Study of Market Arrivals and Price Behaviour of Pigeonpea in Vidarbha Region of Maharashtra

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This is to certify that the thesis entitled ***"Study of Market Arrivals and Price Behaviour of Pigeonpea in Vidarbha Region of Maharashtra"*** *submitted in partial fulfilment of the requirement for the degree of* ***MASTER OF SCIENCE (Ag.)*** *in Department of Agricultural Economics and Farm Management of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is a record of the bonafide research work carried out by* ***Asawari Joshi*** *under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instructions.*

All the assistance and help received during the course of the investigation has been acknowledged by her.

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I, Asawari Joshi D/o Shri. Sudhir Joshi certify the work embodied in thesis entitled “Study of Market Arrivals and Price Behaviour of Pigeonpea in Vidarbha Region of Maharashtra’’ is my own first hand bonafide work carried out by me under the guidance of Dr. **S. B. Nahatkar** at **Department of Agriculture Economics and Farm Management**, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during 2019-20.

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LIST OF ABBREVIATIONS

Abbreviation/Symbol	Stand for
@	At the rate
Fig	Figure
Ha	Hectare
Kg	Kilogram
Max	Maximum
Min	Minimum
No.	Number
%	Percentage
/	Per
Q	Quintal
Mha	Million hectare
Mt	Million tone
Etc	Et cetera
i.e	That is
et al.	And others people
Sr. No.	Serial Number
APMC	Agricultural Produce Market committee
Viz.	Namely

Chapter – I

INTRODUCTION

INTRODUCTION

1.1 Preamble

Agriculture in India is now moving in the world of globalization, liberalization and privatization. The population is increasing at a rapid rate leading to increase in demand for food and other consumer goods of which many have agricultural base. Pulses occupy an important place in Indian Agriculture economy, as they are rich sources of protein. The total world acreage under pulses is about 85.40 million ha with production of 87.40 million tons at 1023 kg/ha yields level. India, with >29 M ha pulses cultivation area, is the largest pulse producing country in the world. India is the largest producer, consumer and importer of pulses in the world accounting for 34% of world area and 26% of world production with productivity of 835 kg/ha during 2017-18 (Anonymus, 2019). In the rainy season, pulses like pigeonpea, green gram, black gram and cowpea are the most important and leading pulse crop of India. The pulses are unique crops as they have in built mechanism to fix atmospheric nitrogen in their root nodules. They are also rich in protein and fit well in various cropping system. India grows such a variety of pulse crop which no other country in the world grows. Among pulses, pigeonpea is a major kharif pulse crop of India. The cultivation of pigeonpea goes back at least 3500 years.

Pigeonpea (Cajanus cajan (L.) Millsp.) commonly known as red gram, arhar or tur. Today pigeonpea is widely cultivated in all tropical and semi-tropical regions of both old and new world. After gram, pigeonpea is the second most important pulse crop in the country. Pigeonpea is a protein rich staple food. It contains about 22% protein, which is almost three times more than that of cereals. Major portion of Indian population belongs to vegetarian group and pulses are the only source of protein for them. Therefore required per capita consumption of pulses per day is 70-80 gm to maintain good health in India (Alemayehu Amera, 2002). India ranks first in area (64%) and production (57%) with productivity is 913 Kg/ha at global level. In India, pigeonpea occupies an area of 44.59 lakh ha with production of 41.80 lakh tons. Other countries producing pigeonpea include Myanmar, Tanzania,

Malawi, Kenya and Burundi. From India pigeonpea is mainly exported to USA, UK, Australia, Canada, Singapore, etc. In India major pigeonpea producing states are Maharashtra, Madhya Pradesh, Karnataka, Uttar Pradesh, Andhra Pradesh, Gujarat, Jharkhand, Odisha.

Maharashtra produces the maximum pigeonpea in India, with 12.29 Lakh ha (27.56%) of area and with 10.73 Lakh tons (25.33%) of production. Productivity of pigeonpea is highest in Maharashtra. Madhya Pradesh is a second largest producer contributing 20% to the total production followed by Karnataka (18%), Gujarat (8%), Uttar Pradesh (8%), Telengana (6%), Jharkhand (5%), Odisha (3%), Andhra Pradesh (3%) and Tamil Nadu (1%) with others 3%. As a kharif crop, sowing of pigeonpea starts from first week of June and continues till first week of July and harvesting carried out in the month of December to January. Arrival of pigeonpea starts in the markets in the month of January. The major trading centres of pigeonpea in Maharashtra are Latur, Amravati, Akola, Washim, Yeotmal, Nanded, Nandura, Shegaon etc. Production of pigeonpea is enough to fulfil the domestic requirement of the state but not enough to fulfil the requirement of the whole country. But demand supply situation of pigeonpea during last one decade causing high fluctuation in price of pigeonpea in Indian market.

Therefore, the study on market arrivals and prices is very useful for identifying reasons for wider fluctuations in prices of pigeonpea over a period of time. As well as the relationship between market arrivals and prices of the crop at different point of time help us to know the extent of inter and intra year variation in them. The price variations are common in agricultural commodity mainly because of seasonality in production and inter market arrivals. Arrivals of pulse in markets, decide the prices of pulses (Agrawal and Sharma, 1990). Market integration concept explains the relationship between two markets that are spatially separated. One of the important indicators of efficient functioning of market is that the markets should be spatially integrated. Integrated markets are those where the prices are determined independently. If the markets located at different places are not integrated, there will be wide differences among the prices in different markets which cannot be explained by transport costs.

By considering the importance of market arrivals and prices of pigeonpea, an imperical study on monthly arrivals and prices, fluctuations in arrivals and prices in the Vidarbha region is intended to undertake. Such studies are useful to formulate economic policies and are beneficial for consumers, producers, traders and Government. Keeping this in view, the present study entitled, “Study of market arrivals and price behaviour of pigeonpea in Vidarbha Region of Maharashtra” is undertaken with the following specific objectives:

1.2 Specific Objectives

1. To study the growth pattern of production component of pigeonpea.
2. To examine the pattern of market arrival and price behaviour and their inter relationship between production components.
3. To analyse the relationship between arrival and price of pigeonpea.
4. To assess the spatial co-integration among major markets of pigeonpea in the region.

1.3 Hypothesis (H_A)

1. The production component of pigeonpea are having positive trend.
2. There is a wide variation in prices and arrivals of pigeonpea.
3. Market arrivals determine the market prices of pigeonpea in a market.
4. The prices prevailing in one market are dependent on the price of other markets.

1.4 Limitations

1. The secondary data for the present study was collected through various records available in Krishi Upaj Mandi for study period hence reliability of data depends on available records only.
2. The price behaviour was studied for selected markets of the region assuming that these markets are influencing market.

1.5 Plan of the study

The thesis is presented in five chapters. The first chapter deals with the introduction along with the objectives, hypothesis and limitations of the study. The second chapter deals with review of literature. The third chapter deals with selection of study area, selection of mandies, collection of data and analytical tools employed. The fourth chapter encompasses a critical analysis of the results and discussion. The final chapter presents the summary and conclusions of the study.

Chapter – II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The review of literature for the research workers is required to assess the studies conducted by the researchers in the past. This provides foundation to the theoretical frame work for present study. Review of literatures provides basic and feedback information for present study on the basis to understand the problem and help in the proper investigation. In the view an attempt has been made to review the work done in the field of market arrivals and price behaviour. There are some of the important and relevant studies done so far reviewed in separate heads as below:

1. Growth pattern of production component.
2. Pattern of market arrival and price behaviour.
3. Relationship between market arrivals and prices.
4. Market Co-integration.

2.1 Growth pattern of production component

Sodhiya (1989) examined the growth trends in area, production and productivity of cereals, pulses and oilseeds in Sagar division of Madhya Pradesh. The paper estimated linear trends in the area, production and productivity of 10 major crops for the period 1956-57 to 1982-83. The crops covered were Wheat, Rice, Sorghum, Millet, Barley (in the cereal group), Chickpeas and Lentils (in the pulse group) and Linseed, Sesame and Soybean (in the oilseeds group). The comparative signs and levels of significance of the regression coefficients suggested preference for cereals over pulses and oilseeds. It was revealed that the decrease in importance of sorghum and millet, the inferior cereal groups was acceptable, but in the case of sesame it was a matter of concern.

Goswami *et. al.* (1995) studied the growth rates of oilseed and pulses in India for three phases i.e Phase-I (1980-81 to 1964-65), Phase-II (1967-68 to 1980-81) and Phase-III (1980-81 to 1990-91) in India. The growth of area, yield and production of oilseeds was significant during the period of 1980-81 to 1990-91 (Phase-III).This has led India to state of self-sufficiency in the production of oilseeds. Reverse was the position in case of pulses. The

growth of area under pulses declined during the decade 1980-81 to 1990-91(Phase-III) and the growth rate of yield was only 1.4%. Therefore, emphasis should be laid in increasing the area and productivity of pulses.

Gajbhiye *et. al.* (2002) studied the growth and instability of chickpea in Akola district of Maharashtra during the periods 1985-86 to 2005-06. It revealed that, the growth rates for area and production of chickpea were found significant. Instability in chickpea indicated that the productivity under chickpea exhibited less variation. It means that, production of chickpea over the period has been almost constant.

Sharma and Sharma (2002) studied the growth and instability in pulses and oilseeds production in Himachal Pradesh. The authors observed that except rapeseeds and mustard, the area and production of all pulses and oilseeds in Himachal Pradesh have shown a disquieting and gloomy trend in the post-green revolution period. Productivity trend were also unsatisfactory. Gram, red gram, rapeseeds, mustard, linseeds and groundnut exhibited instability of a higher order as compared to other crops. Yield contributed relatively more towards the increase in the production of rapeseeds, mustard and green gram, followed by area and interaction effect. Declining productivity contributed more to the decline in the production of red gram and other pulses, while response to decrease in production due to area effect was more pronounced in gram, black gram, lentil, total pulses, groundnut, sesame, linseeds and total oilseeds.

Nahatkar *et. al.* (2005) examined the growth pattern of soybean production in major soybean growing agro-climatic zones of Madhya Pradesh for two decades i.e. decade I (1981-1990) and decade II (1991-2001). The growth of soybean production was higher (25.07%) during first decade (1981-1990) as compared to second decade (1991-2001) growth (6.92%). Therefore, it emphasis increase in soybean production is possible only through breaking yield barriers and reducing existing yield gaps by increasing rate of adoption of technologies with supply of quality inputs.

Ahirwar *et al.* (2007) conducted study on the variability and growth of pigeonpea production in India. The highest growth rates and variation in area

and production, productivity were found in Andhra Pradesh, Mizoram and Rajasthan. The relative change was found negative in area, production and productivity in India during study period.

Sahu *et al.* (2007) worked on statistical account of pulse production in world, India and West Bengal during pre-green revolution, green revolution and post-green revolution periods. It was found that though the area under pulses for world showed different trends, the trends were the same for India and West Bengal since the green revolution.

Chaudhari and Pawar (2010) studied the growth and instability and price analysis of pigeonpea in Marathwada region. They analyzed the data on arrival and prices collected from four APMCs viz.; Latur, Udgir, Osmanabad and Paranda for the period 1985-86 to 2004-05. The study concluded that the maximum arrivals of pigeonpea were recorded in month of January in all the selected markets, while significant negative relationship between arrivals and prices of pigeonpea was observed in Latur market.

Shrivastava *et al.* (2013) studied the growth pattern of major pulses in eastern Uttar Pradesh. They concluded that India is a key player in pulse production contributing 28% to the global basket from an area of about 37% .The country contribution more than 75% of global production of chickpea and pigeonpea the two major pulses of Indian sub-continent. Chickpea contributes about 10.92 million tonnes of grains to the global food packet from about 11.98 million hectares. It was observed that the decline in area under chickpea and pigeonpea in eastern Uttar Pradesh was the main reason for decline in production. Therefore, there is a need to bring more area under chickpea and pigeonpea cultivation and improve the productivity to increase the production.

Pichad *et al.* (2014) examined the performance of chickpea in Amravati district with the objective to study the growth rates and variability in area, production and productivity of chickpea. The secondary data on area, production, productivity of chickpea in Amravati district were collected from various issues of epitome of agriculture and district socio-economic reviews. The data pertained to the period of 20 years i.e. from 1990-91 to 2009-10.

The performance of chickpea was examined by estimating the growth rates and coefficient of variation of area, production and productivity of chickpea. It revealed that, compound growth rates of area, production and productivity for thr period under study were found positive and significant. The coefficient of variation indicated the instability in chickpea area exhibited less variation than production and productivity, in entire period. Production witnessed highest instability as compared to area and productivity at overall period.

Ganvir *et al.* (2015) examined the performance of pigeonpea in Western Vidarbha region of Maharashtra for the period 1980-81 to 2009-10. The study revealed that during the overall period, the compound growth rates and production of pigeonpea in almost all the districts of Amravati division were significantly increased. The highest increasing trend in area and production was found in Akola district and productivity in Buldhana district.

Thakar *et al*. (2017) studied growth and instability in area, production, productivity and also price, arrival seasonality with reference to North Gujarat. Overall in North Gujarat positive growth in yield (3.77%) except Patan was observed. They observed higher seasonal prices and arrivals in green gram, tur, urad in the selected study area.

2.2 Pattern of market arrivals and price behaviour

Tyagi (1990) studied the behaviour of prices and observed that there have been instances when actual prices received by farmers have fallen below the floor level (minimum support prices) for some commodities in some markets.

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

Sarawagi *et al.* (1994) analysed the pattern of arrivals and prices in three regulated markets of Gotegaon, Seoni and Pandhurna in Jabalpur division of Madhya Pradesh. They observed that in different marketing seasons the trends in arrival pattern and prices received for gram was not similar in all markets. They also examined that in peak season the arrival of gram was noticed maximum in all three year in Gotegaon, than Seoni and Pandhurna. The same trend of prices was seen in mid and lean period. It was also revealed from the study that in all the selected markets an inverse relationship between arrivals and prices of gram was observed except in Pandhurna market.

Nahatkar *et al.* (1998) examined the price variation of cotton as a case study of Kukshi regulated market of Dhar district of M.P. The analysis of the data shows the seasonal index of cotton prices was minimum (96.45%) in the second quarter (Jan-March) and maximum (106.73%) during third quarter (April-June). The range of difference between the two was 10.28%, clearly indicating the high seasonal fluctuation of cotton prices. The variation in arrivals of cotton was found to be higher than that of variation in prices. The deterministic study shows that the farmers are more responsive to lagged prices than the current prices.

Vasisht *et al.* (2008) studied the price behavior in fruits and vegetable markets using Co-integration and Error Correction Analysis techniques. The empirical results on the price behavior provided evidence of high volatility in the prices of fruits and vegetables in major markets. There was a presence of long-run relationship across some of the state level markets for less perishable commodities like apple.

Gote *et al.* (2010) examined secondary data from the record of the Agricultural Produce Market Committee (APMC) of Palanpur market for the period from 1995-96 to 2005-06 and pointed out that the market arrivals and prices of groundnut had shown no specific trend and also noticed that the market arrivals in 2000-01 were lower and higher in 2004-05.The prices were highest in July and lowest in the month of September for Palanpur market.

Selvaraj (2011) explained that the price behavior of the agricultural commodities is based on the traditional theory of supply and demand conditions. Due to seasonal behavior of agriculture, it is viewed that during peak arrivals, the prices would be low and vice versa. However the demand is spread throughout the year.

Thombre and More (2013) have made an attempt to study market arrivals and prices of pigeonpea in Marathwada region. The study was based on secondary data collected from APMC (Regulated Market) of Parbhani and Nanded districts. The month wise market arrival and prices data of pigeonpea from respective markets were used for analysis (1980-81 to 2005-06). The seasonal variation in arrivals and prices was calculated by using ratio to moving average method. The relationship between market arrivals and prices of pigeonpea was tested with the help of simple linear regression equation and double log model. The result revealed that, arrivals and prices of pigeonpea had strong season effect. The results confirmed the negative relationship between arrivals and prices in both the markets under the study.

Kanungo (2015) examined the relevance of market arrival of turmeric in price formation in Kandhamal district of Odisha. The statistical analysis explained that the market arrival had a great impact on price formation and the impact was explained by an inverse relationship between market arrival and price. Study revealed that the weak bargaining strength and very low retention power of the small and marginal farmers and tenant cultivators led to the distress sale. Many reasons were attributed for this distress sale such as lack of storage, low level of pecuniary income, a disrupted income flow, current social obligation, indebtedness to the unauthorized money lenders or village mahajanas, poor infrastructure, lack of all-weather transport and inadequate market information.

2.3 Relationship between market arrivals and prices

Ravi (1975) analyzes the marketing problems of coconut and copra in Tiptur and Arsikere regulated markets in Karnataka. This study showed that there was no definite relationship between arrivals and prices of coconut and copra, through in general the prices rules high when arrivals were low. In this

area coconut marketing is dominated by village sales (about 66 percent) followed by sale through commission agents (about 16 percent) and wholesaler (about 11 percent) and the rest directly from farmers (about 7 percent).

Awasthi *et al.* (1985) studied the relationship between arrivals and prices of groundnut in three markets of western region of Madhya Pradesh. The study was based on secondary data collected from Indore, Khargone and Sanwad markets records for the period of 1972-73 to 1981-82. The authors observed abrupt and sudden decline in the price of groundnut, after the harvest period and subsequent moderate price increase up to February. The prices after this period increased substantially till August. However, researchers reported a positive association between prices and arrivals of the produce during the study period.

