TRENDS IN ARRIVAL AND PRICES OF PIGEON PEA IN AKOLA DISTRICT OF MAHARASHTRA

BY

SOLANKE PRAFULLA LAXMAN

B.Sc. (Agriculture)

MASTER OF SCIENCE

IN

AGRICULTURE

(AGRICULTURAL ECONOMICS)

DEPARTMENT OF AGRICULTURAL ECONOMICS

COLLEGE OF AGRICULTURE, PARBHANI

VASANTRAO NAIK MARATHWADA KRISHI VIDYAPEETH

PARBHANI- 431 402 (M.S.) INDIA

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A thesis submitted to
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani
in partial fulfilment of the requirement for the degree of

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2022

DECLARATION BY THE CANDIDATE

I hereby declare that the thesis entitled, **"TRENDS IN ARRIVAL AND PRICES OF PIGEON PEA IN AKOLA DISTRICT OF MAHARASHTRA"**, submitted by me is based on the actual work carried out by me under the guidance and supervision of **Dr. D. S. PERKE** The extent of information derived from the existing literature have been duly cited and referenced. The existing research work or its any part is not submitted anywhere else for the award of any degree or diploma.

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Place: Parbhani

Date: 30 / 11 / 2022

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Reg. No : 2020A/56M

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Research Guide

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(External Examiner)

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(R.V. Chavan)
Member

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(Solanke Prafulla Laxman)

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ABBREVIATIONS

APMC :	Agricultural Produce Market committee
CAGR:	Compound Annual Growth Rate
CV :	Coefficient of Variation
etc:	Et cetera
eqn.:	Equation
et al.:	et alli (and other)
Fig:	Figure
GOI :	Government of India
ha:	Hectare
i.e. :	That is
. J :	Journal
kg:	Kilogram
/:	Per
%:	Percentage
No:	Number (s)
qty:	Quantity
Rs:	Rupee (s)
Sr. No.:	Serial Number
T :	Tonne (s)
Vol:	Volume

THESIS ABSTRACT

THESIS ABSTRACT

1.	Title of the thesis	:	Trends in Arrival and Prices of Pigeon pea in Akola District of Maharashtra
2.	Full name of the candidate	:	Solanke Prafulla Laxman
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ABSTRACT

The cultivation of the Pigeon pea goes back at least 3,500 years. Pigeon pea is grown in region of Maharashtra on 1195.50 (000'ha), with a production of 1084.32 (000'Tonnes) during 2019-20. The normal productivity was about 907 kg/ha. Highest production of Pigeon pea is from Maharashtra which is around 30 per cent of national production. Major District of Vidarbha region growing pulses crops is Akola, Amaravti, Washim, Buldana. In this study we are analyzing the arrivals and prices of pulses in Akola district of Maharashtra.

The Akola district was purposely selected for present study, as it has a major proportion of the area under Pigeon Pea crop. The research is based on trends in arrival and prices of Akola, Murtijapur, Akot APMC's. The arrivals and prices data for selected Pigeon pea crop year wise data were collected from the official records of APMC. Based on availability of data, latest 20 years data from 2001 to 2020 were collected. For analyzing the trend in arrivals and prices of agricultural commodities the compound growth rates of chosen agricultural commodities arrival and prices calculated by using linear and exponential function, seasonal indices were calculated through simple average method and coefficient of variation in arrivals and prices computed in order to assess variability.

The selected markets under annual study of Akola, Murtijapur and Akot markets showed increasing trend in arrivals and prices. Among the selected markets the highest arrivals were in the year 2018–2019 (286.79 per cent), in Akot APMC market followed by Murtijapur APMC market (269.16 per cent), whereas the lean period of arrival in the year 2013 – 2014 (15.52 per cent) in Akot APMC. The highest indices of prices of Pigeon pea were registered in the year 2015-16 (241.13 per cent) in Murtijapur market, followed in 2015-16 (239.78 per cent) in Akola market. The lowest indices of arrivals were registered in the year 2001-02 (29.72 per cent) in Akot market. The correlation between arrivals and prices of Pigeon pea between Akola (0.75) and Akot (0.57) market showing the positive and statistically significant. There exists a high degree of association of prices between markets about i.e., Murtijapur and Akola 0.958, Murtijapur and Akot 0.932 and Akola and Akot 0.943, respectively.

(**Keywords:** Trends in Arrivals and Prices, APMC, Pigeon pea, Peak and Slack period, Seasonal Indices,

CHAPTER-I
INTRODUCTION

CHAPTER – I

INTRODUCTION

Agriculture is most important base for development and plays a vital role in the Indian economy. Over 65-70 per cent of the rural families depend on agriculture. Agriculture has got a main role in Indian economy as the most vital sector. Indian agriculture sector produces 20.2 per cent of India's gross domestic product (GDP) and gives occupation to 50-60 per cent of the countries manpower (Source: National Statistical Office (NSO), M/O Statistics & PI). India is the world's biggest producer of paddy, wheat, pulses, spices and various spice products. Indian agriculture has encounted impressive growth over last few decades. According to DES (Directorate of Economics and Statistic), the food grain production has inclined from 50.82 million tonnes in 1950-51 to 314.51 million tonnes during 2020-21 highest ever since Freedom. From the starting, agriculture is contributing a wide portion to our national income. In 1950-51, agriculture and other agriculture related activities gives about 59 per cent of the overall national income. Although the proportion of agriculture decrease gradually with improvement of other sectors, but the share still remained very high as comparative to that of the developed countries of the world. For example, the share of agriculture has decreased to 54 per cent in 1960-61, 48 per cent in 1970-71, 40 per cent in 1980-81 and then to 20.2 per cent in 2020-21, whereas in United Kingdom and United State of America. Agriculture contributed only 3 per cent to the national income of these countries, which are called to be developed.

In India over two-thirds of our working population are depended completely on agriculture and also similarly count for their subsistence. According to an estimate, about 58 per cent of our working population is engaged in agriculture. At present in comparison to that of 2 to 3 per cent in United Kingdom, and United State of America, 7 per cent in France and 16 per cent in Russia. Thus, the employment pattern of India is very much similar to other under developed countries of the world.

It has been approximated that about 60 per cent of family consumption need is met by agricultural products. Agriculture in our country has been the most important source of supply of raw materials to different important industries in India. Cotton and jute textiles, sugar, edible oil, plantation industries and agro-based cottage industries are also regularly gathering their raw materials straightly from agriculture. About 50

per cent of income generated in the manufacturing industry comes from all these agro-based industries in India. Moreover, India Agriculture is playing a very important role both in the internal and external trade of the country. Agricultural products like tea, coffee, sugar, tobacco, cashew-nut, spices etc. are the major items of our exports and contribute about 50 per cent of our total exports from our country besides manufactured cotton, jute textiles and sugar also provide another 20 per cent of the total exports of the country. Thus nearly 70 per cent of India's exports are belongs to agricultural sector.

Origin and History of Pigeon pea

Cajanus cajan is a leguminous browse plant, the common names are Pigeon pea, red gram, Congo pea, Gungo pea, No eye pea. *Cajanus cajan* is cultivated on large scale in twenty-two countries of the world and it is the sixth most important legume food crop. The cultivation of the Pigeon pea goes back at least 3,500 years. Archaeological finds of Pigeon pea dating to about 3400 years ago (14^{th} century BC) have been found at Neolithic sites in Kalaburaga, Karantaka (Sanganakallu) and its border areas (Tuljapur Garhi and Gopalpur in Orissa) and also the south Indian states, such as kerala, where it is called Tomara Payaru. From India, it travelled to east Africa and West Africa. It came to the American continent, probably in the 17^{th} century. It is well adapted to arid and semi-arid tropical and sub tropical climates.

Importance of Pigeon pea

The forage of *Cajanus cajan* is a fodder taste by ruminants and it is of high nutritive value and serves as vegetable for human consumption and the protein content of the seeds correspond favorably with those of soybean meal and groundnut cake. Production of *Cajanus cajan* in Africa was accounted to be 9.3 per cent of world production but this is small, when compared to the 74 per cent contribution from India. The chemical compositions of *Cajanus cajan* as shown by obtained about 57.3 – 58.7 per cent carbohydrate, (1.2-8.2) crude fibre and (0.6-3.2) per cent lipids. It is a good source of dietary minerals, such as calcium, magnesium, phosphorus, iron, potassium and sulphur Likewise, it is good source of soluble vitamins especially, ribofiavin, thiamine and niacin.

The Protein content of *Cajanus cajan* ranges between (20.6–27 per cent). As lysine was relatively, methionine was relatively low with trypsin inhibitors 10.1 mg /

100 gm and per 0.9 – 1.40. It was found that nutrient content, ether extract and antitrypsin activity were higher in green seeds than mature ones. It's contained as percentage wise (6.1–6.2 per cent) moisture, (19.3–26.3 per cent) protein, (1.3–2.0 per cent) fat, (6.4–8.2 per cent) fiber, (53.5–62.7 per cent) carbohydrates in addition to (132–500 mg/g) calcium and (330–354 kcal/ kg) energy. More than 90 per cent of Pigeon pea production comes from eight states of India.i.e., Maharashtra Madhya Pradesh, Uttar Pradesh, Gujarat, Jharkhand, Telangana, and Andra Pradesh.

Major pulses grown in the country include chickpea, Pigeon pea, lentil, black gram, mung bean, lablab bean, moth bean, horse gram, pea, grass pea, cowpea and broad bean. In India pulses are majorly grown in *Kharif* season. Pigeon pea, Black gram, green gram, Lentil, and other pulses are contributing 41.20 per cent, 19.11 per cent, 13.05 per cent, 9.62 per cent, and 17.03 per cent to the total production of pulses in the country, respectively. The major pulses Chickpea, Pigeon Pea, Lentil, Green gram and Black gram account for nearly 80 per cent of total pulse production in India. India total pulse production in India accounts for 29 per cent of World area and 19 per cent of world production.

Madhya Pradesh is the major pulse producing state in the country, both in terms of (area 22.81 per cent and production 31.07 per cent) followed by Rajasthan area (15.33 per cent and production 11.86 per cent), Maharashtra (area 13.29 per cent and production 8.56 per cent) Karnataka (area 11.01 per cent and production 8.43 per cent) and Uttar Pradesh (area 7.38 per cent and production 7.40 per cent).

Pigeon pea Scenario of India

Area and production of Pigeon pea in India has been more or less stable at 16.56 lakh ha and 4.43 million tonnes, respectively during the year 2019-2020. India is the major producer of Pigeon pea accounting 90 per cent of total production and 80 per cent of total area of the world. India is the largest producer, consumer and importer of pigeon pea in the world. In India Pigeon pea is mainly grown in Maharashtra, Madhya Pradesh, Uttar Pradesh, Jharkhand, Andhra Pradesh and Karnataka. Maharashtra is the leading producer.

Table 1.1 Area, Production and Productivity of Pigeon pea in India (2020)

States	Area	Production	Productivity
	(000' Hectare)	(000' Tonne)	(Kg/Hectare)
Karanataka	1545	1126.31	729
Maharashtra	1195.5	1084.32	907
Telangana	295	266.39	903
Uttar Pradesh	285	279.3	980
Madhya Pradesh	249	274.65	1103
Andra Pradesh	243	118.1	486
Jharkhand	230.56	241.63	1048
Gujarat	212.7	210.79	991
Odisha	128.63	144.58	1124
Other	148.05	145.94	18888
India	4532.44	3891.69	859

(Source: Ministry of Agriculture and Farmers Welfare, Government of India.)

