal price behavior of prices in Tamil Nadu related to IR-20, IR-50 and white ponni varieties of paddy over a period of nine years from 2000 to 2008. The results revealed that the positive trend in prices of three varieties of paddy. The month wise seasonal indices were lower during harvesting season and higher in the slack period. The seasonal index of paddy was low in the month of April and it was highest in the month of July and December.

Khobarkar and Khule (2013) conducted a study and concluded that the monthly seasonal indices for selected pulses arrivals were higher immediately after harvest in all the study markets, the price indices of selected crops were lower during peak arrival months and vice versa. Cyclic fluctuations were found to be more pronounced than seasonal fluctuation in prices. This showed that when maximum production is there, prices decreased and increased during the pre harvest month. Coefficient of variation of real prices was found to be highest.

Karthikeya (2013) revealed that the average egg prices had grown significantly at 28% from 2009 to 2012. This was mainly due to the increased consumption of eggs across India and the feed cost has increased to a large extent. The consumption of egg during winter season is high and this results in high prices in the market.

Rao *et al.* (2014) reported that the annual average wholesale price trends of rice from 1990-91 to 2009-10 has shown a significant increase over the years in both Andhra Pradesh and Guntur market. The annual increase in wholesale prices of rice in Andhra Pradesh was Rs. 44.53 per quintal where as in Guntur market it was Rs. 49.38 per quintal. The month wise seasonal index was lowest on the month of April, May and highest in the month of September, October in Andhra Pradesh and Guntur district respectively.

2.2 STUDIES ON ANALYZING THE IMPACT OF ARRIVALS ON PRICES

Upendra and Chary (1996), while analyzing market arrivals and prices of paddy in regulated markets, pointed out that in the three markets selected for the study, the maximum quantity of arrivals of paddy were observed during the peak market period probably because the farmers who were economically not sound, sold their produce soon after harvest to meet their financial obligations. The trend values of arrivals of paddy exhibited not only an increasing trend over the years but also significant in the three agricultural markets, viz., Karimnagar, Jammikunta and Vemulawada in Andhra Pradesh over time as a result of increasing productivity and production of paddy. The extent of variability in the

market arrivals was found to be higher than in the prices of paddy in all markets selected for the study particularly, in Jammikunta and Vemulawada agricultural markets, the price elasticities of market arrivals of paddy were not only positive but also more than unity indicating that price response was very high. On the contrary, in Karimnagar market, the price elasticity of market arrivals was positive but less than unity showing price response was poor. The positive price elasticity of market arrivals reflects the price consciousness of farmers. With a rise in the prices of agricultural products, farmers were tempted to dispose off more and retain less and as a result, the quantity of arrivals was more in regulated market.

Agarwal and Dhaka (1998) studied the relationship between the arrivals and prices of spices in Rajasthan. The study revealed that, arrivals of chillies were higher in February and the prices of dry chillies were also higher in February when the first lot of new chillies arrived in the market. Prices reached peak level in September when arrivals were low. The pattern of market arrivals of cumin and coriander seed also revealed the existence of seasonality. The correlation coefficient analysis indicated that the relationship between arrivals and prices of subsequent months were negative and significant, indicating thereby that price affected the arrivals more in subsequent months than corresponding month.

Mali *et al.* (1999) analysed the trend in arrivals and prices of vegetables (tomato and lady's finger) in Pune regulated market during the period from 1978-79 to 1996-97. The coefficient of variation of arrivals (56% to 80%) and prices (40% to 80%) of tomato were higher than the variations in arrivals (27% to 60%) and prices (49% to 75%) of lady's finger. The compound growth rate of arrivals (2.11%) and prices (1.02%) of both the vegetables were significant during the same period and prices of both vegetables showed increasing trend indicating the good integration of Pune regulated/vegetable market.

Mundinamani *et al.* (1999) reported that the trend pattern of arrival of groundnut in the study market was mixed one and that of prices was almost identical far as price trend pattern was concerned and continuous upward movement was seen in all markets without any expectation.

Chitra (2000) studied the market arrivals and prices of groundnut in Challakere market for the period 1990-99. The results showed that the estimated trend in arrivals of groundnut was statistically non significant, while prices of groundnut showed a steady increase which was significant. The correlation coefficient estimated for the monthly market arrivals and prices was not significant. Therefore, it was concluded that there was no definite relationship between the arrivals and prices of groundnut. The nature of association between arrivals and prices was negative for the lean periods and was positive for the peak periods and for overall period.

Nadaf (2002) studied the behaviour of price and arrivals of maize in Belgaum district in general and in Gokak (1985-2001), Ramdurga (1987-2001) and Soudatti markets (1986- 2001) in particular. The results indicated that the arrivals were higher during December to March in Gokak and November to February in Ramdurga and Soundatti markets. Whereas the lowest arrivals were seen in Gokak market during August to November; Ramdurga and Soudatti markets recorded the lowest arrivals in April and June. The highest prices were seen in May to September and remaining months a moderate price in Gokak market. In Ramdurga market, increased price was seen from April to September whereas in Soundatti market, price was highest during June to October.

Navadkar *et al.* (2002) in their study on arrivals and prices of vegetables in Gultekadi regulated market, Pune (1978-97) observed inverse relationship between arrivals and mean prices. The correlation coefficients for all the selected vegetables were highly significant at one per cent level of probability. The magnitude of correlation coefficient was the lowest to the extent of 0.61 for cauliflower and it was the highest to the tune of 0.90 in the case of bitter guard.

Kollar (2002) studied price behaviour of Maize in Haveri, Ranebennur (1990-91 to 2000-2001), Gokak and Soundatti markets (1985-86 to 2000-2001). The results indicated that there was a significant and positive relationship between arrivals and prices in all the selected markets. The pattern of relationship was high in Soundatti market.

Chahal *et al*. (2004) studied the price behaviour of green peas in Hoshiarpur and Ludhiana (Punjab) markets from 1994 to 2002 and found that correlation coefficient of arrivals of green peas in Ludhiana market was positive; where as in Hoshiarpur market, it was negative. The authors also found that correlation coefficient of prices of both the markets were positive.

Kumar *et al.* (2006) studied the market arrival and price behaviour of potato in four metropolitan markets (Delhi, Bangalore, Mumbai and Kolkata) for the period 1990- 2001. The results showed a positive correlation coefficient for Delhi market for nine years out of total eleven years. However, these were statistically non significant. In Mumbai market, the relationship turned out to be negative for seven year out of eleven years. The coefficients were negative for Bangalore and Kolkata markets. The negative relationship between market arrivals and potato prices in these markets of Mumbai, Bangalore and Kolkata were statistically significant for a single year only.

Chaudhari and Pawar (2010) revealed that the districts Jalan and Nanded showed significant positive growth in area and production of pigeon pea, while all districts and region recorded higher variability in area, production and productivity of pigeon pea. The maximum arrivals of pigeon pea was recorded in month of January in all the selected markets, while significant negative relationship between arrivals and prices of pigeon pea was served in Latur market.

Sharma (2011) indicated that the lagged price of tomato had a positive and significant correlation with current prices and negative and significant with market arrivals. It was observed that the lagged price of tomato gave high response and explained higher variation indicating that the lagged price of tomato is an important factor in determining the current price than the market arrivals.

Nagpure and Ganvir (2012) revealed that the variation in arrivals have influenced the prices of lemon in all the selected market. Thus the higher fluctuation in arrivals might have resulted in wide variation in prices of lemon. Inter market variations in arrivals was found to be highest during the period June to December (37 to 49 %) in Akola market and Wadegaon

market, while reverse trend is observed in Akola market during the reference period and same trend was observed in the months of January to May (37 to 50 per cent). It may be concluded that variation in supply of lemon significantly affected prices.

Shruthi and Krishnamurthy (2013) in their study revealed that during July and August, the prices were low due to large amount of arrivals. On the other hand, the arrivals were least in November during which the prices achieved moderate. The correlation between prices and arrivals were found to be non significant over the months.

Thombre and More (2013) revealed that market arrivals and prices of pigeon pea had strong season effect. The results confirmed the negative relationship between arrivals and prices in both the markets under the study.

Patil and Bhurke (2014) reported that prices depend upon the arrival of the commodities in the Agricultural Produce Market committee (APMC). Major seasonal movements were observed in the arrivals and prices of the pulses in the different months of the year. As arrivals increased, prices decreased and vice versa.

Kanungo (2015) analyzed that the market arrival has a great impact on price formation. This impact is explained by an inverse relationship between market arrival and price.

2.3 STUDIES ON THE EXPORT AND DOMESTIC COMPETITIVENESS

Ravi and Reddy (1998) analyzed the export competitiveness of jowar, maize, groundnut, sunflower, cotton and coffee grown in the Karnataka state using Nominal Protection Coefficient (NPC) for the period from 1984-85 to 1993-94. The results revealed that values of NPC under exportable hypothesis was above one for all the commodities studied except cotton which had shown Karnataka state was lacking comparative advantage in exporting of jowar, maize,

groundnut, sunflower and coffee. However, values of NPC for jowar, and maize under importable hypothesis were less than one showing efficient import substitutes.

Jayesh (2001) indicated that Russia (64%) and USA (59%) were the stable and loyal markets for Indian pepper as revealed from the values of probability retention that Japan (0.2530) is the most reliable and stable markets for Indian cardamom. It was predicted that the market share of Indian pepper exports to Russia and USA would increase to 24.95 and 34.96 per cent, respectively by 2009-2010. The study further revealed that the market share of Indian cardamom export to Japan would increase to 47.25 per cent during 2009-10 mainly because of their preference for Indian spices.

Desai (2001) examined the export potentialities of mango from India by using Nominal Protection Coefficients (NPC) for the period 1990-1998, which is the ratio of domestic price to the border price. The findings of the study indicated that on an average, the nominal protection coefficients value in fresh mango (0.89), and mango slices (0.45) were lower than one indicating their competitiveness in international market.

Gorton and Davidova (2001) in their study concluded that the considering variations in DRCs by farm type, larger farm in Hungary and the Czech Republic are more internationally competitive than smallest private farms in crop production.

Jyothi *et al.* (2003) indicated that the values of Nominal protection coefficients (NPC's) showed that India has moderate competitiveness for tea, cardamom (small), mango, grapes and potato exports and marginal competitiveness in case of coffee, cashew kernels and onion exports.

Bhat (2004) reported that India’s imports of raw cashew nuts has increased from 4.01 lakh tonnes valued at Rs. 1231 crores in 2002-03 to 4.53 lakh tonnes valued at Rs. 1401 crores in 2003-04. The major countries, which have supplied raw nuts to India during 2003-04, are Ivory Coast, Tanzania, Guinea-Bissau, Benin, Indonesia, Mozambique and Ghana supplying 87.11 per cent of total

imports in terms of quantity and 88.81 per cent in terms of value. The export of cashew kernels from India was 1.01 lakh tonnes valued at Rs. 1804.40 crores in 2003-04. USA was the biggest buyer of Indian cashew kernel with 48503 tonnes valued at Rs. 881.6 crores followed by Netherlands (12237 tonnes values at 210 crores), UAE (6239 tonnes valued at Rs. 102.4 crores), Japan (5522 tonnes values at Rs. 101.9 crores) *etc*. during 2003-04. India had exported 6926 tonnes of cashew nut shell liquid valued at Rs. 7.03 crores during 2003-04, USA was also the largest buyer of Indian CNSL, which accounts for 6600 tonnes valued at Rs. 644.68 lakhs.

Guledagudda (2005) revealed that the nominal protection coefficient was less than unity (0.98) indicating that cashew kernels was competitive for its export to other countries from (Dakshina Kannada) Karnataka, while NPC of raw cashewnut imports by India from abroad (East and West African countries) was also less than unity (0.88) which reveals that raw cashewnut was a efficient import substitute.

Sidhu (2005) analyzed the export performance of chilli that India exports only 5 to 8 per cent of its output due to high domestic consumption and low international demand for our chillies in the developed countries such as North America and European countries. Despite being low, exports of chilli were also highly fluctuating from year to year. During 1999-2002, the average yearly exports were estimated as 58653 tonnes against 4096 tonnes by 1975-78. The export grew at the rate of 12.0 per cent per annum during 1975-76 to 2001-02.

Thanuja (2005) reported that the international prices of Cochin ginger were found to be decreased in I and III phase and increasing in II Phase. An average NPC value over 20 years for the domestic market price was 0.70 indicating moderate competitiveness in the international market. Pakistan and Saudi Arabia were found to be highly loyal markets for Indian ginger indicated by the retention of their previous shares of exports from India.

Singh *et al.* (2008) The study resulted that there is a great potential of increasing the exports of pepper and grapes as their export performance ratio is significant. The export performance of tomato, banana, pear, pineapple and natural rubber are insignificant and inconsistent.

Gireesh (2009) revealed that the nominal protection coefficient was less than unity (0.98) indicating that cashew kernels was competitive for its export to other countries from India, while NPC of raw cashewnut imports by India from abroad (East and West African countries) was also less than unity (0.88) reveals that raw cashewnut was a efficient import substitute.

Yeledhalli and Kulkarni (2009) in their study revealed that Malaysia has shown the increasing trend while UAE has shown decling trend. UAE and Sri Lanka have been loyal markets for Indian onion market. The NPC for onion was 0.947 during 2000-01 under exportable hypothesis. The DRC ratio worked out to be less than unity (0.23) indicating high export competitiveness of onion.

Ohlan (2013) in their study revealed that the values of NPC are above unity (1.28) indicating lack of export competitiveness for dairy products. One of the major reasons for the lack of export competitiveness may be the low quality of dairy products being exported from India.

Guledagudda *et al.* (2014) The analysis of export competitiveness in general, indicated that all the commodities were found to be competitive for their export to other countries as was evident from NPCs of less than unity. The NPCs for cashew kernel have been estimated both under the importable and exportable hypothesis. The NPC for the period 2004 under exportable hypothesis was 0.98, which also revealed that the domestic prices received by the farmers were lower than the international prices.

2.4 STUDIES ON FORECASTING THE FUTURE PRICES

Noble and Sathianandan (1991) studied on trend analysis in all-India mackerel catches by using ARIMA models. The suitable model was identified as ARIMA (1,0,0), for forecasting by using the annual catch data from 1950 to 1989.

He concluded that the fitted ARIMA model was better with the spawning stock in making predictions. Catch predictions by this also hinted at 10-year cycle but seemed to lack seasonal term. The 10 year cycle seen in the commercial landings may be dependent on the spawning stock and spawning success.

Saeed *et al.* (2000) studied on forecasting of wheat production in Pakistan by using ARIMA Models. The diagnostic checking had shown that ARIMA (2,2,1) was appropriate. The forecasts from 1998-99 to 2012-13 were calculated based on the selected model. These forecasts would be helpful for the policy makers to foresee ahead of time the future requirements of grain storage import and export in Pakistan.

Ansari and Ahmed (2001) applied ARIMA modeling for time series analysis of world tea prices and export prices in industrialized countries. The results of the estimated ARIMA equation implied that the information on the current period's tea price is sufficient to forecast the next periods and the industrialized countries' export prices can be forecasted from information on the prices of the previous two periods. The authors concluded from the fitted ARIMA models that the autoregressive process generated both price series and there was no influence of external factors.

Gangadharappa (2005) fitted ARIMA model to study the variation in arrivals and prices of potato in Bangalore, Belgaum, kolar, Hassan and Hubli markets of Karnataka during 1996-97 to 2003-04. Box-Jenkins method was applied for precise forecasting of arrivals and prices of potato for the monthly data to all the selected markets. Of all the ten series, he found only two series, which yielded Box –Pierce 'Q' statistic which was significant and AIC was minimum.

Satya *et al.* (2007) made an attempt to forecast milk production using statistical time series modeling techniques such as double exponential smoothing and Auto- Regressive Moving Average (ARIMA) for the study period of twenty five years (1980-81 to 2004-05). On validation of the forecast from these models, ARIMA model performed better than the other one.

Chandran and Pandey (2007) studied potato wholesale prices of Delhi market were analysed using univariate seasonal ARIMA model. Based on the Shwartz Bayes Criterion (SBC) and Akaike Information Criterion (AIC), the estimated best model was ARIMA (1,1,1), (1,0,0). The seasonal indices showed that generally the price is low from December to May and it picks up from June, and reaches the maximum in October. Short term forecasts based on this model were close to the observed values.

Nikhil (2008) in his study fitted an interactive Auto Regressive Integrated Moving Average (ARIMA) Process to monthly average prices of two varieties of arecanut. The ACF and PACF showed auto regressive and moving average process with seasonality component in the selected markets. The auto correlation coefficients were significant in both the varieties, which implied that there was a strong seasonality component in the error terms. Using the model, the prices of both types of arecanut were ex-post forecasted. Accordingly, prices of both varieties reached a peak in the month of August and declined thereafter.

Selvam *et al.* (2008) in their study of price forecasting of banana by used ANN and ARIMA models for measuring in terms of mean absolute percentage error (MAPE). The results of the ANN model had better prediction accuracy than ARIMA models in banana price forecasting.

Chandrakala (2009) analysed spatial and temporal behavior of arrivals and prices of groundnut in Karnataka. ARIMA model was employed to forecast the arrivals and prices of groundnut in selected markets. Among five markets (Challakere, Chitradurga, Bellary, Yadagir and Davangere markets) the Bellary market yielded the best results.

Nehru and Rajaram (2009) studied on Prediction of Wheat production in India by ARIMA technique. ARIMA (1,1,0) was selected as best model based on AIC and SBC. The predicted values of Wheat production showed that there will be steady increase from 2008-09 to 2014-15.

Padmashree *et al.* (2010) study showed that the prices of groundnut and sunflower and arrivals of groundnut at challakere market depends on previous years and on two months back values and sunflower arrivals depends on one month back values.

Sharma (2010) studied on forecasting of Food grain production of India by ARIMA model. Based on AIC and SBC, ARIMA (0,1,1) was selected as best model for data of 1950-51 to 2003-04. Food grain production for next 6 years was estimated. It was estimated 224.74 M.tonnes in 2010.

Sivaramane and Mathur (2010) studied on forecasting of rice exports from India by ARIMA technology. Based on using AIC criterion, ARIMA (0,1,1) was found better than others. The forecasts for rice were generated for three periods 2010, 2015 and 2020. The export of rice in the future would be about 6-7 million tones.