Dinkar (1990) analyzed the relationship between arrivals and prices of groundnut in three markets of Raichur district of Karnataka state computing monthly index numbers of market arrivals and prices for the years 1979-80 to 1985-86. It was reported that, the prices ruled high in May to June in all the markets. The correlation coefficient of arrivals and market price was negative in Kukanoor and Koppal markets confirming that high arrivals in the markets have depressed the prices there by putting the farmers into disadvantages position. However, in Raichur market, the correlation coefficient was found to be positive. This revealed that arrival pattern may not influence the price and forces not taken into account in the analysis may determine the price.

Sharma and Nahatkar (1995) worked on relationship between market arrivals and prices of soybean with special reference to Krishi Uppaj Mandi, Sehore. They analyzed the data on market arrival and prices of soybean for the period of 1977 to 1990. They observed that the variation in annual market arrivals of soybean was higher as compare to price while maximum price was found in the month of September and minimum for October. The negative correlation coefficient was found in between annual arrivals and prices. Whereas positive and significant for monthly arrivals and prices.

Brahm *et al.* (1998) undertook a study to analyze the inter and intra year variation in market arrivals and prices of Urdbean in all the regulated market of Uttar Pradesh for the last decade (1983-84 to 1992-93). The positive coefficient of correlation (0.59) was observed between annual production and market arrivals. The moderated degree of negative coefficient of correlation was observed between market arrival and prices.

Nahatkar *et al*. (1999) found negative relationship between annual arrivals and prices of wheat in the market, during most of the years. This reveals that as the arrivals increased, the prices of wheat decreased.

Mourya (2002) in his study on trend and seasonality in arrivals and prices of soybean found that the arrivals and prices of soybean in general varied in opposite side to each other and having a definite trend.

Pal (2002) reported that the correlation between arrivals and whole sale prices of gram was negative and non-significant at 5% probability level in Chandali district of U.P. The study in this section revealed that quantum of arrivals of pulses was more in the season followed immediately after harvest and lower in the subsequent season of the year. Market arrivals and wholesale prices were negatively correlated.

Kumar (2003) studied relationship between arrivals and prices of onion in selected markets of India from 1994-2000. The results revealed that the arrivals fluctuated to a great extent and prices had a tendency to rise in all the markets during the study period. The correlation coefficients between yearly arrivals and prices of onion were found to be negative and significant over the years in most of the markets. This indicated inverse relationship between market arrivals and prices.

Verma *et al.* (2004) in their study on relationship between market arrivals and prices of onion in Indore market (1996-2002) observed positive correlation between arrivals and prices from 1999 to 2002, and negative correlation from 1996 to 1999, which indicated that increase in arrivals lead to reduction in price and decrease in arrivals of onion lead to increase in prices. Price of onion was the lowest in the month of April followed by May.

Rathore (2011) reported that the computed values of correlation coefficient between seasonal arrivals and prices showed clear cut relationship between arrivals and prices of soybean. The values of 'r' for the all four seasons were positive and significant indicating the existence of relationship between the variables under consideration. Especially in peak, mid and lean season, the supply varied directly with the seasonal prices.

2.4 Market Integration

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

Thakur (1974) studied food grain marketing efficiency in Gujarat. To estimate the market integration, he computed the correlation coefficients between wholesale prices of ten markets. He found that only three markets showed higher correlations between wholesale prices for paddy as compared to bajra and jowar. The correlation coefficients of prices series between different markets were high, which pointed out to a high degree of pricing efficiency.

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

Yogisha *et al.* (2006) studied market integration for major agricultural commodities by employing distributed lag model, which was superior over correlation analysis. Distributed lag model of potato prices resulted that, Chickballpur market took less than a day to transfer the prices signals from Bangalore followed by Srinivaspur (93.48 days), Chintamani (13.03 days) and Kolar (16.18 days). In case of onion, chickballpur took 1.38 days followed by Chintamani (4.38 days), Kolar (7.45 days) and Srinivaspur (7.93 days) to reflect Banglore onion prices. Kolar took 8.34 days to reflect Bangalore ragi

prices. In case of groundnut prices, Kolar took less than 6 days and it was highest (16.01days) for Srinivaspur market.

Thaung and Choi (2007) investigated the performance and efficiency of marketing system of chickpea, green gram and pigeonpea in each selected township. Study assessed the spatial market price integration to evaluate the performance of pulses marketing in Myanmar. The percentages of co-integrated can be seen 57% for chickpea, 65% for green gram and 85% for pigeonpea. It can be concluded that there exit the long-run- co-integration for pigeonpea price correlation and moderately co-integration for both chickpea and green gram within the Yangon and Mandalay markets.

Moe et al. (2008) studied the impact of agricultural market reform on pulses market integration in Myanmar. The analysis was carried out by using Johansen's multivariate co-integration method and Granger causality test. All price series were integrated at order 1. One co-integration equation was found in long-run for all markets, but there was disequilibrium condition in short run market integration. Mandalay prices Granger caused all prices of markets of black gram and green gram, and Yangon prices Granger caused all markets except Myingyan in pigeonpea. Yangon and Mandalay markets are the leading markets for price formation.

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

Manohar *et al.* (2012) examined the market integration and price behaviour in maize markets. They collected monthly wholesale price data from January, 2005 to 2009 of Maize were used for study. They examine the degree of special integration in the regional maize markets of Rajasthan. The result shows that the correlation coefficient in monthly wholesale prices of maize between all the selected market pairs was positive and significantly

different from zero. The value of correlation coefficients among prices of maize in most of market pairs ranged between 0.76 and 0.91 proving thereby that the selected markets were highly integrated. The maize prices in some markets moved independently of corresponding market which might be due to non-movement of produce from one market to the other. In order to achieve the goal of integration, government should strengthen the market intelligence and communication within markets. Also, for better integration among the markets, infrastructural facilities should be improved.

Jalikatti *et al.* (2013) conducted study on price integration of onion in major markets of Northern Karnataka. The study was conducted during the year 2011-12 based on the secondary data. The markets for the study were selected based on the maximum quantity of arrivals of onion to the markets and the major markets of onion in Northern Karnataka are Hubli, Belgaum, Bijapur and Raichur. The price data pertaining to the study was collected from the respective APMC for a period of 15 years (1996-97 to 2010-11). Zero order correlation matrix was employed to assess the extent of integration between the markets and respective price. The study reveals that Hubli market would influence the prices in Belgaum market to a greater extent. This is mainly because Hubli is a major market for onion.

Mayaka (2013) analysed co-integration in Kitale and Nairobi markets using deflated and seasonally adjusted monthly average price data over 216 months (1994 to 2011) the study presented trade between surplus and deficit markets by applying co-integration, Granger causality and the TAR model to present the relationship between the four markets. Result shows that all markets were integrated of order zero before differencing. Co-integration test revealed that all the markets were co-integrated while granger causality test confirmed independent causality with only one market link showing bidirectional causality leading to symmetric price adjustment between Kitale and Nairobi markets.

Jodalli and Yeledhalli (2015) examined integration of groundnut in different markets. The prices of groundnut between the markets are highly integrated in terms of price movement. This clearly indicates that the prices are governed not only based on arrivals, but also on other factor like

transportation and communication network. Integration of markets thus, helps to bring about stabilization in prices and also to create a favourable and healthy competitive environment in the market. This can be achieved successfully by strengthening the services like market information and intelligence system, providing storage facilities and improving the market infrastructure facilities etc.

Chen *et al.* (2016) investigated market integration and asymmetric price transmission in the world rice export markets using monthly rice price from Thailand, Vietnam and United states, they employ the Johansen test and estimate the threshold vector error correction model (TVECM). Their main findings are that exports price in the three countries are co-integrated, with Thailand and the United States the price leaders, and that the Vietnamese price adjusts faster to long-run equilibrium when it is above its equilibrium level with Thailand U.S. prices. The result suggested that, marketing ration and competition rather than collusion are prevalent in world rice markets.

Chapter – III

MATERIALS AND METHODS

MATERIALS AND METHODS

Methodology is of vital importance in scientific investigation. The research requires applying an appropriate method and procedure for conducting investigation, analysis and interpretation. It includes selection of study area, selection of mandies, nature of data collection, analytical techniques employed in justifying the objectives of the study. The methodology adopted in this study is outlined as follow.

3.1 Selection of study area
3.2 Selection of mandies
3.3 Collection of data
3.4 Period of the study
3.5 Analytical tools

Section I

3.1 Selection of study area

The area selected for this study was Vidarbha region of Maharashtra because this region accounts for 48% of area of the pigeonpea. Vidarbha region has 11 districts (Amravati, Akola, Buldhana, Yavatmal, Washim, Bhandara, Chandrapur, Gadchiroli, Gondia, Nagpur, Wardha) divided into two divisions (Amravati and Nagpur) , among 11 districts Amravati district was selected on the basis of maximum area and production of pigeonpea and maximum arrivals in market for last three years.

3.2 Selection of mandies

The top five APMCs were selected from Amravati district for the present study on the basis of arrival of pigeonpea. The secondary data were collected on arrival and prices during last ten years from five APMCs *viz.,* Amravati, Achalpur, Anjangaon, Daryapur, Dhamangaon.

3.3 Collection of data

The monthly data on arrival and price from selected APMCs were collected personally. As the study was based on secondary data, the required information on market arrivals and prices of pigeonpea crop was collected

from the annual reports of the selected Agriculture Produce Market Committee (APMC's). The required secondary data were also collected from published record and marketing websites i.e., www.agmarket.nic.in.The secondary data on area , production , productivity of pigeonpea for Amravati district were collected from District Statistical office and official websites.

3.4 Period of the study

The collected secondary data pertains to the periods from 2009-10 to 2018-19. The secondary data on area, production and productivity of pigeonpea is collected for the same period.

3.5 Method of analysis

The collected data as per objectives were analyzed using the statistics which provides various tools to look into the variables at depth. The tools used in this study have been spelled out as follow:

3.5.1 Growth pattern of production component of pigeonpea

Growth pattern of pigeopea for Amravati district was analyzed using following tools.

- Absolute change: - One of the best method for observing comparison of change over time/region/crop by estimating absolute change. This can be worked out using the base and current year data of the given period. Absolute change explains the overall variation in components of production from base year.

  Absolute change = Yn – Yo

- Relative change: - The absolute change does not explain comparative change amongst the components of production, hence relative change were worked out. Relative change has been worked out using following formula which is a good measure for depicting change.

$$\text{Relative change (\%)} = \frac{Yn - Yo}{Yo} \times 100$$

Where,

Yn = TE average (2016-17 to 2018-19)

Yo = TE average (2009-10 to 2011-12)

- Linear trend: - To estimate the linear trend the following equation was fitted to know the trend in production component of pigeonpea.

$$Y = a + bt$$

Where,

Y = Area, production, productivity, arrivals, prices

a = Constant

b = Regression coefficient

t = Time variable

- Linear Growth rate

$$LGR(\%) = \frac{b}{y} * 100$$

Where,

b = regression coefficient

y = average area/production/productivity

3.5.2 Price behaviour and inter relationship between production components

For examining the pattern of market arrival, price behaviour and inter relationship between production components the following statistical measures were used.

- Mean: - It is a very useful statistical measure to measure central tendency of a sample. The most common average used is :

$$\overline{x} = \frac{\sum x}{n}$$

Where,

$\overline{X}$ = Mean of the distribution

Σx = Sum of the total values

N = number of the items in the series

- Co-efficient of variation: - Coefficient of variation is the percentage variation in around the mean. The coefficient of variation of market arrivals and prices were worked out for comparing the variability present in market arrivals and prices.

$$CV = \frac{S.D.}{Mean} \times 100$$

Where,

SD = Standard deviation

Mean = Arithmetic mean

CV = Coefficient of variation

- Regression:- Regression is a set of statistical processes for estimating the relationship between a dependent and one or more independent variables. For this study simple regression is workout between production and annual arrival of pigeonpea in the market for Amravati district and talukas of the district.

3.5.3 Relationship between arrivals and prices

- Correlation coefficient:- Correlation analysis was adopted to assess the relationship between arrivals and prices of pigeonpea in Amravati district. The coefficient of correlation was calculated by using the following equation.

$$r = \frac{n\,(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{(n\Sigma x2 - (\Sigma x)2)(n\Sigma y2 - (\Sigma y)2)}}$$

- Regression: - Regression is a set of statistical processes for estimating the relationship between a dependent and one or more independent variables. It is used for estimation of rate of change in prices due to pattern of arrival.

$$b = \frac{\Sigma(xi - x)(yi - y)}{\Sigma(xi - x)2}$$

3.5.4 Market Co-integration

Johansen's Co-integration Test

The market arrivals and prices vary between different markets and regions due to localization, market segmentation, variations in weather and other factors. The monthly arrivals and prices data used for Co-integration tests start with the premise that for a long run equilibrium relationship to exist between the two variables and they should have the same temporal characteristics. Thus, the first step involves testing for stationary of variables. In econometrics, a time series that has a unit root is known as a random walk

which is an example of non-stationary series. If the original series is found to be non- stationary, the first differenced of the series are tested for stationary.

The extent of integration will determine the arrivals and prices of pigeonpea markets are in party with the different markets. Co-integration between the arrivals and prices of the major markets were evaluated by regressing the arrivals and prices of pigeonpea in different markets. The residual was examined for the order of integration in that of Engle and Granger (1987). The basic relationship that is commonly used to test for the existence of market integration is

$$P_{it} = \alpha_o + \alpha_1 P_{Jt} + \varepsilon_t$$

Where,

P_i and P_j = price series of pigeonpea in two markets I and j

ε_t = residual term

Profile of Study Area

Section II

3.1 State Profile

Maharashtra is a state in the western peninsular region of India occupying a substantial portion of the Deccan Plateau. It is India's second-most populous state and third-largest state by area, spread over 307,713 km^2 (118,809 sq miles), and includes the major cities Mumbai, Pune, Nashik and Nagpur. The name, Maharashtra first appeared in a 7th century and the state was formed in 1st May 1960 with Bombay as the capital. Maharashtra is divided into 36 districts, which are grouped into six divisions. Geographically, historically, and according to political sentiments, Maharashtra has five main regions**:**

- Vidarbha - (Nagpur and Amravati divisions) - (Old Berar Region)
- Marathwada - (Aurangabad Division)
- Khandesh and Northern Maharashtra Region - (Nashik Division)
- Konkan - (Konkan Division)
- Paschim Maharashtra Region - (Pune Division)

3.1.1 Profile of Amravati District

Vidarbha is the north-eastern region of the Indian state of Maharashtra, comprising Nagpur and Amravati Division. Amravati division's former name is Berar (Varhad in Marathi). It occupies 31.6% of the total area and holds 21.3% of the total population of Maharashtra. Amravati is a city in the Indian state of Maharashtra. Amravati is the second largest and populous city of Vidarbha region of Maharashtra after Nagpur. Amravati is located at 20.93°N and 77.75°E. It has an average elevation of 343 meters (1125 feet). It lies 156 km (97 miles) west of Nagpur and serves as the administrative centre of Amravati District and of Amravati Division.The area of study has been confined to major pigeonpea producing district in the Vidarbha region of Maharashtra including, Amravati district in which five APMC's Amravati, Anjangaon, Achalpur, Daryapur and Dhamangaon was selected on

the basis of maximum area and production of pigeonpea and maximum arrivals in market for last three years.

3.1.2 Climate and Rainfall

Amravati has a tropical wet and dry climate with hot, dry summers and mild to cool winters. Summer lasts from March to June, monsoon season from July to October and winter from November to March. The average annual rainfall in the district is 877.4 mm (34.54") in the plains. The normal annual rainfall over the district varies from 700 mm to about 1700 mm. It is the minimum in the south western parts of the district around 709 mm in Daryapur. This increases towards north and reaches a maximum in the northern part around Chikaldhara (1647 mm). The average rainfall for the last ten years ranges from 712 mm (Daryapur) to 1407 mm (Chikhaldhara). It is observed that the average annual rainfall for the last ten years of the district is much less than the normal annual rainfall. Thus the rainfall has definitely decreased in the district over the period of time.

3.1.3 Demographic Feature

As per the Census 2011, the district has an area of 12210.0 sq.kms and a population of 2,888,445 persons. While the area of the District accounts for 3.97 percent of the total area of the State, the share of population of District is 2.57 percent of the total population of the State with the density of population is 236.6 persons per sq. km. The district has literacy level of 87.38%. The details are given table 3.1.

Table 3.1: Demographic particulars of Amravati district (2018-19)

Population			Area (sq km)	Density (Per sq km)	Sex Ratio (Female per 1000 males)			Literacy Percentage	
Male	Female	Total	12210.00	236.6	Rural	Urban	Total	Male	Female
1,480,768	1,407,677	2,888,445			947	957	951	91.46	83.10

Source: Directorate of census operation Maharashtra (2011)

3.1.4 Land Utilization Pattern

Major soil types are deep black soil, medium deep black soil, and shallow black soil. Main source of income in the Amravati district is from the agriculture sector and per capita income is Rs. 79945. The geographical area of Amravati district is 12.22 lakh hectare out of total geographical area, about 3.91 per cent of land is under non agricultural usage i.e., barren and uncultivable land and land under non-agricultural use.