Domestic scenario

Pigeon pea is grown in region of Maharashtra on 1195.50 (000'ha), with a production of 1084.32 (000'Tonnes) during 2019-20. The normal productivity was about 907 kg/ha. Highest production of Pigeon pea is from Maharashtra, which is around 30 per cent of national production. (Source: Ministry of Agriculture and Farmers Welfare, Government of India.)

Scope of Study

The present study is selected with an extent to know the trends in arrivals and prices and market integration among the selected agricultural commodity. It is observed that the seasonal price fluctuation is mostly, due to poor storage facilities and inadequate market information. As demand for agricultural commodities are increasing, the supply plays an active role in determining the price of goods. Agricultural commodities are produced seasonally, but are required for consumption throughout the year. The increase and decrease in seasonal arrivals of agricultural commodities shows a direct relationship with the price. Thus, price is one of the most important determinants of profit or loss in the farm business and income of the farmers.

Analysis of price and market arrivals over time is important for formulating a sound agricultural price policy. Fluctuations in market arrivals largely contribute to the price instability of the produce. In order to device appropriate ways and means for reducing price fluctuation of agricultural commodities, there is a need to have a thorough understanding of price behavior over time and space.

Objective of the study:

1. To study trends in market arrival and prices of Pigeon pea
2. To know the Peak and slack period in arrival and prices of Pigeon pea
3. To study the market integration of Pigeon pea in Akola District

Hypothesis

1. Prices of major Pigeon pea are low in peak season and high in slack season
2. Market prices determine the market arrival of the Pigeon pea in the market

Limitations

1. Due to limitation of time and available quantum of data, the study was restricted to limited aspect of selected major Pigeon pea in Akola district APMC's.
2. The study was based entirely on secondary data collected from three APMC's of Akola district.
3. The source of the data may not provide sufficient supporting material to allow the researcher to judge the quality of the research. The study is based on secondary data collected from APMC's and AGMARKNET website. Hence, the findings cannot be generalized beyond the limit of the area of the study.

CHAPTER-II
REVIEW OF LITERATURE

CHAPTER - II

REVIEW OF LITERATURE

The research works carried out in the past relevant to the present investigation were reviewed in this chapter under the following sub-heads.

1. To Study trends in arrival and prices of Pigeon pea
2. To know the peak and slack period in arrival and prices of Pigeon pea
3. To study the market integration of Pigeon pea market in Akola District

1.To Study trends in arrivals and prices of Pigeon pea

Bhanumate (2011) studied on the trend analysis of agricultural commodities for the period 1986 to 2006 in APMC Solapur. The study looked at how agricultural products performed in markets that were regulated by the industry. They noted agricultural commodity arrivals have generally shown favorable trends. They demonstrated that arrival of Rice recorded 7.22 per cent yearly growth rate, Sorghum and Wheat came succeeding with 4.23 and 3.34 per cent each. They saw the arrival of Pigeon peas and a decreased in green gram during the research period. Pigeon pea arrival is decreasing at a comparatively highest rate. When compared to the annually decline in Green gram arrival.

Rathore (2011) reported that the rate of growth from season to season chain base respective index number was calculated, it was noted that peak season had the greatest number of arrivals. Once more, from the forward season, it fell 2.06 per cent, onward the mid season. Arrivals in the followings two seasons were lower than in the onward base seasons. Prices typically vary annually or year to year due to difference in yield, which eventually affect arrivals. Although local supply and arrivals have a higher proportionate part even through costs primarily depend on the total in all available prices. Thus, it was noticed that the rate of growth, with the reference to base year, had discontinuous trend during the period of 15 years. The yearly price fluctuations were not making on regularity.

Ramachandra *et al.* (2012) studied an econometric analysis of sunflower arrivals and prices. The seasonal indicators of sunflower arrivals in all of the selected market places indicated that arrivals peaked from October to January. In Bagalkot and

Bellary markets, the highest arrivals were seen in the month of October, but in Gulbarga, Ranebennur, and Raichur markets, it was observed in the months of December and January. In all markets, the months of July and August saw the lowest levels of arrivals.

Thorat *et al*. (2012) determined the trend in analysis of arrivals and prices of important agricultural commodities in APMC Pune. It is assumed that as more agricultural products enter the market, their prices may presume and vice versa. For this analysis, the information on arrivals and six important commodities were not fully utilized. Data from the Agricultural Produce Committee Pune's yearly reports for the previous ten years were used for the study the data was first put through a correlation analysis. It indicated that there was nothing negative. Additionally, there was no consortium between annual arrivals and prices of these six commodities from the prior year, with the exception of the potato product. Due to the great demand for potatoes, there perhaps a positive and significant association in this area. During the years additionally, an attempt has been made to look at the arrivals trend and the prices of six goods, on average.

Pandit *et al.* (2012) conducted a study on analysis of price behaviour of rice in Eastern Indian Markets. The implementation of ordinary least square methods to the examination of the nominal price trend for the examination of the nominal price trend for the years 1975 to 2008 revealed that all regression coefficients were statistically significant, indicating that prices have significantly increased over time in all market place. Month-wise indices were created, and it was discovered that these differences were not as noticeable as they are for perishable goods. The harvest prices of Boro paddy and wheat, used in the empirical study of spatial price linkage among regionally chosen markets of Bangladesh using the Engle-Granger Co integration Method, show that these markets were highly integrated. That implies that information regarding price adjustments is completely and immediately imported to the other market places in Bangladesh.

Changule *et al.* (2012) analyzed the arrivals and prices of sunflower in APMC of Latur district for the period of 1991-1992 to 2010-2011 and the trend cyclic and regular variation were calculated by the ratio to operating average method. The results revealed that highest arrivals index was in the January 297.05 per cent and lowest arrival index in the month of September 16.02. Price index was highest in the July

(104.51 per cent) while price index was lowest in the month of October (93.58 per cent).

Naidu (2013) conducted research on the time series analysis of sunflowers in the Andhra Pradesh's state of Kurnool district. Examining the irregularity pattern of market arrivals and sunflower prices was one of two aims of this study. District was selected based on its importance as a market and production hub for the Rayalaseema region of Andhra Pradesh. Time series data are used in the study to determine correlation, trend, seasonality, and two-way ANOVA. Sunflower's coefficient behavior in Kurnool and Adoni markets in the Kurnool district (Andhra Pradesh) India. Findings revealed a descending trend in arrivals and rising the price trend in both sectors. Within a year, the market arrivals were subject to seasonality, and the seasonal pattern remained stable throughout time. While seasonality in prices was not seen in the Kurnool market inside a year as well as between the years, and neither was a seasonal trend. Adoni Market has changed above the years. Adverse correlation between market arrivals and prices in both markets above time, regular by the correlation coefficient between the years and the months.

Thombre and More (2013) studied market arrivals and prices of pigeon pea in Marathwada region. The study was based on secondary data collected from agricultural produce market committee (Regulated Market) of Parbhani and Nanded districts. The month wise market arrivals and prices data of pigeon pea 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 difference between market arrivals and prices of pigeon pea was tested with the help of simple linear regression equation and double log model. The results revealed that, arrivals and prices of Pigeon pea had vigour’s seasonal effect. The results confirmed the negative relationship between arrivals and prices in both the markets under the study.

Bandke and Chandrakant (2014) studied trends in arrival and price of major pulses in Marathwada region. Their study was useful to formulate economic policies beneficial for consumers, producers, traders and government. The analytical tools used were Seasonal indices, Coefficient of variation, Standard deviation, Trend, Mean, Compound growth rate and Linear growth rate. Findings of the present study lead to draw some conclusions. The pulses were sold immediate after harvest showing

high arrivals in post harvest months. Aurangabad and Jalana markets are big markets in district showing less variation in prices over the year. In crop wise condition of coefficient of arrivals and prices of black gram, green gram and pigeon pea is analysed.

Syed (2014) study was undertaken in APMC, Bangarpet of Karnataka state to examine production, market arrivals, price behaviour and market linkages with paddy processing unit. The information on market arrivals and prices were collected from the APMC. The study revealed that the production of paddy in Bangarpet taluka has shown the decreasing trend and quantity of market arrivals of paddy in APMC yard has shown increasing trend. The market arrivals were at its highest during the month of December and lowest during October.

Vani *et al.* (2015) studied arrival and price behaviour of groundnut in selected markets Kurnool of Andhra Pradesh. It was analyzed that there was maximum trends in the price of groundnut and highest in Karimngar (Rs 28.76/qt) and was minimum in Kurnool Market (Rs 10.28/qt). In Kurnool Market, April witnessed peak seasonal prices index of 107.8. The price index was lowest in September. Coefficent of multiple determinations (R^2) was 107.8. The market Price contributed 64 per cent of change in arrivals of groundnut.

Navadkar *et al.* (2016) Studied trends in arrivals and prices of green gram in western Maharashtra, an attempt has been made in this paper to study the arrivals and prices of green gram were collected from the purposively selected APMC, Barshi for the years from 2001-02 to 2011-12 order to compute the trends, growth rates and relationship between arrivals and prices. In case of price variability of green gram there was maximum variability in prices during the month of February and lowest in the month of August. At the Barshi market, the prices of green gram have been highest rapidly over the period of eleven years. The arrivals could not increase which may be due to decline in production and productivity of green gram in the study area. The arrivals in this market were, thus, inversely correlated to prices.

Hile *et al.* (2017) studied trends in arrivals and prices of major agricultural commodities in APMC, Satara. The study revealed that, arrivals of Jawar Wheat, Soyabean, Pigeon pea and Chickpea had indicated fluctuation yearly during the period of below study (2000-01 to 2011-12). The prices of all commodities were found to be

increased over entire period. This study suggested that the jowar for sell in the APMC Satara during the month of November to January and the wheat growers shall bring wheat for the sell in the APMC's Satara during the month of March to May and in case of soyabean, the growers shall bring soybean for sell in APMC Satara during the month of December to January.

Verma *et al.*(2017) analyzed price behaviours of soybean in selected district of southern Rajasthan to work out the trend, secondary data was collected from 2000 to 2014 from publish government sources. The time element single explained 89.3% to 93.0% variation annual wholesale price in selected markets. The result of compound growth rates revealed that wholesale price of soybean recorded significant growth rate in selected market of southern Rajasthan four markets were selected from four district namely Pratapgarh, Chittorgarh, Bhilwasa, and Banswara.

Grover *et al.* (2018) studied the price and arrival of cotton i.e., advancement, seasonal variation and volatility among the chosen cotton markets in Haryana. The monthly data on prices and arrivals of cotton were collected for the period from 2005-06 to 2016-17. Compound growth rate, moving average method and CV measure were used in the study. The results indicated considerable increase in cotton prices for the selected markets, whereas arrivals growth was observed to be positive but non-significant in all the markets except Uklana and Fatehabad markets having negative growth due to shift in cropping pattern. Seasonal analysis results showed that the cotton arrivals in the selected markets were higher in the months of October to January (Peak period) and lower in the months of February to May. The intra year prices in selected cotton markets during the study period remained almost stable with less than 10 of variation, whereas for the overall period the Coefficient of Variation ranged from 28.50 to 30.88 per cent in the selected cotton markets indicating presence of not much higher volatility during the study period. The increased volatility can be addressed through elasticity management and by employing risk management judicious like crop insurance, future markets etc.