Sreekanth (2010) conducted a study on spatial and temporal behaviour of arrivals and prices of groundnut and sunflower in Andhra Pradesh by using the ARIMA model to forecast the prices. The results of price forecasted from July to December, 2010 in the selected markets indicated that the price would range from Rs 2135 to Rs 2946 per quintal of groundnut pods and in case of sunflower prices indicated that they would range from Rs 1863 to Rs. 2894 per quintal for the same period and these forecasted results were more valid in comparison with real time prices.

Ayyub *et al.* (2011) reported that ARIMA (4,2,4) is an appropriate model for the time series data of meat production and price index from the year 1991 to 2008. Further diagnostic checks using N Par test exhibited that up to the year 2020; there will be a significant increase in the price index of meat.

Bubark *et al.* (2011) has forecasted the price for harvesting months viz: April-June was Rs 4000 per quintal. Average price realized by farmers before May 2011 was 2400 per quintal whereas those who retained coriander and waited for forecasted price realized Rs 3980 per quintal (after May to June).

Devi *et al.* (2011) used the ARIMA model to forecast sunflower and groundnut prices in Kurnool market for the period from January 2010 to May 2010 from the model prices of 13 years. The results revealed that the forecasts were found fairly accurate when compared with real time prices.

Kumar (2011) reported that the ARIMA model was outperformed the H-WMES model for forecasting onion price. Hence, seasonal ARIMA model can be successfully used for modeling as well as forecasting of monthly price of onion in Bengaluru.

Ozer and Ilkdogan (2013) examined cotton prices in the world by Box Jenkins method of ARIMA model. By using 102 per month which covers the period January 2004 and June 2012of the world price of cotton, the seasonal model of ARIMA(1,1,1) (1,0,1)12 has been identified as the most appropriate model.

Sankar (2011) studied on forecasting of fish product export in Tamil Nadu. Based on ARIMA (p, d, q) and its components ACF, PACF, Normalized BIC, Box-Ljung Q statistics and residuals estimated, ARIMA (0,1,2) was selected. Based on the chosen model, it could be predicted that the fish product export would increase to 1,14,695 tonnes in 2015 from 74,549 tons in 2008 in Tamil Nadu.

Tripathi *et al.* (2013) study on area, production and productivity of pearl millet reveals a spectacular simple growth rates which shown that pearl millet production for the year 2020 to be about 9.15 million tons and area would be around be 8.67m.ha in 2020 and yield model had shown that the yield of pearl millet would be 1083.12kg/ha in 2020.

Meena *et al.* (2014) concluded that there was slight difference between actual price and forecast prices of mustard seed and mustard oil. The forecasted value of mustard seed and oil showed an increasing trend of prices in selected markets.

Rao *et al.* (2014) The models selected for forecasting for whole sale price of rice was ARIMA (2, 2, 0) and ARIMA (0, 1, 1) in Andhra Pradesh and Guntur district respectively based on the Schwartz Bayes Criterion (SBC) and Akaike Information Criterion (AIC).The forecasts of rice wholesale prices were found to be fairly accurate and showed increased trends in both Andhra Pradesh and Guntur district.

Chapter III

MATERIAL AND METHODS

This chapter gives a comprehensive view of methodology adopted for the present study viz., the study area, nature and sources of data, and the various statistical tools and techniques employed for analyzing the data and for evaluating the objectives of the present study. These are presented under the following headings.

3.1 Selection of the Market

3.2 Nature and Sources of Data

3.3 Methods of Analysis

3.4 Concepts and Terms Used

3.1 SELECTION OF THE MARKET

For the purpose of present study, Duggirala turmeric market was selected purposively.Duggirala market is located in Guntur district of Andhra Pradesh. The Agricultural Market Committee, Emani (HQ), Duggirala was bifurcated from Agricultural Market Committee, Tenali with effect from 25-10-1984, and constituted with entire area of revenue mandals of Duggirala, Kolluru, Kollipara by the Government of Andhra Pradesh.

Turmeric marketing takes place through out the year but the peak season of marketing starts from February to June. Average daily arrivals of turmeric is 35-75 mt with minimum of 30mt and maximum of 225mt. The total annual arrivals for the year 2013-14 is 15986mt as compared to 16995mt in 2012-13 and 21594mt in 2011-12 respectively. Total production of turmeric in Guntur in 2012-13 found to be 32695mt out of which 52% of commodity is marketed in selected market and overall 4% of the production of state (411000mt).There is one cold storage unit which provides storage facility for the farmers and the capacity of the cold storage unit is 1000 mt. There are 13 turmeric processing units at the yard. Hence Duggirala market has been taken as the study area.

3.2 NATURE AND SOURCES OF DATA

The time series data on monthly arrivals and prices of Turmeric required for the study were collected from the registers maintained in the respective APMCs. These markets maintain data on daily, monthly and yearly arrivals and prices of Turmeric.

The data on arrivals refer to the total arrivals during the month in quintals in the market. The data on prices refer to modal prices in a month. Modal price was considered superior to the monthly average price as it represented the major proportion of the commodity marketed during the month in a particular market.

The data pertaining to export price of turmeric was collected from Spices Board, *www.indiastat.com*, Agriculture Statistics at a Glance of various years, Thedomestic price was considered as the average of price of turmeric in selected market.

3.3 METHODS OF ANALYSIS

3.3.1.1 Time Series Analysis

Time series analysis was done to study the variations in monthly prices and arrivals of Turmeric for the period of 13 years (2002-2014). A time series is a complex mixture of four components namely, Trend (T), Seasonal (S), Cyclical (C) and Irregular (I) variations. These four types of movements are frequently found either separately or in combination in a time series. The relationship among these components is assumed to be additive or multiplicative, but the multiplicative model is the most commonly used method in economic analysis, which can be represented as

$Y_t = T_t \times S_t \times C_t \times I_t$

Where, Y_t Denotes the time series data on prices/market arrivals

T_t Denotes the trend component

S_t Denotes the seasonal component

C_t Denotes the cyclical component

I_t Denotes the irregular component

3.3.1.1 Estimation of Trend

Trend in time series refers to the general growth in the phenomenon. The trend can be studied by several methods like the method of least squares, the free hand method, the moving average method and the method of semi averages. For estimating the long run trend in prices, the method of least squares estimate was employed. To know the trends in annual prices and market arrivals of turmeric in the selected market, different type of trend equations were used that is linear and non-linear equations based on their suitability was fitted to explain the behaviour

This method of ascertaining the trend in a series of annual prices involves estimating coefficient of intercept (a) and slope (b) in the linear function form. The equation adopted for this purpose was specified as follows.

3.3.1.1 The linear trend equation

$$Y = a + bt$$

Where

Y= yearly average arrivals / price per quintal of turmeric.

t= Time, t= 1, 2, 3, 4…..N (measured in years)

a = intercept

b = Slope of the trend line was fitted to the yearly average arrivals and prices of turmeric.

Using this information the trend analysis was carried out.

Since linear trend is not found better fit for the data of annual arrivals and prices of turmeric of the selected market, the **quadratic and cubic functions** of the following types were used.

$Y = a + b_1t + b_2t^2 + e$ type of quadratic equation was fitted for the data of annual arrival and prices of turmeric of the selected markets and these quadratic function also found to be not good fit for equation.

Then tried for the **cubic function as following type.** **$Y = a + b_1t + b_2t^2 + b_3t^3 + et$** which was fitted for the data for annual arrivals and pricesof turmeric of the selected markets

Where,

Y = Annual prices and arrivals)

t = time period (years)

a = intercept parameter

b_1, b_2 and b_3 = Regression co-efficients

et = error term.

The co-efficients obtained from the above functions for annual arrivals and prices of turmeric of the selected markets were assessing the trend values.

3.3.1.2. Estimation of seasonal indices of turmeric data

To measure the seasonal variations in prices and arrivals, seasonal indices were calculated employing twelve months ratio to moving average method.

MA = T*I

MA = Moving Average

T= Trend component

I = Irregular component

The seasonal indices were calculated by adopting the following steps

In the first step, 12 months moving totals were generated. These totals were divided by 12 to compute 12 months moving average. Then a series of centered moving averages were worked out. For calculating the seasonal indices, 13 years (2002-2014) monthly data was considered.

In the next step, original values were expressed as a percentage of corresponding centered moving averages. Further, the irregular component in the series was removed. Afterwards, these percentages were arranged in terms of monthly averages. Then the average index for each month was computed. Finally these monthly average indices were adjusted in such a way that their sum becomes 1200. This can be done by working out a correction factor and multiplying the average for each month by this correction factor. The correction factor (K) is worked out as follows.

$$K = 1200/ S$$

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. This method of calculating seasonal indices was employed by Singh *et al*. (2000).

3.3.1.3 Cyclical Variations

The most commonly used method for estimating the cyclical component was done by the trend method using multiplicative hypothesis.

a) The trend values were estimated by trend equation.

b) Then by dividing the observations on prices by estimated trend values and multiplying by 100. This yielded an index of cyclical component along with irregular component.

$$\frac{\text{Original price or index number of prices}}{\text{Estimated trend value}} = \frac{T \times C \times I}{T} \times 100 = (C \times I)\ 100$$

Where, T, C and I are Trend, Cyclical and Irregular components.

c) The irregular component was removed by taking the weighted three years moving average of (C ×I) series obtained. Then the cyclical component obtained by this method was plotted to observe the cycles. (Acharya and Agarwal, 1994).

3.3.1.4 Irregular variations

Irregular component does not involve any definite pattern therefore it is generally estimated as residual component. The C*I component is obtained by dividing original values of arrivals and prices of turmeric by the estimated trend values. The cyclic component (C) was isolated from C*I component by taking 3 years moving average of C*I series. Using these C*I and C the irregular component components can be computed by the following formula

$$I = (C*I/C)100$$

3.3.2. Regression Analysis

Regression analysis was carried out to ascertain the response of prices to a given change in arrivals. The simple linear regression model was used for analysis. The equation fitted for the purpose was specified as follows.

$$Y = a + bX + e$$

where,

Y = Prices

a = Intercept

b = Slope or regression coefficient

X = arrivals

e = Error

As shown in the equation, Y was assumed to be the dependent variable while X was taken as an independent variable.

3.3.3.1 Export competitiveness

Competitiveness is ability of a nation to grow successfully and to maintain its share of world trade. The export competitiveness of turmeric in the present study has been assessed by using a simple measure known as Nominal Protection Coefficient (NPC). NPC is a straight forward measure of competitiveness. It is calculated as ratio between the domestic price to the border price or reference price of the commodity.

The NPC helps in measuring the divergence of the domestic price from the world reference price and thus determines the degree of domestic protection/un-protection of the commodity in question (Rakotoarisa and Gulati, 2006) Symbolically,

$$NPC = Pd / Pr$$

Where,

NPC = Nominal protection coefficient

Pd=Domestic price of the turmeric

Pr= Border price or reference price of turmeric

If the nominal protection coefficient is greater than one, then the commodity is Non competitive, compared to the situation that what would prevail under free trade and if it is less than 0.5 highly competitive and from 0.5 to 1.0 it is regarded as moderately competitive.

NPC basically helps in measuring the divergence of domestic price from the international price and thus determines the degree of competitiveness of the commodities.

3.3.3.2 Domestic competitiveness

Domestic Resource Cost: It is the value of domestic resource it takes to save or earn a unit of foreign exchange through the production or export of the commodity.

$$DRC_i = \frac{\sum_{j=k+1}^{n} a_{ij} V_j}{P_i^r - \sum_{j=1}^{k} a_{ij} P_j^r}$$

a_{ij}, j= k+1 to n is the technical coefficient for domestic resources and non-tradable inputs.

V_j= shadow price of domestic resources and non-tradable inputs necessary to estimate the opportunity costs of domestic production.

P^r_i= border/reference price of traded output.

a_{ij}, j= 1 to *k*, is the technical coefficientfor traded inputs and

P^r_j= border/reference prices of traded inputs.

Tradeable inputs are those that are traded at the international level and non tradeable are those which are not traded globally. When the DRC is smaller than 1, domestic production is efficient and internationally competitive. When the DRC is greater than 1, domestic production is not efficient and internationally not competitive. The balanced case is when we observe DRC is equal to one.(Gorton *et al.* 2000).

3.3.4 Forecasting of Prices

The Box-Jenkins procedure is concerned in fitting a mixed Auto Regressive Integrated Moving Average (ARIMA) model to a given set of data. The main objective in fitting ARIMA model is to identify the stochastic process of the time series and predict the future values accurately. These methods have also been useful in many types of situation which involve the building of models for discrete time series and dynamic systems. But, this method was not good for lead times or for seasonal series with a large random component (Granger and Newbold, 1970).

Auto Regressive Integrated Moving Average (ARIMA) Model

Originally ARIMA models have been studied extensively by George Box and Gwilym Jenkins during 1968 and their names have frequently been used synonymously with general ARIMA process applied to time series analysis, forecasting and control. However, the optimal forecast of future values of a time-series are determined by the stochastic model for that series. A stochastic process is either stationary or non-stationary. The first thing to note is that most time series are non-stationary and the ARIMA model refer only to a stationary time series. Therefore, it is necessary to have a distinction between the original non-stationary time series and its stationary counterpart.

ARIMA model is a combination of AR and MA models with suitable order of differencing. The first step in developing ARIMA model is to examine data for stationarity. This can be identified through Auto Correlation Function (ACF) of actual data. For reducing the data to stationarity, the data are therefore transformed by taking first order differences (d=1). If the auto correlation functions of differenced data indicate a rapid decrease, then it can be concluded that the transformed data is stationary. If not again the data has to be transformed by taking second order differences (d=2). Continuing in a similar way as that of d=1, the order of differencing i.e., d can be determined.

After determining the differencing order ‘d’, the order of auto regressive (p) and moving average (q) components, can be obtained as follows :

If the auto correlation function corresponding to the transformed data decays after the q^{th}lag, then it is taken as MA (q) model; likewise, if partial auto correlation function indicates a decaying after p^{th} lag, it indicates existence of AR (p) model i.e., the characteristics p and q are determined on the basis of PACF and ACF of the stationary data. The ARIMA (p,d,q) model is then formulated as

$$Z_t - b_1 Z_{t-1} - \ldots - b_p Z_{t-p} = U_t - \emptyset_1 U_{t-1} - \ldots \emptyset_q U_{t-q}$$

Where, $Z_t = Y_t - \bar{Y}$(deviation of Y_t from mean Y).

The formulation of ARIMA model requires Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF).The ACF can be generated on the basis of auto correlation coefficients (ρ_j) corresponding to different lags (j), defined as;

$$\rho_j = \frac{\sum Y_t Y_{t-j} - \frac{1}{n}[(\sum Y_t)(\sum Y_{t-j})]}{\sum Y_t^2 - \frac{1}{n}(\sum Y_t)^2} \quad ; \qquad j = 1\ldots$$

The PACF can be obtained through the Yule-walker's equations on the basis of ρ_j's . The Yule-walker's equations can be described as

$$\rho_j = \emptyset_{k1}\rho_{j-1} + \ldots + \emptyset_{k(k-1)}\rho_{j-k+1} + \emptyset_{kk}\rho_{j-k} \quad ; \qquad j = 1,\ldots K$$

Where,

$\emptyset$'s = Partial Auto Correlation coefficients

ρ_j =Auto correlations corresponding to the j^{th} lag.

Stationarity and non-stationarity

The term stationarity means that the process generating the data is in equilibrium around a constant value and that the variance around the mean remains constant over time. The data must be roughly horizontal along time axis.

If mean changes over time (with some trend cycle pattern) and variance is not reasonably constant then series is non-stationary in both mean and variance.

If a time series is not stationary, then it can be made more nearly stationary by taking the differencing of the series. Conversely a stationary process may be summed or integrated to give a non-stationary process.

Let X_t be a random variable and X_t(where t= 1, 2……n) be the observations on X_t with density function f (X_t). If the observation are independent, then

$$F(X_1, X_2 \ldots\ldots X_n) = f_1(X_1)\, f_2(X_2) \ldots f_n(X_n)$$

This implies that joint distribution is independent of historical time.The assumption of stationary reduces the number of parameters in the joint probability density function of a random variable X_t in the series.

Since the ARIMA model refer only to a stationary time series, the first stage of Box-Jenkins model is reducing non stationary series X_t to a stationary series Y_t by taking first difference as follows

$$Y_t = (1-B)\, X_t \qquad (3.1)$$

where,B – Backward shift operator

The backward shift operator is convenient for describing the process of differencing. To define, such that

$$B_i X_t = X_{t-i} \qquad i = 1, 2\ldots$$

Suppose the first difference of the series doesn't become stationary then second order differencing is done as follows;

$$Y_t = \nabla(\nabla X_t) \qquad (3.2)$$

$$= (1-B)^2 X_t \qquad (3.3)$$

In general, if it takes a d^{th} order difference to achieve stationarity we will write

$$d^{th} \text{ order difference} = (1-B)^d X_t$$

The general ARIMA (o, d, o) model will be

$$= (1- B)^2 X_t = e_t \qquad (3.4)$$

Where, e_t is error term distributed normally with

$E(e_t) = 0$, $V(e_t) = e_t^2$ and

$Cov(e_i, e_j)$ = for all t. $(i \neq j)$

In order to test the stationarity, compute the auto correlation functions (ACF) of different series (Y_t) up to 16 lags. If the ACF for first and higher differences drop abruptly to zero then it indicates the series is stationary.

3.3.4.1 Stationary time series model

A stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the disturbance or lag between the two time periods and not on the actual time at which the covariance is computed (Damodar, 1995).

ARIMA model is a combination of AR and MA models with suitable order of differencing. Hence before describing ARIMA model, it is essential to know AR and MA models.

(a) An Auto Regressive Process (p, o, o)

If the observation Y_t depends on previous observation and error term U_t it is called auto regressive process (AR process)

$$Y_t = a + b_1 Y_{t-1} + U_t$$

Where,

Y_t= The value of variable for forecasting at time 't' (Price, in the study)

a = Constant ;b_1= Regression coefficient

U_t = Random error

This model is known as AR(1) model. The above model can be extended to any number of lags, as follows

$$Y_t = a + b_1 Y_{t-1} + \ldots\ldots\ldots\ldots + b_p Y_{t-p} + U_t$$

The above model is then AR (P) model or AR (P) process.

The values of autoregressive coefficient lies between -1 and +1.