Table 3.2: Land utilization pattern of Amravati district

Sr. No	Particulars	Area ('00' ha)	Percent
1	Geographical area	12217	100.00
2	Area under forest	3101	25.38
3	Barren and uncultivable land	195	1.59
4	Permanent pastures and other grazing land	531	3.91
5	Land under misc. tree crops	70	0.57
6	Cultivable waste land	93	0.76
7	Land under non-agricultural use	435	3.56
8	Current fallow	136	1.12
9	Other fallow	143	1.18
10	Net sown area	7513	61.49
11	Area sown more than once	2776	22.72
12	Gross cropped area	10289	84.21
13	Cropping intensity	136.95 %	-

Source: Land utilization statistics of Maharashtra state 2017-18

About 3.56 per cent land is under other uncultivable land excluding fallow land i.e., permanent pasture and misc. trees and groves. 1.12 per cent of land is under current fallow and other fallow where as 61.49 per cent is net area sown with cropping intensity of 136.95 per cent.

3.1.5 Cropping Pattern

This district produces major crops like soybean, cotton, pigeonpea, sorghum, green gram, chickpea, and wheat. Amravati is the main growing region for the cotton and pigeonpea. Also various horticultural crops, medicinal and aromatic crops are cultivated in the area. The information on area under different crops grown in Amravati district was furnished in the table 3.3.

Table 3.3: Cropping pattern of Amravati district (2018-19)

Sr. No.	Season and Crops	Area (Ha)	Percentage to GCA
1.	Paddy	103	1.01
2.	Jowar	245	2.39
3.	Wheat	1318	12.80
4.	Other cereals	306	2.99
	Total Cereals	**1972**	**19.18**
5.	Gram	562	5.46
6.	Pigeonpea	1087	10.56
7.	Other pulses	986	9.58
	Total pulses	**2635**	**25.60**
	Total food Grain	**4607**	**44.77**
8.	Groundnut	167	1.62
9.	Safflower	163	1.58
10.	Sunflower	148	1.43
11.	Soybean	1664	16.17
	Total Oilseeds	**2142**	**20.81**
12.	Cotton	3488	33.90
13.	Sugarcane	52	0.50
	Total Nonfood Grain	**3540**	**34.40**
	Net sown area	7513	61.49
	Sown more than once	2776	22.72
	Gross cropped area	10289	84.21
	Cropping Intensity	136.95%	

Source: District socio-economic survey 2018-19

3.1.6 Irrigation sources

Irrigation is the important input playing a crucial role in pushing up the crop yields. This is necessary to develop the agriculture for the economic development. Rivers, wells, bandharas and minor projects are the main sources of irrigation in the district. Various rivers streaming through the district act as main source of irrigation like Wardha, Purna, Tapti, etc.

Table 3.4: Total irrigation project in Amravati district

Major	1
Medium	4
Minor	65
Total	70

Table 3.5: Source-wise area under irrigation

Sr. No.	Sources	Area (ha)
1.	Surface irrigated area	2340
2.	Wells	44700
3.	Irrigation through other sources	15329
4.	Total area under irrigation	59829
5.	Net sown area	7513
6.	Percentage of irrigated area to net sown area (%)	7.96

(Source: Socio-economic review and district statistical abstract of Amravati district 2018-19)

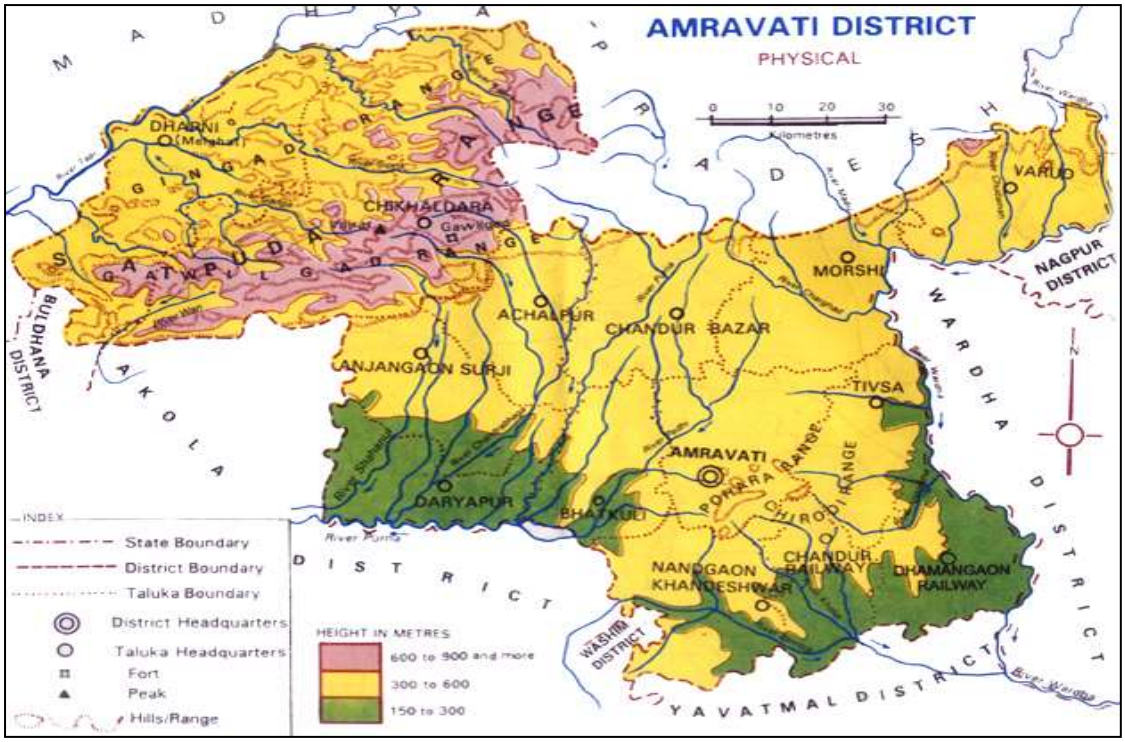

Fig. 3.1: Physical map of Amravati district

Fig. 3.2: Map of Amravati district

Chapter - IV

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

This chapter deals with the results obtained from the analysis of secondary data within the limits of the objectives of the present study. In this chapter the findings of this study are presented with following objectives.

4.1 Growth pattern of pigeonpea production components

4.2 Pattern of market arrival, price behaviour and their relationship with production components

4.3 Relationship between arrival and price of pigeonpea

4.4 Spatial co-integration among major markets of pigeonpea in the region

4.1 Growth pattern of pigeonpea production components

The growth in area, production and productivity for pigeonpea in district using of time series data. The absolute and relative changes in the current year over the base year during the study period (i.e. 2009-10 to 2018-19) were also workout. The data on the same are presented in tables from 4.1 to 4.4.

Table 4.1: Changes in area, production and productivity of Pigeonpea in Amravati district

Indicators	Base year	Current year	Absolute Change	Relative Change (%)
Area (000'ha)	1164.00	1159.07	-04.93	-00.42
Production (000' tons)	907.67	1278.57	370.91	40.86
Productivity (kg/ha)	788.00	1099.93	311.93	39.59

Base year (2009-2010 to 2011-12) and current year (2016-17 to 2018-19)

The data presented in table 4.1 shows that there was absolute change of -4.93 thousand ha and relative change was -0.42 % in area for pigeonpea in Amravati district which shows decline in area of pigeonpea crop in the district mainly due to introduction of soybean crop. As far as absolute change (370.91 thousand tons) and relative change (40.86%) in production of pigeonpea is concern, this shows increasing trend and this was mainly due to high absolute change (311.93 Kg/ha) and relative change (39.59%) in productivity of this crop despite reduction in area.

The trend coefficient with respect to area, production, productivity of pigeonpea for the Amravati district were worked out using time series data. The information on the same is presented in table 4.2

Table 4.2: Linear trend and growth rates of area, production and productivity of pigeonpea in Amravati district

Particulars	Trend		Linear growth rates
	Constant (a)	Regression coefficient (b)	
Area	1135.04	-01.11 (12.13)^{NS}	-00.10
Production	874.17	26.02 (42.43)^{NS}	02.25
Yield	786.64	20.95 (38.12)^{NS}	02.32

(Figures in parenthesis represent standard error of coefficient b)

NS: Non- significant

It is revealed from the results that with respect to area the regression coefficient is negative and therefore the growth is negative although it is insignificant, showing that there is marginal reduction in area under pigeonpea in the district. On the contrary the production and productivity of pigeonpea shows increasing trend with nearly identical growth rate in Amravati district. Thus, it could be concluded that in Amravati district increasing growth rate in production was observed despite of marginal reduction in acreage and this was mainly on account of increasing growth rate of productivity in the district during the period of the study.

This leads to accept the hypothesis that the production and productivity have a positive trend.

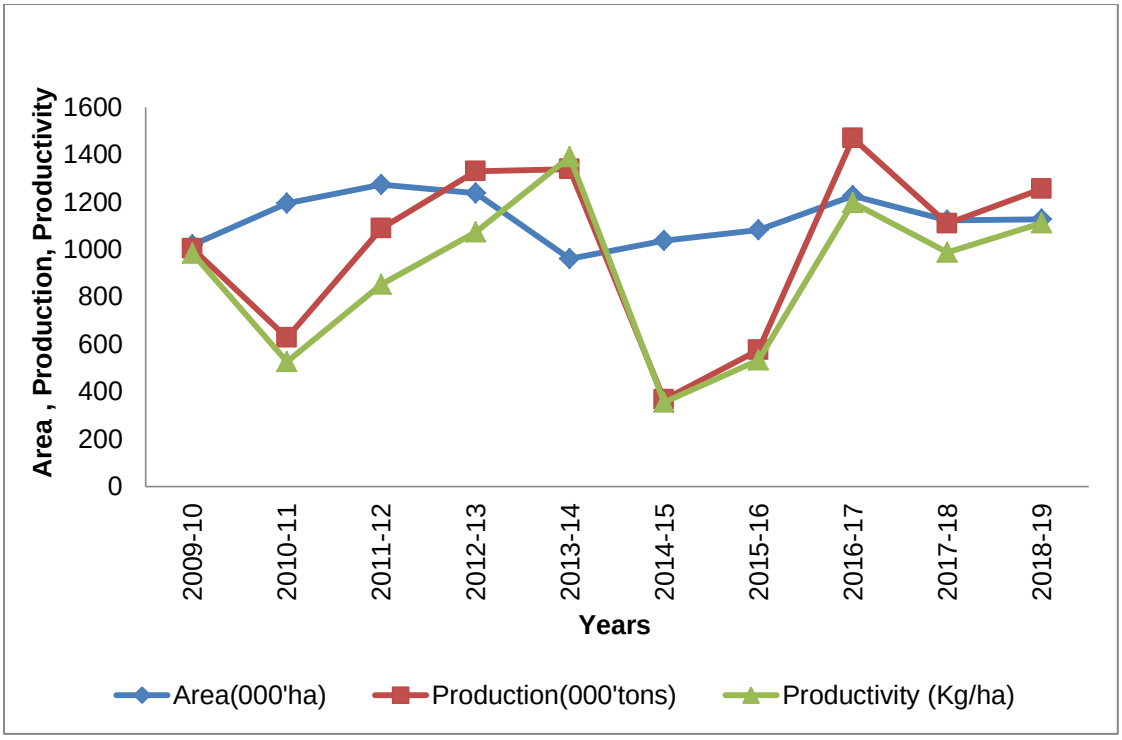

Fig. 4.1: Trend of area, production and productivity of pigeonpea in Amravati district

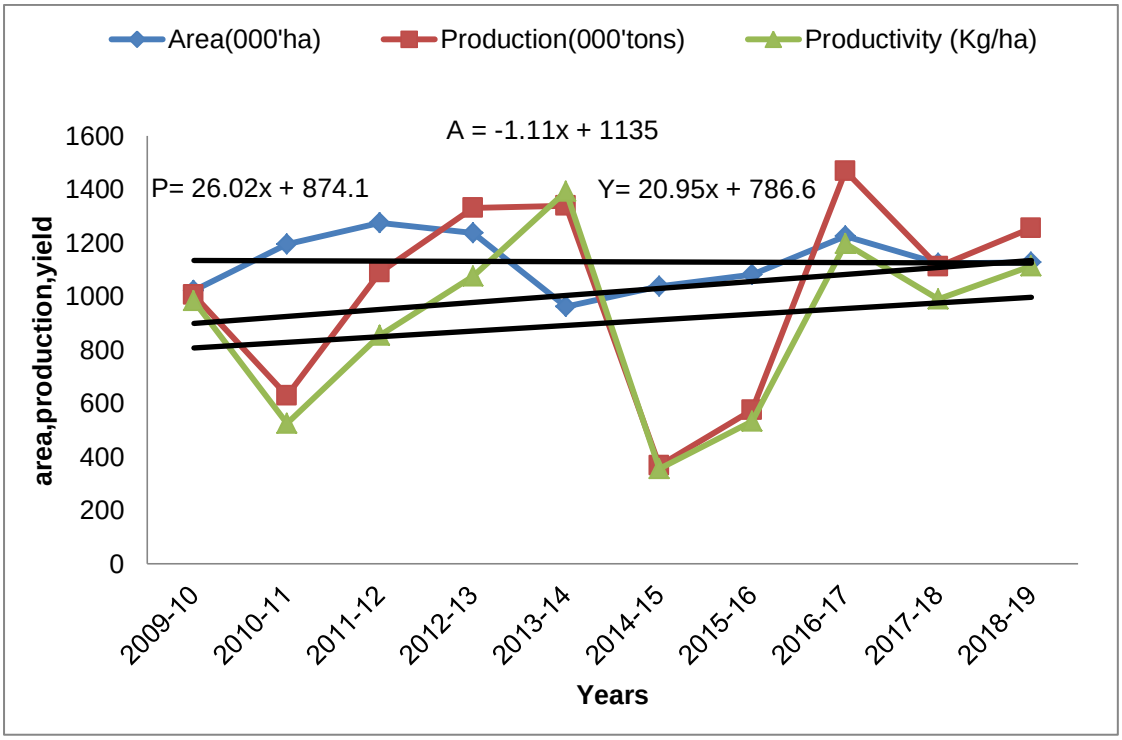

Fig. 4.2: Linear trend in area, production and productivity of pigeonpea in Amravati district

4.2 The pattern of market arrival and price behaviour and their inter relationship between production components

4.2.1 Annual arrival and prices

The trends and variations of annual market arrivals and prices has been analyzed for pigeonpea in selected mandies and data on the same are presented in table 4.3 and 4.4.

In Amravati regulated market, the average annual arrivals during last eleven years was 27399 quintals, with a variation of 85.24%. The lowest annual arrival was reported during the year 2015 (777 q) coupled with highest price of Rs.8837 /q and the highest arrival was reported during 2017 with just half of the price of year 2015. This clearly indicates that farmers' acreage response to higher prices is nullified within two years of the response and a price goes down with increase in arrival.

In Achalpur mandi, the average annual arrivals during last eleven years was 5285 quintals, with a variation of 77.61%. The lowest annual arrival was reported during the year 2014 (190.70 q) but it is not reflected in highest prices during this particular year. The highest arrival was reported during 2013 with moderately high price as compared to prices during past three years. This clearly indicates that in this particular mandi the arrival and prices of pigeonpea are not showing any definite trend.

In Anjangaon market, the average annual arrivals during last eleven years was 4667 quintals, with annual variation of 23.96%. The annual average modal price of pigeonpea was 4423 /q with annual variation in prices to the tune of 32.71%. In this market the highest arrival was reported for the year 2015 and the prices was a highest during the year 2016 for this mandi.

In Daryapur regulated market, the average annual arrivals during last eleven years was 8659 quintals, with an annual variation of 65.86 %. The modal price of pigeonpea was on an average was Rs. 4706 /q with annual variation of 44.21%. The highest arrival was during the 2017 and prices were higheat during the year 2015. In Dhamangaon regulated market, the average annual arrivals during last eleven years was 5124 quintals, with an annual variation of 58.69%. The annual average model price was Rs. 4513 /q with a

variation of 30.87 per cent. The highest arrival was reported for the year 2016 and price was highest during the year 2016.

On overall basis the annual arrival in these mandies was 10227 quintal and price of Rs.4576 /q with variation of 60.67 and 35.04 per cent respectively, revealing that the annual average prices of pigeonpea in the study area are more stable as compared to annual average arrivals. The mandi wise data revealed that the mean annual arrival and prices were higheat for Amravati mandi as compared to other mandies of the Amravati district, revealed that the arrival in mandi is mainly governed by the prices paid in mandi for the produce.

Table 4.3: Variation in annual arrival and model prices of pigeonpea in sample mandies of Amravati district

Years	Amravati		Achalpur		Anjangaon		Daryapur		Dhamangaon		Average	
	AR	MP	AR	MP	AR	MP	AR	MP	AR	MP	AR	MP
2009	8300	3429	9393	3000	2414	3190	3239	3032	1873	3434	5044	3212
2010	16672	3983	2443	4204	5791	3759	9035	3860	3524	3933	7493	3945
2011	13294	3344	8443	3043	4981	3270	13493	3288	7429	2985	9528	3198
2012	11333	3448	7823	3046	3572	3389	11418	3493	4563	3695	7742	3391
2013	28192	3773	10898	3672	4795	4042	6607	2849	4953	4056	11089	3757
2014	5465	4335	190.7	4466	4530	4151	331	4780	1760	4285	2455	4301
2015	777	8837	1168	7649	6278	5744	1982	9018	1930	5905	2427	6612
2016	44205	8613	8382	8058	4309	8125	12508	8281	10418	7906	15964	8387
2017	71546	4474	7528	4335	5927	4009	19979	4051	9776	4627	22951	4379
2018	50458	4053	851	3783	3958	3887	7038	3852	5538	3646	13569	3985
2019	51151	5170	1020	4751	4783	5089	9614	5256	4597	5168	14233	5171
Mean	27399	4860	5285	4546	4667	4423	8659	4706	5124	4513	10227	4576
SD	23355	1984	4102	1744	1118	1447	5702	2081	3007	1393	6205	1604
CV (%)	85.24	40.82	77.61	38.36	23.96	32.71	65.86	44.21	58.69	30.87	60.67	35.04

AR: Annual arrivals (Quintals) and MP Average model prices (Rs/qtls)

4.2.2 Relative change and trend in annual arrival and prices

The data on absolute change, relative change and trend coefficient of annual arrival and prices are presented in table 4.4.