Navasare, *et al.* (2018). examined the behaviour of fluctuations in prices and arrivals of Sorghum, Pigeon pea, Soybean, Chickpea and Bajra, which are chosen for study in APMC market in of Ahmednagar district. Intra year (month wise) arrival and price relationship of Pigeon pea over a month in Ahmednagar APMC. It shows that month-wise arrival of Pigeon pea period of 12 month where highest arrival

was 2300.583 qt. in the month of February, Followed by 2154.25 qt. in the month of January because of highest cultivation of Tur in surrounding area of Ahmednagar APMC and commencement of harvesting season i.e., in peak period. Lowest arrival was in the month of September and August i.e., 130.33 qt. and 138.92 qt. respectively due to slack period. Index number for arrival was the highest in the month of February i.e., 508.70 per cent, followed by January i.e., 476.34 per cent due to highest arrival of Pigeon pea. In the month of December per quintal highest price was Rs.3851.42. Index number for price was maximum in the month of December i.e., 116.48 per cent because of highest price in the month of December, when arrival of gram was less. During peak period when arrival was more, prices were low and when arrival was decline during slack season, prices were more i.e., arrivals and prices were inversely proportional to each other.

Paul *et al.* (2020) analyzed the market arrivals and prices of paddy in major markets of Telangana. The study was carried out to inspection the price behaviour of paddy and the relationship between market arrivals and prices in Suryapeta and Tirumalagiri markets of Telangana. In look on of this the present study was undertaken by collecting month difference in paddy prices. The price indices were lowest in the month of November in suryapeta markets, where as Tirumalagiri market in price indices were minimum in the month of December. The study concluded that there was an inverse relationship between market arrivals and the prices.

Kamble *et al.* (2021) studied the market arrivals and prices various agricultural commodities observance the price movement to decline the gap in market arrival. The study is based on the secondary data of 15 years from 2005-06 to 2019-20, which was collected from APMC Solapur and APMC Pandharpur in Solapur district. For the analytical framework, the Exponential Regression Equation was used to study the trend in arrivals and prices. The results revealed that both Solapur and Pandharpur market showed positive growth rate with respect to arrivals during the study period. Among both the markets, highest growth rate was observed in Solapur market with compound growth rate at 5.58 per cent per annum at ten per cent level of significance. In Pandharpur market, arrivals registered a compound growth rate of 1.65 per cent per annum which was statistically non-significant.

Balai *et al.* (2021) studied the seasonal price behaviour of major *Rabi* pulse crops in Rajasthan. The study based on time series data on arrivals and prices of major

Rabi crops. Whole sale prices of selected *Rabi* pulse crops were collected for 10 years (January 2008 to December 2017) in selected Krishi Upaj Mandi Samiti of Rajasthan. The study based on secondary data collected from different sources i.e., viz., AGMARK and NAFED and Krishi Upaj Mandi Samities. Two districts of Rajasthan state i.e., Bikaner and and Bundi were selected purposively. One Krishi Upaj Mandi Samiti from each district were chosen, based on maximum tri-annum average (2015-16 to 2017-18) arrivals and prices of major *Rabi* pulse crops in the market. Seasonal Index of arrivals and prices of selected pulse crops were worked out by ratio to moving average method. The study revealed that there was inverse relationship between price and arrivals of gram and lentil in the KUMS, Bikaner and Bundi of Rajasthan. It might be due to distress sale, lack of storage facilities and overdue burden of the farmers.

2. To know peak and slack period in arrival and prices of Pigeon pea

Jadhav *et al.* (2011) conducted a study on the trends and seasonal variation in soybean arrivals and pricing in the Amravati district. In order to conduct this study, secondary data on the arrival and costs of soybeans in APMC's., Achalpur, and Amravati were used. Morshi and Daryapur over the ten-year period, from (1999–2000) to (2008–2009). All of the selected market places arrival and price indices were seen to rise in cases where relative to the base year, of soybean. Monthly seasonal indicator of the selected. The highest arrivals of soybean were discovered right after harvest. Although the price index of during peak arrival months, soybean was seen to be lower, and vice versa.

Andhalkar *et al*. (2011) conducted a study on the arrival and costs of the main pulses in a few APMC's in the Amravati district. Based on secondary data on the arrival and costs of a few key pulses in APMC's, of Amravati, and Achalapur for a 15-year period, from 1994–1995 to 2008–2009. Amravati APMC experienced fluctuation. The greatest intra-year arrival index was discovered in cases of chickpea and pigeon pea from February to April. In relation terms of prices, the month had seen highest pigeon pea and chickpea price in the month of August to November and July to September respectively. Arrival and price have no discernible relationship. Pigeon pea and chickpea in Amravati and Achalpur APMC had unfavourable results.

Mahalle *et al.* (2014) reported that an increasing trend in arrivals was found in Washim, Yeotmal, Nandura and Shegaon markets. Whereas, decline trend in arrivals observed in Akola, Latur and Nanded markets. All study markets revealed increasing positive trend in wholesale price of Pigeon pea during study period. The price behaviour in off-season was higher and reverse was the case in on-season. Washim market had higher intra year price variation followed by Latur, Akola, Yeotmal, Shegaon and Nanded market. The lagged price is a vital factor in determining the current price than the market arrivals. The market integration showed that out of seven markets five markets were integrated.

Sharma *et al.* (2014) the present study was devoted to an analysis of behaviour of market arrivals and prices of pearl millet in Rajasthan. In Jodhpur market, the arrivals of pearl millet followed more or less the same pattern as in Nagaur. In Jaipur market, the arrivals in peak period were highest. The lowest arrivals were in the peak period followed by mid-period and lean period. The seasonal indices analysis of arrivals and prices reported that when major portion of the produce was received in the market, the prices were at the lowest. The correlation between arrivals and price in Jodhpur market was positive and statistically significant. This positive and significant correlation coefficient could be attributed to the off-season supplies of pearl millet which fetched maximum prices.

Mahalle *et al.* (2014) studied the behavior of market arrivals and prices of chickpea in chosen markets in Maharashtra. The results revealed that both market arrivals and prices of chickpea had increasing trends in all selected markets, during 1997 to 2011. Seasonal fluctuations were observed in market arrivals as well as in prices of chickpea across the markets. The Intra Year Price Rise and Average Seasonal Price Variation for chickpea varied between 8.26 per cent to 12.49 per cent and 7.93 per cent to 11.75 per cent respectively in markets stability in the marketing system. Johansen market integration methodology concluded that out of four markets, two are co-integrated. Error correction mechanism established the reality that chickpea markets came to price equilibrium in long run.

Sharma and Burark (2015) conducted their study on the maize price behavior and market concentration in Rajasthan's Nimbahera market. In light of this, the current study was carried out by collecting monthly wholesale maize prices in Rajasthan's major maize market places over a period of 12 years (2002 to 2013). The

seasonal price index provides a measure of maize price variance from month to month. Maize prices were found to be highest in the off-season and lowest in the harvest season. Maize is a *Kharif* crop; therefore, arrivals were particularly high from October to January. During the months of April to August, when arrivals were limited, maximum seasonal indicators of prices were seen. In Nimbahera, the Lorenz ratio was less than 0.5 markets. It can be concluded that the moderate market competitiveness in markets as the arrivals were concentrated among few large traders.

More *et al.* (2015) studied with an objective, firstly, to know the pattern of market arrivals and prices of major pulse crops and secondly, to identify the seasonality in arrivals and prices. The study resulted that, there is an inverse relationship between arrivals and prices of pigeon pea and chickpea crops over the years in Latur and Hingoli markets. Arrivals of pigeon pea in Latur market were seasonal (January to May), Maximum arrivals of pigeon pea was recorded in the month of January followed by February and March. The price index of pigeon pea was highest in the month of November with high coefficient of variation (176.25) indicating non surety of getting higher prices during this month. In chickpea, the highest arrival index was observed in the month of March followed by April. The price index was seen maximum during the month of October followed by November with lower Coefficient of variation value indicating that, the farmer should adjust their sale pattern of chickpea in the month of October and November for profitable marketing.

Benke *et al.* (2016) examined price behaviour of important agricultural commodity green gram in Akola district. The data on arrivals and prices of green gram crop under study for the period of 20 years i.e., from 1987-06 were used. The data were collected from the records of Akola APMC's. The results showed that arrival was found to be positively associated in period I (1987-96) of study and negatively associated in period II (1997- 2006) of study for Akola APMC's. Despite pronounced seasonality in arrivals there were negligible variations in seasonal prices of green gram. Cyclical fluctuations were found to be more pronounced than seasonal fluctuations in prices. This resulted that when maximum production is there, prices decreased and increased during the pre harvest month.

Thakare *et.al.* (2016) studied was suggested that the wheat growers should bring wheat to the APMC in Kolhapur for sale between December and March. During

the months of August to December, paddy growers must bring paddy to the APMC in Kolhapur, for sale. During the months of September to December, onion producers must bring their crop to the APMC in Kolhapur for sale. In order to gain favourable rates for their produce, potato can be brought for sale in APMC Kolhapur, during the months of September to December, groundnut during April and September to January, and jaggery during August and October to December in order to get good prices for their produce.

Sahoo *et al*. (2017) studied the fluctuation in the prices and arrivals of the Bengal gram for the period of 2003-2016 by collecting secondary data from APMC market. The major APMC Markets are selected purposively on the basis of high prices and arrivals in Uttar Pradesh and Madhya Pradesh, which are the major Bengal gram growing states of India. Positive and significant growth rate has been observed in the prices of selected APMC markets Bareilly and Shujalpur which was 0.78 and 0.49 respectively but there observed a positive and insignificant growth rate in the arrivals which was 0.07 and 0.02 at 5 per cent level of significance. Both Bareilly and Shujalpur market have high seasonal indices in the month of May and June and also observed the high post-harvest arrivals in the months. The low arrivals in the month August, January, and July observed the shortage and speculation in the pulse market. There was an inverse relationship between arrival and prices of Bengal gram in the selected markets.

Deokate *et al.* (2020) studied the price analysis of oilseeds in APMC, Ahmednagar Maharashtra. The APMC Ahmednagar provided secondary information on arrivals and prices of main oilseeds Soybean (10 years from the years 2009-10 to 2017- 18). Overall, soybean arrivals were up 4.93 per cent, while prices were up 9.78 per cent. The highest price index was 85.47 per cent in May, followed by 85.47 per cent in August. The Correlation coefficients for Soybean were negative throughout the year, showing that increasing arrivals resulted in lower prices the concept of inverse association is demonstrated in this case.

Mulla *et al.* (2020) studied the price behavior of onion in Kurnool 20 market. Price of onion in the Kurnool market at an annual growth of 6.22 per quintal per annum. The results revealed that during study period, the highest and lowest seasonal index of Onion price was indicated in the month of August and May, respectively.

Dhok *et al.* (2020) study was done to learn more about the socio-economic traits of the turmeric growers and the seasonal indices of the spice in the Sangali district of Maharashtra. Six villages were chosen at random from the Miraj and Palus tehsil in the Sangali district. For 2015-16 those details 60 samples of turmeric growers from chosen communities provided information pertinent to the goal. To retrieve data, Percentages, Averages, and Standard deviation were employed. The respondent's socioeconomic status, and Coefficient variation was utilised to test the hypothesis hypothesis. The results showed that the respondents' average age was 44.83 years. Sangali market, the arrivals were registered and were maximum in the month of March i.e 293.01 followed by April and May and it was 205.60 and 183.93, respectively and minimum in October i.e., 22.13. In case of prices, the maximum indices were obsrerved in the month of October i.e.,121.20 and lowest in the month of March i.e., 88.59.

Kachroo *et al.* (2021) studied trends and seasonality analysis in prices and arrivals of selected agricultural commodities in India. The study was formulated to find the fluctuation in the prices of the high value agricultural commodities, (castor, Cumin, soybean, coriander, turmeric). The result of the study showed that there was a positive and significant relationship between growth rate and prices of selected commodities with Cumin showing the highest growth rate of 9.87 per cent in arrivals followed by turmeric 9.05 percent and lowest in coriander 5.06 per cent.