(b) A Moving Average Process (o,o,q)

If the observation Y_t depends on the error term u_t and also on one or more previous error terms (u_t's) then we have moving average MA(q) process.

$$Y_t = \mu + \beta_0 u_t + \beta_1 u_{t-1} + \beta_2 u_{t-2} + \ldots\ldots\ldots + \beta_q u_{t-q}$$

Where,

Y_t= The value of the variable for forecasting at time 't' (i.e., price)

μ = Constant

u = Stochastic error term

This model is known as MA (q) model. In short, a moving average process is simply a linear combination of error terms.

(c) An Auto Regressive Moving Average (ARMA) Model

In the model Y_t depends on AR as well as MA variables and can be specified as

$$Y_t = \theta + \alpha_1 Y_{t-1} + \beta_0 \mu_t + \beta_1 \mu_{t-1}$$

There was one autoregressive and one moving average term. Here θ represents a constant term. In general, in an ARMA (p,q) process, there is p autoregressive and q moving average terms.

In the light of the above models let us consider the ARIMA model

(d) An Auto Regressive Integrated Moving Average (ARIMA) model

Time series exhibit perceptible periodic pattern for instance price and arrivals of agricultural commodities usually have a seasonal pattern process than the general. The ARIMA notation can be extended readily to handle seasonal

aspects and the general short hand notation is ARIMA. If the time series data is integrated of order 1 i.e., I(1), its first differences are I(0), that is stationary. Similarly sometime series data is I(2). Its second difference is I(0). In general, if a time series is I(d), after the differencing it d times we obtain an I(0) series.

The original time series ARIMA (p,d,q) where p denotes the number of autoregressive terms, d the number of times the series has to be differenced before it become stationary, and q the number of moving average terms.

The main stages in setting up a Box-Jenkins forecasting model are as follows:

1. Identification
2. Estimating the parameters
3. Diagnostic checking and
4. Modification

1. Identification of models

A good starting point for time series analysis is a graphical plot of the data. It helps to identify the presence of trends.

Before estimating the parameter (p, q) of model, the data are not examined to decide about the model which best explains the data. This is done by examining the sample ACF (Auto Correlation Function) and PACF (Partial Auto Correlation Function) of different series Y_t. Usually ACF and PACF are calculated up to maximum of 24 lags(k).

The sample autocorrelations for k time lags can be found and denoted by rk as follows

$$Pk\ (Y_t) = rk\ (Y_t)$$

$$= \frac{e_o(Y_t)}{e_k(Y_k)}$$

where, $C_k(Y_k) = \frac{1}{n}\sum_{t=1}^{n}\left(Y_t - \overline{Y}\right)\left(\overline{Y}_{t+k} - \overline{Y}\right)$

$K = 0, 1, 2, \ldots 16$; $T = 1, 2, \ldots n-k$

$Y = \frac{1}{n}\sum_{t=1}^{n}\overline{Y}_t$ (n = Length of the time period)

Both ACF and PACF are used as the aid in the identification of appropriate models. There are several ways of determining the order type of process, but still there was not exact procedure for identifying the model.

2. Estimation of parameters

After tentatively identifying the suitable model, next step is to obtain least squares estimates of the parameters such that the error sum of squares is minimum.

$$S(\theta, \emptyset) = n\sum_{k=1}^{n} e_t^2$$

where, t = 1, 2, 3…n

There are fundamentally two ways of getting estimates for such parameters:

a) Trial and error: Examine many different values and choose set of values that minimizes the sum of squares of residual.

b) Iterative method: Choose a preliminary estimate and let a computer program refine the estimate iteratively.

3. Diagnostic checking

After having estimated the parameters of a tentatively identified ARIMA model, it is necessary to do diagnostic checking to verify that the model is adequate.

Examining ACF and PACF of residuals may show up an adequacy or in adequacy of the model. If it shows random residuals, then it indicates that the tentatively identified model was adequate. When an inadequacy is detected, the checks should give an indication of how the model need to be modified, after which further fitting and checking takes place.

Here selection of model was done by criteria like Schwarz Bayesian information criterion (SBIC), R^2 values.

Shwarz Bayesian Criterion (SBC)

In statistics, the Bayesian information criterion (BIC) or Shwarz criterion (also SBC, SBIC) is a criterion for model selection among a finite set of models. It is based, in part, on the likelihood function, and it is closely related to Akaike information criterion (AIC).

The formula for the BIC is

$$- 2. \ln p(x/k) \approx BIC = - 2 . \ln L + k \ln (n)$$

Under the assumption that the model errors or disturbances are independent and identically distributed according to a normal distribution and that the boundary condition that the derivative of the log likelihood with respect to the true variance is zero.

$$BIC = n. \ln \sigma_e^2 + k. \ln (n)$$

Where, $\sigma_e^2$is the error variance

The error variance in this case is defined as

$$\hat{\sigma}_e^2 = \frac{1}{n} \sum_{i=1}^{n} (x_i - \overline{x})^2.$$

R^2-Criteria

R^2 is a statistic that will give information about the goodness of fit of a model. In regression, the R^2 coefficient of determination is a statistical measure of how well, the regression line approximates the real data points. An R^2 of 1.0 indicates that the regression line perfectly fits the data.

The most general definition of the coefficient of determination is

$$R^2 = 1 - \frac{ESS}{TSS}$$

ESS-Error Sum of Squares

TSS-Total Sum of Squares

4. Forecasting

After satisfying about the adequacy of the fitted model, it can be used for forecasting. Forecasts based on the model.

$$(1-ØB) = (1- \phi B)e_t$$

were computed for up to 2 years ahead. The above model gives the forecasting equation as

$$Y_t = Øy_{t-1} + e_t - \theta e_{t-1}$$

Given the data up to time‘t’ the optional forecast of Y model at the t is the conditional expectation of Y_{t+1}.It allows, in particular, that

$$e_t = Y_t - Y_{t-1}$$

“The errors e_t in fact the forecast errors for unit lead time. That for an optimal forecast these ‘one step ahead’ forecast errors ought to form an uncorrelated series is otherwise obvious”. The forecast of the variable in the t^{th} year (Y_t) in ARIMA model is based on its past values.

3.4 Terms and concept used

Trend (T): over a long period of time, time series is very likely to show a tendency to increase or decrease over time. The factors responsible for such changes in time series are mainly the growth of population, change in the taste of people, technological advances in the field, etc.

There are different types of trends, some of them are linear and some are non linear in their form. For shorter period of time, in most of the situations the straight line provides the best description of trend and for longer period of time, the non-linear form generally provides a good description of the trend. Often, it may be possible to describe such movements with a structured mathematical model. In the absence of such a definite format, approximately a polynomial or a free hand curve describes the movements. Hence to work out the trend in arrivals and price, polynomial equation was used.

Seasonal variation (S): The variation within a year is called as seasonal variation. The maincauses of seasonal variations are production periods, customs, climate, *etc*.

Cyclical movements (C): Cyclical movements are fluctuations which differ from periodic movements. Cyclical movements have longer duration than a year and are periodicity of several years as in business cycles.

Irregular variations (I): Here the effects could be completely unpredictable changing in a random manner. A given observation is affected by episodic and accidental factors. These are also known as causal series and are affected by the unknown causes.

Nominal protection coefficient (NPC) : NPC is the ratio of domestic price to the world reference price (border price) adjusted for transfer costs. If NPC is greater than one, the commodity is not competitive and less than one refers to competitive advantage in exporting the commodity concerned.

Domestic resource cost: can be defined as the value of domestic resource it takes to save or earn a unit of foreign exchange through the production or export of the commodity. It is estimated as a ratio of the proportion of non traded inputs to the value added by the proportion of traded input in the production of the commodity.

Chapter IV

RESULTS AND DISCUSSION

In view with the pre determined objectives of the study, the data on market arrivals and prices of turmeric were collected from Duggirala market and further subjected to statistical analysis. For better exposition, the results are presented under the following sub-heads and subsequently discussed.

4.1 Trends in market arrivals and prices of turmeric in Duggirala market.

4.2 Seasonal variations in market arrivals and prices of turmeric in Duggirala market.

4.3 Cyclical variations in market arrivals and prices of turmeric in Duggirala market.

4.4 Irregular variations in market arrivals and prices of turmeric in Duggirala market.

4.5 Impact of market arrivals of turmeric on prices in Duggirala market.

4.6 Export and domestic competitiveness of turmeric.

4.7 Forecasting of future prices of turmeric in Duggirala market.

4.1 TRENDS IN MARKET ARRIVALS AND PRICES OF TURMERIC IN DUGGIRALA MARKET

4.1.1 Observed Trends in Market Arrivals of Turmeric in Duggirala Market

The analysis of trend component in the annual average market arrivals of the turmeric was carried out by considering the direction of the movement of market arrivals over a period of 13 years from 2002-2014. The observed trend in market arrivals of turmeric are presented in the table 4.1 and figure 4.1.

From the table 4.1 and fig 4.1 the market arrivals of turmeric in Duggirala market shows that there was an increasing trend for the first three years until 2005 and thereafter the market arrivals showed fluctuations from 2005-2014.The market arrivals were recorded as highest in the year 2005 followed by 2014 with arrivals of 23553.75qtl and 20567.25qtl respectively and lowest during the year 2010 (9379.83qtl) and 2002 (10042.5qtl) respectively.

The Per cent deviation of market arrivals from previous years can be seen from last column of the table 4.1 which indicated that the market arrivals decreased during the year 2006, 2008, 2010, 2012, 2013 which suggests that the market arrivals in these years were decreasing as compared to their previous years respectively and during the rest of the years market arrivals were positive indicating increasing in the market arrivals as compared to their previous years. The highest per cent change can be found in the year 2011 as the market arrivals were increased by 87 per cent to its previous year and the highest decrease was recorded in the year 2006 as the market arrivals were decreased by -37 per cent to its previous year.

Table 4.1 Observed trends in market arrivals of turmeric in Duggirala market

Sl No	Year	Market arrivals (qtl)	Per cent deviation of market arrivals from previous years
1	2002	10042.50	
2	2003	14089.90	40.30
3	2004	16649.10	18.16
4	2005	23553.80	41.47
5	2006	14644.70	-37.82
6	2007	14872.10	1.55
7	2008	10104.40	-32.05
8	2009	10753.60	6.42
9	2010	9379.83	-12.77
10	2011	17544.80	87.04
11	2012	15586.10	-11.16
12	2013	11675.20	-25.09
13	2014	20567.30	76.16

Source: Agricultural Marketing Committee Duggirala

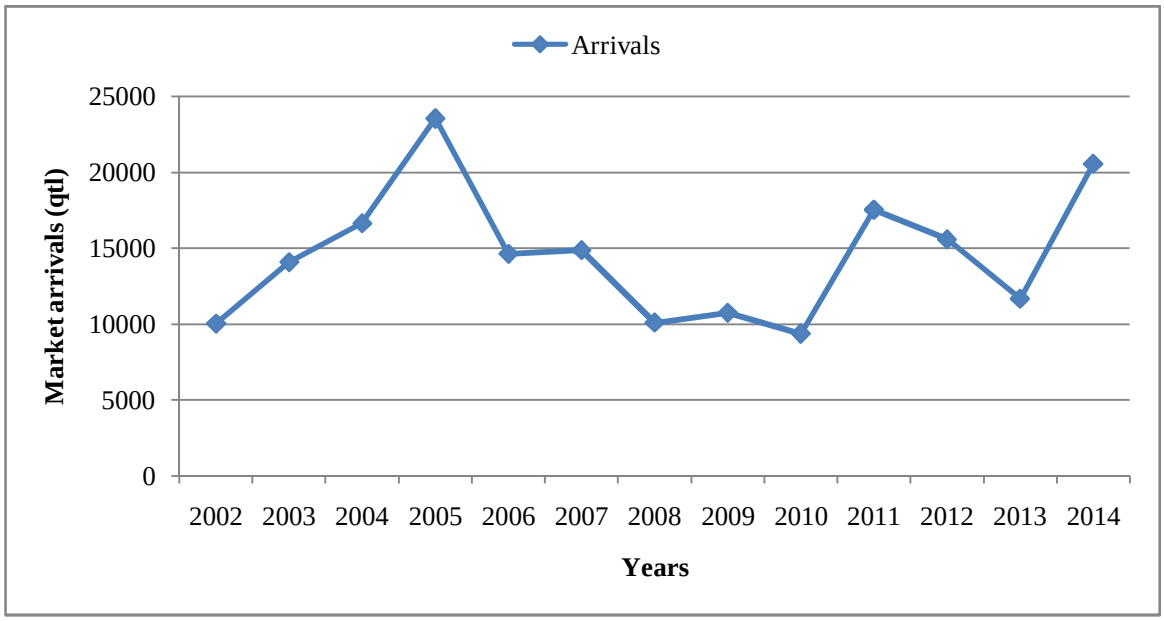


Fig 4.1 Observed trends in market arrivals of turmeric in Duggirala market

4.1.2 Estimated Trends in the Market Arrivals of Turmeric in Duggirala Market

In order to have a better understanding about the behaviour of market arrivals trend equations were fitted. The different types of trend equations were fitted depending upon its better R^2 value to assess the trends in market arrivals. Among them the cubic model was suited to explain the market arrivals. The estimated trend equation for market arrivals are presented in the table 4.2.The results of the estimated trend values obtained from the equation for the turmeric was presented in Table 4.3.and fig 4.2. From the table the variability of the arrivals can be explained by the trend variable by 42%.

Table 4.2 Trend equation in market arrivals of turmeric in Duggirala market

	Regression co-efficients				Criteria		
Model	**a**	**b_1**	**b_2**	**b_3**	**R^2**	**F**	**Std. error**
Cubic	4852.102	7318.314^{N}	-1317..44*	65.137*	0.422	2.19	3770.77

Note: *Significant at 5 per cent level of probability, N – non significant.

From the above table the trend equation can be written as follows

$$\hat{Y} = 4852.10 + 7318.31\,x - 1317.44\,x^2 + 65.137\,x^3$$

Y is the dependent variable market arrivals

'x' is the independent variable, time in years

'a' is the intercept

'b_1, b_2 and b_3 are the regression coefficients

The estimated trends in the market arrivals reveal that in the initial years of the study period the market arrivals of turmeric in the market were increasing significantly up to 2005 showing positive trend but in mid period, the market arrivals in the markets has been declined till 2011 indicating negative trend and in later three years 2012, 2013 and 2014 it showed positive increasing trends and found to be significant.

The estimated market arrivals were recorded as highest in the year 2014 followed by 2005 with estimated trend values showing 20449.07qtl and 17215.30qtl respectively and lowest during the year 2002 and 2011 with estimated trend values showing 10918.18qtl and 11428.54 qtl respectively.

The per cent change over previous years for estimated trend market arrivals were indicating negative during the year 2006-2011 as the market arrivals were decreasing throughout these years as compared to their previous years and the market arrivals were increasing and showing positive during the year 2003-2005 and 2012-2014. The highest per cent increase was recorded during the year 2003 as it was increased by 35 per cent as compared to its previous year and highest decrease was found during the year 2009 by -10 per cent as compared to its previous year.

Table 4.3 Estimated trends in market arrivals of turmeric in Duggirala market

Sl No	Year	Estimated market arrivals (qtl)	Per cent change over previous years
1	2002	10918.18	
2	2003	14740.19	35.00
3	2004	16708.95	13.35
4	2005	17215.30	3.03
5	2006	16650.04	-3.28
6	2007	15404.01	-7.48
7	2008	13868.02	-9.97
8	2009	12432.90	-10.34
9	2010	11489.46	-7.58
10	2011	11428.54	-0.53
11	2012	12640.95	10.60
12	2013	15517.52	22.75
13	2014	20449.07	31.78

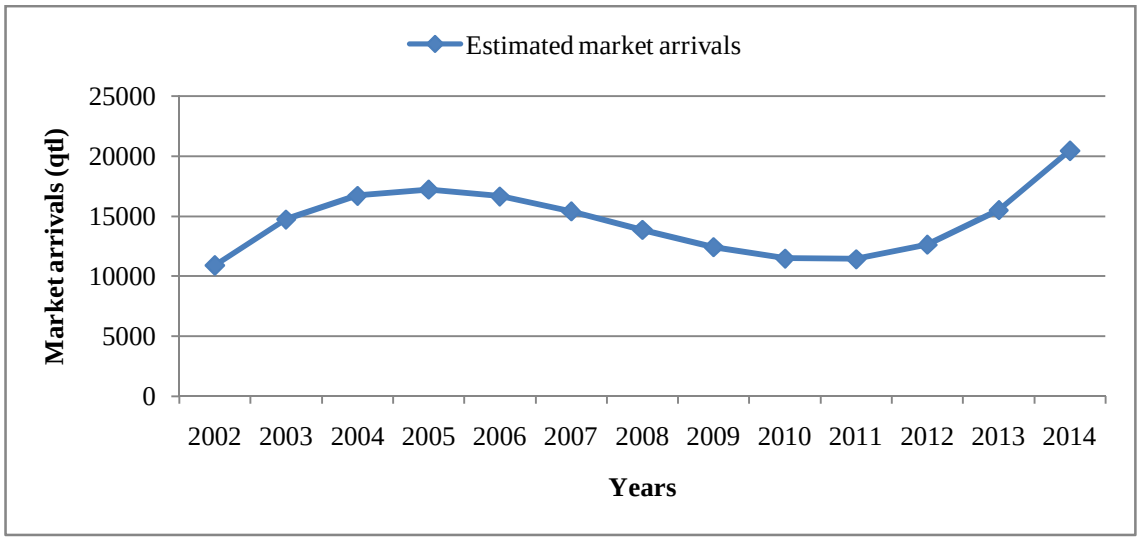


Fig 4.2 Estimated trends in market arrivals of turmeric in Duggirala market

4.1.3 Observed Trends in Prices of Turmeric in Duggirala Market

The results of the observed trend for prices of turmeric is presented in table 4.4 and fig 4.3.The results of the observed trend for average prices of turmeric revealed that there was an initial increase in price for 2003 later the prices were

decreased and shown decreasing trend for the next 5 years until 2007 later it showed gradual increase and reached the peak in the year 2010 with Rs 12395.00/quintal and later again it was followed by fall in prices showing decreasing trend till 2012 and at the later stage during the year 2013 and 2014 we can find the increase in the prices. The lowest price was recorded in the year 2007 with Rs 1825.00/quintal.