Table 4.4: Relative change in pigeonpea annual arrival and model prices and their trend in sample mandies of Amravati district

Years	Amravati		Achalpur		Anjangaon		Daryapur		Dhamangaon		Average	
	AR	MP	AR	MP	AR	MP	AR	MP	AR	MP	AR	MP
BY	12755	3586	6760	3416	4395	3406	8589	3393	4275	3450	7355	3452
CY	57718	4566	3133	4289	4889	4328	12210	4386	6637	4480	16918	4512
AC	44963	980	-3627	874	494	922	3621	993	2362	1030	9563	1060
RC (%)	352.5	27	-54	26	11	27	42	29	55	30	130	31
b	5113.49**	252.45	-541.7	226.76	93.71	212.68	371.8	264.71	340.04	206.57	1075.47*	239.5
t	3.17	1.39	1.46	1.43	0.87	1.67	0.67	1.39	1.21	1.69	2.11	1.71

BY Base year, CY Current year, AC Absolute change, RC Relative change, r correlation coefficient, b regression coefficient, t Test for b value.

**significant at 1% and * significant at 5%

The data shows that the relative change in annual arrival was highest in Amravati mandi and it was lowest and negative for Achalpur mandi. The relative change in prices per quintal was highest in Daryapur mandi. On an average for all the selected mandies the relative change in annual arrival was 130% and for prices it was 31% revealing that the change in arrival was higher as compared to change in prices.

Regarding the trend in annual arrival in Amravati mandi, it was positive and highly significant showing annual change of 5113.49 quintals. This revealed that the annual increment in arrival of pigeonpeas is very high in Amravati mandi. The trend of annual prices of pigeonpea in this mandi shows that there was annual increment of Rs. 252.45 /q and it is also highest as compared to other selected mandies.

The trend analysis of annual arrival and prices of Achalpur mandi shows that the arrival over the year was decreased annually by 541.73q. On the other hand the prices shows positive trend with annual increment of Rs.226.76/q. This reveals that in the jurisdiction of Achalpur mandi the area under pigeonpea is substituted by soybean and other kharif crops.

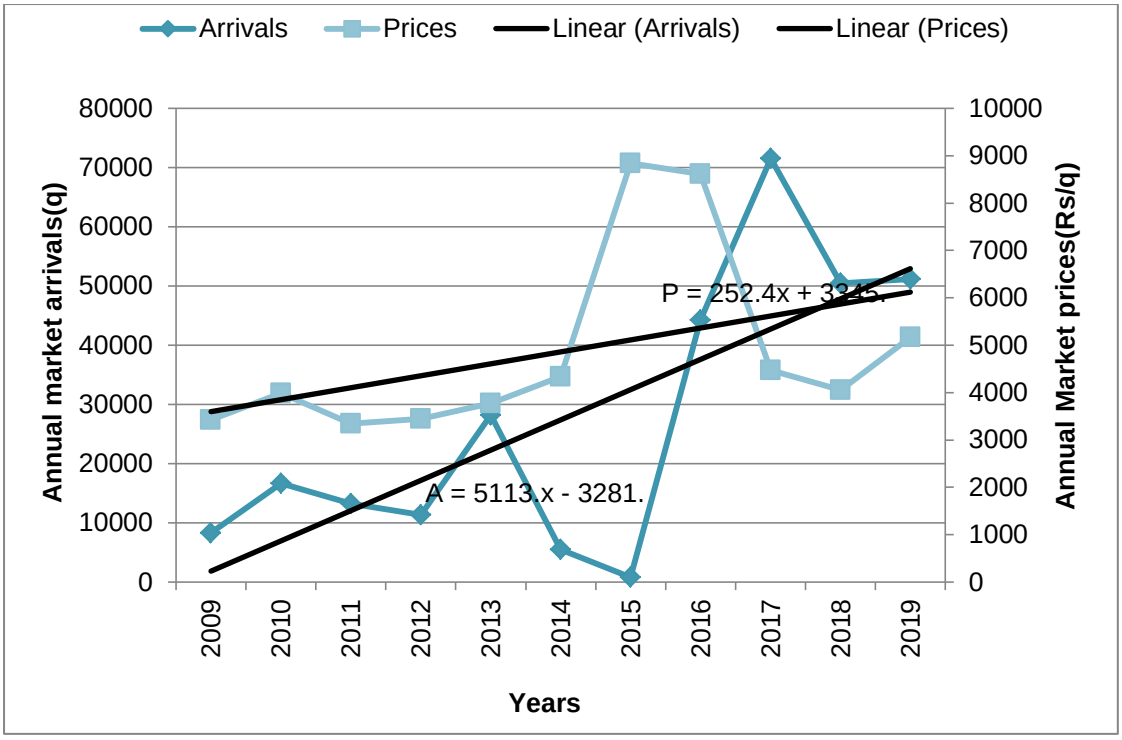

Fig. 4.3: Trend of annual market arrivals and prices of pigeonpea in Amravati market

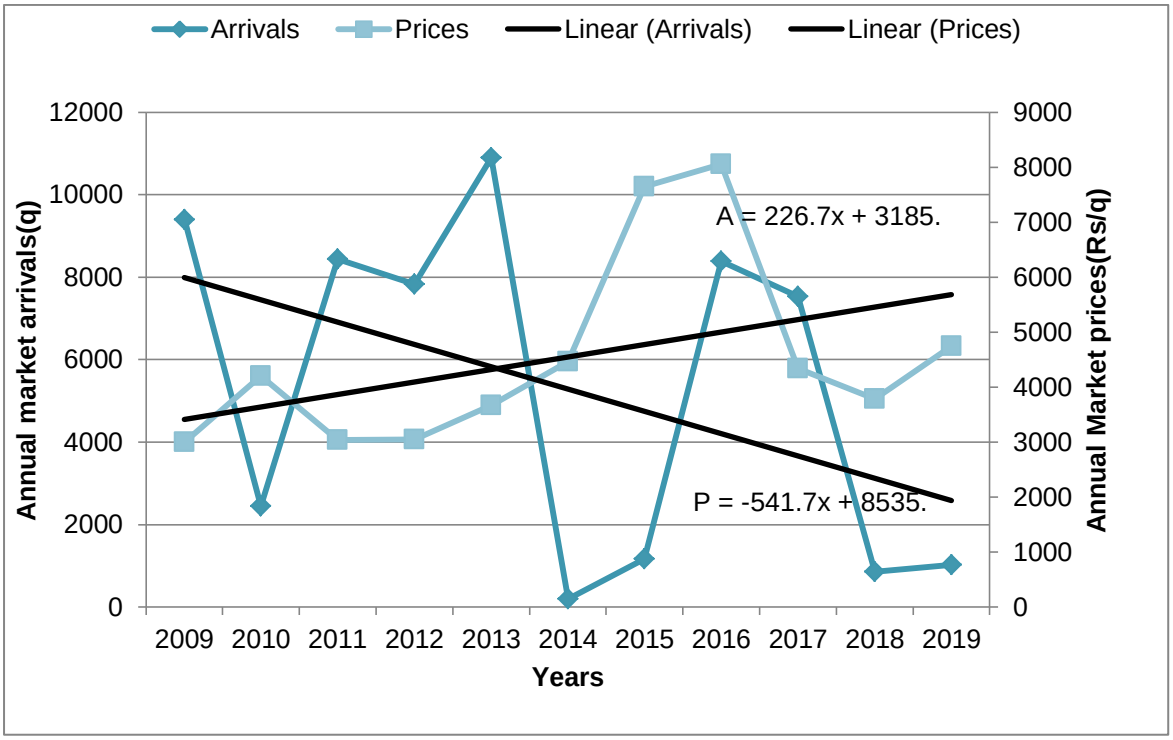

Fig. 4.4: Trend of annual market arrivals and prices of pigeonpea in Achalpur market

In Anjangaon mandi the trend of arrival was positive with regression coefficient of 93.71 and for prices it was 212.68 which was significant at 5 per cent probability level. The relative change in arrival and prices are not sizeable revealing that the arrival and prices of pigeonpean in this mandi is more or less stable during the period of the study.

In Daryapur mandi the relative change in annual arrival was higher as compared to annual prices. The trend value shows positive movement and there was sizeable movement from mean value in annual arrival and prices in this mandi.

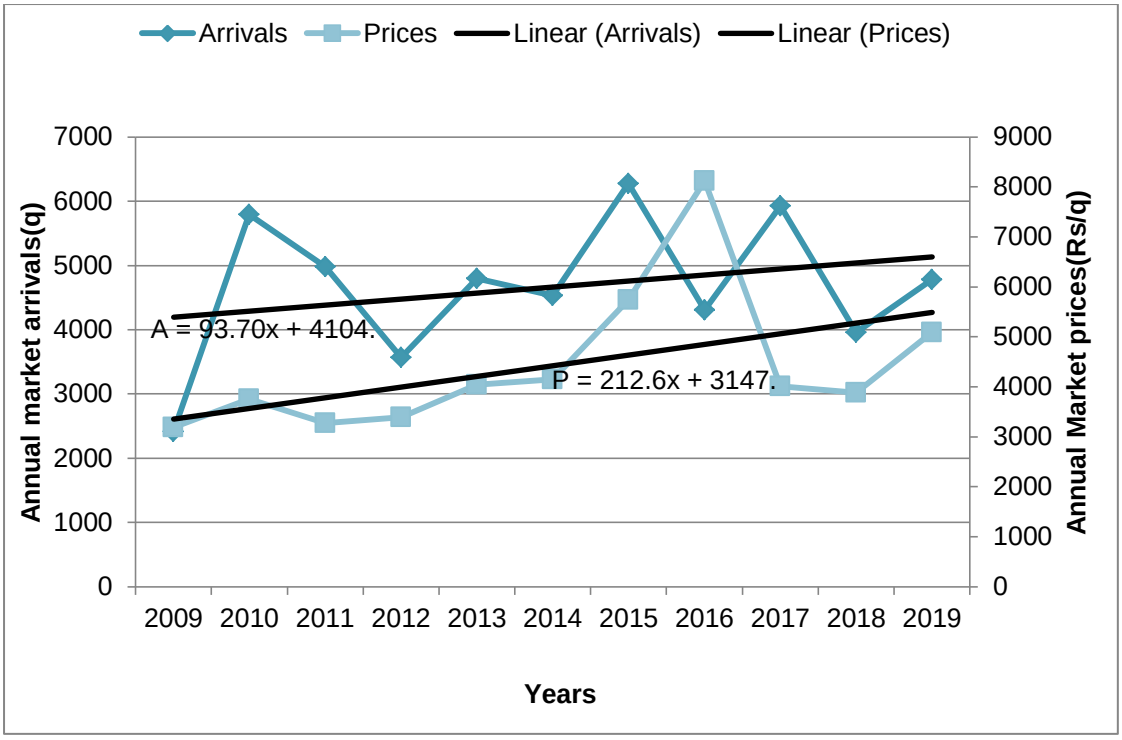

Fig. 4.5: Trend of annual market arrivals and prices of pigeonpea in Anjangaon market

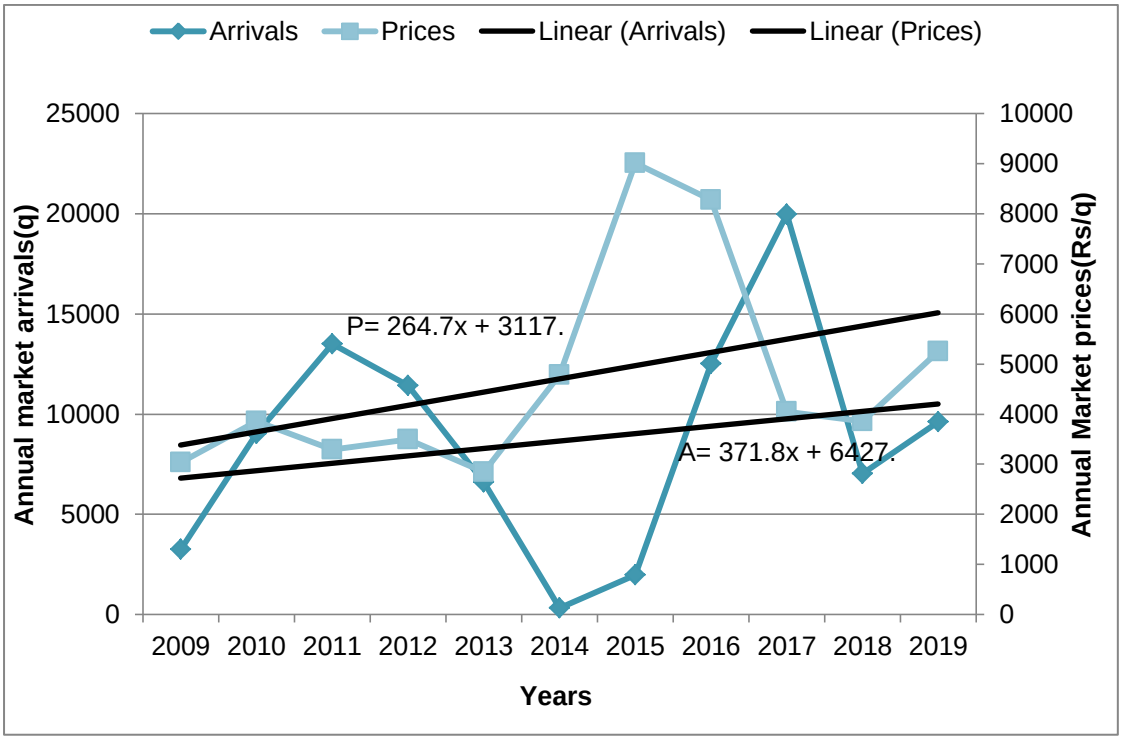

Fig. 4.6: Trend of annual market arrivals and prices of pigeonpea in Daryapur market

In Dhamangaon mandi the relative change in annual arrival of pigeonpea was 55.25% and in prices it was just 30%. The trend coefficient shows that the rate of changes in annual arrival was 340.04 q /annum and for prices it was Rs.206.57/q.

On the basis of pooled analysis it can be revealed that the trend of change in arrival was 1075.47 and it is siginificant at 5 % but for prices the trend value is not showing significant trend. This leads to revealed that the arrival of pigeopea in the mandies of Amravati district increases on account of increase in area and yield of pigeonpea but farmers are not benefiting through increase production on account of relatively lower increase in its prices.

This leads to accept the hypothesis that there is wide variation in arrival and prices of pigeonpea in the study area.