3. **To study market integration of Pigeon pea markets in Akola districts**

Manohar *et al.* (2012) examined the degree of special market integration in the regional maize markets of Rajasthan. The results show that all of the examined market pairs had positive and statistically significant correlation coefficients for monthly wholesale prices of maize. The maximum number of the market pairs' Correlation coefficient values for maize prices ranged from 0.76 to 0.91 demonstrating the highly interconnected nature of the chosen markets. A lack of produce mobility from one market region to another may have caused the maize prices in some market place to change independently of the corresponding market. Government should improve market information and market communication in order to attain the integration goal.

Naik and Somashekhar (2012) evaluated integration of Sunflower markets in South Karnataka. Market integration for sunflower was studied by employing Zero

order correlation analysis. The result of the analysis revealed, that a very high degree of association was found between Chitradurga and Challkere markets (0.95) and a low degree of association of prices (0.87) was found between Davanagere and Mysore markets. Similar degree of association was found between Challkere and Mysore (0.934) markets and also Challkere and Davanagere (0.89) i.e., prices in Challkere market influences the price of both Davanagere prices in Mysore and Gouribidhanur markets are influenced by prices in Davanagere markets by 0.88 and 0.88 degrees, respectively. Consequently, the intense competition present in one market may have prices in other markets were influenced in the same manner.

Jalikatti *et al.* (2013) studied the price integration of Onion in markets of Northern Karnataka.The major markets selected for the study are Hubli, Belgaum, Bijapur, and Raichur. The analysis revealed that the Hubli markets influences the price of onion in the Belagum markets to a greater extent as Hubli is a major hub for onion.

Sendhil *et al.* (2013) conducted the study on price discovery, transmission and volatility. By examining the long-term link between markets utilising Co integration analysis, the study examined the convergence between the spot and futures markets. The findings indicate that, with the exception of barley, there is a long-term link between spot and futures prices for all commodities. The study also shows that trading in wheat and maize futures is effective. The degree of spot price volatility brought on by future trading, as determined by the coefficients of the GARCH model, had shown that volatility in spot markets persisted, but was not of an explosive nature.

Patil *et al.* (2014) they studied price movement of Pigeon pea i.e., seasonal variation, price volatility and co-integration among the major Pigeon pea markets in Maharashtra. For study purpose the data related to monthly average prices of Pigeon pea were collected from major markets of Maharashtra State viz. Akola, Latur, Jalgaon and Nagpur for the period of ten years. Moving average method used to study seasonal variation. The econometric tools like Augmented Dickey–Fuller test, Johansen's Multiple Co-integration test, Granger Causality Test and ARCH-GARCH model were used to arrive at conclusion. The results of study showed that the prices of Pigeon pea were higher in the months from July to October in all selected markets. The cyclical variation observed in the prices of Pigeon pea in the selected markets. For all selected markets the price series showed the consequences of unit root and

were stationary at first difference. The selected markets show long run equilibrium relationship and co-integration between them. Most of the markets showed bidirectional Causality influence on Pigeon pea prices of each other. Akola, Latur, Jalgaon and Nagpur market, showed volatility shocks are not quite persistent in these markets.

Bannor *et al.* (2015) studied the integration of the cluster beans markets in Rajasthan. The results showed that Sri Ganganagar and Anoopgarh and Hanumangarh market. In most cases, price is transmitted readily from one market to another. The growth rates of cluster bean prices per annum in all the chosen four markets are minimal. The results indicate a long run relationship between sri Ganganagar and Hanumangarh, Anoopagarh and Sikar and Hanumangarh and Sikar markets. The highest speed of adjustment running was from Anoopgarh to Sikar towards long run equilibrium at a rate of 117.1 per cent.

Wani *et al.* (2015) examined integration and price forecasting of apple in India. The research types and grades of the chosen fruits are out of equilibrium in the near term. However, the analysis discovers no co-integration for the American super variety in two pairs of markets (Delhi- Srinager and Banglore-Kolkata) and for the Moharaji special in one pair (Banglore Kolkata). Under various market conditions, the Granger Causality test indicates 39 and 18 bidirectional and uni-directional causations, respectively. Additionally, the results of the Vector Error Correction Model (VECM) show a combination of positive. The wholesale weekly prices of three commercial Apple in India during September 2005 to February 2013.

Vasudev *et al.* (2015) the study was carried out to study the effectiveness of the state of Telangana's chosen agricultural markets. To ascertain the degree of geographic market integration among the various agricultural markets, correlation analysis and co-integration analysis were conducted. The Dickey-Fuller unit root test and the Engle-Granger test were used to study the time series data for Co-integration and to ascertain the degree of market integration. For maize market integration analysis resulted a substantial connection between Warangal, Nagarkurnool, Nizamabad and Siddipet that ranged from 0.666 to 0.868, all of which were significant at the 1% level of significance. According to the Dickey Fuller unit root test, the market prices for all the crops were stationary for a while.

Mahalle *et al.* (2015) examined the market integration of wheat in Maharashtra. Both market arrivals and prices of wheat have depicted increasing trends in almost all the selected markets of Maharashtra. The seasonality in arrivals of wheat has been found maximum than the seasonality in market prices, showing a rise in market instability. Out of the seven, four markets have been indicated spatially integrated. Some market pairs have reported bi-directional causality, while others have depicted unidirectional causality. Almost all the selected wheat markets have resulted long-run equilibrium relationship and existence of co-integration among them.

Bannor and Mathur (2015) examined the spatial price transmission between mustard markets pairs in Rajasthan state of India using monthly mustard price series of six markets from 2006-2014. The co-integration tests deplects, Tonk and Alwar; Tonk and Dausa; Bharatpur and Alwar and Sri Ganganagar and Dausa are integrated in the long run at lag one. Tonk and Bharatpur and Bharatpur and Dausa are also integrated in the long run at lag two. Error correction model resulted that, the lowest speed of adjustment towards long run equilibrium was from Tonk to Bharatpur at rate of 43.2 per cent. The highest speed of adjustment was 103.8 per cent running Bharatpur to Alwar market towards long run equilibrium. Impulse response function results show, when an unexpected positive shock is given to market price in Tonk Sri Ganganagar and Bharatpur, the response there of from other trading markets will be permanent over a period of twelve months.

Deshmukh *et al*. (2017) examined the details among major pulse market in Solapur district. Market integration allows price signals to be transmitted from one market to another. Hence the study under taken to test market integration of pulses. Monthly price data of Pigeon pea and Chick pea for Eleven years from 2004-05 to 2014-15 was collected. The price of pigeon pea and Chick pea was showed in rupees per quintal. The markets are selected for the study were Solapur, Barshi, Mohol. To test null hypothesis of non stationary against alternative of stationary to Augmented Dickey-Fuller test based on unit root test. Results depicted that, all the Pigeon pea and Chick pea prices are non-stationary at level and become stationary at first differentiation confirms that all prices are integrated in same order. Market integration results observed that, all markets under the study are co-integrated and converge to

long run equilibrium. The pair wise integration results related the markets are integrated but not strongly.

Ganga Devi *et al.* (2019) the study examined the pricing, arrivals pattern and market integration of the two important pulse crops, gram and Pigeon pea in Gujarat state. The website (agmarknet.gov.in) of a few regulated markets was used to collect secondary data on monthly wholesale pricing and arrivals over the previous ten years (2007 to 2016). According to the study, the inter-year price study reveals an upward tendency in annual price indices and the cost of gram and Pigeon pea in particular maximised significantly in every one of the chosen markets had a positive and statistically significant compound growth rate over the course of the research. The intra annual pricing analysis showed that the two crops' prices generally varied according to the season, with prices increasing during the off-season and falling during the important season in the majority of the selected markets. The arrivals pattern reveals that in the chosen markets, there were higher arrivals during the off-season. This might be because the biggest stockholders announced their stocks as the new season gets underway. Market integration's findings resulted that there were both positive and significant correlation was discovered for each market pair, indicating that the gram and Pigeon pea.

Wavdhane *et al.* (2020) analyzed to know the Market integration of Green gram i.e. Seasonal variation, Price volatility and Co-integration for study purpose the data related to monthly average prices of Green gram were collected from important markets of Maharashtra state viz. Buldhana, Akola, Amravati and Latur markets for the period 2005 to 2016. Moving average method was used to study seasonal variations. The econometric tools like augmented Dickey-Fuller test, Johansen's multiple co-integration tests, Granger causality test and ARCH-GARCH model were used to study price volatility and Co-integration among different markets. The results of study showed that the prices of Green gram were maximum in the months from December to June in all the chosen markets. The cyclical variation examined in the prices of Green gram in the selected markets. For all selected markets, the price series explained the consequences of unit root and were stationary at first difference. The selected markets reported long run equilibrium relationship and Co-integration between them. Most of the markets resulted bidirectional influence on Green gram

prices of each other. Buldhana, Akola, Amravati and Latur market, recorded price volatility in Green gram prices.

Shivakumar *et al.* (2021) estimated the market integration using price transmission and price volatility happening in the vital domestic markets for one of the imported pulses namely green gram. The data was sourced from 2006 to 2018 on monthly regularity prices of green gram. In order to remove the non – stationary element in the price series, the augmented Dickey-Fuller test was used, which were non-stationary at levels but became stationary at the first difference. The price volatility prevailing in the green gram markets of India was estimated by GARCH (1,1) model resulted that all the markets were exhibiting consistence variability in market prices and proved the existence of a long-run equilibrium for green gram prices.

CHAPTER-III
MATERIALS AND METHODS

CHAPTER –III

METHODOLOGY

In Indian markets, fluctuation in market arrival and prices is typical characteristics of Agriculture Marketing. Indian farmers in general sell their produce in the market as soon as the crop is harvested, which causes prices to drop as a result of maximum arrival in the market. Proper market information to the primary producers would help them to make decisions that are in their benefit. This chapter discusses the methodology used to accomplish the present study. The data source, period of study and analytical techniques utilized to derive the inference are all covered in this chapter. Akola district, which serves as one of the major administrative districts in Maharashtra and purposively selected for the study due to maximum area under cultivation of Pigeon pea. This region is heavily reliant on the monsoon and is ideally suitable for cultivation of pulse crops. Keeping this in view, the present study is undertaken to study the "Trends in arrival and prices of Pigeon pea in Akola district of Maharashtra''

3.1 Salient features of Akola District

3.1.1 Location and Geographical Area

Akola is a district in the Indian state of Maharashtra. Akola district is one of the eleven districts of Vidarbha Region of Maharashtra State. It is situated in the northern part of the State and lies between north latitudes 20°16' and 21°17' and east longitudes 76°38' and 77°38'. Akola district forms the central part of Amravati division and was a former British Raj Berar Province. Area of the district is 5,428 km². It is bounded on the north and east by Amravati district, to the south by Washim district and to the west by Buldhana district. Washim was earlier a part of Akola till 1999. There are ranges of Gavilgad hills on the north of the district. Anjangaon, Daryapur and Nandgaon khandeshwar tehsils of Amravati district and Karanja tehsil of Washim district are on the east. The district headquarters is located at Akola town. For administrative convenience, the district is divided in seven talukas viz., Akola, Barshitakli, Murtijapur, Akot, Telhara, Balapur and Patur. The district has 7 towns and 1009 villages.