The per cent deviation of prices were recorded negatively during the years 2004 to 2007 and again in the year 2011 and 2012 as the prices were decreasing when compared to their previous years prices in the market and rest of the years i.e. during 2003, 2008-2010 and 2013-2014 the prices indicating an increase as compared to observed previous years. The highest price increase was observed during the years 2009 and 2010 as the prices were more a doubled their previous years i.e. Rs 6232/qtl and Rs 12395/qtl and highest decrease was found during the year 2011 indicating a decrease of -41 per cent to its previous year prices.

Table 4.4 Observed trends in the prices of turmeric in Duggirala market

Sl No	Year	Prices (Rs/qtl)	Per cent deviation of prices from previous years
1	2002	1943.00	
2	2003	2704.00	39.15
3	2004	2519.00	-6.83
4	2005	2097.50	-16.74
5	2006	1968.00	-6.17
6	2007	1825.00	-7.26
7	2008	3094.00	69.52
8	2009	6232.00	101.44
9	2010	12395.00	98.89
10	2011	7210.00	-41.82
11	2012	4082.00	-43.38
12	2013	4780.00	17.09
13	2014	5266.00	10.17

Source: Agricultural Marketing Committee Duggirala

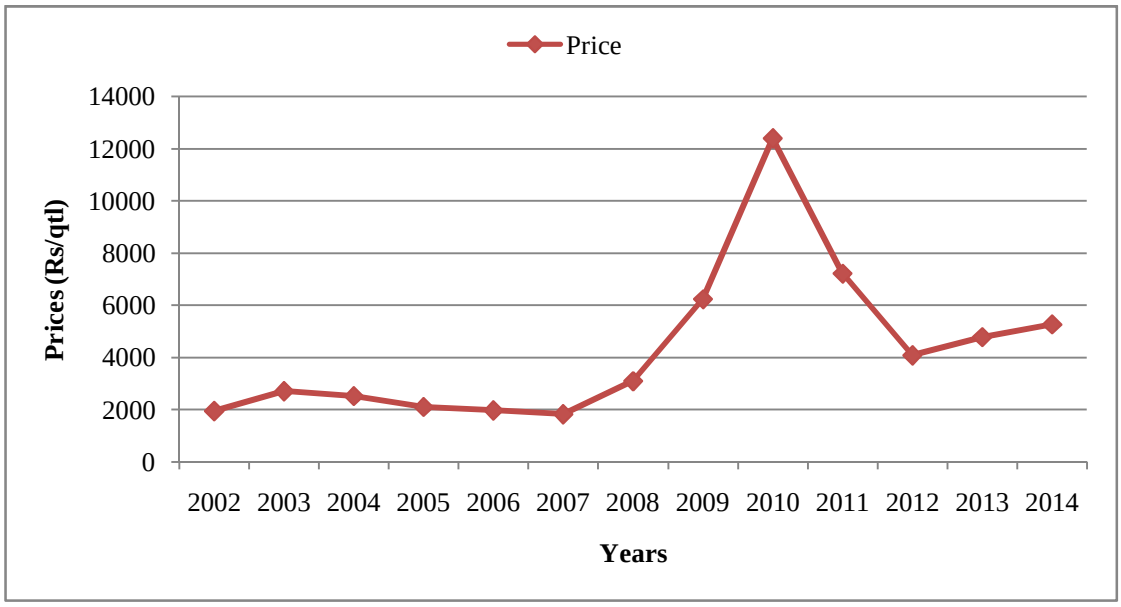


Fig 4.3 Observed trends in prices of turmeric in Duggirala market

4.1.4. Estimated Trends in the Prices of Turmeric in Duggirala Market

The estimated trend equation for prices are presented in the table 4.5. The results of the estimated trend values obtained from the equation for the prices of turmeric was presented in Table 4.6. and fig 4.4. From the table the variability of the prices can be explained by 51% by the trend variable.

Table 4.5 Trend equation for prices of turmeric in Duggirala market

	Regression co-efficients				criteria		
Model	**a**	**b_1**	**b_2**	**b_3**	**R^2**	**F**	**Std. error**
Cubic	4986.50	-2697.23	596.47*	-30.40^N	0.51*	3.141	2422.06

Note: *Significant at 5 per cent level of probability.

From the above table the trend equation can be written as

$$\hat{Y} = 4986.50 - 2697.23\,x + 596.47\,x^2 - 30.40\,x^3$$

Y is the dependent variable prices

'x' is the independent variable, time in years

'a' is the intercept

b_1, b_2 and b_3 are the regression coefficients

The estimated trend in the prices of turmeric revealed that in the initial two years 2003 and 2004, the prices of turmeric were decreasing showing negative trend until the year 2005. But in later years, the prices was showed an increasing trend till 2012. While in later period, three years the price of turmeric trend was again showing decreasing trend.

The trend in the prices of turmeric were recorded as the highest in the year 2011 followed by 2012 with trend values showing Rs 7258.00/qtl and Rs 7023.00/qtl respectively and lowest during the year 2004 and 2003 with trend values showing Rs 1442.00/qtl and Rs1735.00/qtl respectively.

The per cent change over previous years for estimated prices indicated negative during the year 2003, 2004 and from 2012-2014 as these years indicated the decline in the prices when they are compared to their previous years prices and remaining years were having positive values as the prices were increasing in nature as compared to their respective previous year prices. The highest per cent increase was found in the year 2006 with increase of 45 per cent and highest decrease was found in the year 2003 decreasing by -39 per cent.

Table 4.6 Estimated trends of the prices of turmeric in Duggirala market

Sl No	year	Estimated prices (Rs/qtl)	Per cent change over previous years
1	2002	2855.00	
2	2003	1735.00	-39.24
3	2004	1442.00	-16.86
4	2005	1795.00	24.48
5	2006	2612.00	45.47
6	2007	3709.00	42.01
7	2008	4905.00	32.23
8	2009	6016.00	22.66
9	2010	6862.00	14.04
10	2011	7258.00	5.77
11	2012	7023.00	-3.23
12	2013	5975.00	-14.92
13	2014	3930.00	-34.22

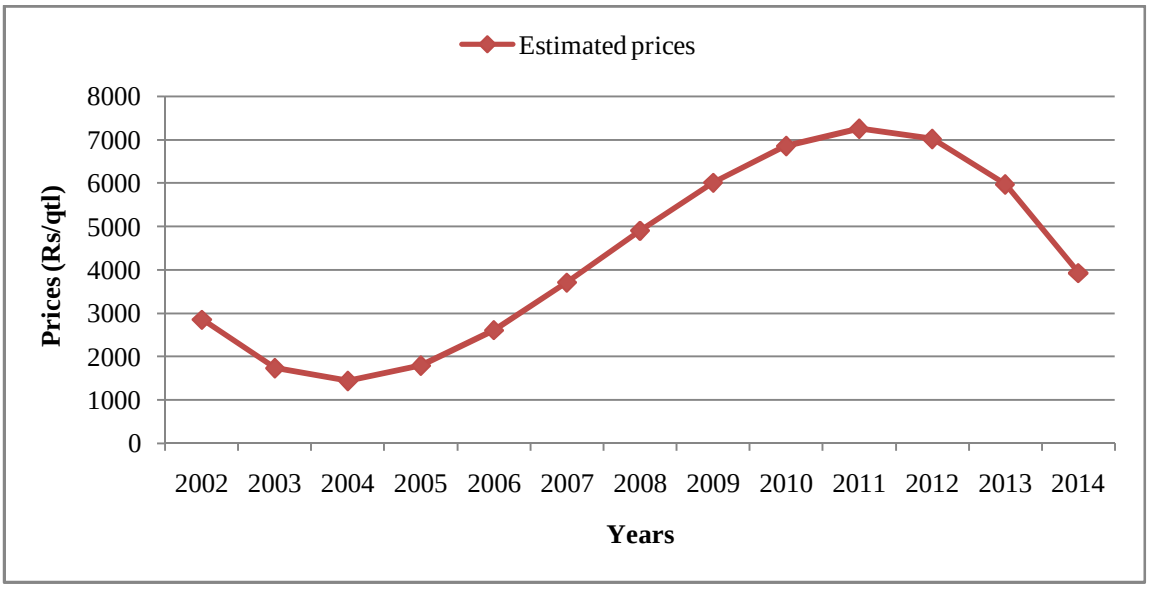


Fig 4.4Estimated trends in the prices of turmeric in Duggirala market

4.1.5 Observed relationship in market arrivals and prices of turmeric in Duggirala market

The relationship between observed trend in market arrivals and prices of turmeric are presented in the table 4.7 and figure 4.5. The market arrivals were taken on primary axis and prices were taken on secondary axis. The prices were recorded maximum in the market in the year 2010 where the market arrivals recorded lowest in the market. During the year 2005 the market arrivals were recorded maximum and the prices were lower in the same year indicating that when the market arrivals were maximum result in the decrease in the price and vice versa.

Table 4.7 Observed relationship of market arrivals and prices of turmeric in Duggirala market

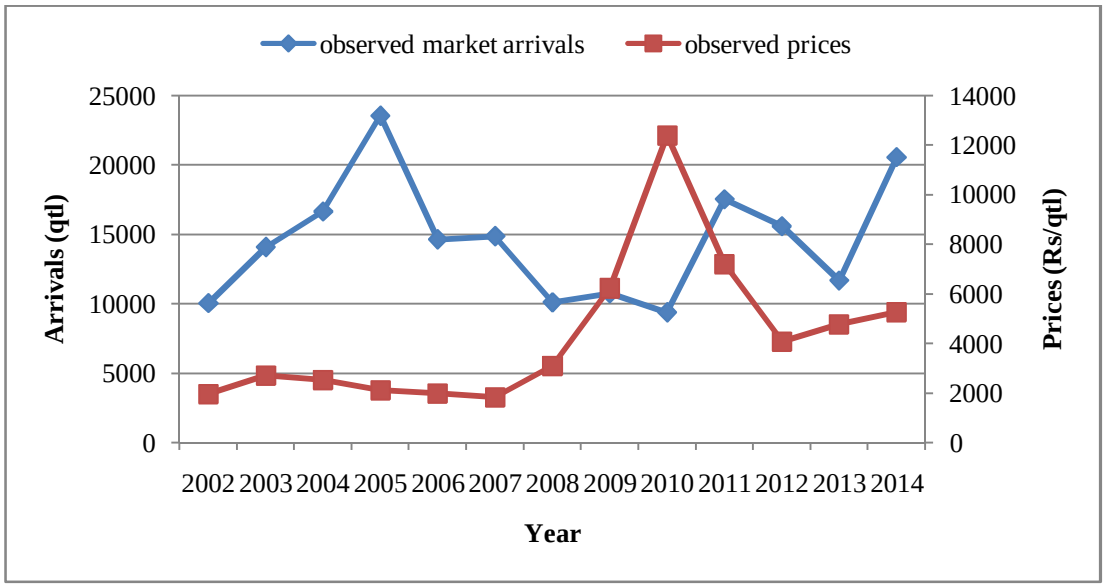
Sl. No	Year	Market arrivals (Qtl)	Prices (Rs/qtl)
1	2002	10042.50	1943.00
2	2003	14089.90	2704.00
3	2004	16649.10	2519.00
4	2005	23553.80	2097.50
5	2006	14644.70	1968.00
6	2007	14872.10	1825.00
7	2008	10104.40	3094.00

Table Contd..

8	2009	10753.60	6232.00
9	2010	9379.83	12395.00
10	2011	17544.80	7210.00
11	2012	15586.10	4082.00
12	2013	11675.20	4780.00
13	2014	20567.30	5266.00

Source: Agricultural Marketing Committee Duggirala

Fig 4.5 Observed trends in market arrivals and prices of turmeric in Duggirala market



4.1.6 Relationship Between Estimated Trends of the Market Arrivals and Prices of Turmeric

The relationship between the estimated trends in the market arrivals and prices can be observed from the table 4.8 and fig 4.6. The estimated market arrivals were taken on primary axis and estimated prices were taken on secondary axis. The highest market arrivals were found highest in the year 2014 and followed by 2005 and the prices were low during the same year in the market. The prices were recorded highest in the year 2011 where the market arrivals were among the lowest. This suggests that whenever the market arrivals are more at the market the prices were recorded lowest and vice versa.

Table 4.8 Estimated trend values of the market arrivals and prices of turmeric in Duggirala market

Sl. No	Year	Estimated market arrivals (Qtl)	Estimated Prices (Rs/qtl)
1	2002	10918.18	2855.00
2	2003	14740.19	1735.00
3	2004	16708.95	1442.00
4	2005	17215.30	1795.00
5	2006	16650.04	2612.00
6	2007	15404.01	3709.00
7	2008	13868.02	4905.00
8	2009	12432.90	6016.00
9	2010	11489.46	6862.00
10	2011	11428.54	7258.00
11	2012	12640.95	7023.00
12	2013	15517.52	5975.00
13	2014	20449.07	3930.00

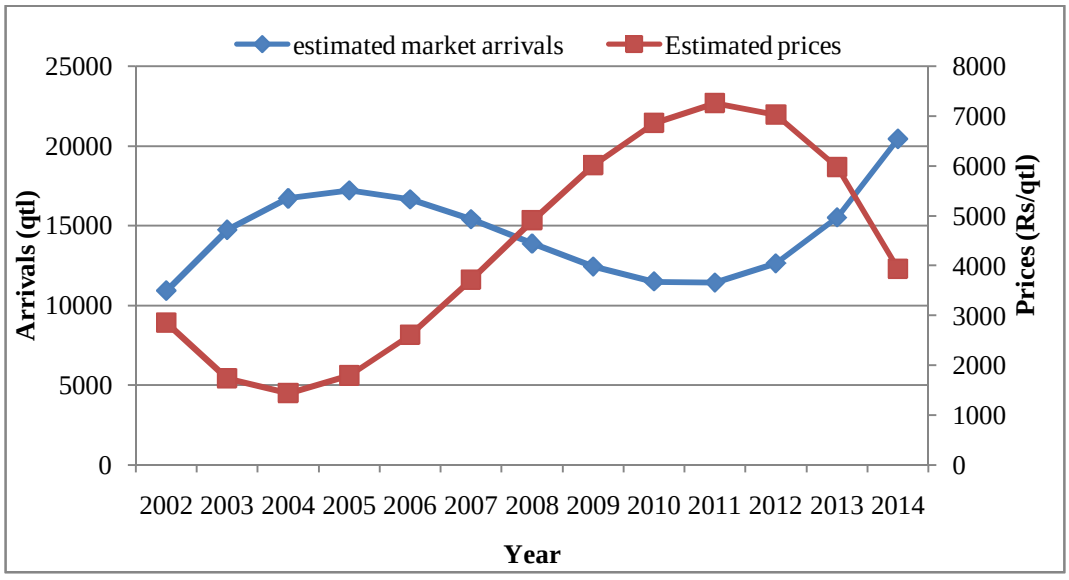


Fig 4.6 Estimated trends in the market arrivals and prices of turmeric

4.1.7. Relationship between observed and estimated market arrivals of turmeric at Duggirala market

In order to know the relationship between the observed market arrivals and estimated market arrivals the per cent deviation of market arrivals from observed to estimated is calculated and presented in the table 4.9. During the years 2002-2004, 2007-2010 and 2013-2014 as the observed market arrivals decreased in nature as compared to the estimated market arrivals hence they show negative sign. The highest decrease of observed market arrivals as compared to estimated market arrivals was found in the year 2008 as it was decreased by -37.24 per cent and the highest increase was found in the year 2011 as the observed market arrivals were increase by 34.86 per cent and 2005 by 26.91 per cent.

Table 4.9 Observed and Estimated market arrivals of turmeric at Duggirala market

Sl No	Year	Observed market arrivals (qtl)	Estimated market arrivals (qtl)	Per cent deviation of market arrivals from observed to estimated
1	2002	10042.50	10918.18	-8.71
2	2003	14089.90	14740.19	-4.61
3	2004	16649.10	16708.95	-0.35
4	2005	23553.80	17215.3	26.91
5	2006	14644.70	16650.04	-13.69
6	2007	14872.10	15404.01	-3.57
7	2008	10104.40	13868.02	-37.24
8	2009	10753.60	12432.9	-15.61
9	2010	9379.83	11489.46	-22.49
10	2011	17544.80	11428.54	34.86
11	2012	15586.10	12640.95	18.89
12	2013	11675.20	15517.52	-32.91
13	2014	20567.30	20449.07	0.57

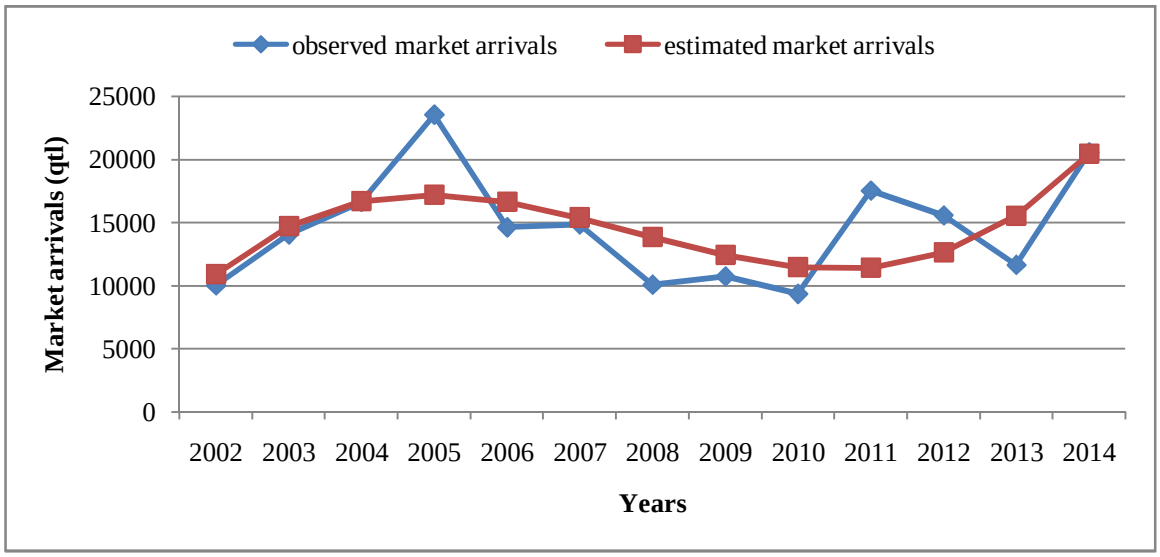


Fig 4.7 Observed and estimated market arrivals of turmeric at Duggirala market

4.1.8 Relationship Between Observed and Estimated Prices of Turmeric at Duggirala Market

The relationship between the observed and estimated prices of turmeric at Duggirala market along with the per cent deviation are presented in the table 4.10 and fig 4.8. The observed prices were indicating negative during 2002, 2006-2008 and 2011-2013 as the prices were decreasing and less than the estimated prices. During the year 2003-2005, 2009-2010 and in 2014 the observed prices were more as they compared to the estimated prices hence they indicate positive values. The highest increase in the per cent deviation of price as compared to observed and estimated prices are found in the year 2010 as the per cent of increase was found to be 44.64 and 2004 by 42 per cent. The highest decrease in the prices were found in the year 2007 as it was decreased by -103 per cent.