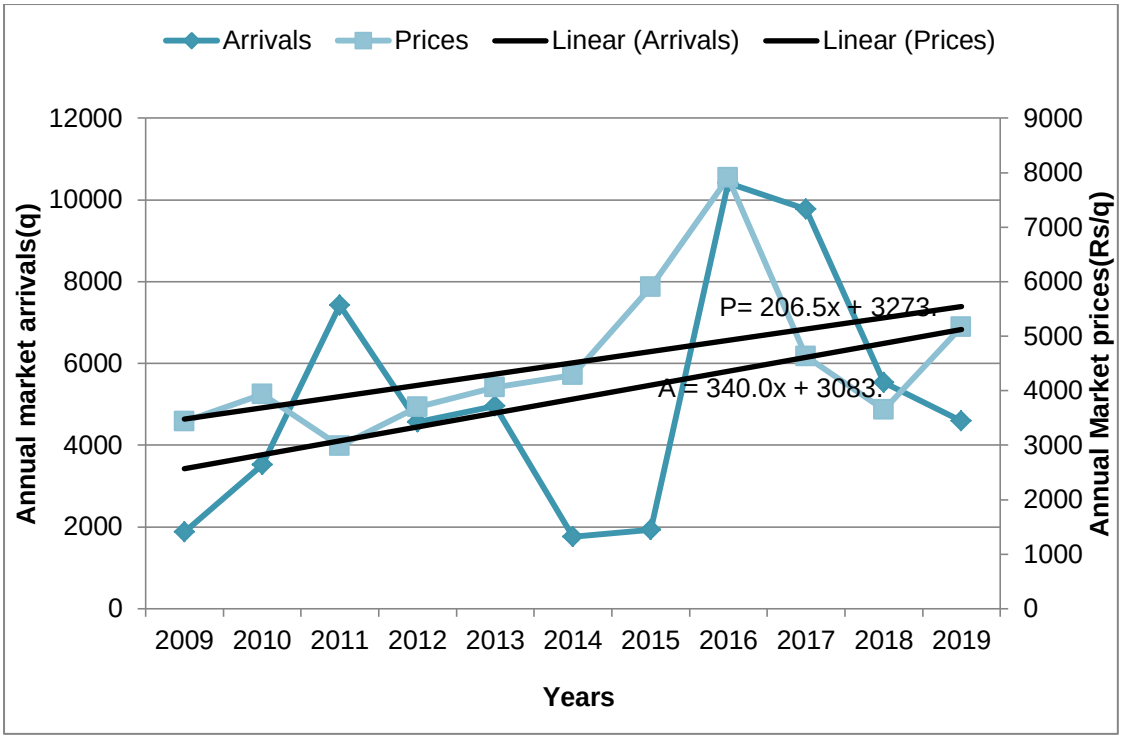

Fig. 4.7: Trend of annual market arrivals and prices of pigeonpea in Dhamangaon market

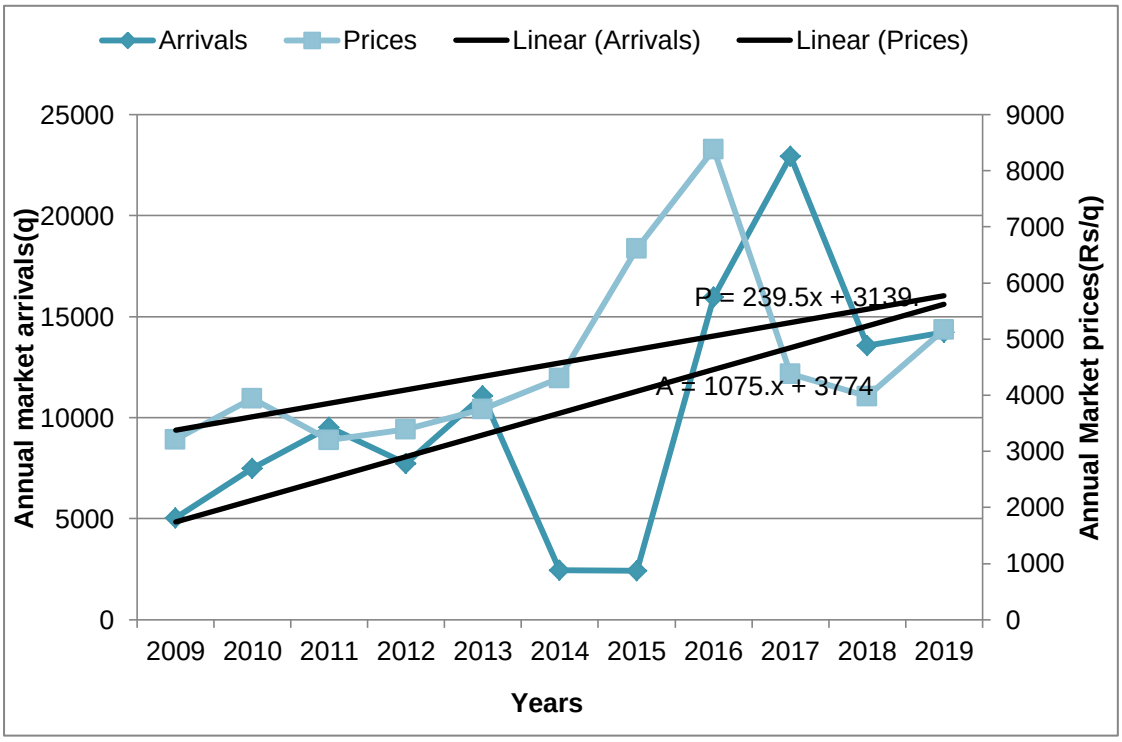

Fig. 4.8: Trend of annual market arrivals & prices of pigeonpea in selected mandies of Amravati district

4.2.3 Monthly arrival and prices

The data on monthly arrival and prices of pigeonpea in selected mandies are presented in table 4.5.

Table 4.5: Variation in monthly arrival and model prices of pigeonpea in sample mandies of Amravati district

Years	Amravati		Achalpur		Anjangaon		Daryapur		Dhamangaon		Average	
	MR	MP	MR	MP	MR	MP	MR	MP	MR	MP	MR	MP
Jan	3199	5762	1211	4675	883	4774	1698	5080	469	6025	1492	4228
Feb	5416	4448	1507	4299	1112	4456	1957	4306	837	4690	2166	3995
Mar	5034	4431	1147	3846	912	4323	1658	4350	611	4742	1872	4717
Apr	4942	5047	956	3408	567	4423	1179	4759	636	4870	1656	4314
May	3424	4912	556	4278	388	4673	875	4502	800	5019	1208	3826
Jun	2892	4934	529	4376	316	4615	848	4666	703	4803	1058	3091
Jul	1517	4505	256	4352	169	4273	443	4281	419	4289	561	2244
Aug	1285	4410	108	3541	129	4104	410	3848	359	4088	458	3544
Sep	1345	5423	120	3441	94	3942	255	4838	372	4128	437	1485
Oct	1021	5616	114	4255	59	3643	204	4360	115	4389	303	3462
Nov	648	5423	61	4801	55	3878	188	17384	67	4440	204	3328
Dec	585	6077	152	3510	96	4914	186	5869	149	4017	233	3264
Mean	2609	5082	560	4065	398	4335	825	5687	461	4625	971	3458
SD	1791	575	516	494	380	386	654	3718	263	550	697	899
CV (%)	69	11	92	12	95	9	79	65	57	12	72	26

MR: Monthly arrivals (quintals) and MP model prices (Rs/qtl)

The data presented in above table shows that the mean monthly arrival in Amravati mandi was 2609q throughout the year and mean monthly prices are Rs. 5082 /q and this was highest among the selected mandies of the district. The variation in monthly arrival was found to be highest in Anjangaon mandi revealing that the variation of arrival was widely spread in this mandi as

compared to other mandies. For monthly prices, the variation was found to be highest for Amravati mandi may be on account of high variability in arrival during different months.

The percentage distribution of mean arrival during different months shows that (Table 4.6) in Amravati mandi more than 60 per cent of the arrivals reached during the period of five months starting from January to May. Remaining <40 per cent is arrived during the reaming seven months. In Achalapur mandi nearly 70 per cent of the total arrival reached in this mandi during the period of four months viz., January to April and remaining is arrived during the period of remaining eight months. In Anjangaon mandi similar trend in arrival was observed. On the other hand in Daryapur mandi first four months of the year are vary fabourable with respect of arrival of pigeonpean in the mandi. On the contrary in Dhamangaon mandi 60 per cent of arrival was during the first four months of the year. On An average it is observed that more than 80 per cent of the arrival received in the mandi during the months of January to June in the Amravati district.

Table 4.6: Pooled percent arrival in different months of pigeonpea in different markets of Amravati district

Month/Market	Per cent to total arrival					
	Amravati	Achalpur	Anjangaon	Daryapur	Dhamangaon	Average
January	10.21	18.03	18.47	17.15	8.48	12.8
February	17.29	22.45	23.26	19.76	15.12	18.59
March	16.07	17.07	19.08	16.74	11.04	16.07
April	15.78	14.23	11.87	11.91	11.48	14.21
May	10.93	8.27	8.12	8.84	14.44	10.37
June	9.23	7.87	6.62	8.57	12.69	9.08
July	4.84	3.81	3.53	4.47	7.57	4.81
August	4.1	1.6	2.69	4.14	6.48	3.93
September	4.29	1.78	1.97	2.58	6.72	3.75
October	3.26	1.69	1.24	2.06	2.08	2.6
November	2.06	0.9	1.16	1.9	1.2	1.75
December	1.86	2.26	2	1.88	2.68	2
Total	100	100	100	100	100	100

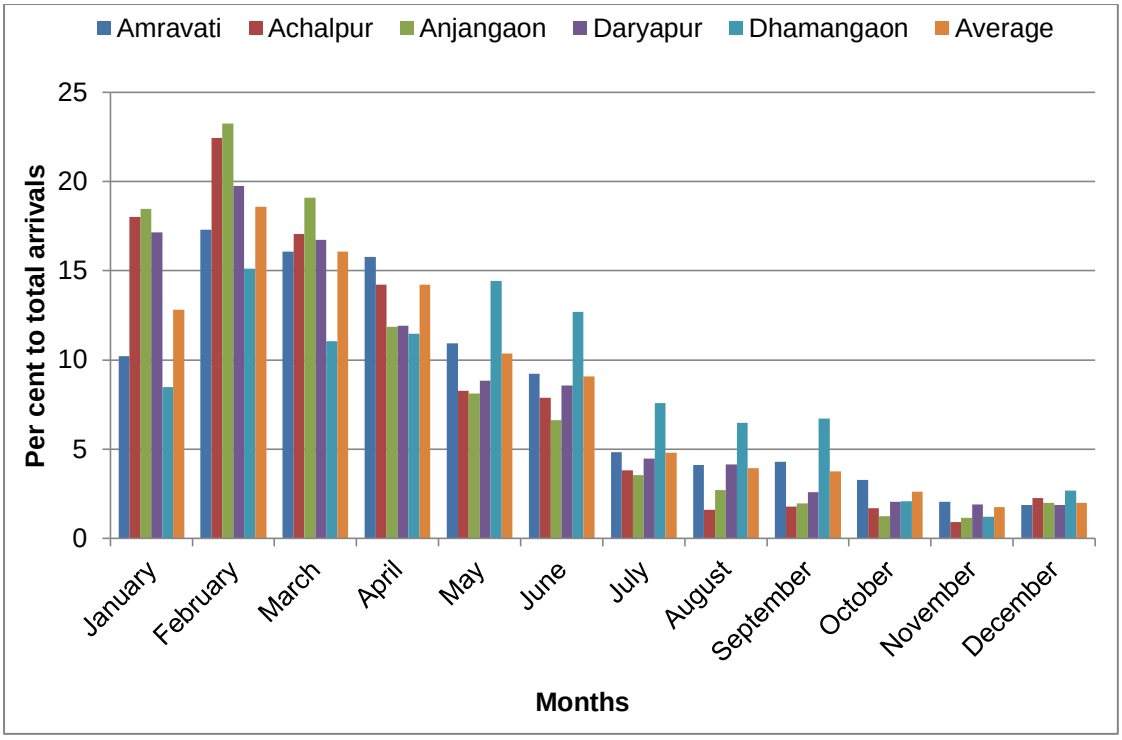

Fig. 4.9: Distribution of monthly arrival to total arrivals of pigeonpea in different APMC

4.2.5 Variability in annual arrivals and prices

The pattern of market arrivals and price behaviour of pigeonpea crop was examined over the period 2009 to 2019 by using mean and coefficient of variation for each of the twelve months and data on the same are presented in the table 4.7.

Table 4.7: Variability in arrivals of Pigeonpea in different months in the selected Markets of Amravati district

Mean= quintals, CV= per cent

Markets	Amravati		Achalpur		Anjangaon		Daryapur		Dhamangaon		Average	
Month	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
January	3199	111	1211	107	883	43	1698	72	469	148	1449	84
February	5416	74	1507	75	1112	41	1957	56	837	61	2014	60
March	5034	90	1147	77	912	48	1658	117	611	59	1689	80
April	4942	109	956	83	567	42	1179	92	636	68	1585	87
May	3424	102	556	86	388	59	875	62	800	100	1146	65
June	2892	74	529	93	316	54	848	64	703	94	955	73
July	1517	91	256	101	169	61	443	93	419	101	506	86
August	1285	114	108	93	129	75	410	105	359	89	477	93
September	1345	98	120	86	94	83	255	68	372	107	458	89
October	1021	102	114	90	59	78	204	99	115	90	272	93
November	648	116	61	135	55	75	188	89	67	94	194	99
December	585	92	152	151	96	115	186	109	149	133	219	85

The analysis across different markets showed that in the Achalpur market the variation in the markets arrivals of pigeonpea was maximum (135% to 151%) during the month of November to December and quite low (75% to 77%) during the month of February to March. The average value of pigeonpea received in Achalpur market was lowest (61 q) in the month of November and it was maximum (1507q) during the month of February. In Amravati market the variation in the arrivals of pigeonpea in term of coefficient of variation was more pronounced. It ranged from 114% in August to 116% in

the November. The average market arrivals ranged from 5416 quintals in February to 5416 quintals in March. This shows that in this mandi arrival is more or less steady during the months of February to April.

The extent of variability in the arrivals was however lower in Anjangaon market as it is evident from relatively small range of coefficient of variation, in February it was 41% to 48% in March. The mean of pigeonpea arrivals varied from 883 quintals in January to 1112 quintals in February and maximum arrivals received during first three months with low variability. As far as Daryapur market was concerned, the variability in arrivals was more pronounced during the month of December (109%) to 117% in March. The mean monthly arrivals ranged from 1698 quintals in January to 1957 quintals in February. In Dhamangaon market the variability was recorded from 133% in December to 148% in January and mean arrivals varied from 800 quintals in May to 837 quintals in February. This revealed that even in off season the arrival is sizable in this mandi. Overall in Amravati district the variability was recorded from 93% to 99% in the month of August to November and quite lowest during the month of February (60%). The average pigeonpea arrival in Amravati district was minimum 194 quintals in the month of November and maximum in the month of February 2014 quintals. Thus overall analysis revealed that variation in monthly arrivals was lower during the harvesting period and more during the sowing period. The quantity arrived in the market also follows the same trend.

4.2.5 Prices variability

The data on monthly prices variability in different selected markets for pigeonpea is presented in table 4.8.

Table 4.8: Variability in monthly prices of Pigeonpea in selected markets of Amravati district

Mean = quintals, CV= per cent

Markets	Amravati		Achalpur		Anjangaon		Daryapur		Dhamangaon		Average	
Month	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
January	4557	36	4243	37	4358	35	4430	36	4435	34	4405	34
February	4503	33	4374	32	4386	31	4624	34	4401	31	4458	31
March	4551	35	4367	29	4403	32	4646	34	4444	30	4482	31
April	4852	33	4278	29	4557	35	4787	36	4605	34	4616	32
May	4597	35	4558	36	4651	35	4982	40	4742	32	4706	34
June	4511	36	4664	37	4583	37	4945	41	4818	34	4704	36
July	4792	32	4698	34	4711	33	5220	43	4769	34	4838	34
August	5121	45	4576	27	4792	33	4607	26	4631	30	4745	32
September	5127	41	4571	29	4684	41	4805	33	4607	32	4759	34
October	4828	61	4789	39	4629	43	4870	39	4563	34	4736	43
November	4542	21	4616	33	4519	28	4891	36	4511	24	4616	28
December	5145	38	4391	37	4321	35	4407	45	4469	28	4547	36

The price variability was measured in term of coefficient of variation. In the Achalpur market the variability was found to be highest during the month of October when there is practically little arrivals in the mandi and it was found to be lowest during August when arrival are sizeable in the market. Whereas, in the Amravati market the price variability was highest in the month of October (61%), and quite low in the month of November (21%). As far as in Anjangaon market is concern the variability in the prices were more are less identical during all the months of the year with minor variation (28 to 41%). This revealed that the prices in this mandi are more stable as compared to other mandies. Similarly in Daryapur and Dhamangaon mandies the variability in prices of pigeonpea during the different months are lower and these are in the range of 24 to 41%. On an average in Amravati district the price variability was noted high during the lean season (October 43%) and it was lowest before the arrival of the produce in the market (November 25%).

4.2.6 Seasonal variations in market arrival and prices

The mismatch between round the year demand and seasonality in the production of crop leads to seasonal variations in prices and arrivals of agricultural commodities. These variations may be entirely due to seasonal production, poor storage facilities and retention power of pigeonpea growers. The data on pattern of seasonal variation in arrivals and prices of pigeonpea in selected mandies are computed using indices and are presented in table 4.9 and 4.10.

The seasonal fluctuations are regularly recurring pattern that are completed once in twelve months. Such seasonality is seen in the arrivals as well as in the prices of farm products (Nahatkar *et al.,*1998). It arises from the nature of production, supply and demand in the markets and price formations for crops. Seasonal variations in arrival and prices that arise from climatic factors and biological growth process of plants are also depicted through indices.

Table 4.9: Seasonal indices of market arrivals of pigeonpea in different markets of Amravati district

(Per cent)

Month/Market	Amravati	Achalpur	Anjangaon	Daryapur	Dhamangaon	Average
January	123	216	222	206	102	154
February	208	269	279	237	181	223
March	193	205	229	201	132	193
April	189	171	142	143	138	171
May	131	99	97	106	173	124
June	111	95	79	103	152	109
July	58	46	42	54	91	58
August	49	19	32	50	78	47
September	52	21	24	31	81	45
October	39	20	15	25	25	31
November	25	11	14	23	14	21
December	22	27	24	23	32	24

The data presented in table 4.9 represents the existence of seasonal variations in the arrivals of pigeonpea in all the selected markets. The peak

season for arrivals in Achalpur, Amravati, Anjangaon, Daryapur and Dhamangaon market were observed during the month of February and lower during the month of November and December respectively.

Table 4.10: Seasonal indices in market prices of pigeonpea in different markets of Amravati district

(Per cent)

Month/Market	Amravati	Achalpur	Anjangaon	Daryapur	Dhamangaon	Average
January	113	115	110	89	130	122
February	88	106	103	76	101	116
March	87	95	100	76	103	136
April	99	84	102	84	105	125
May	97	105	108	79	109	111
June	97	108	106	82	104	89
July	89	107	99	75	93	65
August	87	87	95	68	88	102
September	107	85	91	85	89	43
October	111	105	84	77	95	100
November	107	118	89	306	96	96
December	120	86	113	103	87	94

The arrivals of pigeonpea start striking in the market from the month of December- January and continued for next five months. The peak period of arrivals is January to May. Due to large arrivals during this period the prices starts decline. The lean period is from June to October. The maximum peak prices were observed during the month of September to January in Amravati market, and during the month of May to February in Achalpur, the month of January to June in Anjangaon and November to December in Daryapur and January to June in Dhamangaon markets. The maximum lowest prices is found during the month of February to August in Amravati market ,May to June in Achalpur market and in the month of July to November in Anjangaon, during the month of January to October in Daryapur and July to December in Dhamangaon markets.