These are divided in to four sub divisions and seven tahsils. The major part of the district comes under Purna-Tapi basin. Purna is the main river flowing through the district. Katepurna, Uma, Morna, Man and Nirguna, which are the tributaries of the Purna. The northern fringe of Akola district is hilly and forms part of Satpura Range. South of these hill ranges, covering almost entire north-central part constitutes the Alluvial plain. Southern part of the district is characterized by hilly rugged terrain as a part of Deccan Plateau. Purna is the main river flowing through the district. Other important rivers are Man, Morna. The Purna River forms the part of north boundary of the district, and the top north portion of the district lies within its watershed along with Aas River and Shahanur River. From hydro geological status, Deccan Trap Basalt of upper Cretaceous to lower Eocene age is the major rock formation in the district covering the southern part, whereas almost entire four northern part is underlain by Recent Alluvium. Northern part of the district, covering about 2650 sq. km. in parts of Akot, Akola and Telhara talukas is underlain by Purna Alluvium.

3.1.2 Rainfall

Akola is located at an altitude of 925 ft (287m) to 1036.745 ft (316m) above sea level. The annual rainfall averages 800 mm. Most of the rainfall occurs in the monsoon season between June and September, but some rain does fall during January and February.

The district does not have any large area under extensive hill ranges. The Northern extreme of the district in the foothills of Satpura and the ghat country through which the land rives from the Purna plains to Balaghat plateau as well as the isolated broken hill terrain in the extreme. On the north, Akola is bordered by the Melghat Hills and forest region. The highest point in Akola District at about 950–970 m is present there in the northern Satpuda region. The Morna River flows through Akola. Purna river forms a part of the north border of the district, and the top north portion of the district lies within its watershed along with Aas River and Shahanur River. Vaan River forms a part of the northwest boundary of the district after entering from the Amravati district. Man River drains the south western portion of the district. Morna River drains the mid-south portion of the district, while the southeast is drained by the Katepurna and Uma rivers. Some of the rivers in Akola and their tributaries are Purna, Uma, Katepurna, Shahanur, Morna, Man, Aas and Vaan.

3.1.3 Natural Economic Resources

Deccan Traps occupied a major part of the district. Trap rocks are very hard and compact and are dark grey in colour. Trap rocks being dense, hard and compact are extensively used as building stones, road metal, and railway ballast as an aggregate in cement concrete. Erosive agents and weathering together have formed good fertile soils near the river beds.

3.2 Agriculture

Most of the people of Akola District are occupied in agricultural activities as according to Census, 2011 the percentage of cultivators is 16.88 per cent and that of agricultural labourers is 50.58 per cent. Thus, together they constitute 67.46 per cent of the total workers of the district. The district is divided in four sub divisions and seven tahsils.

3.3 Soils and Climate

The soils are basically derived from volcanic trap rocks which are quite fertile. The great plain which is known as “Payanghat” occupies about 80 percentage of the district and contains chiefly rich black soils. On the left bank of Purna river covering entire Tahsil of Balapur, Akola, Murtijapur and northern portion of Patur and Barshi-Takli, an open widely cultivated tract is found, where an intensive cultivation of Cotton, Jowar and wheat is carried out. Sugarcane and Chillies are also produced depending upon the irrigation facility, which due mainly wells. The right bank of Purna river, covering major portion of Telhara and Akot Tahsils is most fertile part of the Purna valley and is chiefly a rich black soil country, well cultivated and wooded with mango groves. In the vicinity of the hills of Gavilgarh and Ajanta Soils are shallow, stony and less productive. Sourthern portion of Patur and Barshitakli and northern portion of Telhara and Akot Tahsils fall under this type of soils. This area is devoted entirely to the growth of *Kharif* crops and it is more dependent on the rainfall. Akola district shows a little variation in its climate along the North-South direction. Akola district mainly features Tropical Savannah Climate. But the Northern parts of the district consisting of hills and mountains that are raised to about 950 to1000 meters shows a subtropical climate featuring heavily cold winters. The summers are extremely hot, while the winters are dry and very cold the temperature may drop to or below 9 °C. The district has recorded a minimum temperature of 9 °C while a

maximum of 44.4 °C. The normal annual rainfall over the district varies from about 740 mm to 860 mm. The average annual rainfall for the last ten years 2009-2019 ranges from 656.20 mm (Balapur) to 742.80 mm (Murtijapur).

3.4 Sampling Data

3.4.1 Selection of District

In the first stage, the Akola district was purposely selected for present study, as it has a major proportion of the area under Pigeon Pea crop. The topography and climatic condition prevailing in the district is highly suitable for the cultivation of pulses crops. Keeping this in view and the importance of pigeon pea cultivation in the district, the present study is undertaken. The findings study will help the farmers and the market committees, to take favourable decision in the coming future.

3.4.2 Selection of market

There are a total of seven Agricultural Produce Market Committee (APMC) functioning in the district. The data were collected from Akola, Akot and Murtijapur three major Agricultural Produce Market Committees, in this district and hence purposively selected.

3.4.3 Selection of the commodity

As one of the most important commodity with record of maximum quantity of arrival in the district APMC's of Akola is Pigeon pea, only Pigeon pea was selected for present study as it would help the market functionaries to take fruitful decision and receive better price realisation.

3.4.4 Collection of data

The nature of data used for the study is entirely based on a secondary source of data. The required data were collected from the selected market committees from the published sources such as annual reports and maintained records of APMC and further complied to derive conclusion.

3.4.5 Period of Study

The required data related to market arrival and prices of selected Pigeon pea crop was collected for the period 2000-01 to 2019-20, which includes 20 years of data.

3.5 Analytical Technique

3.5.1 Analytical tools and techniques

Data was analyzed by using simple tabular analytical tools such as Mean, Frequencies, Ratios, and Percentages etc. Apart from this, functional analysis such as the trend in market arrivals and prices, Seasonal indices, Standard deviation, Coefficient of variation, Growth rate and the Pearson's correlation coefficient was worked out to derive a precise conclusion from the study. The procedure involved in the analysis is explained in the following sections.

a) Trends in market arrival and prices

The analysis of price and market arrivals over time is important to know the fluctuations in them and also its helps to formulate appropriate ways and means for reducing price fluctuations of agricultural commodities. The time series data pertaining to monthly arrivals and prices of Pigeon pea was collected from APMC's, The following Linear functional form was used to estimate and examine the trends in market arrivals and prices.

$$\mathbf{M = a + bt} \qquad \textbf{equation 1}$$

$$\mathbf{P = c + dt} \qquad \textbf{equation 2}$$

Where,

M = Monthly market arrival of pigeon pea in quintals

P = Price of pigeon pea in rupees per quintals

a = Intercept.

b = Regression coefficient (rate of change in monthly market arrivals for a unit change in the time (dm/dt)

t = Time variable in years

c = Intercept

d = Regression coefficient (dp/dt)

The annual compound growth rates of arrivals and prices of Pigeon pea were worked out by using an exponential equation as below.

Compound growth rate (CGR) will be estimated by using exponential model, the formula,

CGR (r) = Anti log (B-1) x 100

b) Peak and slack in arrival and prices

Seasonal indices are those periodic movements in business activity which occur regularly over period of time and have their origin in the year itself. Since such variations repeats during a period of twelve months, it was calculated and with higher accuracy level. To obtain a statistical description of a pattern of seasonal variation, it is desirable to first free the data from the effects of trend, cycles and irregular variations. Once these other components had been eliminated, seasonal index was calculated in index form as a measure of seasonal variation. Thus specific seasonal index refers to the seasonal changes during a particular year. To examine the peak and slack period, monthly seasonal indices was worked out by using simple average method.

$$\textbf{Seasonal indices} = \frac{Xi}{\bar{X}} \times 100$$

Where,

Xi = monthly average for 1 years

$\bar{x}$ = mean of 12 month, average

c) Standard deviation

Standard deviation is the measure of dispersion. This measure of dispersion was estimated by squaring the deviation of each observation from the mean, adding the squares and dividing it by the total number of observation (n) and extracting the square root.

$$\textbf{Standard deviation} = \sqrt{\frac{\sum_1^n (X_i - X)^2}{n-1}}$$

Where,

Xi = arrivals/ prices

$\bar{X}$i = Mean of arrivals / Prices

i = 1, 2, 3…..n

N = number of years / month

d) Coefficient of variation:

The variability in arrivals and prices of Pigeon pea in selected APMC during the period of study was calculated by using coefficient of variation. Coefficient of variation is defined as the "Percentage variation in the mean as the standard deviation being stated as the total variation in the mean". The coefficient of variation of each market was worked out by comparing the variability present in market arrivals and prices.

$$C.V. = \frac{SD}{mean} \times 100$$

Where,

SD = Standard deviation

Mean = Arithmetic mean

CV = Coefficient of Variation

e) Correlation between arrival and prices

For achieving one of the objectives of the study i.e. to study the relationship between market arrival and prices, the method of correlation was used. The correlation for the arrivals and prices of Pigeon pea was calculated. The correlation is the measure of degree of relationship amongst two series i.e. arrivals and prices. The formula used for calculating the Pearson's coefficient of correlation (r_{xy})

$$\mathbf{r_{xy}} = \frac{\mathrm{COV\ (X,Y)}}{\mathrm{dx,dy}}$$

Where,

x = Arrival mean

y= Price mean

r = Correlation coefficient

Cov (x,y) = Co- variation between x and y

dy= Standard deviation of y

dx= Standard deviation of x

For the significance of correlation coefficient (r) formula used was as below.

$$\textbf{t test} = \frac{r\sqrt{n-k}}{\sqrt{1-r^2}}$$

Where,

r = Correlation coefficient,

n = number of observation

k = number of parameter

f) Market integration:

Market integration of agricultural products gained importance in developing countries, due to potential application to develop the national economy. Market integration analysis examines how different markets over space are related. Efficient market integration enhances supply security, reduced price risks, prevent food shortage, reduce market entry barriers and support the effectiveness of macro-level economic policies. If agricultural markets are not integrated, then spatially distribute markets will not be able to respond to the price signals of isolated markets with surplus of food. Addition to this, poorly integrated markets may transmit inaccurate price information, thereby leading to inefficient product movement (Goodwin & Schroeder, 1991). Market integration was worked out by estimating bivariate Correlation coefficient (r) between price changes in different selected market. (Acharya and Agarwal 1994)

$$\mathbf{r} = \frac{\sum(P_{11}-P_1)(P_{21}-P_2)}{\sqrt{\sum(P_{11}-P_1)^2(P_{21}-P_2)^2}}$$