Table 4.10 Observed and estimated prices of turmeric at Duggirala market

Sl No	Year	Observed prices (Rs/qtl)	Estimated prices (Rs/qtl)	Per cent deviation of prices from observed to estimated
1	2002	1943.00	2855.00	-46.93
2	2003	2704.00	1735.00	35.85
3	2004	2519.00	1442.00	42.75
4	2005	2097.00	1795.00	14.40
5	2006	1968.00	2612.00	-32.71
6	2007	1825.00	3709.00	-103.23
7	2008	3094.00	4905.00	-58.53
8	2009	6232.00	6016.00	3.46
9	2010	12395.00	6862.00	44.64
10	2011	7210.00	7258.00	-0.66
11	2012	4082.00	7023.00	-72.04
12	2013	4780.00	5975.00	-24.99
13	2014	5266.00	3930.00	25.37

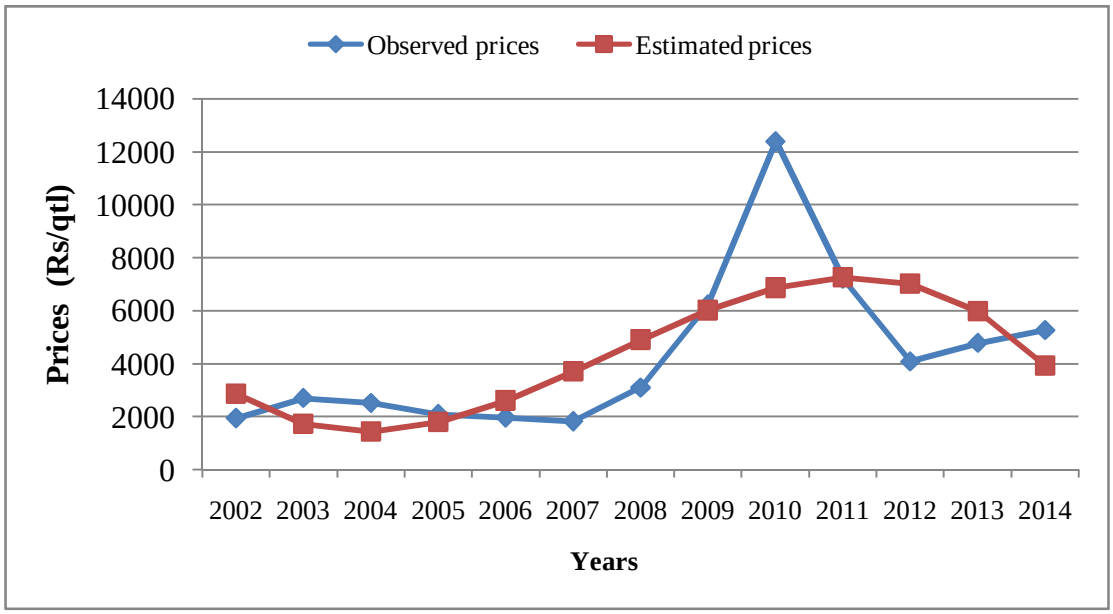


Fig 4.8 Observed and estimated prices of turmeric at Duggirala market

4.2. SEASONAL VARIATIONS IN MARKET ARRIVALS OF TURMERIC IN DUGGIRALA MARKET

The pattern of variation in market arrivals within a year is revealed by seasonal indices, computed for each month from 2002-2014. In order to examine the extent of the seasonal variations in market arrivals, the indices of seasonal variations for market arrivals were worked out. To identify the long run seasonal variations,time series data relating to monthly market arrivals of turmeric were subjected to the percentage centered 12 months moving average method.

4.2.1 Seasonal Indices of Market Arrivals in Turmeric in Duggirala Market

The seasonal indices of monthly market arrivals of turmeric in Duggirala market are presented in Table 4.11 and fig 4.9. The monthly market arrivals results revealed that the highest market arrivals were found in the month of June, May and July with seasonal market arrival indices of 191.94, 160.87 and 145.92 respectively. The lowest monthly market arrival indices were found in the month of November, February and January with 60.32, 62.67 and 69.18 respectively.

The per cent change from previous months for the seasonal market arrival index is shown in the last column of table 4.11. The per cent change was indicated negative for the months of February and July to November as the market arrivals were decreasing when they were compared to their previous months. The per cent change was indicated positive for the months of March to June and in December as the market arrivals were increasing as compared to their previous months. The highest per cent increase in market arrivals was found in the month of May by 121 per cent as compared to its previous month and highest decrease was found in the month of September by -37 per cent compare from its previous month.

Table 4.11 Seasonal indices in market arrivals of turmeric in Duggirala market

Sl. No	Month	Seasonal market arrival index	Per cent change from previous months
1	January	69.18	
2	February	62.67	-9.41
3	March	69.45	10.82
4	April	72.72	4.71
5	May	160.87	121.19
6	June	191.94	19.31
7	July	145.92	-23.97
8	August	126.88	-13.05
9	September	78.77	-37.91
10	October	77.64	-1.43
11	November	60.32	-22.30
12	December	85.58	41.87
13	**Total**	1200.00	

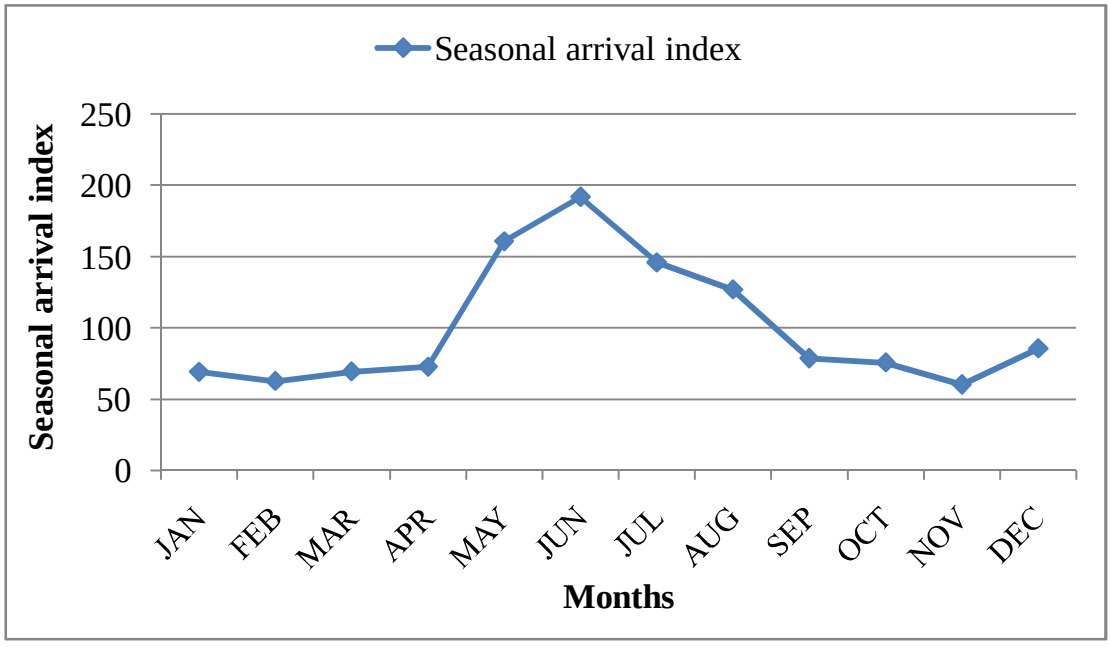


Fig. 4.9. Seasonal indices in market arrivals of turmeric in Duggirala market

4.2.2 Seasonal Variations in Prices of Turmeric in Duggirala Market

The seasonal indices of monthly prices of turmeric in Duggirala market was presented in Table 4.12 and shown in Fig 4.10. Marginal increase in the seasonal price index was found in the months of January and December followed

by August and October i.e. 104.85, 104.30,103.39 and 102.03 respectively of every year in turmeric. The lowest seasonal price index was noticed in the months of July, April and March i.e. 95.54, 95.79 and 96.50 respectively. The increase or decrease in seasonal price index was less by five per cent either way.

The per cent change from previous months for the seasonal price index is shown in the last column of table 4.12. The per cent change was indicated negative for the months of February to April, July, September and November as the prices were decreasing in these months as compared to their previous months and per cent change of prices were positive in the months of May, June, August, October and December as prices were increasing during these months when compared to their previous month prices. The highest increase in the price is found in the month of August by eight per cent and marginal decrease was found in the month of February by -4.65 per cent.

Table 4.12Seasonal price indices of turmeric in Duggirala market.

Sl. No	Month	Seasonal price index	Per cent change from previous months
1	January	104.85	
2	February	99.97	-4.65
3	March	96.50	-3.47
4	April	95.79	-0.73
5	May	98.18	2.50
6	June	98.81	0.63
7	July	95.54	-3.30
8	August	103.39	8.21
9	September	100.81	-2.49
10	October	102.03	1.20
11	November	99.77	-2.21
12	December	104.30	4.53
13	**Total**	1200.00	

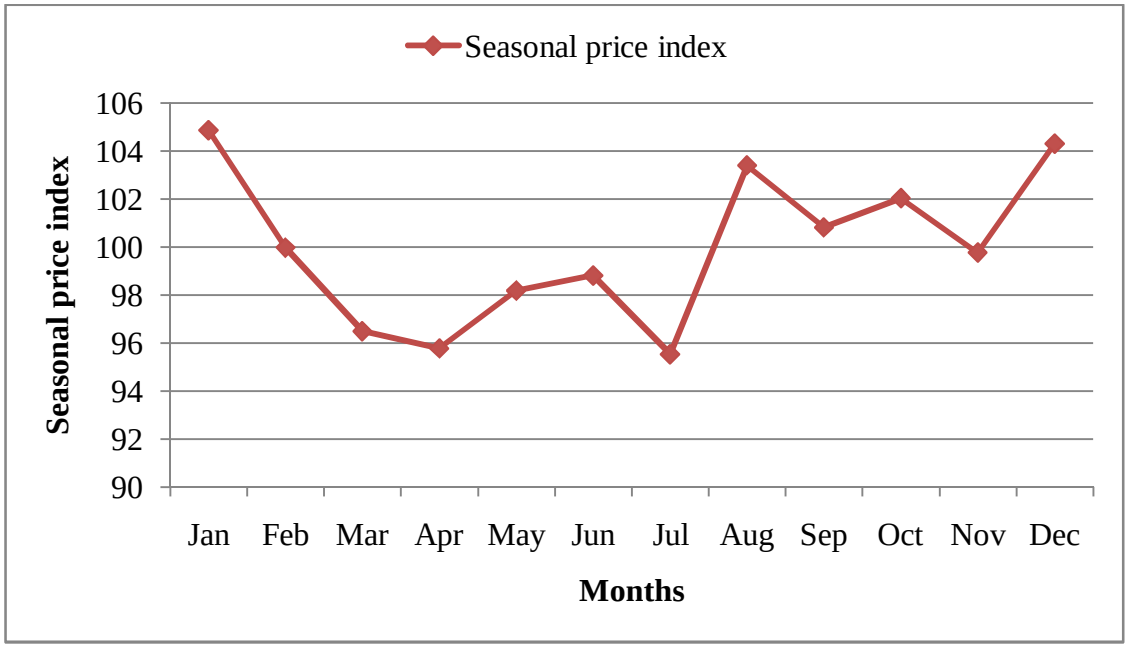


Fig 4.10Seasonal prices indices of turmeric in Duggirala market

4.2.3 Relationship Between Seasonal Indices in Market Arrivals and Prices of Turmeric in Duggirala Market

The relationship between Seasonal indices in market arrivals and prices of turmeric in Duggirala market are presented in the table 4.13 and fig 4.11. During the months from January to April and from September to December the seasonal price index were more than the seasonal market arrival index and the market arrivals were higher than the seasonal price index in the months from May to August. The highest seasonal price index was observed in the month of January which also indicate that the one of the lowest seasonal market arrivals were observed in the same month. The market arrivals were found high in the month of June and July resulting lower prices in the month of July. The lower the Seasonal indices of market arrivals indicated that the prices were high and vice versa.

4.13 Seasonal indices in market arrivals and prices of turmeric in Duggirala market

Sl. No	Month	Seasonal market arrivals index	Seasonal price index
1	January	69.18	104.85
2	February	62.67	99.97
3	March	69.45	96.50
4	April	72.72	95.79
5	May	160.87	98.18
6	June	191.94	98.81
7	July	145.92	95.54
8	August	126.88	103.39
9	September	78.77	100.81
10	October	77.64	102.03
11	November	60.32	99.77
12	December	85.58	104.30
13	**Total**	1200.00	1200.00

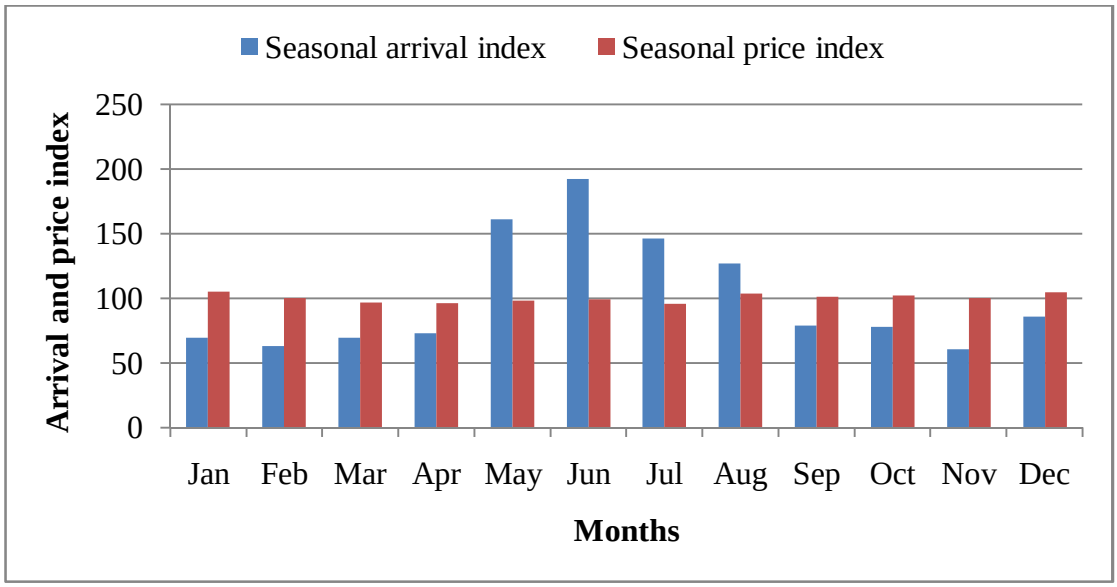


Fig 4.11 Seasonal indices in market arrivals and prices of turmeric in Duggirala market

4.3.1 Cyclical Variations in Market Arrivals of Turmeric in Duggirala Market

Cyclical variation in market arrivals were analyzed in order to know the variation in annual market arrivals over the years from 2002 to 2014 in Duggirala market. Cyclical component obtained by trend method has been presented in Table 4.14. The cyclical market arrival component values were plotted against the years corresponding them and cycles were observed from Fig 4.12 for Duggirala market. The cyclical market arrival component in turmeric showed increasing at initial level in the year 2003 and 2004 later gradual decreasing up to 2009 and later again showing increasing cycle in 2010 and 2011 and decreasing during 2012 and 2013. From 2002 to 2009 one cycle is observed and next cycle started from 2010 with expansion in arrivals.