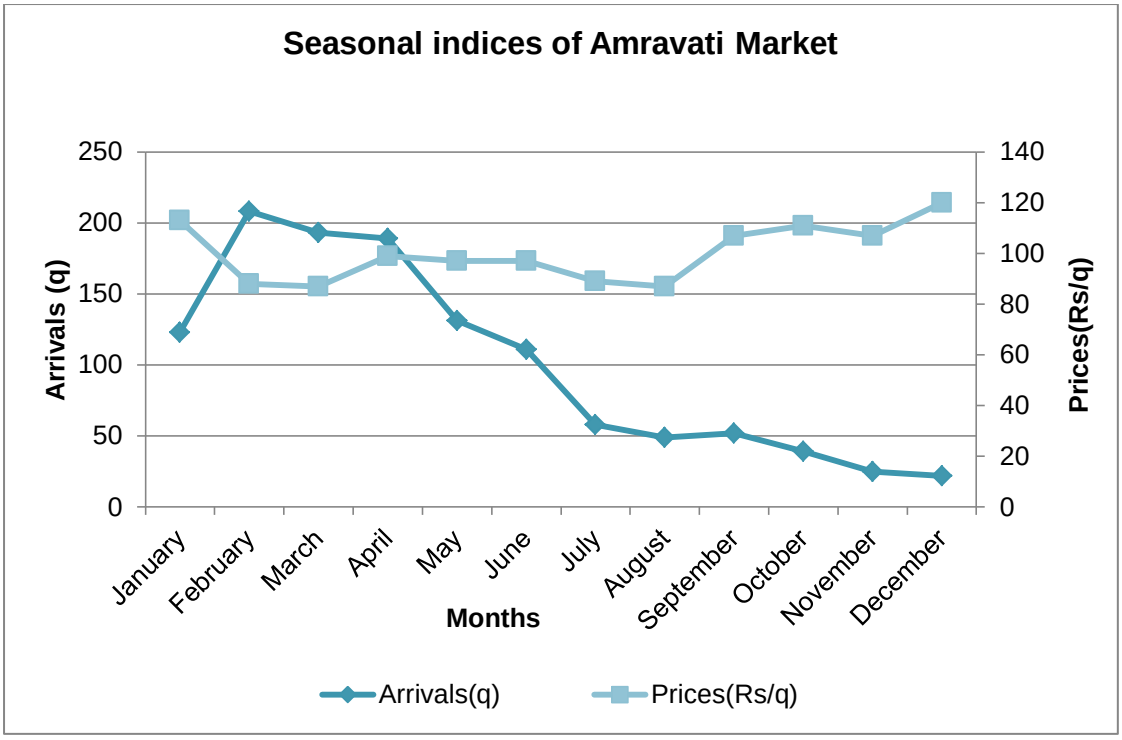

Fig. 4.10: Seasonal indices of market arrivals and prices of pigeonpea in Amravati market (2009-2019)

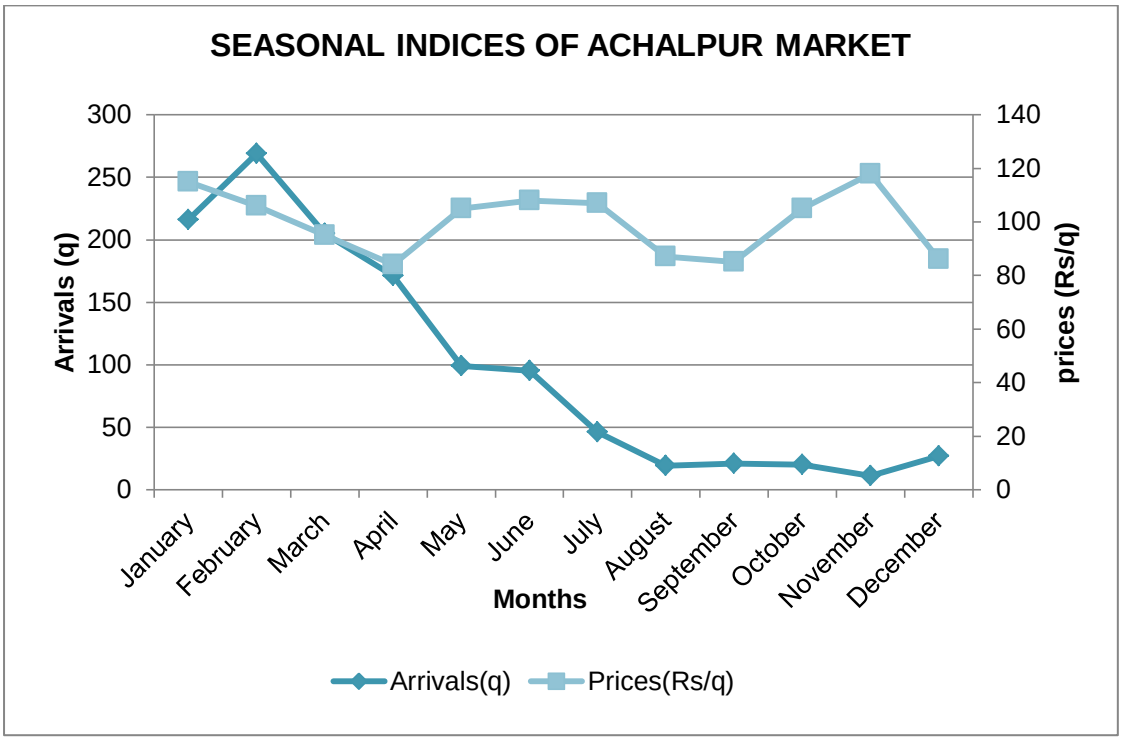

Fig. 4.11: Seasonal indices of market arrivals and prices of pigeonpea in Achalpur market (2009-2019)

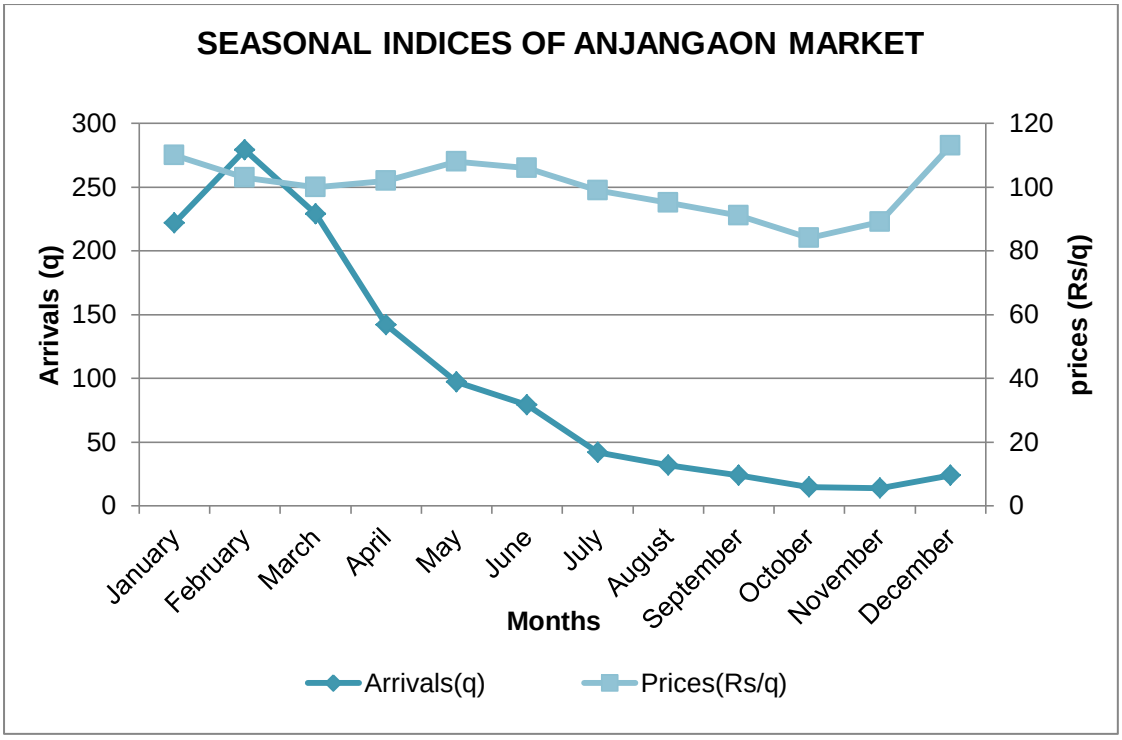

Fig 4.12: Seasonal indices of market arrivals and prices of pigeonpea in Anjangaon market (2009-2019)

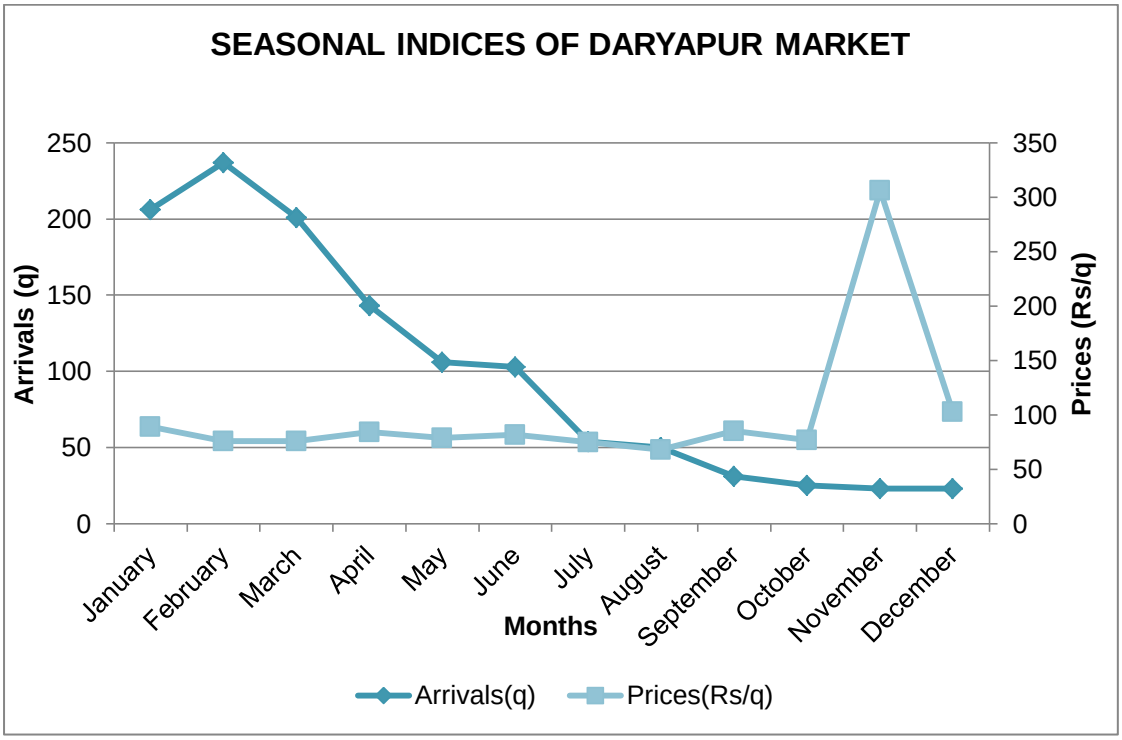

Fig. 4.13: Seasonal indices of market arrivals and prices of pigeonpea in Daryapur market (2009-2019)

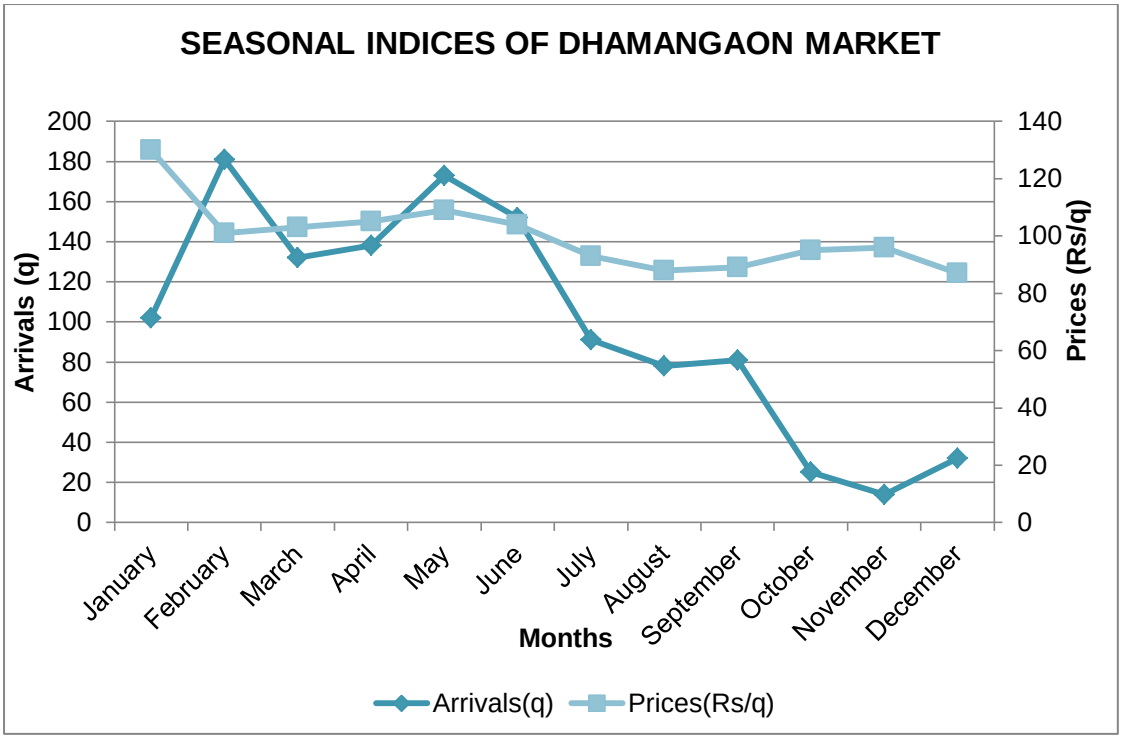

Fig 4.14: Seasonal indices of market arrivals and prices of pigeonpea in Dhamangaon market (2009-2019)

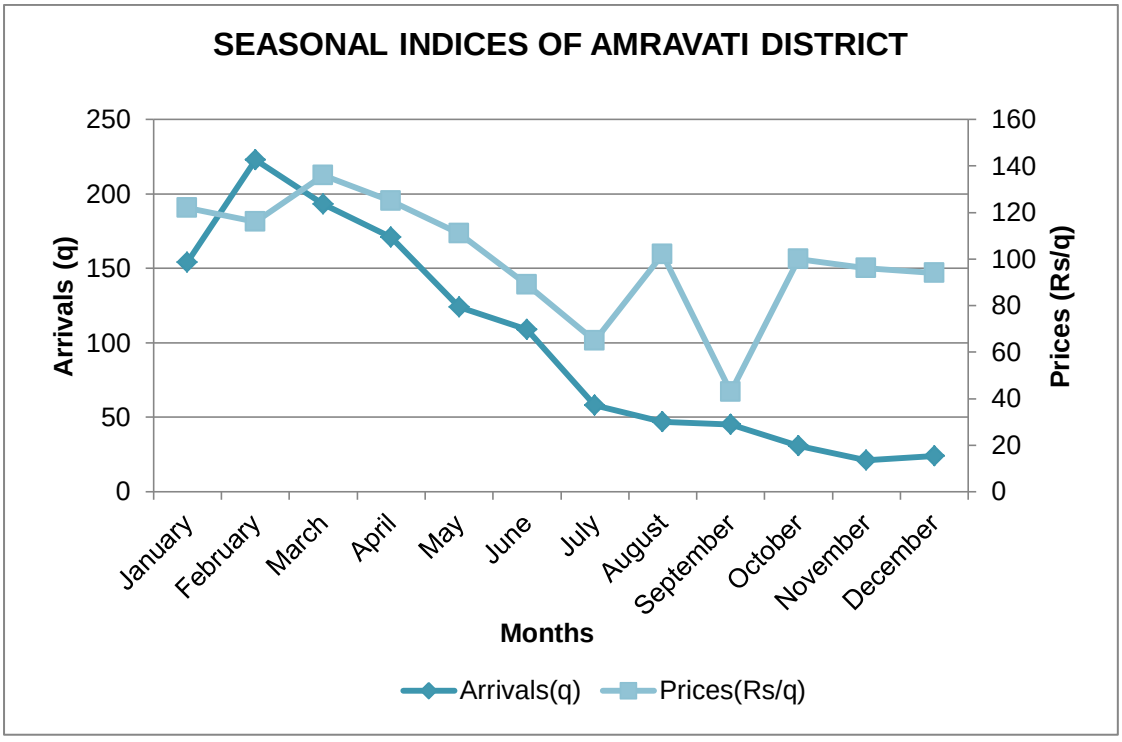

Fig. 4.15: Seasonal indices of market arrivals and prices of pigeonpea in Amravati district (2009-2019)

4.3 Inter relationship of market arrivals and prices with production components

The area of pigeonpea was increased from 1021.00 thousand ha (2009-10) to 1128.10 thousand ha (2018-19) and the arrival were increased from 5043.80 quintals (2009-10) to 13568.60 quintals (2018-19) during last ten years. This shows that on account of technological breakthrough in production specially development of high yielding varieties and hybrids of pigeonpea with appropriate technology help in increasing the production which reflects in increased arrival in the market. The regression coefficient between area and annual arrival were 14.52 and the correlation coefficient between these variables was 0.24 in Amravati district. This revealed that with the increase in area under pigeonpea by one ha the arrival in the market increased by 14.52 q.