Where,

R= Simple correlation coefficient

P11=Price of the commodity in first market

P21= Price of the commodity in second market

P1= Mean of prices in first market

P2 = Mean of the prices in second market

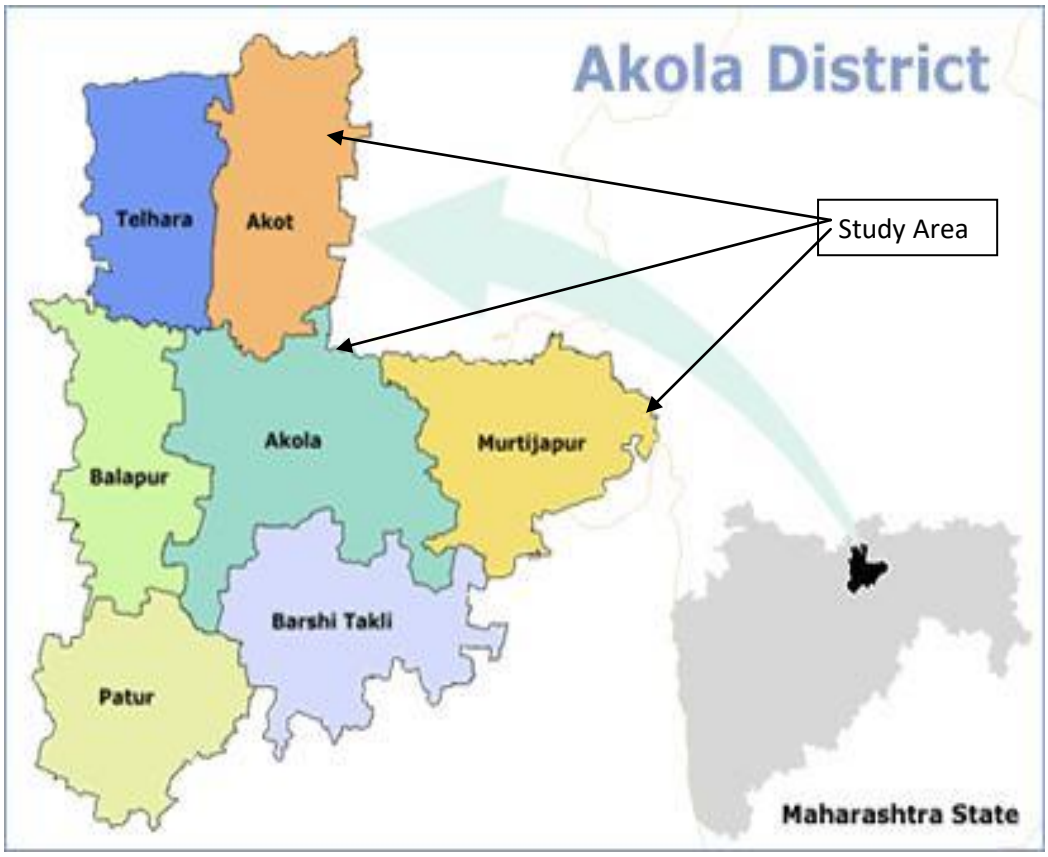

Fig. 3.1 Map of the selected Akola district of Maharashtra

CHAPTER-IV
RESULTS AND DISCUSSION

CHAPTER-IV

RESULTS AND DISCUSSION

This chapter is devoted to systematically present the results obtained from the present study and interpret the same to arrive to a valuable conclusion. The aim of the study was to analyzed the trend in arrival and prices of Pigeon pea in Akola district of Maharashtra. The time series data on market arrivals and prices were collected and compiled from the selected Akola, Murtijapur and Akot market APMC's. The collected data on market arrival and prices were analyzed with the help of statistical tools.

The important of the objective was to compute the growth rate, peak and slack periods, relationship between prices of Pigeon pea in Akola, Murtijapur and Akot markets for a period of 20 years from 2000-01 to 2019-20 and months from January to December of the year 2020.

The results of the study are discussed under the following sections:

4.1. Trends in arrival and prices of Pigeon pea

4.2. The peak and slack period in arrival and prices of Pigeon pea

4.3. The market integration of Pigeon pea markets in Akola district

4.1 Trend in arrival and prices of Pigeon pea:

The time series data on annually arrivals and prices of Pigeon pea covering the time period of twenty years 2000-01 to 2019-20 was collected from Akola, Murtijapur and Akot APMC's. Trend in arrivals and prices of Pigeon pea was evaluated by using linear and exponential function and the compound growth rate was worked out.

4.1.1 Pigeon pea Arrival:

The data of Pigeon pea from 2000-01 to 2019-20 was collected from Akola, Murtijapur, and Akot APMC's and analyzed. The trends of arrival of Pigeon pea determined by using linear function in Table 4.1, the annual arrivals of Pigeon pea are presented.

Table 4.1 Marketwise trends of arrivals for Pigeon pea (2000-01 to 2019-20)

Variables	Akola	Murtijapur	Akot
a	80187.88	17673.45	-17551.46
b	9396.33	4575.39	4608.67
R^2	0.64020	0.49139	0.63043
t	5.65*	4.17*	5.54*

*Significant at the 5 per cent level of significance

The trends analysis of annual arrival of Pigeon pea in Akola, Murtijapur and Akot markets was depicted in Table 4.1. The table reveals that, trends values of arrivals in Akola (9396.33), Murtijapur (4575.39) and Akot (4608.67) market was found significant trend.

Compound growth rate was calculated by exponential linear function with respect to Pigeon pea arrival for selected APMC's during period i.e. (2000-01 to 2019-20) and the results were presented in the Table 4.2

Table 4.2 Marketwise compound growth rate of arrivals for Pigeon pea (2000-01 to 2019-20)

Variables	Akola	Murtijapur	Akot
a	4.98	4.42	4.26
b	0.02	0.03	0.05
R^2	0.63	0.53	0.54
t	5.42	4.37	4.51
CGR (per cent)	2.35*	3.19*	4.83*

*Significant at the 5 per cent level of significance

Yearly growth rate of arrival was calculated with respect to Pigeon pea for all the markets and the same was given in Table 4.2. Akola, Murtijapur and Akot APMC showed positive growth rate which was significant at 5 per cent level of significance. In case of Akot APMC the growth rate was found highest 4.83 per cent among selected APMC's. It was indicating that the R^2 value of concerning APMC's Akola, Murtijapur and Akot were 0.63, 0.53 and 0.54, respectively. Similar finding was noted by Sahoo *et.al* (2017). Studied arrivals of Bengal gram and found that there was positive and significant growth rate had been observed in the prices of APMC of Bareilly and shujalpur, which was 0.78 and 0.49, respectively. There was inverse relationship between Arrival and Prices of Bengal gram in selected market.

4.1.2 Pigeon pea Prices:

The trends of prices of Pigeon pea determined by using linear function given in Table 4.3, the yearly prices of Pigeon pea were given.

Table 4.3 Marketwise trends of Prices for Pigeon pea (2000-01-2019-20)

Variables	Akola	Murtijapur	Akot
a	861.05	960.97	914.11
b	237.72	208.72	239.42
R^2	0.67	0.63	0.72
t	6.08*	5.61*	6.88*

*Significant at the 5 per cent level of significance.

The yearly trends analysis of prices of Pigeon pea in Akola, Murtijapur and Akot markets was presented in Table 4.3. The table reveals that positive trend values of prices in Akola (237.72), Murtijapur (208.72) and Akot (239.42) market showed increasing trend and significant at 5 per cent level.

Yearly compound growth rate was calculated by exponential function with respect to Pigeon pea prices for selected APMC's during the period i.e., 2000-01 to 2019-20 and the same are presented in Table 4.4.

Table 4.4 Marketwise compound growth rate of prices for Pigeon pea (2000-01 to 2019-20)

Variables	Akola	Murtijapur	Akot
a	3.12	3.13	4.26
b	0.03	0.03	0.04
R^2	0.79	0.77	0.54
t	8.17	7.74	4.50
CGR (per cent)	3.40*	3.07*	4.82*

*Significant at the 5 per cent level of significance.

APMC's showed positive growth rate in the study period, which was significant at 5 per cent level of significance. Akot APMC was highest growth rate of 4.82 per cent among selected APMC's followed by Akola and Murtijapur. It was indicating that the R^2 value of with respect to APMC's Akola, Murtijapur and Akot were 0.67, 0.63 and 0.72 respectively. All APMC's indicated significant at the 5 per

cent level of significance. Similarly, Verma, D. K., *et.al.* also observed the similar result of compound growth rates, which revealed that the wholesale prices of soybean crop recorded significant growth rates in selected markets of Southern Rajasthan. Also, Kachroo *et.al.* (2021) analyzed the prices and arrival of selected agricultural commodities and stated that positive and significant relationship of growth rate and prices of selected commodities with jeera showing the highest growth rate of 9.87 per cent in arrivals followed by turmeric 9.05 per cent.

4.2 Seasonal indices of arrival and prices of Pigeon pea:

The seasonal indices were evaluated in the percentage of arrivals and prices of Pigeon pea in the selected markets. Seasonal indices of Pigeon pea in Akola, Murtijapur and Akot market was worked out by using simple average method for the period of 2000-01 to 2019-20 years and monthly one year of 2020 and the results obtained were presented in this section.

4.2.1 Seasonal indices of arrivals of Pigeon pea

The annual seasonal indices of arrivals of Pigeon pea in Akola, Murtijapur and Akot computed and the results were presented in Table 4.5

It was observed that in Akot APMC, annual seasonal indices of arrivals were highest in the year of 2018-19 (286.79 per cent) followed by 2017-2018 (269.80 per cent), and 2019-2020 (253.17 per cent), whereas lowest arrivals were during the year 2013-2014 (15.52 per cent), 2007-2008 (34.38 per cent) and 2001-2002 (36.80 per cent), respectively.

In Akola APMC the seasonal indices of arrival were highest in the year 2011-12 (165.56 per cent) followed by 2017-18 (162.08 per cent), and 2016-2017 (151.62 per cent), whereas lowest seasonal indices were observed in the year of 2000 -2001 (51.34 per cent), 2004-2005 (56.57 per cent) and 2006-2007 (59.96 per cent), respectively. In Murtijapur APMC the seasonal indices of arrivals were highest in the year 2017-2018 (269.16 per cent) followed by 2011-2012 (180.93 per cent) and 2018-2019 (178.62 per cent), whereas lowest seasonal indices were observed in the year of 2007-2008 (27.76 per cent) followed by 2002-2003 (43.52 per cent) and 2009 - 2010 (54.45 per cent), respectively.

Table 4.5 Marketwise yearly seasonal indices of arrivals of Pigeon pea 2000-01 to 2019-20 **(Per cent)**

Sr. No.	Year	2000-01 to 2019-20		
		Akola	Murtijapur	Akot
1	2000-2001	51.34	54.43	47.94
2	2001-2002	71.22	63.44	36.80
3	2002-2003	77.15	43.52	38.84
4	2003-2004	73.90	58.35	61.96
5	2004-2005	56.57	64.97	39.80
6	2005-2006	63.36	69.04	39.18
7	2006-2007	59.96	68.01	63.85
8	2007-2008	60.73	27.76	34.38
9	2008-2009	73.71	56.67	51.80
10	2009-2010	67.22	54.45	43.09
11	2010-2011	115.14	106.93	47.45
12	2011-2012	165.56	180.93	122.05
13	2012-2013	132.27	126.54	84.75
14	2013-2014	118.14	127.65	15.52
15	2014-2015	104.19	113.44	125.80
16	2015-2016	150.55	106.46	128.26
17	2016-2017	151.62	140.90	208.75
18	2017-2018	162.08	269.16	269.80
19	2018-2019	130.27	178.62	286.79
20	2019-2020	115.00	88.74	253.17

Among the selected markets the highest arrival were in the year 2018–2019 (286.79 per cent), in Akot APMC market followed by Murtijapur APMC market (269.16 per cent), whereas the lean period of arrival in the year 2013 – 2014 (15.52 per cent) in Akot APMC market were observed in selected markets.

Similarly, Mahalle *et.al.* (2014) results were found regarding the increasing trend in arrivals for washim, Yeotmal, Nandura and Shegaon market, where as decreasing trends in arrivals in Akola, Latur and Nanded.

4.2.2 Marketwise variation of arrivals of Pigeon pea (2000-01 to 2019-20)

The annual Mean, Standard deviation and Coefficient of variation (CV) for arrivals of Pigeon pea in Akola, Murtijapur and Akot market were estimated presented in Table 4.6

Table 4.6 Marketwise variation of arrival of Pigeon pea (2000-01 to 2019-20)

Year	2000-01 to 2019-20		
	Mean (Qtl.)	SD	CV (per cent)
Akola	178849.45	69475.99	38.84
Murtijapur	65715.10	38614.12	58.75
Akot	81239.60	70103.80	86.29

It was observed that, mean arrivals of Pigeon pea during study period was high in Akola market 178849.45 quintals, whereas Murtijapur and Akot APMC's showed the arrivals as 65715.10 and 81239.60 quintals, respectively.