Table 4.14 Cyclical component in market arrivals of turmeric in Duggirala market

Sl. No	Year	Arrival (Qtl)	Trend value	(C × I)100 Component	Weighted three year moving average of market arrivals (C × I)
1	2002	10042.50	10918.18	91.98	
2	2003	14089.91	14740.19	95.59	95.74
3	2004	16649.13	16708.95	99.65	110.69
4	2005	23553.75	17215.30	136.82	108.15
5	2006	14644.67	16650.04	87.96	107.11
6	2007	14872.08	15404.01	96.55	85.80
7	2008	10104.42	13868.02	72.87	85.31
8	2009	10753.58	12432.90	86.50	80.34
9	2010	9379.83	11489.46	81.64	107.22
10	2011	17544.75	11428.54	153.52	119.49
11	2012	15586.08	12640.95	123.30	117.36
12	2013	11675.17	15517.52	75.24	99.71
13	2014	20567.25	20449.07	100.58	

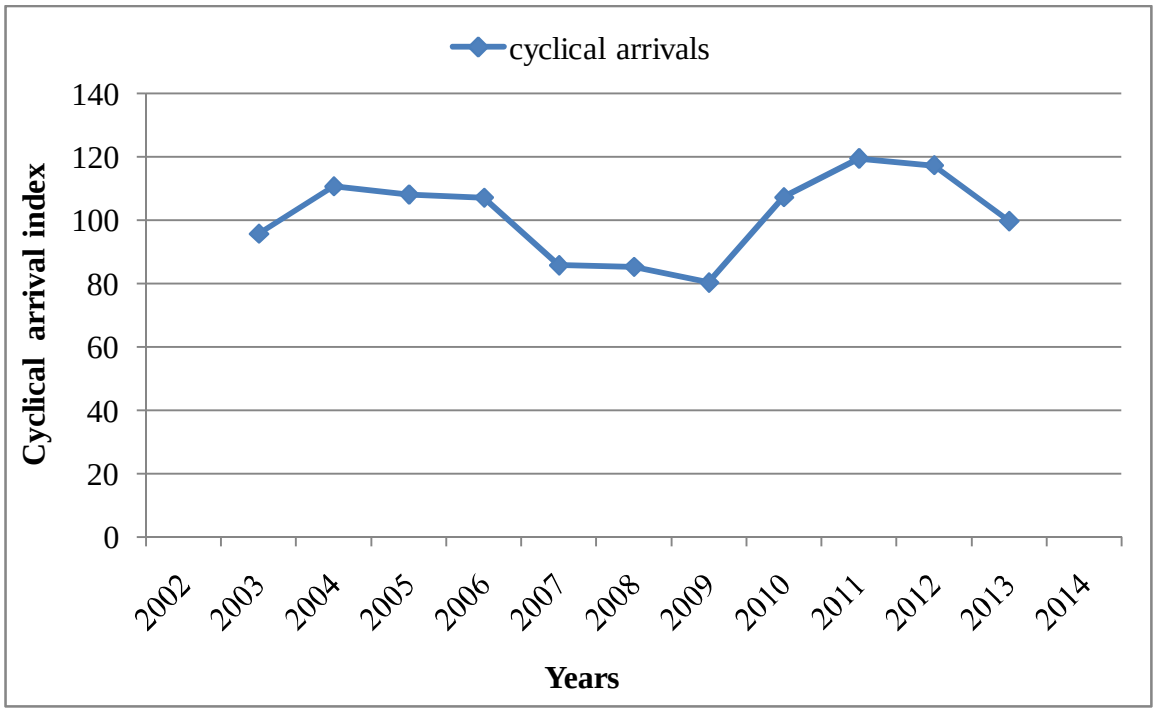


Fig 4.12 Cyclical component in market arrivals of turmeric in Duggirala market

4.3.2 Cyclical Variation in Prices of Turmeric in Duggirala Market

Cyclical component obtained by trend method was presented in Table 4.15 and Fig 13 for Duggirala market. The cyclical price component in turmeric showed an increase during 2003 and thereafter decreasing trend till 2007 and from 2008 the prices again started to increase till 2010 and later showing the decreasing till 2012 and thereby increasing in the year 2013. One price cycle from 2004 to 2010 with decreasing trend can be observed and second cycle started with increase in prices.

Table 4.15 Cyclical component in prices of turmeric in Duggirala market

Sl. No	Year	Price (Rs/q)	Trend value	(C × I)100 Component	Weighted three year moving average of prices (C × I)
1	2002	1943.33	2855.00	68.05	
2	2003	2704.16	1735.00	155.88	132.88
3	2004	2519.41	1442.00	174.69	149.13
4	2005	2097.50	1795.00	116.83	122.29
5	2006	1968.00	2612.00	75.35	80.46
6	2007	1825.00	3709.00	49.20	62.54
7	2008	3093.75	4905.00	63.07	71.95
8	2009	6232.08	6016.00	103.58	115.76
9	2010	12395.08	6862.00	180.64	127.85
10	2011	7210.41	7258.00	99.34	112.70
11	2012	4082.08	7023.00	58.12	79.15
12	2013	4780.00	5975.00	80.00	90.70
13	2014	5266.25	3930.00	134.00	

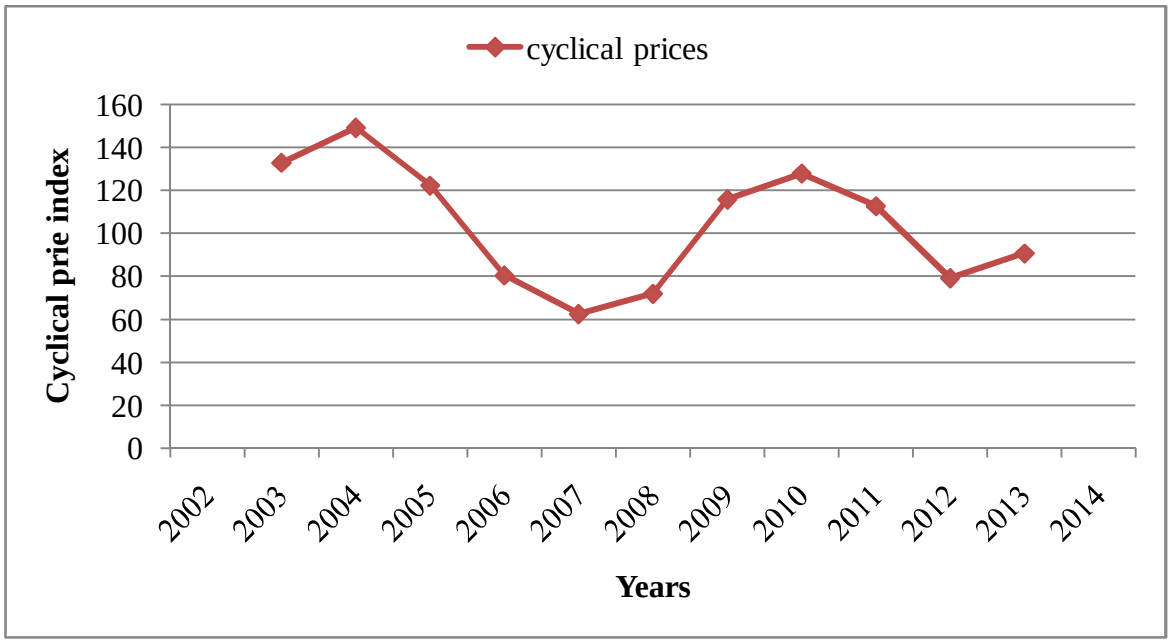


Fig 4.13 Cyclical variations in prices of turmeric in Duggirala market

4.3.3 Relationship Between Cyclical Variations in Annual Market Arrivals and Prices of Turmeric in Duggirala Market

The relationship between cyclical variations in annual market arrivals and prices of turmeric are presented in the table 4.16 and fig 4.14. The cyclical component in market arrivals and prices showed clear cycles i.e., both the market arrivals and prices were increasing in the year from 2003 to 2004 thereafter the market arrivals were decreasing until 2009 where as the prices were decreasing until 2008. During the year 2010 and 2011 the market arrivals were again increasing whereas in the year 2009 and 2010 the prices were increasing in nature. At the last phase of the cycle the market arrivals were decreasing in nature during the year 2012 and 2013 and the prices were also decreasing during 2011 and 2012 and finally increasing during the year 2013. From fig. 4.14, it can be observed that a one well defined cycle could be observed in case of market arrivals and prices at Duggirala market in opposite directions. The correlation coefficient is found to be 0.28. for cyclical market arrivals and prices.

Table 4.16Cyclical variations in market arrivals and prices of turmeric in Duggirala market

Sl. No	Year	Market arrivals (qtl)	Trend	(C*I)*100	MA(C*I)	Prices (Rs/qtl)	Trend	(C*I)*100	MA(C*I)
1	2002	10042.5	10918.18	91.97		1943.33	2855.00	68.05	
2	2003	14089.91	14740.19	95.58	95.73	2704.16	1735.00	155.88	132.89
3	2004	16649.13	16708.95	99.64	110.68	2519.41	1442.00	174.69	149.15
4	2005	23553.75	17215.30	136.81	108.13	2097.50	1795.00	116.83	122.31
5	2006	14644.67	16650.04	87.95	107.10	1968.00	2612.00	75.35	80.47
6	2007	14872.08	15404.01	96.54	85.78	1825.00	3709.00	49.20	62.55
7	2008	10104.42	13868.02	72.86	85.30	3093.75	4905.00	63.07	71.96
8	2009	10753.58	12432.90	86.49	80.33	6232.08	6016.00	103.58	115.77
9	2010	9379.833	11489.46	81.63	107.21	12395.08	6862.00	180.64	127.86
10	2011	17544.75	11428.54	153.51	119.48	7210.41	7258.00	99.34	112.71
11	2012	15586.08	12640.95	123.29	117.35	4082.08	7023.00	58.12	79.16
12	2013	11675.17	15517.52	75.23	99.70	4780.00	5975.00	80.00	90.71
13	2014	20567.25	20449.07	100.57		5266.25	3930.00	134.00	

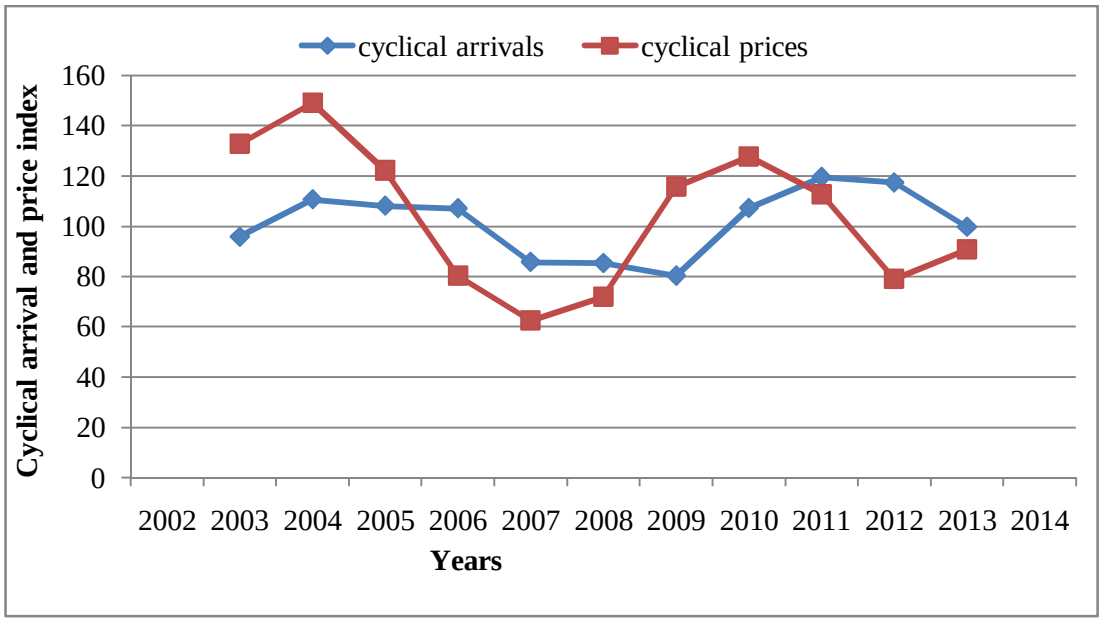


Fig 4.14 Cyclical variations in market arrivals and prices of turmeric in Duggirala market

4.4. IRREGULAR VARIATIONS IN MARKET ARRIVALS AND PRICES OF TURMERIC IN DUGGIRALA MARKET

Irregular component does not involve any definite pattern therefore it is generally estimated as residual component. The cyclic component (C) was isolated from C*I component by taking 3 years moving average of C*I series. Using these C*I and C the irregular component components can be computed.

4.4.1 Irregular variations in market arrivals of turmeric in Duggirala market

The results of the irregular component of market arrivals are presented in the table 4.17 and fig 4.15. The irregular component in the market arrivals shows alternative movement over the time i.e., increasing and decreasing in nature except the market arrivals in the year 2013 showing decreasing trend even after 2012 also indicating decreasing irregular component. The irregular component in the market arrivals were highest in the year 2011 (128.48) followed by 2005 (126.52) and were found lowest in the year 2013 (75.46) followed by 2010 (76.14).

Table 4.17 Irregular component in market arrivals of turmeric in Duggirala market

Sl. No	Year	Market arrivals (qtl)	(C*I)100	(C*I)	Irregular component
1	2002	10042.5	91.97		
2	2003	14089.91	95.58	95.73	99.84
3	2004	16649.13	99.64	110.68	90.02
4	2005	23553.75	136.81	108.13	126.52
5	2006	14644.67	87.95	107.10	82.11
6	2007	14872.08	96.54	85.78	112.54
7	2008	10104.42	72.86	85.30	85.41
8	2009	10753.58	86.49	80.33	107.67
9	2010	9379.833	81.63	107.21	76.14
10	2011	17544.75	153.51	119.48	128.48
11	2012	15586.08	123.29	117.35	105.06
12	2013	11675.17	75.23	99.70	75.46
13	2014	20567.25	100.57		

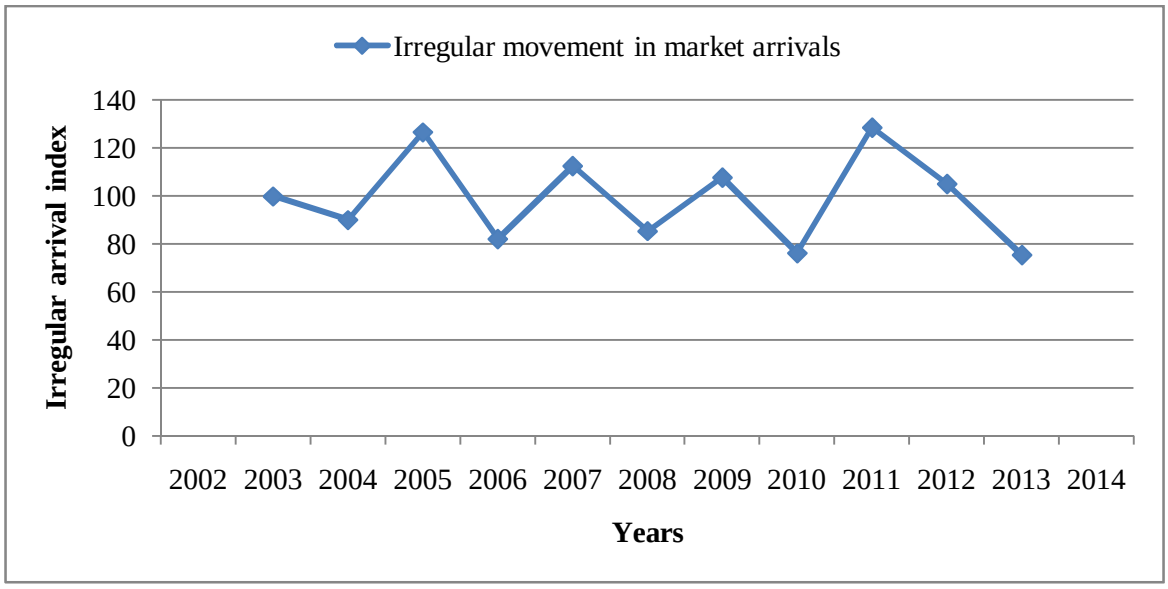


Fig 4.15 Irregular movements in market arrivals of turmeric in Duggirala market

4.4.2 Irregular Component in Prices of Turmeric in Duggirala Market

The Irregular component in prices of turmeric are presented in the table 4.18 and fig 4.16. The irregular component in the prices indicating decreasing from the year 2003-2007 years and thereafter showing increasing till 2010 and after 2010 the irregular movements in the prices were decreasing in the year 2011 and 2012 at the final year 2013 the irregular movements were found to be in increasing nature. The irregular component in the prices were recorded highest in the year 2010 with irregular indices 141.28 followed by 2003 with irregular indices 117.31 and were lowest in the year 2012 followed by 2007 with irregular indices 73.43 and 78.66 respectively.

Table 4.18 Irregular component in prices of turmeric in Duggirala market

Sl. No	Year	Price (Rs/qtl)	(C*I)100	(C*I)	Irregular component
1	2002	1943.33	68.05		
2	2003	2704.16	155.88	132.89	117.31
3	2004	2519.41	174.69	149.15	117.13
4	2005	2097.50	116.83	122.31	95.52
5	2006	1968.00	75.35	80.47	93.64
6	2007	1825.00	49.20	62.55	78.66
7	2008	3093.75	63.07	71.96	87.65
8	2009	6232.08	103.58	115.77	89.48
9	2010	12395.08	180.64	127.86	141.28
10	2011	7210.41	99.34	112.71	88.14
11	2012	4082.08	58.12	79.16	73.43
12	2013	4780.00	80.00	90.71	88.20
13	2014	5266.25	134.00		

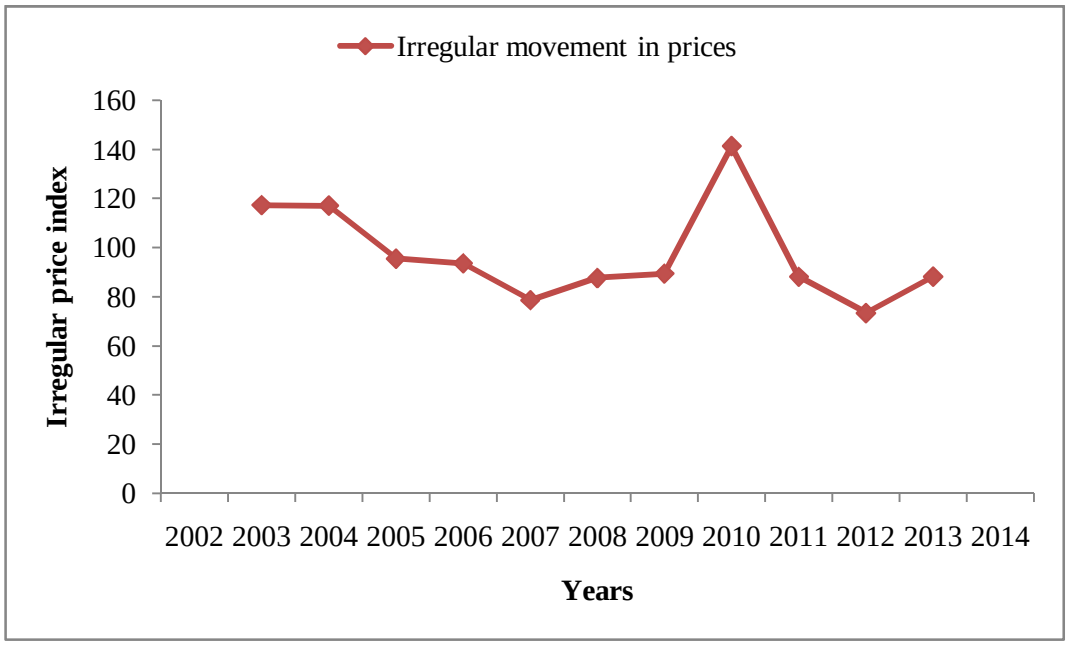


Fig 4.16 Irregular component in prices of turmeric in Duggirala market

4.4.3 Relationship Between Irregular Variations in Market Arrivals and Prices of Turmeric in Duggirala Market

The relationship between irregular variations in market arrivals and prices of turmeric is presented in the table 4.19 and fig 4.17. The irregular component in the market arrivals and prices and were decreasing during 2003-2004 and later the irregular movement in market arrivals were increasing later after 2004 and decreasing after 2005 showing alternatively increasing and decreasing trend till 2012 but in the year 2013 the irregular movement in market arrivals were decreasing even after the year 2012 showing decreasing irregular movements meanwhile the irregular movement in the prices keeps on falling from 2003 to 2007 and thereafter increasing from 2008 and reached highest in the year 2010 and after 2010 the irregular movement in prices again decreased till 2012 but at the end during the year 2013 the irregular movement in prices shown increasing trend . The irregular component in the prices were recorded highest in the year 2010 followed by 2003 and were lowest in the year 2012 followed by 2007. In the year 2010 the irregular movement of market arrivals were recorded highest and lowest in the year 2012.