The area of pigeonpea were increased from 1021.00 thousand ha (2009-10) to 1128.10 thousand ha (2018-19) and on account of increased area the price were increased from Rs. 3212 /qtl (2009-10) to Rs.3985 /qtl (2018-19) during last ten years. The regression coefficient between area and annual price were - 2.19 and the correlation coefficient between them was - 0.14 in Amravati district. This revealed that the one ha increase in area tends to decline in prices of pigeonpea by Rs.1.26 /q although it is not significant.

Table 4.11: Inter relationship of area of pigeonpea with market arrivals and prices in Amravati district

Year	Area (000'ha)	Arrival (quintals)	Area (000'ha)	Prices (Rs/q)
2009-10	1021	5043.8	1021	3212
2010-11	1196	7493	1196	3945
2011-12	1275	9528	1275	3198
2012-13	1238	7741.8	1238	3391
2013-14	962	11089	962	3757
2014-15	1038	2455.3	1038	4301
2015-16	1082	2427	1082	6612
2016-17	1226.1	15964	1226.1	8387
2017-18	1123	22951	1123	4379
2018-19	1128.1	13569	1128.1	3985
Regression coefficient	14.52		- 2.19	
Correlation coefficient	0.24		- 0.14	

The production of pigeonpea were increased from 1005.00 thousand tons (2009-10) to 1225.40 thousand tons (2018-19) and the arrival were increased from 5043.80 quintals (2009-10) to 13568.60 quintals (2018-19) during last ten years. The regression coefficient between production and annual arrival were 10.97 and the correlation coefficient between them was 0.64 in Amravati district. This revealed that with the increase in production by one thousand ton the arrival is increases by 10.97 tons.

On the other hand with the increase in production the prices of the pigeonpea decrease. The regression coefficient between production and annual price were - 0.30 and the correlation coefficient between them was - 0.07 in Amravati district. This shows that with the increase in production by one ton the prices increase by Rs. 0.30/q although it was insignificant because the demand for pigeonpea based dal is not meet out through present production levels in India and we have to import the pulses from other countries.

Table 4.12: Inter relationship of market arrivals and prices with production of pigeonpea in Amravati district

Year	Production (000'ton)	Arrival (quintals)	Production (000'ton)	Prices (Rs/qtl)
2009-10	1005	5044	1005	3212
2010-11	629	7493	629	3945
2011-12	1089	9528	1089	3198
2012-13	1331	7742	1331	3391
2013-14	1339	11089	1339	3757
2014-15	368	2455	368	4301
2015-16	576	2427	576	6612
2016-17	1469.3	15964	1469	8387
2017-18	1111	22951	1111	4379
2018-19	1255.4	13569	1255	3985
Regression coefficient	10.97		- 0.30	
Correlation coefficient	0.64		- 0.07	

The productivity of pigeonpea were increased from 984.00 kg/ha (2009-10) to 1112.80 kg/ha (2018-19) and the arrival were increased from 5043.80 quintals (2009-10) to 13568.60 quintals (2018-19) during last ten years. The regression coefficient between productivity and annual arrival were 11.32 and the correlation coefficient between was 0.59 in Amravati district. This shows that even if area remains stagnant under pigeonpea the enhancement in productivity leads to increased arrival in market. With one kg increase in productivity leads to increased in arrival by 11.32 tons in the district even if area keeps stable.

But on the the other hand with increase in productivity of pigeonpea price were increased from Rs. 3212 /qtl (2009-10) to Rs.3985.00/qtl (2018-19) during last ten years. The regression coefficient between productivity and annual price was -0.03 and the correlation coefficient between them was -0.01 in Amravati district. This revealed that with increase in productivity by one kg the prices per quintal decrease by Rs.0.03.

Table 4.13: Inter relationship of productivity of pigeonpea with market arrivals and prices in Amravati district

Year	Productivity (Kg/ha)	Arrival (quintals)	Productivity (Kg/ha)	Prices (Rs/qtl)
2009-10	984	5043.8	984	3212
2010-11	526	7493	526	3945
2011-12	854	9528	854	3198
2012-13	1075	7741.8	1075	3391
2013-14	1392	11089	1392	3757
2014-15	355	2455.34	355	4301
2015-16	533	2427	533	6612
2016-17	1198	15964.4	1198	8387
2017-18	989	22951.2	989	4379
2018-19	1112.8	13568.6	1112.8	3985
Regression coefficient	11.32		-0.03	
Correlation Coefficient	0.59		-0.01	

4.3 Relationship between market arrivals and prices

The relationship between market arrival and prices is worked out on annual and monthly basis and data on the same are presented in tables 4.14 and 4.15.

Table 4.14: Relationship between annual market arrival and prices in selected mandies of the Amravati district

Particulars	Amravati	Achalpur	Anjangaon	Daryapur	Dhamanaon	Average
Correlation coefficient	0.04	-0.25	0.21	-0.15	0.37	0.18
Regression coefficient	0.003^{NS}	-0.10^{NS}	0.28^{NS}	-0.05^{NS}	0.17^{NS}	0.04^{NS}
t-value of regression coefficient	0.04	-0.79	0.21	- 0.48	1.20	0.55

NS: Non-significant

The data presented in above table clearly shows that there is inverse relationship between market arrival and prices of pigeonpea in Achalpur and Daryapur although these relationships are insignificant. On the contrary the positive relationship between arrival and prices were observed for Amravati, Anjangaon, Dhamangaon and average for all mandies and this may be due to arrival of less quantity of the produce throughout the year. The coefficient of regression for all the mandies are less than one indicating that the affect of annual market arrival is not strongly governed by the prices and vice-versa.

Table 4.15: Relationship between annual market arrival and prices in selected mandies of the Amravati district

Particulars	Amravati	Achalpur	Anjangaon	Daryapur	Dhamanaon	Average
Correlation coefficient	0.16	0.14	0.42	-0.32	0.45	0.66
Regression coefficient	0.002^{NS}	0.14^{NS}	0.43^{NS}	-1.82^{NS}	0.96^{NS}	0.85^{NS}
t-value of regression coefficient	0.52	0.47	1.50	-1.07	1.63	2.79

NS: Non-significant

The data presented in table 17 shows the relationship between monthly arrival of pigeonpea and its prices. From the data it is clear that even on monthly basis the relationship between prices and arrival is negative for one market viz., Daryapur. But this relationship is more pronounced as compared to relationship between annual arrival and prices in different mandies. This shows that arrival and prices for different months are strongly and related as compared to annual arrival and prices.

This leads to accept the hypothesis that there is strong relationship between market arrival and prices.

4.4 The spatial co-integration among major markets of pigeonpea in the region

Johansen Multiple co-integration trace test was applied for estimating the long-run relationship between the prices and arrivals in selected markets. Co-integration is used instead of regular regression method because of its capacity in dealing with non-stationary series. The most popular co-integration method, developed by Johansen (1988) is applied. The test shows whether the selected pigeonpea markets are integrated or not.

The presence of at least two co-integration equations at 5 per cent level of significance confirms that there exists long run equilibrium relation in the markets. The trace test results presented in the table 4.16 and 4.17 for pigeonpea price and arrival showed that trace statistics value was greater than the critical value at 5 per cent level which implied that there existed co-integration among the markets. Hence, we obtain at most five co-integration equation at 5 per cent level of significance. This revels revealed that there is long run equilibrium / co- moment in arrival and prices series among Achalpur, Amravati, Anjangaon, Daryapur and Dhamangaon markets during the periods under study.

Table 4.16: Johansen test estimates for prices of pigeonpea for selected markets of Amravati district

Unrestricted Cointegration Rank test (trace)				
Hypothesized No. Of CE(s)	**Eigen value**	**Trace statistic**	**0.05 critical value**	**Prob.****
None*	0.4147	134.03	64.282	0.000
At most 1	0.2357	69.748	32.263	0.009
At most 2	0.1635	37.485	21.425	0.043
At most 3	0.0844	16.060	10.593	0.178
At most 4	0.0445	5.466	5.466	0.019

Trace test indicates 1 co-integration eqn (s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** Mackinnon-Haug-Michelis (1999)

Table 4.17: Johansen test estimates for arrivals of pigeonpea for selected markets of Amravati district

Unrestricted Cointegration Rank test (trace)				
Hypothesized No. Of CE(s)	**Eigen value**	**Trace statistic**	**0.05 critical value**	**Prob.****
None*	0.5218	170.16	88.53	0.000
At most 1	0.3031	81.62	43.33	0.000
At most 2	0.2063	38.28	27.72	0.003
At most 3	0.0806	10.55	10.08	0.210
At most 4	0.0039	00.47	00.47	0.491

Trace test indicates 1 co-integration eqn (s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** Mackinnon-Haug-Michelis (1999)

Hence the it can be concluded that the price and arrival behavior in the selected markets of pigeonpea in Amravati district are co-integrated revealing that the prices and arrival of pigeaonpea in any one of the selected market is affected by another selected markets. Similar results were reported by Mukim *et. al* (2009), Gandhi and Koshy (2006) and Gosh (2011).

This leads to accept the hypothesis that the price behaviour of one market leads to affect the price behaviour for pigeonpea in another market in study area.

CHAPTER - VI

SUMMARY, CONCLUSION AND SUGGESTIONS

SUMMARY, CONCLUSIONS AND SUGGESTIONS

Agriculture in India is now moving in the world of globalization, liberalization and privatization. The population is increasing at a rapid rate leading to increase in demand for food and other consumer goods of which many have agricultural base. India grows such a variety of pulse crop which no other country in the world grows. Among pulses, pigeonpea is a major kharif pulse crop of India. The cultivation of pigeonpea goes back at least 3500 years. In Maharashtra the area covered by pigeonpea is 12.29 Lakh ha with a production of 10.73 Lakh tons. Production of pigeonpea is enough to fulfil the domestic requirement of the state but not enough to fulfil the requirement of the whole country. But demand supply situation of pigeonpea during last one decade causing high fluctuation in price of pigeonpea in India market. Therefore the study of market arrivals and prices is very useful. As well as the relationship between market arrivals and prices of the crop at different point of time help us to know the extent of inter and intra year variation in them. The price variations are common in agricultural commodity mainly because of seasonality in production and inter market arrivals. Market integration concept explains the relationship between two markets that are spatially separated. Against this backdrop the present study was undertaken to gain insights into the behaviour of market arrivals and prices of pigeonpea in selected markets of vidarbha region of Maharashtra.

Objectives

1) To study the growth pattern of production component of pigeonpea.
2) To examine the pattern of market arrival and price behaviour and their inter relationship between production components.
3) To analyse the relationship between arrival and price of pigeonpea.
4) To asses the spatial co-integration among major markets of pigeonpea in the region.

Methodology

The selection of the major markets for pigeonpea was done on the base of largest arrivals for the markets. Later observing the arrivals in different markets the top five major markets of pigeonpea were selected to be specific Amravati, Daryapur, Achalpur, Dhamangaon and Anjangaon. The secondary data on the time series for monthly arrivals and prices of pigeonpea were gathered from official website of Agricultural marketing of selected markets for a time period from 2009 to 2019 and later these information was analyzed to different statistical tools.

To study the growth pattern, the absolute change, relative change and trend analysis method was utilized. Coefficient of variation and mean was analyzed to study the pattern in arrivals and prices of pigeonpea. Regression analysis and correlation co-efficient was done to appraise the relationship between market arrivals and prices of pigeonpea. Johanson's co-intregration test was utilized to know the impact on prices of pigeonpea in chosen markets.

Conclusion

A. Growth pattern of pigeonpea production components

1) It was analyzed from the data that the absolute change and relative change in area, production and productivity of pigeonpea crop was found to be negative (-04.93ha)(-00.42%) for area and positive for production (370.91 ha) (40.86%) and productivity (311.99ha) (39.59%) in Amravati district.
2) The trend analysis shows that there was negative trend in area (-01.11) and positive for production (26.02) and productivity (20.95) in Amravati district.
3) Linear growth rate for area of pigeonpea crop was found negative while for production and productivity it was found to be positive.

B. Pattern of market arrival, price behaviour and their relationship with production components

1) It was observed that the annual average prices of pigeonpea in the study area are more stable as compared to annual average arrivals. The mandi wise data revealed that the mean annual arrival and prices were highest for Amravati mandi as compared to other mandies of the Amravati district, revealed that the arrival in mandi is mainly governed by the prices paid in mandi for the produce.

2) The pattern of relative change and trend in arrivals and prices of pigeonpea leads to revealed that the arrival of pigeopea in the mandies of Amravati district increases on account of increase in area and yield of pigeonpea.

3) The overall analysis revealed that variation in monthly arrivals was lower during the harvesting period and more during the sowing period. The quantity arrived in the market also follows the same trend. The arrival over the months was significantly declines in all the selected mandies of the district.

4) The study of seasonal variation of arrivals and prices indicates that the peak season for arrival was observed in Achalpur, Amaravati, Anjangaon, Daryapur and Dhamangaon market were during the month of February respectively and lower during the month of November and December respectively.

5) The maximum peak prices were observed during the month of September to January in Amravati market, and during the month of May to February in Achalpur, the month of January to June in Anjangaon and November to December in Daryapur and January to June in Dhamangaon markets. The maximum lowest prices is found during the month of February to August in Amravati market ,May to June in Achalpur market and in the month of July to November in Anjangaon, during the month of January to October in Daryapur and July to December in Dhamangaon markets.

6) The positive relationship was seen between area, production, productivity and arrival which indicates as the area, production, productivity increases arrival also increases.

7) The inverse relationship between area, production, productivity and prices was observed in Amravati district which shows that the increase in area, production, productivity lowered the prices of pigeonpea.

C. Relationship between arrival and price of pigeonpea

1) The inverse relationship between annual arrivals and prices was noticed for Achalpur, Daryapur market which indicate that the increase in arrivals lowered the prices of pigeonpea. Whereas, positive relationship was noticed for Amravati, Anjangaon, Dhamangaon market.
2) The inverse relationship between monthly arrivals and prices was noticed for Daryapur market which indicates that the increase in arrivals lowered the prices of pigeonpea. Whereas, positive relationship was noticed for Amravati, Achalpur, Anjangaon, Dhamangaon market.

D. The spatial co-integration among major markets of pigeonpea in the region

The result of Johansen's co-integration test for different markets of pigeonpea indicates the presence of at least five co-integration equations at 5 per cent level of significance.

Suggestions

Findings would suggest some following measures:

1) The results obtained from the study helps the farmers to take the decision in which month they can sell the produce to get maximum price.
2) The seasonal fluctuations in arrivals have unfavorable impact on prices in regulated markets over different month in the year.
3) There is need for upgrading the market arrivals with the increased in prices of products as prices plays an important role for increasing arrivals of the products and particularly affected the arrivals of the products.

4) The study of trend of prices shows that there is slightly rise in nominal prices of pigeonpea over the time in all the markets ,pigeonpea growers should be provided with remunerative prices for their produce.
5) Appropriate price support and procrurement policies are required to be adopted by the Government in order to maintain the acerage under pigeonpea for reducing the gap between demand and supply.