The Standard deviation was highest in the Akot market (70103.80), followed by Akola market (69475.99) and the lowest in the Murtijapur market (38614.12). The value Coefficient of variation of arrivals for Pigeon pea during the study period were observed 38.84 per cent, 58.75 per cent and 86.29 per cent Akola, Murtijapur and Akot, respectively. The maximum Coefficient variation observed in Akot market because Standard deviation observed in Akot APMC highest comparatively Akola and Murtijapur market.

4.2.3 Marketwise monthly seasonal indices of arrivals of Pigeon pea (2019-20)

The monthly seasonal indices of arrivals of Pigeon pea in Akola, Murtijapur and Akot were computed and the results presented in Table 4.7.

The seasonal indices of market arrivals of pigeon pea in the selected markets were presented in Table 4.7. Monthly seasonal indices were calculated in order to ascertain the long run seasonal variations in arrivals of Pigeon pea.

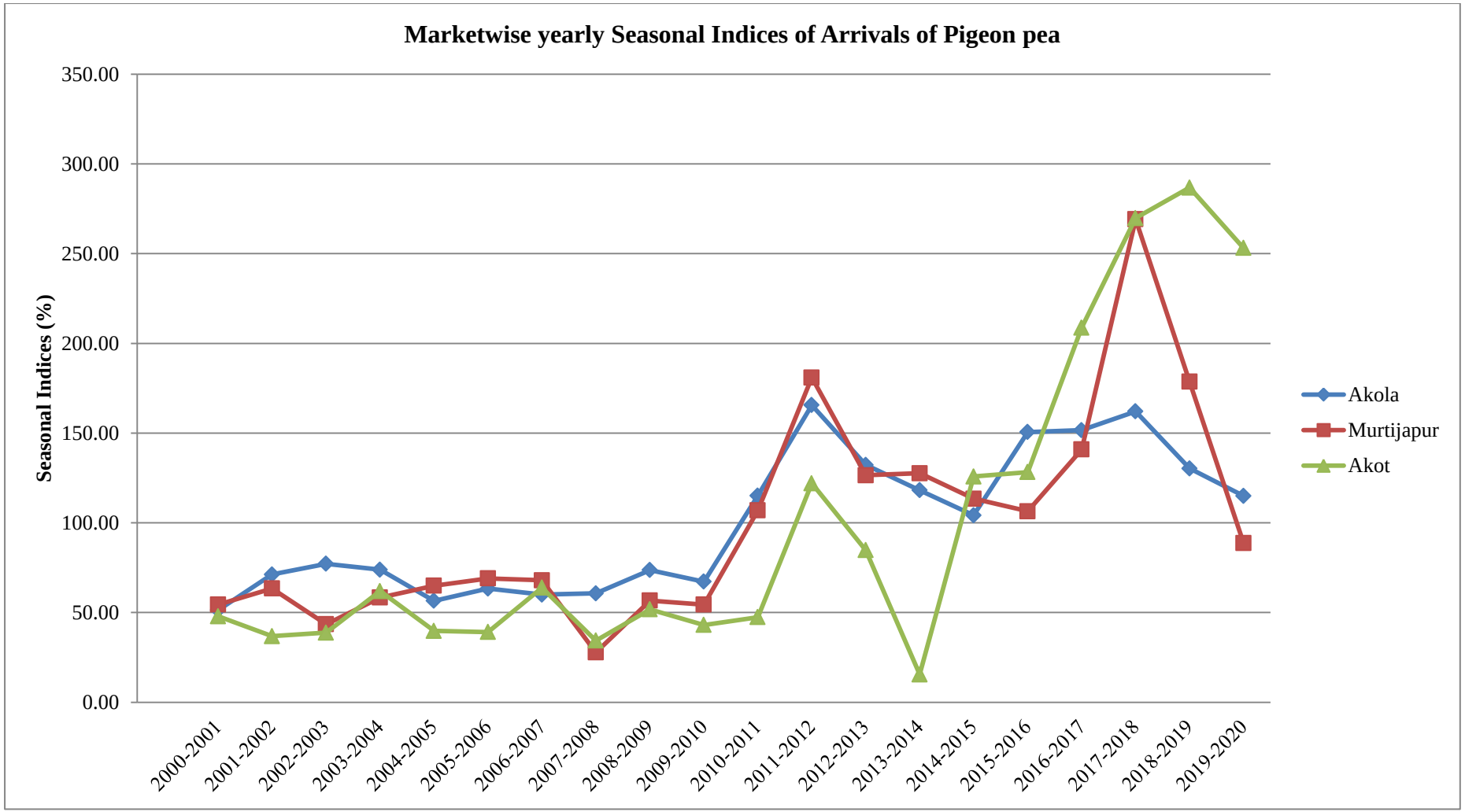

Fig. 4.1: Marketwise yearly seasonal indices of arrivals of Pigeon pea 2000-01 to 2019-20

Table 4.7 Marketwise monthly seasonal indices of arrivals of Pigeon pea 2019-20

(Per cent)

Month	Akola	Murtijapur	Akot
January	58.06	53.51	131.56
February	396.80	78.34	282.81
March	248.57	123.81	204.78
April	63.37	66.28	52.11
May	114.15	57.44	178.39
June	152.09	248.43	151.95
July	61.02	72.18	35.60
August	41.42	37.82	49.38
September	29.65	36.58	37.18
October	16.81	200.11	22.20
November	8.73	136.64	4.37
December	9.28	88.81	49.62

The results showed the existence of seasonality in all the markets. Higher indices of market arrivals of Pigeon pea were noticed immediately after harvest in both Akola, and Akot which reached peak, during February (396.80 and 282.81), respectively. Gradually started arrivals decreasing from July and were in October, November and December. The market from February to June was glutted with Pigeon pea produce because mostly the farmers sold their produce immediately after harvest. The higher markets arrivals were found in APMC's (more than 110 per cent) to be significant in the months of February, March, May and June in the selected markets.

Among the selected markets the highest arrivals were in the month of February (396.80 per cent) in Akola market followed by Akot market (282.81 per cent) and Murtijapur market showed highest in the month of June (248.43 per cent) followed by October (200.11 per cent), whereas the lowest arrivals in the month of November (4.37 per cent) in Akot APMC market. Devi *et.al*. (2019). Recorded similar results during the monthly pattern arrivals of gram and Pigeon pea in selected market reported maximum arrivals of gram in Rajkot market in the month of September (292.90 per cent) and minimum in the month June (94.09 per cent). Also, More,S.S. *et.al.* (2015) noted that the arrivals of Pigeon pea in Latur market were

seasonal (January to May), maximum arrival of Pigeon pea were recorded in the month of January followed February and March.

4.2.4 Marketwise variation of monthly arrivals of Pigeon pea 2019-20

Monthly Mean, Standard deviation along with Coefficient of variation (CV) of arrival for Pigeon pea in Akola, Murtijapur and Akot market were estimated to study the trends and distribution of arrivals and prices. The results obtained were depicted in the following Table 4.8.

Table 4.8 Marketwise variation of monthly arrival of Pigeon pea 2019-20.

Year	2019-20		
	Mean (Qtl)	SD	CV (per cent)
Akola	15342.58	17889.77	116.60
Murtijapur	37613.16	24931.80	66.28
Akot	6787.58	5963.93	87.86

It was observed that mean arrivals of Pigeon pea during period was high in Murtijapur market 37613.16 quintals. Followed by Akola market 15342.58 quintals and lowest in the Akot market 6787.58 quintals. The Standard deviation was highest in the Murtijapur market (24913.80), followed by Akola market (17889.77) and the lowest in the Akot market (5963.93). The Coefficient of variation of in arrivals of Pigeon pea, during the study period was observed that 116.6 per cent, 66.28 per cent and 87.86 per cent in Akola, Murtijapur and Akot markets, respectively.

4.2.5 Seasonal indices of prices of Pigeon pea

The marketwise annual seasonal indices of prices of Pigeon pea in Akola, Murtijapur and Akot were computed and presented in Table 4.9

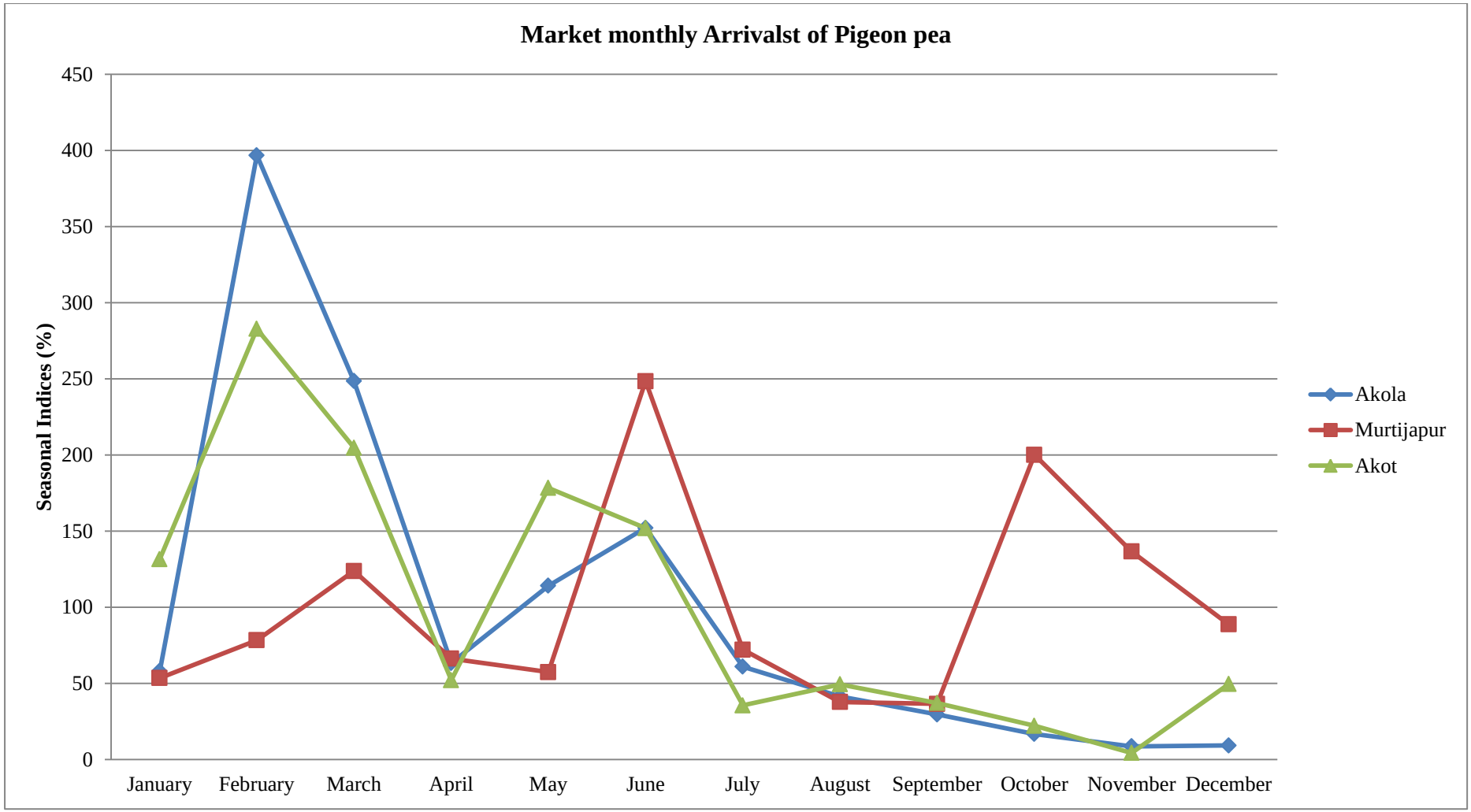

Fig. 4.2 Marketwise monthly seasonal indices of arrivals of Pigeon pea 2019-20

Table 4.9 Marketwise yearly seasonal indices of prices of Pigeon pea 2000-01 to 2019-20 (Per cent)