Table 4.19 Irregular component in market arrivals and prices of turmeric in Duggirala market

Sl. No	Year	Market Arrivals				Prices			
		Market arrivals (qtl)	(C*I)100	(C*I)	Irregular component	Price (Rs/qtl)	(C*I)100	(C*I)	Irregular component
1	2002	10042.5	91.97			1943.33	68.05		
2	2003	14089.91	95.58	95.73	99.84	2704.16	155.88	132.88	117.31
3	2004	16649.13	99.64	110.68	90.02	2519.41	174.69	149.13	117.13
4	2005	23553.75	136.81	108.13	126.52	2097.50	116.83	122.29	95.53
5	2006	14644.67	87.95	107.10	82.11	1968.00	75.35	80.46	93.64
6	2007	14872.08	96.54	85.78	112.54	1825.00	49.20	62.54	78.67
7	2008	10104.42	72.86	85.30	85.41	3093.75	63.07	71.95	87.66
8	2009	10753.58	86.49	80.33	107.67	6232.08	103.58	115.76	89.47
9	2010	9379.833	81.63	107.21	76.14	12395.08	180.64	127.85	141.28
10	2011	17544.75	153.51	119.48	128.48	7210.41	99.34	112.70	88.14
11	2012	15586.08	123.29	117.35	105.06	4082.08	58.12	79.15	73.42
12	2013	11675.17	75.23	99.70	75.46	4780.00	80.00	90.70	88.19
13	2014	20567.25	100.57			5266.25	134.00		

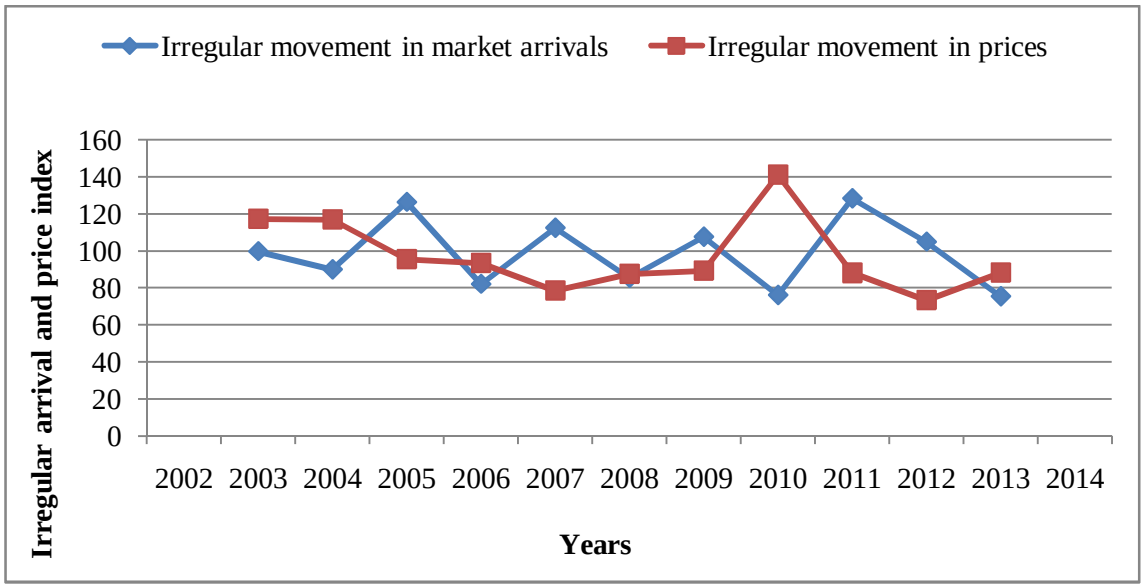


Fig 4.17 Irregular component in market arrival and prices of turmeric in Duggirala market

4.5. IMPACT OF MARKET ARRIVALS OF TURMERIC ON PRICES IN DUGGIRALA MARKET

The impact of turmeric market arrivals on prices in the Duggirala market is analyzed by using Simple linear regression model and correlation coefficient. The results could be seen from Table 4.20 and fig 4.18 which reveals that the regression coefficient and correlation coefficient is found to be significant at 5 per cent level. Hence there is a significant inverse relationship between market arrivals and prices of turmeric i.e., higher the market arrivals lower the prices in the Duggirala market.

Table 4.20 Impact of market arrivals of turmeric on prices in Duggirala market

Market	Intercept	Regression coefficient	R^2	t-value	F-value	Std error	No of observations
Duggirala	5244.98	-0.06*	0.033	2.31*	5.36*	470.61	156

Correlation coefficient = -0.18*

***** significant at 5 per cent level of significance

The equation can be written as Y= 5244.98+(-0.06)x

Y is taken as price X is taken as market arrivals

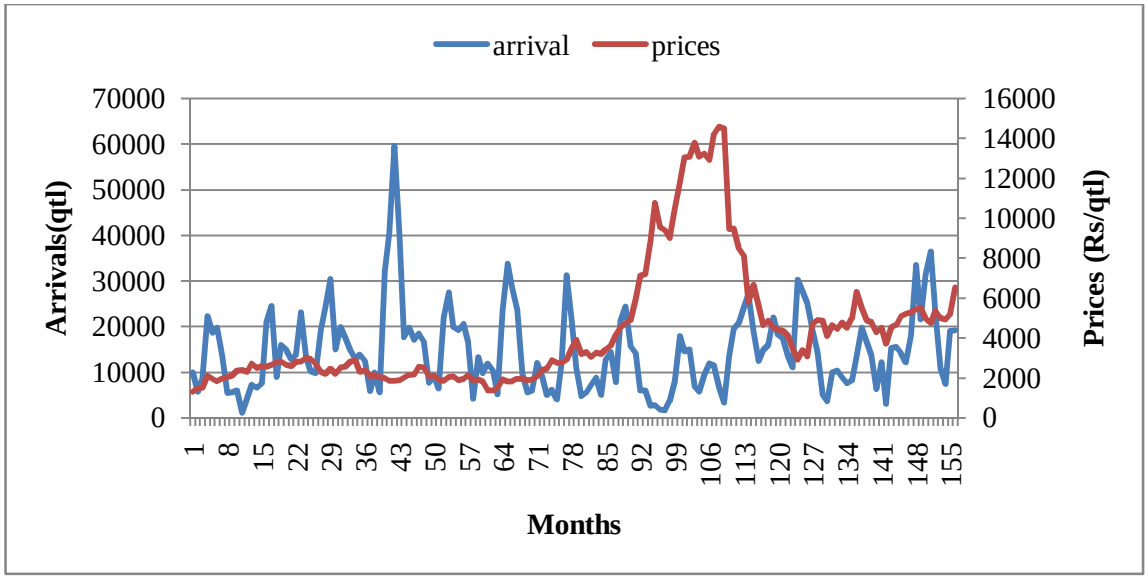


Fig 4.18. Association of turmeric market arrivals and prices at Duggirala market

4.6. EXPORT COMPETITIVENESS OF TURMERIC

4.6.1 Competitiveness of Turmeric Exports of India

The competitiveness of exports was analyzed by using the Nominal protection coefficient (NPC). This measures the deviation of domestic price from bordered price or reference price. If NPC is less than 0.5 considered highly competitive, and if it is between 0.5 to 1.0 indicates moderately competitive and if it is more than 1.0 indicates not competitive. The Nominal Protection Coefficient (NPC) of turmeric exports from India for the period 2002 to 2014 was presented in Table 4.21 and fig 4.19.

It was clear from the results that the average NPC of turmeric during the period 2002-2014 was 0.47 indicating its highly export competitiveness. The NPC of turmeric during the period from 2002 to 2008 was indicating highly competitiveness. For the period 2009, 2011and 2014 it was moderately competitive with NPC value 0.56, 0.62 and 0.53 respectively. In 2010 the NPC was 1.35 indicating non competitiveness for turmeric export.

The average NPC value revealed that India has highly competitiveness for turmeric (0.45) export. Similar results were obtained from Rajur and Patil in their study of export performance of chilli.

Table 4.21 Nominal Protection co-efficient of turmeric

Sl. No	Year	Domestic price	International price	NPC
1	2002	1943.00	7110.00	0.28
2	2003	2704.00	8102.00	0.34
3	2004	2519.00	8715.00	0.29
4	2005	2097.00	8725.00	0.25
5	2006	1968.00	8489.00	0.24
6	2007	1825.00	7329.00	0.25
7	2008	3094.00	8063.00	0.39
8	2009	6232.00	11128.00	0.57
9	2010	12395.00	9425.00	1.32
10	2011	7210.00	11557.00	0.63
11	2012	4082.00	9513.00	0.43
12	2013	4780.00	9830.00	0.49
13	2014	5266.00	9884.00	0.54

Source: 1)Agricultural marketing committee Duggirala 2)Spices board.

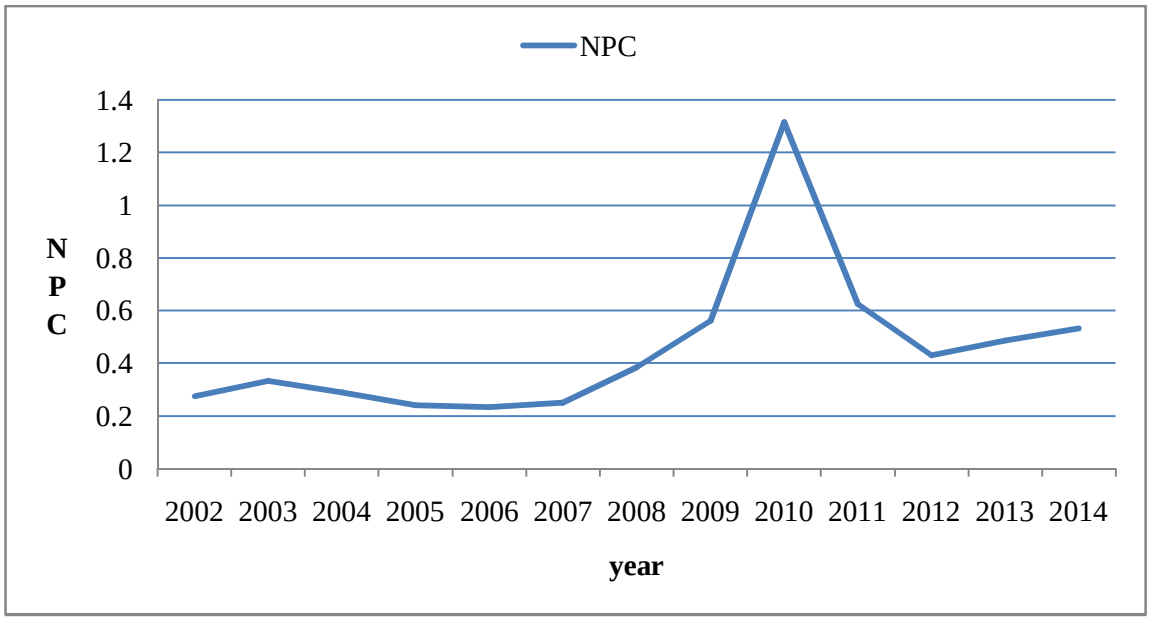


Fig 4.19 Nominal Protection Co efficient of turmeric (export competitiveness)

4.6.2. Domestic Competitiveness of Turmeric

The domestic resource cost is defined as the value of domestic resource it takes to save or earn a unit of foreign exchange through the production or export of the commodity. It is estimated as a ratio of the proportion of the non traded inputs to the value added by the proportion of traded inputs in the production of that commodity.

The domestic competitiveness was analyzed by using the Domestic Resource Cost (DRC) which is defined as the value of domestic resources, it takes to save or earn a unit of foreign exchange through the production or export of the commodity.If DRC < 1, the input is used efficiently and it is export competitive, If DRC > 1, the input is used inefficiently and is not export competitive.

In this Table 4.22 we observed that the human labour, machine labour and bullock labour which is a non tradable input followed by all other inputs seeds, fertilisers, manures, plan protection chemicals and etc which all are considered as a tradable inputs. The average ratio of the proportion of the non traded inputs to the value added by the proportion of traded inputs in the production of turmeric is worked out to be less than unity i.e., 0.76 indicating that the input is used efficiently and it is export competitive.

4.22 Domestic Competitiveness of Turmeric

Particulars/ year	2012 (₹/Acre)	2013 (₹/Acre)	2014 (₹/Acre)
Marginal value of non tradeable inputs			
Human labour	24350	26800	33000
Machine labour	5200	6400	4000
Bullock labour	2000	3200	4500
Total value of non tradeable inputs (A)	31550	36400	41500
Marginal value of tradeable inputs			
seeds	50000	27500	30000
fertilizers	12800	10500	10000
chemicals	4000	3500	5000
Manures	4000	3000	2000
Miscellaneous	2000	3000	1500
Total value of tradeable inputs (B)	74800	47500	48500
Reference price (rs/kg) (C)	95.12	98.3	98.84
Exchange rate(1$=rs) (D)	53.94	58.54	61.01
Domestic Resource Cost = {A/B-(C*D)}	0.45	0.87	0.97
Average DRC	0.76		

Source : Field Survey Data

4.7 FORECASTING OF MONTHLY PRICES OF TURMERIC

The Box-Jenkins model is concerned with fitting of a mixed Autoregressive Integrated Moving Average (ARIMA) to a given set of time series data. For the present study, ARIMA model was used for predicting the future prices of turmeric in Duggirala market and the results are presented as below

Identification of Model

The tentative models were first identified based on the autocorrelation function (ACF) and partial autocorrelation function (PACF) for the different series Y_t for the selected markets. The number of lags shown was up to 16 which are presented in the table 4.24. Based on ACF and PACF charts many models were tested.

Estimation of Parameter

After identifying the model tentatively the next step is to obtain the estimates by the method of least square estimates of parameters for both markets. Such error sum of square was to be minimum. Then the residuals of model were to be estimated.

Diagnostic Checking

Residual analysis was carried out to check the adequacy of the models. The residuals of ACF and PACF were obtained from the tentatively identified model. The adequacy of the model is judged on values of Box – Pierce Q statistics, Schwarz Bayesian Criterion (SBC), Mean Absolute Percentage Mean(MAPE) and sum of the squares of residuals. The forecasts were tested based on SBC and R^2 value criteria to assess the accuracy of the model. Finally the Model ARIMA(1,1,1) was identified as the best model and hence used for forecasting purpose.

4.7. FORECASTING OF PRICES OF TURMERIC IN DUGGIRALA MARKET

The prices were determined by using the fitted ARIMA (1,1,1) model and tabulated in the Table 4.25. The table revealed that the estimated prices were very close to the observed prices during the period January 2002 to December 2016. The forecasted turmeric prices per quintal in Duggirala market were found to be ranging from Rs 1339 to Rs 8187per quintal. The price forecasted when compared with real prices indicated that the per cent of deviation was found to vary from -4.48 to 5.9 which is very low.

The forecasts from the various models were checked for their efficacy by comparing them with the actual values. Similar model was used Olajide *et al.* in their study of forecasting the inflation rate in Nigeria.

4.23 Residual Analysis of Monthly Prices of Turmeric in Duggirala Market

In filling the forecasting modes the data set is divided into two parts (110 and 46 observations) and one part is used for fitting the model and one for validating the model. Since the values between two models are close together hence the model applied is correct.