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APPENDICES

APPENDIX-I

Area, production and productivity of pigeonpea crop in Amravati district

Year	Area(000''ha)	Production(000''tonnes)	Productivity(kg/ha)
2009-10	1021	1005	984
2010-11	1196	629	526
2011-12	1275	1089	854
2012-13	1238	1331	1075
2013-14	962	1339	1392
2014-15	1038	368	355
2015-16	1082	576	533
2016-17	1226.1	1469.32	1198
2017-18	1123	1111	989
2018-19	1128.1	1255.4	1112.8

APPENDIX-II

Monthly arrivals and prices of pigeonpea crop of Amravati APMC

Arrival= 000'' quintals, Prices=Rs/qtl

Year	Month	Prices	Arrival	Year	Month	Prices	Arrival	Year	Month	Prices	Arrival
2009	Jan	2933	2306.2	2010	Jan	4090	2645.9	2011	Jan	3671	23.5
	Feb	3009	2621.8		Feb	3731	5154.8		Feb	3840	219.9
	March	3268	1657.5		March	3973	4774.8		March	3380	460.8
	April	3607	937.9		April	4379	1545.5		April	3889	1120.9
	May	3807	426.1		May	4209	1010.2		May	2972	723.9
	June	3068	184.3		June	4343	962.03		June	2731	3232.6
	July	5290	34.1		July	4431	273.96		July	3882	2753.2
	Aug	4960	14.7		Aug	3486	136		Aug	3848	1796.6
	Spet	4969	56.2		Spet	3620	481		Spet	2989	1625.2
	Oct	5274	27.7		Oct	3998	703.9		Oct	2950	351.1
	Nov	5435	33.3		Nov	3990	213.8		Nov	3233	430.3
	Dec	5830	815		Dec	3383	6.2		Dec	3141	556.1
Year	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**
2012	Jan	3353	1900.2	2013	Jan	3676	4053.8	2014	Jan	4350	20.5
	Feb	3314	3624.7		Feb	3665	10486.2		Feb	4350	20.5
	March	3319	1997.3		March	3665	8683.4		March	4350	20.5
	April	3369	764.7		April	4470	2689.1		April	4331	4010.1
	May	3409	1022		May	3667	1483.3		May	4346	1085
	June	3826	794.3		June	4064	1597.73		June	4328	335.4
	July	3408	253.1		July	4143	303.92		July	4343	4
	Aug	4807	260.9		Aug	3934	0.9		Aug	4328	3.2
	Spet	4516	157.4		Spet	3665	793.8		Spet	4341	1.6
	Oct	4199	197		Oct	3993	0.8		Oct	NA	NA
	Nov	3520	176.1		Nov	3658	2150.0		Nov	5100	0.3
	Dec	3683	185.5		Dec	4100	0.8		Dec	4930	5.1

Year	Month	Prices	Arrival	Year	Month	Prices	Arrival	Year	Month	Prices	Arrival
2015	Jan	5350	4.8	2016	Jan	8991	11486	2017	Jan	4541	1739
	Feb	5360	0.6		Feb	8358	3826		Feb	4615	9822
	March	5200	3.6		March	8932	1573		March	4686	14768
	April	6493	7.8		April	9003	5529		April	4650	18216
	May	5364	12		May	8799	3787		May	4635	8100
	June	5377	16.2		June	8788	4996		June	3757	4857
	July	5421	20.4		July	8885	958		July	3633	3498
	Aug	11576	24.6		Aug	6352	1472		Aug	4186	4102
	Spet	9463	28.8		Spet	8830	3694		Spet	4592	2333
	Oct	11072	33		Oct	8831	3040		Oct	3828	1619
	Nov	5453	3		Nov	5888	2248		Nov	3901	1412
	Dec	8823	769		Dec	8697	1596		Dec	4542	1080
Year	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**				
2018	Jan	4157	3107	2019	Jan	5015	7897				
	Feb	4178	9519		Feb	5116	8882				
	March	4179	5411		March	5106	5981				
	April	4182	5456		April	4993	9149				
	May	3874	9559		May	5486	7043				
	June	4169	5080		June	5174	3658				
	July	3694	2141		July	5582	2498				
	Aug	3678	3082		Aug	5178	1979				
	Spet	4132	3069		Spet	5278	1237				
	Oct	3658	2013		Oct	5303	1232				
	Nov	4418	1049		Nov	5367	918				
	Dec	4367	972		Dec	5096	677				

Monthly arrivals and prices of pigeonpea crop of Achalpur APMC

Arrival= 000'' qtl, Prices=Rs/qtl

Year	Month	Prices	Arrival	Year	Month	Prices	Arrival	Year	Month	Prices	Arrival
2009	Jan	2823	3440.9	2010	Jan	3981	405.9	2011	Jan	3365	416
	Feb	2956	2197.5		Feb	4011	535.7		Feb	3635	1030.2
	March	3170	1670.5		March	4229	557.5		March	3532	1108.5
	April	3170	1041.1		April	4322	651		April	3194	1890.3
	May	3763	629.6		May	4446	727.1		May	2761	1437.6
	June	3990	113.0		June	4570	802.9		June	2629	1294.2
	July	4825	154.8		July	4071	101.8		July	3441	853
	Aug	4823	41.6		Aug	3699	237.2		Aug	2857	1456.8
	Spet	4973	66.8		Spet	3776	168.5		Spet	2766	1534.3
	Oct	4940	37.5		Oct	4027	141.3		Oct	2662	270.8
	Nov	4805	956.2		Nov	3988	229.4		Nov	3348	141.9
	Dec	5025	1300.8		Dec	2883	65.5		Dec	2766	789.5
Year	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**
2012	Jan	2614	276.1	2013	Jan	3454	2317.7	2014	Jan	3438	19.5
	Feb	3143	1840.4		Feb	3685	3366.9		Feb	3781	19.5
	March	3223	2052.9		March	3482	1685.4		March	4186	19.5
	April	2632	1562.1		April	4421	945.5		April	4400	19.5
	May	2632	771.3		May	4384	910.2		May	4427	19.5
	June	3703	966		June	3581	792		June	4383	20.2
	July	2678	219.7		July	4108	443.5		July	4383	30
	Aug	3049	641.3		Aug	4201	8.5		Aug	4501	42
	Spet	3075	527		Spet	3507	218.5		Spet	4838	21
	Oct	3101	412.7		Oct	4204	209.4		Oct	4930	43
	Nov	2565	24.1		Nov	4148	611.0		Nov	5105	21
	Dec	2691	110.3		Dec	4193	920.2		Dec	4642	13.5

Year	Month	Prices	Arrival	Year	Month	Prices	Arrival	Year	Month	Prices	Arrival
2015	Jan	5000	18	2016	Jan	8404	2907	2017	Jan	4361	691
	Feb	4987	37		Feb	8067	2006		Feb	4420	2393
	March	5197	55		March	7574	567		March	4165	2525
	April	4951	50		April	7185	513.3		April	4416	1915
	May	6348	95		May	8411	814		May	4318.0	4
	June	6863	68		June	8619	815		June	4316.0	950
	July	6870	53		July	8220	312		July	4392.6	764.8
	Aug	6838	30		Aug	6340	235		Aug	4342.5	579.6
	Spet	6871	26		Spet	6312	281		Spet	4379.8	394.4
	Oct	9583	76		Oct	6186	235		Oct	4393.1	209.2
	Nov	8350	4		Nov	5517	50		Nov	4386.7	24
	Dec	8455	656		Dec	4746	160		Dec	4412.0	161.2
Year	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**				
2018	Jan	4536	88	2019	Jan	4697	423				
	Feb	4450	90		Feb	4983	160				
	March	4287	95		March	4994	104				
	April	3308	97		April	5063	144				
	May	3471	182		May	5179	158				
	June	3355	166		June	5297	34				
	July	3291	133		July	5401	20.6				
	Aug	4175	160		Aug	5506	75.2				
	Spet	4175	57		Spet	5610	129.8				
	Oct	3543	3		Oct	5113	13				
	Nov	3473	4		Nov	5086	11				
	Dec	3403	49		Dec	5080	7				

Monthly arrivals and prices of pigeonpea crop of Anjangaon APMC

Arrival= 000'' qtl, Prices=Rs/qtl

Year	Month	Prices	Arrival	Year	Month	Prices	Arrival	Year	Month	Prices	Arrival
	Jan	2814	775		Jan	3792	579		Jan	3655	737.5
	Feb	3046	672.5		Feb	3587	1162.5		Feb	3850	885
	March	3088	370		March	3677	1070		March	3683	815
	April	3604	247.5		April	4177	852		April	3322	515
	May	3671	153.1		May	4070	620		May	3055	570
	June	3939	77.7		June	4056	532.5		June	2792	595
2009	July	5054	69.1	**2010**	July	3811	188.1	**2011**	July	2867	405
	Aug	4941	12.8		Aug	3422	167.2		Aug	2816	315
	Spet	4342	16.6		Spet	3388	131		Spet	2519	285.3
	Oct	4685	7		Oct	3189	143		Oct	2356	214.3
	Nov	4575	1.7		Nov	3100	150		Nov	3028	69.5
	Dec	4043	11.4		Dec	2909	195.5		Dec	3011	74
Year	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**
	Jan	3350	165		Jan	3525	870		Jan	4090	889.5
	Feb	3200	730		Feb	3929	1403		Feb	4090	889.5
	March	3133	780		March	4322	1240		March	4070	1552.5
	April	3178	622.5		April	4443	235		April	4144	900
	May	3492	425		May	4277	162.5		May	4209	606
	June	3740	420		June	4185	297.5		June	4150	148.5
2012	July	4330	152.5	**2013**	July	4116	109.5	**2014**	July	4244	150
	Aug	4407	58.5		Aug	4400	105		Aug	4975	103.8
	Spet	4122	20		Spet	4211	226.5		Spet	4540	81.6
	Oct	3858	10		Oct	4113	72		Oct	4919	61.5
	Nov	4254	72		Nov	4083	52.5		Nov	5038	21
	Dec	3428	26.5		Dec	3936	21.6		Dec	4638	15.3

Year	Month	Prices	Arrival	Year	Month	Prices	Arrival	Year	Month	Prices	Arrival
2015	Jan	5087	1281.6	2016	Jan	8473	1418	2017	Jan	4126	768
	Feb	5319	2093.5		Feb	8018	820		Feb	4131	1586
	March	5540	975		March	8010	555		March	4095	1657
	April	5759	635		April	8794	341		April	3830	840
	May	6688	590		May	8550	201		May	3815	61
	June	6762	263		June	8512	483		June	3422	181
	July	6991	111		July	7906	135		July	3469	100
	Aug	8637	43		Aug	5994	102		Aug	4095	280
	Spet	9477	18		Spet	6525	111		Spet	3862	216
	Oct	9875	12		Oct	5994	59		Oct	3517	113
	Nov	7650	12		Nov	5163	35		Nov	3650	64
	Dec	8444	256		Dec	4273	49		Dec	3717	61
Year	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**				
2018	Jan	4132	747	2019	Jan	4896	1480				
	Feb	4084	743		Feb	4996	1020				
	March	3922	450		March	4892	563				
	April	3691	427		April	5189	623				
	May	3773	222		May	5558	657				
	June	3413	309		June	5442	171				
	July	3548	322		July	5481	114				
	Aug	3578	171		Aug	5450	56				
	Spet	3370	89		Spet	5171	33				
	Oct	3396	85		Oct	5018	30				
	Nov	4125	71		Nov	5045	17				
	Dec	4327	322		Dec	4809	19				

Monthly arrivals and prices of pigeonpea crop of Daryapur APMC

Arrival= 000'' qtl, Prices=Rs/qtl

Year	Month	Prices	Arrival	Year	Month	Prices	Arrival	Year	Month	Prices	Arrival
2009	Jan	2770	394.7	2010	Jan	3966	957.4	2011	Jan	3755	1662.1
	Feb	3064	1312.4		Feb	3725	1271.6		Feb	3945	1901.4
	March	3113	834.7		March	3938	1143.9		March	3757	790.4
	April	3502	337.3		April	4281	828.2		April	3489	1174.5
	May	3435	151		May	4176	1302.6		May	3125	1857.3
	June	4060	93.7		June	4089	1150.2		June	2852	2168.2
	July	5253	72		July	3851	433.5		July	2941	1498.5
	Aug	4402	26.4		Aug	3530	456.3		Aug	2847	1554.6
	Spet	3925	3.9		Spet	3570	344.8		Spet	3106	387.4
	Oct	4946	10.3		Oct	3271	538.8		Oct	2919	75.1
	Nov	5111	260.15		Nov	3154	430.7		Nov	3122	109.7
	Dec	2175	2.6		Dec	2938	177.2		Dec	3109	313.9
Year	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**
2012	Jan	3320	2606.8	2013	Jan	3597	2657.8	2014	Jan	4275	130.2
	Feb	3349	2695.9		Feb	3937	1548.3		Feb	4275	130.2
	March	3258	1798.5		March	4333	763.4		March	4275	130.2
	April	3355	1437.9		April	4566	345.1		April	4465	154.6
	May	3723	1139.9		May	4433	654.6		May	4950	154.6
	June	3886	652.5		June	4308	515.5		June	5050	166.8
	July	4482	447.5		July	4156	120		July	5233	179
	Aug	4773	294.6		Aug	4550	454.7		Aug	4700	102.7
	Spet	4285	128.1		Spet	4639	804.3		Spet	5219.5	15
	Oct	3926	81.4		Oct	4729	1153.9		Oct	5345.4	93.1
	Nov	3662	35.7		Nov	4819	1503.4		Nov	5471.3	36.6
	Dec	3344	99.1		Dec	4225	2.2		Dec	5597.3	21.7

Year	Month	Prices	Arrival	Year	Month	Prices	Arrival	Year	Month	Prices	Arrival
2015	Jan	4800	2.1	2016	Jan	8903	3912	2017	Jan	4230	856
	Feb	7000	2.1		Feb	8151	1540		Feb	4150	4599
	March	7209	2.1		March	8113	1291		March	4186	6752
	April	7252	2.1		April	8800	1920		April	3897	3818
	May	8699	39		May	8705	770		May	4096	863
	June	8922	560		June	8658	1003		June	3504	798
	July	10103	168		July	8677	290		July	3513	436
	Aug	7050	251		Aug	5686	153		Aug	4048	451
	Spet	8432	174		Spet	6877	479		Spet	3951	478
	Oct	9563	49		Oct	6433	465		Oct	3745	382
	Nov	9491	17		Nov	5615	403		Nov	3771	359
	Dec	9663	722		Dec	4501	219		Dec	3831	187
Year	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**				
2018	Jan	4095	1271	2019	Jan	5024	2662				
	Feb	4108	1277		Feb	5164	1464				
	March	3982	728		March	4937	818				
	April	3800	616		April	5247	1158				
	May	3787	709		May	5668	1263				
	June	3487	754		June	5580	788				
	July	3550	647		July	5664	316				
	Aug	3523	457		Aug	5568	351				
	Spet	3480	237		Spet	5367	305				
	Oct	3481	73		Oct	5211	163				
	Nov	4247	111		Nov	5336	186				
	Dec	4088	158		Dec	5010	140				

Monthly arrivals and prices of pigeonpea crop of Dhamangaon APMC

Arrival= 000''qtl Prices=Rs/qtl

Year	Month	Prices	Arrival	Year	Month	Prices	Arrival	Year	Month	Prices	Arrival
2009	Jan	2828	543.5	2010	Jan	4043	76.2	2011	Jan	4150	92.1
	Feb	2828	543.5		Feb	3759	583.7		Feb	3916	253.9
	March	3256	329.5		March	3849	771.5		March	3682	415.7
	April	3541	350.1		April	4357	674.4		April	3342	347
	May	3796	205		May	4139	522.5		May	3040	942.1
	June	4484	232.7		June	4045	236.9		June	2755	1485.9
	July	5240	173.8		July	3910	119		July	2803	1248.5
	Aug	4618	20.8		Aug	3538	253.3		Aug	2696	971.7
	Spet	4597	9.5		Spet	3475	263		Spet	3106	1285.4
	Oct	4645	5.2		Oct	3180	20		Oct	2875	176.9
	Nov	5200	2.4		Nov	2875	3.3		Nov	3033	50.1
	Dec	4700	0.1		Dec	3135	26.32		Dec	2813	575.5
Year	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**
2012	Jan	3176	204.8	2013	Jan	3755	491.5	2014	Jan	4000	7
	Feb	3349	929.8		Feb	3904	1738		Feb	4000	130
	March	3208	637.3		March	4226	936.5		March	4150	138
	April	3306	640		April	4323	759.2		April	4175	385
	May	3674	704.6		May	4300	27.4		May	4175	470
	June	3888	578.2		June	4200	92.5		June	4140	320
	July	4451	401.3		July	4006	284.5		July	4263	249
	Aug	4741	300.5		Aug	4350	113.6		Aug	4285	448.1
	Spet	4185	131.5		Spet	4110	193		Spet	4324	499.5
	Oct	3925	35		Oct	4183	250.5		Oct	4815	10
	Nov	4587	134.9		Nov	4200	66.5		Nov	4975	50.5
	Dec	4732	76.4		Dec	4292	168.2		Dec	4789	285.8

Year	Month	Prices	Arrival	Year	Month	Prices	Arrival	Year	Month	Prices	Arrival
2015	Jan	5325	520	2016	Jan	8434	2285	2017	Jan	4250	84
	Feb	5460	815		Feb	7938	1361		Feb	4250	1240
	March	5793	698		March	7823	1038		March	4250	1115
	April	5950	115		April	8669	1114		April	4250	1663
	May	6184	204		May	8408	1155		May	5050	2870
	June	6925	50		June	8468	1127		June	5050	2160
	July	7356	67		July	7964	561		July	3397	26
	Aug	7850	46		Aug	6046	573		Aug	3822	247
	Spet	8004	46		Spet	6365	648		Spet	3813	149
	Oct	8371	46		Oct	6094	231		Oct	3494	70
	Nov	6500	2		Nov	5357	142		Nov	3611	84
	Dec	7593	137		Dec	4550	123		Dec	3698	68
Year	**Month**	**Prices**	**Arrival**	**Year**	**Month**	**Prices**	**Arrival**				
2018	Jan	4094	55	2019	Jan	4730	855				
	Feb	4055	432		Feb	4950	887				
	March	3795	252		March	4850	196				
	April	3661	350		April	5079	596				
	May	3759	519		May	5636	580				
	June	3492	851		June	5550	595				
	July	3573	1180		July	5496	300				
	Aug	3576	799		Aug	5418	263				
	Spet	3382	515		Spet	5321	153				
	Oct	3512	260		Oct	5104	95				
	Nov	4029	194		Nov	5250	72				
	Dec	4156	131		Dec	4700	5				

CURRICULUM VITAE

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Name of the Author: Miss. Asawari Joshi

Place: Akola, Dist- Akola (MH)

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The author of this thesis Asawari Joshi, D/o Mr. Sudhir Joshi was born on 5th August 1995 at Akola (Maharashtra). She has joined the following institutions and successfully completed the degree of M.Sc. (Ag.) during the year 2019-20.

Educational Qualification

Name of Degree	Subjects (Major)	University/Board	Year	Percentage of marks/ OGPA Obtained
M.Sc. (Ag.)	Agricultural Economics and Farm Management	Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, MP	2020	7.16
B.Sc. (Ag.)	Agriculture	Dr. Panjabrao Deshmukh Krishi Vidyalaya, Akola(MH)	2017	7.36
12th	Biology, Physics, Chemistry	N.K. Gokhale Jnr. College Akola.	2013	61.83%
10th	English, Mathematics, Science	M.K.K.V High School Akola	2011	84.00%

Special interests

a. Linear Programming
b. Econometrics

For the partial fulfilment of the master's degree programme he was allotted a research problem on **"Study of Market Arrivals and Price Behaviour of Pigeonpea in Vidarbha Region of Maharashtra"** which was successfully conducted by his and being submitted in the form of the thesis.