Market	Model	MAPE	SBC	R^2	No of observations
Duggirala	ARIMA(1,1,1)	8.65	13.13	0.95	110
Duggirala	ARIMA(1,1,1)	9.91	14.00	0.92	46

Table 4.24 ACF and PACF of turmeric prices in Duggirala market

Sl. No	Lag	Autocorrelation	Std. error	Partial Autocorrelation	Std. error
1	1	0.97	0.07	0.97	0.08
2	2	0.94	0.07	-0.01	0.08
3	3	0.90	0.07	-0.13	0.08
4	4	0.87	0.07	0.05	0.08
5	5	0.83	0.07	-0.23	0.08
6	6	0.79	0.07	0.01	0.08
7	7	0.74	0.07	-0.12	0.08
8	8	0.69	0.07	-0.15	0.08
9	9	0.63	0.07	-0.10	0.08
10	10	0.57	0.07	-0.04	0.08
11	11	0.51	0.07	0.06	0.08
12	12	0.47	0.07	0.15	0.08
13	13	0.42	0.07	-0.05	0.08
14	14	0.36	0.07	-0.03	0.08
15	15	0.31	0.07	-0.07	0.08
16	16	0.27	0.07	0.14	0.08

Table 4.25 Forecast of monthly prices of turmeric

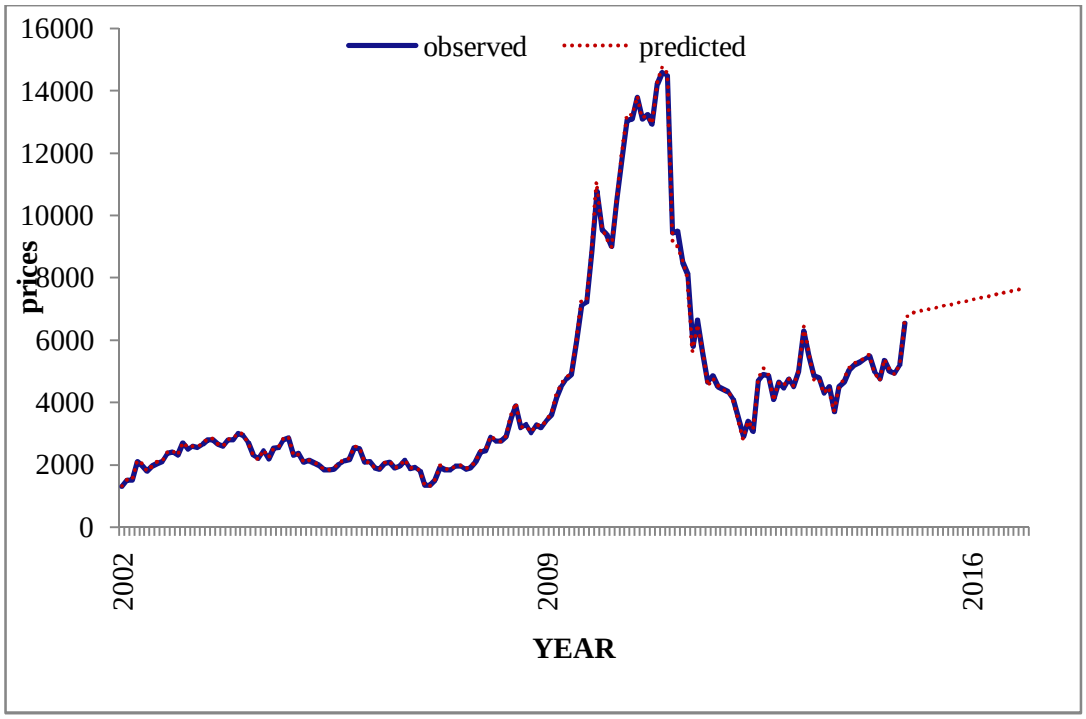
Sl No	Year	Month	Real price	Forecasted price	Per cent deviation
1	2002	January	1300	1335.53	-2.74
2		February	1500	1546.03	-3.07
3		March	1500	1550.11	-3.35
4		April	2100	2162.92	-3
5		May	1950	2031.46	-4.18
6		June	1800	1799.41	0.04
7		July	1950	1969.78	-1.02
8		August	2050	2106.22	-2.75
9		September	2100	2143.70	-2.09
10		October	2370	2418.11	-2.03
11		November	2400	2458.51	-2.44
12		December	2300	2324.35	-1.06
13	2003	January	2700	2740.68	-1.51
14		February	2500	2561.35	-2.46
15		March	2600	2612.25	-0.48
16		April	2550	2586.01	-1.42
17		May	2650	2682.68	-1.24
18		June	2800	2849.20	-1.76
19		July	2800	2845.12	-1.62
20		August	2650	2668.91	-0.72
21		September	2600	2610.80	-0.42
22		October	2800	2839.29	-1.41
23		November	2800	2853.33	-1.91
24		December	3000	3039.95	-1.34
25	2004	January	2950	2995.85	-1.56
26		February	2711	2720.34	-0.35
27		March	2311	2292.37	0.81
28		April	2200	2186.68	0.61
29		May	2450	2491.13	-1.68
30		June	2191	2236.95	-2.1
31		July	2530	2550.81	-0.83
32		August	2550	2616.61	-2.62
33		September	2805	2851.47	-1.66
34		October	2860	2916.04	-1.96
35		November	2300	2300.43	-0.02
36		December	2375	2349.50	1.08
37	2005	January	2075	2102.41	-1.33
38		February	2150	2159.18	-0.43
39		March	2052	2086.33	-1.68
40		April	1975	1992.65	-0.9
41		May	1832	1846.33	-0.79
42		June	1835	1852.82	-0.98

43		July	1865	1900.05	-1.88
44		August	2021	2064.91	-2.18
45		September	2125	2176.90	-2.45
46		October	2173	2214.69	-1.92
47		November	2562	2617.44	-2.17
48		December	2505	2570.84	-2.63
49	2006	January	2075	2069.61	0.26
50		February	2111	2096.32	0.7
51		March	1900	1928.46	-1.5
52		April	1850	1860.11	-0.55
53		May	2030	2067.15	-1.83
54		June	2075	2129.04	-2.61
55		July	1890	1912.40	-1.19
56		August	1950	1962.36	-0.64
57		September	2135	2184.63	-2.33
58		October	1875	1910.76	-1.91
59		November	1925	1928.50	-0.19
60		December	1800	1829.54	-1.65
61		January	1350	1343.86	0.46
62	2007	February	1350	1334.99	1.12
63		March	1500	1545.84	-3.06
64		April	1910	1984.35	-3.9
65		May	1825	1889.88	-3.56
66		June	1825	1839.83	-0.82
67		July	1950	1985.10	-1.8
68		August	1950	1995.19	-2.32
69		September	1865	1889.20	-1.3
70		October	1900	1922.35	-1.18
71		November	2075	2120.61	-2.2
72		December	2400	2468.08	-2.84
73	2008	January	2445	2508.85	-2.62
74		February	2880	2934.79	-1.91
75		March	2750	2814.14	-2.34
76		April	2750	2762.17	-0.45
77		May	2900	2936.79	-1.27
78		June	3500	3583.11	-2.38
79		July	3900	4013.86	-2.92
80		August	3200	3221.59	-0.68
81		September	3300	3253.72	1.41
82		October	3025	3055.49	-1.01
83		November	3275	3299.10	-0.74
84		December	3200	3253.05	-1.66
85	2009	January	3415	3449.49	-1.01
86		February	3610	3672.12	-1.73
87		March	4150	4230.53	-1.95
88		April	4500	4602.03	-2.27

89		May	4750	4822.80	-1.54
90		June	4890	4945.18	-1.13
91		July	5955	6056.72	-1.71
92		August	7125	7330.21	-2.89
93		September	7210	7351.92	-1.97
94		October	8850	8960.38	-1.25
95		November	10780	11080.98	-2.8
96		December	9550	9689.20	-1.46
97	2010	January	9400	9256.10	1.54
98		February	9011	9001.51	0.11
99		March	10500	10597.14	-0.93
100		April	11800	12064.96	-2.25
101		May	13050	13270.84	-1.7
102		June	13100	13230.12	-1
103		July	13800	13850.72	-0.37
104		August	13100	13152.14	-0.4
105		September	13250	13211.56	0.3
106		October	12930	12959.46	-0.23
107		November	14200	14278.18	-0.56
108		December	14600	14786.05	-1.28
109	2011	January	14500	14552.98	-0.37
110		February	9450	9156.78	3.11
111		March	9500	9013.86	5.12
112		April	8500	8541.93	-0.5
113		May	8100	8055.15	0.56
114		June	5800	5656.76	2.47
115		July	6650	6504.21	2.2
116		August	5600	5688.12	-1.58
117		September	4650	4528.85	2.61
118		October	4850	4794.11	1.16
119		November	4500	4552.44	-1.17
120		December	4425	4421.87	0.08
121	2012	January	4350	4367.81	-0.41
122		February	4100	4112.25	-0.3
123		March	3500	3471.31	0.82
124		April	2900	2837.14	2.17
125		May	3400	3407.80	-0.23
126		June	3075	3150.84	-2.47
127		July	4700	4790.80	-1.94
128		August	4900	5106.39	-4.22
129		September	4850	4882.14	-0.67
130		October	4100	4062.59	0.92
131		November	4650	4636.86	0.29
132		December	4460	4547.56	-1.97
133	2013	January	4760	4789.19	-0.62
134		February	4500	4541.19	-0.92

135		March	5000	5031.67	-0.64
136		April	6300	6458.42	-2.52
137		May	5500	5614.15	-2.08
138		June	4850	4739.11	2.29
139		July	4800	4757.98	0.88
140		August	4300	4315.23	-0.36
141		September	4500	4497.73	0.06
142		October	3700	3708.51	-0.23
143		November	4500	4497.13	0.07
144		December	4650	4778.51	-2.77
145	2014	January	5050	5117.65	-1.34
146		February	5200	5269.18	-1.34
147		March	5290	5335.50	-0.87
148		April	5400	5441.52	-0.77
149		May	5500	5545.81	-0.84
150		June	4975	4983.37	-0.17
151		July	4750	4711.30	0.82
152		August	5350	5398.11	-0.9
153		September	5000	5080.07	-1.61
154		October	4930	4914.50	0.32
155		November	5200	5236.30	-0.7
156		December	6550	6692.67	-2.18
157	2015	January		6867.67	
158		February		6903.21	
159		March		6938.75	
160		April		6974.28	
161		May		7009.82	
162		June		7045.36	
163		July		7080.89	
164		August		7116.43	
165		September		7151.97	
166		October		7187.50	
167		November		7223.04	
168		December		7258.58	
169	2016	January		7294.11	
170		February		7329.65	
171		March		7365.19	
172		April		7400.72	
173		May		7436.26	
174		June		7471.80	
175		July		7507.33	
176		August		7542.87	
177		September		7578.41	
178		October		7613.94	
179		November		7649.48	
180		December		7685.02	

These results showed that the real and estimated prices of turmeric in Duggirala were showing closer values so that ARIMA (1,1,1) model presented fairly good forecast of turmeric in Duggirala market upto December 2016. The price estimates for the period from January 2002 to December 2014 were found to be fairly accurate when the same were observed in the actual prices in the market. Hence the prices for the period January 2015 to December 2016 were forecasted using ARIMA (1,1,1) and tabulated in the table 4.25 which reveal that the prices for the coming years are increasing which is a good sign to the farmers to for turmeric cultivation.



Overview of results and discussions

The trends in arrivals were fitted by cubic model and market arrivals were recorded as highest in the year 2014 and lowest during the year 2002. The trends in prices were fitted by cubic model and prices were recorded as highest in the year 2011 and lowest during the year 2004. The month wise seasonal arrivals revealed that the highest arrivals were found in the month of June and May and lowest in the month of November and February respectively.The highest seasonal price index was found in December, and lowest in the month of April respectively. The cyclical variations in market arrivals showed one cycle from

2002-2009 and prices of turmeric showed one cycle from 2004-2010.The irregular component in the market arrivals were highest in the year 2005 and lowest in the year 2013 and in the prices were recorded highest in the year 2010 and lowest during the year 2012.There was a negative impact on price by the turmeric market arrivals. The export competitiveness of turmeric showed highly export competitive. The Domestic Resource Cost (DRC) of turmeric indicated that the input is used efficiently and it is export competitive. The forecasts of turmeric prices were found to be fairly accurate when compared to real prices at market and observed less than five per cent variation between the both the prices.

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Note: The literature is cited as per the "Thesis Guidelines" prescribed by Acharya N. G. Ranga Agricultural University, Rajendranagar, Hyderabad-30.

Chapter V

SUMMARY AND CONCLUSIONS

The present study entitled “An Analysis of Price Behaviour of Turmeric in Guntur District of Andhra Pradesh” was taken up mainly for farmers in Proper planning for the dispose of their produce which can considerably increase their income without incurring much additional cost. The study was intended to probe into the following objectives.

5.1 OBJECTIVES

1. To study the trends, seasonal, cyclical and irregular variations in market prices and arrivals of turmeric in Duggirala market in Andhra Pradesh.
2. To analyze the impact of arrivals on prices of turmeric in Duggirala market of Andhra Pradesh.
3. To study the export and domestic competitiveness of turmeric.
4. To forecast the future prices of turmeric in Duggirala market of Andhra Pradesh.

5.2 METHODOLOGY

The present study utilized was based on secondary data to fulfill the objectives. The time series data on monthly arrivals and prices of Turmeric required for the study were collected from the registers maintained in the APMCs of Duggirala. For the purpose of present study, Duggirala turmeric market was selected purposively as it was the major turmeric market in the state and turmeric was selected purposively because Andhra Pradesh is the leading turmeric growing state in the country.

The data on arrivals refer to the total arrivals during the month in quintals in the market. The data on prices refer to model prices in a month. Model price was considered superior to the monthly average price as it represented the major proportion of the commodity marketed during the month in a particular market.

The data pertaining to export price of turmeric was collected from Spices Board, *www.indiastat.com*, Agriculture Statistics at a Glance of various years, The domestic price was considered as the average of wholesale price of Turmeric in selected markets of the country.

Tools of analysis

Multiplicative model has been used to estimate the trend, seasonal, cyclical and irregular movements and in market prices and arrivals and 12 months moving average method was used to construct the seasonal indices. Simple linear regression analysis was used to know the impact of arrivals on prices. Nominal Protection Coefficient (NPC) and Domestic resource cost (DRC) and was used to estimate the domestic and export competitiveness of turmeric. Box-Jenkins model was used to forecast the future prices.

5.3 MAJOR FINDINGS OF THE STUDY

Trends in the arrivals and prices of turmeric

The arrivals were recorded as highest in the year 2014 followed by 2005 with trend values showing 20449.07qtl and 17215.30qtl respectively and lowest during the year 2002 and 2011 with trend values showing 10918.18qtl and 11428.54 qtl respectively.

The trend in the prices of turmeric were recorded as highest in the year 2011 followed by 2012 with trend values showing Rs 7258.00/qtl and Rs 7023.00/qtl respectively and lowest during the year 2004 and 2003 with trend values showing Rs 1442.00/qtl and Rs 1735.00/ qtl respectively.

Seasonal Variations in arrivals and prices of turmeric

The results reveal that the highest arrivals were found in the month of June, May and July with seasonal indices of 187.32, 156.99 and 142.41 respectively. The lowest arrivals were found in the month of November, February and January with 60.32, 62.67 and 69.18 arrival indices.

The Seasonal Variations in prices of turmeric revealed that the highest seasonal price index was found in January, December followed by august and October, as the indices were 104.44, 104.30, 103.39 and 102.03 respectively of every year in turmeric. The seasonal price index was noticed lowest in the month of July, April and March with monthly indices 95.54, 95.79 and 96.50 respectively.

Cyclical variations in arrivals and prices of turmeric

The cyclical component in turmeric showed increasing at initial level from 2002-2005 later decreasing up to 2007 and again increasing cycle till 2014. From 2002 to 2009 one cycle is observed and next cycle started from 2010 with expansion in arrivals.

The cyclical price component in turmeric showed an increase during 2003 and thereafter decreasing trend till 2007 and from 2008 the prices again started to increase till 2010 and later showing the decreasing till 2012 and thereby increasing in the year 2013. One price cycle from 2004 to 2010 with decreasing trend can be observed and second cycle started with increase in prices.

Irregular variations in arrivals and prices of turmeric

The irregular component in the arrivals were highest in the year 2005 followed by 2011 and were found lowest in the year 2013 followed by 2010. The irregular component in the prices were recorded highest in the year 2010 followed by 2003 and lowest during the year 2012 and 2007.

Impact of arrivals of turmeric on prices

The results which reveals that there is a significant inverse relationship between market arrivals and prices of turmeric i.e., higher the market arrivals lower the prices.

Competitiveness of turmeric exports of India

The average NPC value revealed that India has highly competitiveness for turmeric (0.45) export. The results revealed that the average NPC of turmeric during the period 2002-2014 was 0.47 indicating its highly export competitiveness. The a NPC of turmeric during the period from 2002 to 2008 was indicating highly competitiveness. For the period 2009, 2011and 2014 it was moderately competitive with NPC value 0.56, 0.62 and 0.53 respectively. In 2010 the NPC was 1.35 indicating non competitiveness for turmeric export.

The average DRC of turmeric was found to be less than unity (0.76) indicating that the input is used efficiently and it is export competitive during the period 2012-2014.

Forecasting of monthly wholesale prices of price

ARIMA model was used to forecast turmeric prices the identified model was (1,1,1) which yielded the best results. The forecasted turmeric prices per quintal in Duggirala market were found to be ranging from Rs 4711 to Rs 7685 for the months from January 2014 to December 2016.

5.4 CONCLUSIONS

The following conclusions have emerged from the present study:

1. The trends in arrivals were recorded as highest in the year 2014 and lowest during the year 2002. The trends in prices shows a gradual increase and reached the peak in the year 2011 where the lowest price were recorded in the year 2004.

2. The month wise seasonal arrivals reveal that the highest arrivals were found in the month of June and lowest in the month of November respectively.The highest seasonal price index was found highest in January and lowest in the month of July respectively.

3. The cyclical variations in arrivals and prices of turmeric showed one cycles each.

4. The irregular component in the arrivals were highest in the year 2005 and were found lowest in the year 2013. The irregular component in the prices were recorded highest in the year 2010 and lowest during the year 2012.

5. There was a negative impact of arrivals on prices of turmeric in the selected market.

6. The average NPC of turmeric during the period 2002-2014 was 0.47 indicating its highly export competitiveness.

7. The average DRC of turmeric was found to be less than unity (0.76) indicating that the input is used efficiently and it is export competitive during the period 2012-2014.

8. The analysis of forecasting of turmeric prices indicated that ARIMA model (1,1,1,) was found suitable for the purpose. The price forecasts estimated for the period from January 2014 to December 2014 were found to be fairly accurate when the same were compared to the actual prices in the market.

POLICY IMPLICATIONS

1. Seasonal indices of arrivals and prices indicated that the prices were low during high arrivals and vice versa. Hence, the farmers are suggested to plan the sale of turmeric in the months of December and January.

2. The wide and frequent fluctuations in arrivals in the market can be overcome to some extent by providing suitable storage structures at the market and providing more pledge loan facilities and also selling the produce in off season to get good prices for the produce.

3. The Nominal Protection Coefficient and Domestic Resource Cost ratios found to be less than one; hence there is competitive advantage for export of turmeric from India. Therefore, it should be encouraged.

4. The forecast prices showed an increasing trend and the variation from real prices to forecasted prices was only less than five percent. Hence the forecast can be taken as reliable for future forecasting of prices.

LIST OF ABBREVIATIONS AND SYMBOLS USED

%	:	per cent
AMC	:	Agricultural Market Committee
ARIMA	:	Auto Regressive Integrated Moving Average
b	:	Regression Co-efficient
df	:	Degrees of freedom
DRC	:	Domestic Resource Cost
e.g.	:	For example, for instance
et al.	:	and others people
etc.	:	and so on (other things)
Fig	:	Figure
i.e.,	:	that is
No.	:	Number
NPC	:	Nominal protection coefficient
Qtl	:	Quintal
R^2	:	Co-efficient of Multiple Determination
Rs.	:	Rupees
Rs/q	:	Rupees per quintal
S.E	:	Standard error
Viz.,	:	Namely

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