Sr. No.	Year	2000-01 to 2019-20		
		Akola	Murtijapur	Akot
1	2000-2001	46.85	50.75	44.05
2	2001-2002	45.69	47.58	29.72
3	2002-2003	51.38	53.92	79.05
4	2003-2004	60.47	57.10	46.53
5	2004-2005	49.51	63.44	41.57
6	2005-2006	52.90	52.40	48.13
7	2006-2007	51.20	71.69	60.41
8	2007-2008	70.53	73.05	67.03
9	2008-2009	88.38	79.30	80.95
10	2009-2010	79.44	106.74	127.77
11	2010-2011	119.71	97.95	104.72
12	2011-2012	94.63	90.12	110.79
13	2012-2013	112.83	118.44	107.76
14	2013-2014	122.36	87.77	122.75
15	2014-2015	157.66	147.66	160.44
16	2015-2016	239.78	241.13	206.47
17	2016-2017	166.63	161.77	170.36
18	2017-2018	119.71	126.88	126.78
19	2018-2019	130.32	112.73	127.62
20	2019-2020	139.99	159.58	137.10

It was observed from the table that the highest seasonal indices of prices of Pigeon pea for Akola market were registered in the year 2015-16 (239.78 per cent) followed by 2016–17 (166.63 per cent) and 2014–15 (157.66 per cent), whereas lowest prices were observed in the year 2001-02 (45.69 per cent), 2000-01 (46.85 per cent) and 2004-05 (49.51 per cent), respectively.

In Murtijapur APMC the seasonal indices of prices were highest in the year 2015-16 (241.13 per cent) followed by 2016-17 (161.77 per cent) and 2014-15

(147.66 per cent). Whereas, lowest seasonal indices observed in the year of 2001-02 (47.58 per cent), 2000-01 (50.75 per cent) and 2005-06 (52.40 per cent).

In Akot APMC the seasonal indices of prices were highest in the year 2015-16 (206.47 per cent) followed by 2016-17 (170.36 per cent) and 2014-15 (160.44 per cent). Whereas, lowest seasonal indices were observed in the year of 2001-02 (29.72 per cent) followed by 2004-05 (41.57 per cent) and 2000-01 (44.05 per cent).

The highest indices of prices of Pigeon pea were registered in the year 2015-16 (241.13 per cent) in Murtijapur market, followed in 2015-16 (239.78 per cent) in Akola market. The lowest indices of arrivals were registered in the year 2001-02 (29.72 per cent) in Akot market.

4.2.6 Market variation of arrivals and prices of Pigeon pea:

The Mean of prices of Pigeon pea in selected APMC's along with Standard deviation and Coefficient of variation were calculated and presented in Table 4.1

Table 4.10 Marketwise variation of prices of Pigeon pea (2000-01 to 2019-20)

Year	(2000-01 to 2019-20)		
	Mean (Rs)	SD	CV (per cent)
Akola	3357.20	1714.75	51.07
Murtijapur	3152.60	1547.38	49.08
Akot	3428.10	1664.09	48.54

It was observed that, Mean of Pigeon pea during study period was highest in Akot market 3428.10 Rs /quintal, whereas Akola and Murtijapur APMC's showed prices 3357.20 and 3152.60 Rs/quintal, respectively.

The results of Standard deviation showed that highest Standard deviation was recorded in Akola (1714.75) and Akot (1664.20) while lowest Standard deviation was recorded in Murtijapur (1547.38) APMC's.

The Coefficient of variation in prices of Pigeon pea, during study period was observed that 51.07 per cent, 49.08 per cent and 48.54 per cent Akola, Murtijapur and Akot, respectively. The maximum variability observed in Akola market. Similarly, results were reported by Joyal *et.al.* (2021) revealed noted that the Coefficient of variation in yearly prices of pear millet the prices ranged from 19.93 to 22.42 per cent.

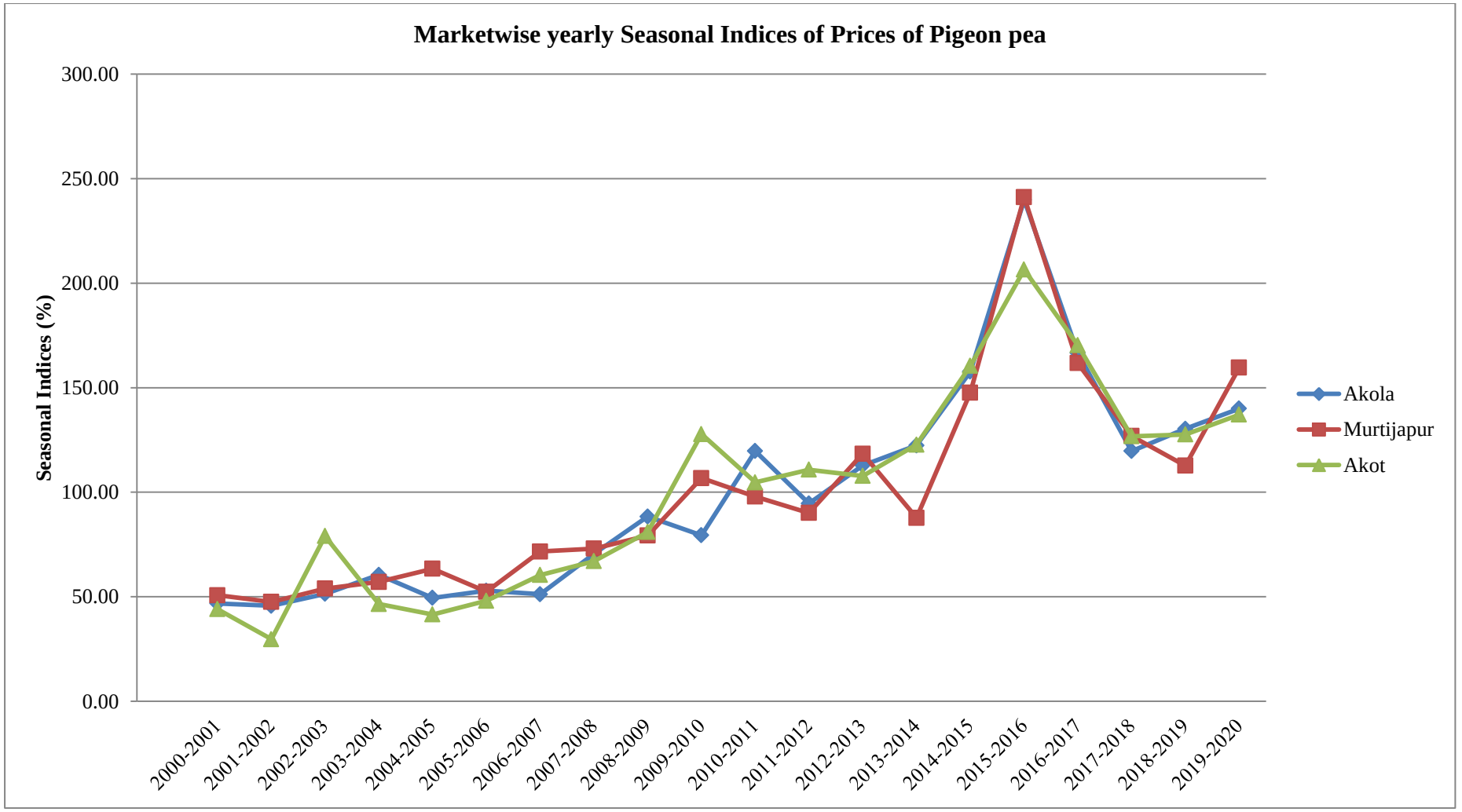

Fig. 4.3 Marketwise yearly seasonal indices of prices of Pigeon pea 2000-01 to 2019-20

4.2.7 Market variation monthly seasonal indices of prices of Pigeon pea (2019-20)

Table 4.11 Monthly seasonal indices of prices of Pigeon pea 2019-20 (Per cent)

Month	Akola	Murtijapur	Akot
January	89.45	104.98	91.75
February	90.44	108.04	92.04
March	92.41	84.44	91.84
April	93.40	89.44	96.55
May	89.71	84.69	97.51
June	103.29	122.43	97.51
July	100.82	119.07	98.47
August	96.37	96.74	101.84
September	107.99	94.96	106.16
October	123.55	91.98	130.76
November	115.64	99.72	103.76
December	96.88	103.14	91.84

The marketwise monthly seasonal indices of prices of Pigeon pea were computed and presented in Table 4.11.

It was observed that in Akola APMC, monthly seasonal indices of prices were highest in the month of October (123.55 per cent) followed by November (115.64 per cent) and September (107.99 per cent), whereas lowest prices were during January (89.45 per cent), followed by May (89.71 per cent) and February (90.44 per cent), respectively.

The highest seasonal indices of prices of Pigeon pea were registered in the month June (122.43 per cent) followed by July (119.07 per cent) and February (108.04 per cent) in Murtijapur APMC, whereas lowest seasonal indices observed in the month of March (84.44 per cent), May (84.69 per cent) and April (89.44 per cent).

In Akot APMC the seasonal indices of prices were highest in the month of October (130.76 per cent) followed by September (106.16 per cent) and November (103.76 per cent). Whereas, lowest seasonal indices of prices observed in the month of January (91.75 per cent) and March (91.84 per cent). Similar results were obtained by Andhalkar G.K. (2011), showed that the highest arrivals as well as price variation

occurred in Amravati APMC and the highest price index observed in the month of July to September and August to November.

4.2.8 Market variation of monthly prices of Pigeon pea

Table 4.12 Market variation prices of Pigeon pea 2019-20

Year	2019-20		
	Mean (Rs)	SD	CV (per cent)
Akola	5058.50	551.46	10.90
Murtijapur	3691	451.76	12.23
Akot	5204.16	562.82	10.81

The monthly Mean of prices of Pigeon pea in selected Akola, Murtijapur and Akot APMC's along with Standard deviation and Coefficient of variation were calculated and presented in the Table 4.12

Akot market recorded highest Mean for prices (Rs. 5204.06) followed by Akola market (Rs. 5058.50) and lowest Mean indicated in Murtijapur market (Rs. 3691). The results of Standard deviation showed that highest Standard deviation was recorded in Akot market (562.82), while lowest Standard deviation in Murtijapur market (451.76) followed by Akot market (562.82).

The Coefficient variation for prices of Pigeon pea, during study period was observed as 12.23 per cent, 10.90 per cent and 10.81 per cent Murtijapur, Akola and Akot, respectively.

4.2.9 Correlation between arrivals and prices of Pigeon pea

The degree of relationship between yearly market arrivals and prices of Pigeon pea was studied by computing Pearson's coefficient of correlation analysis, given in table 4.13

Table 4.13 Correlation between arrival and prices 2000-01 to 2019-20

Market	Correlation coefficients
Akola	0.75**
Murtijapur	0.42
Akot	0.57**

**.Significant at the 1 per cent level of significance

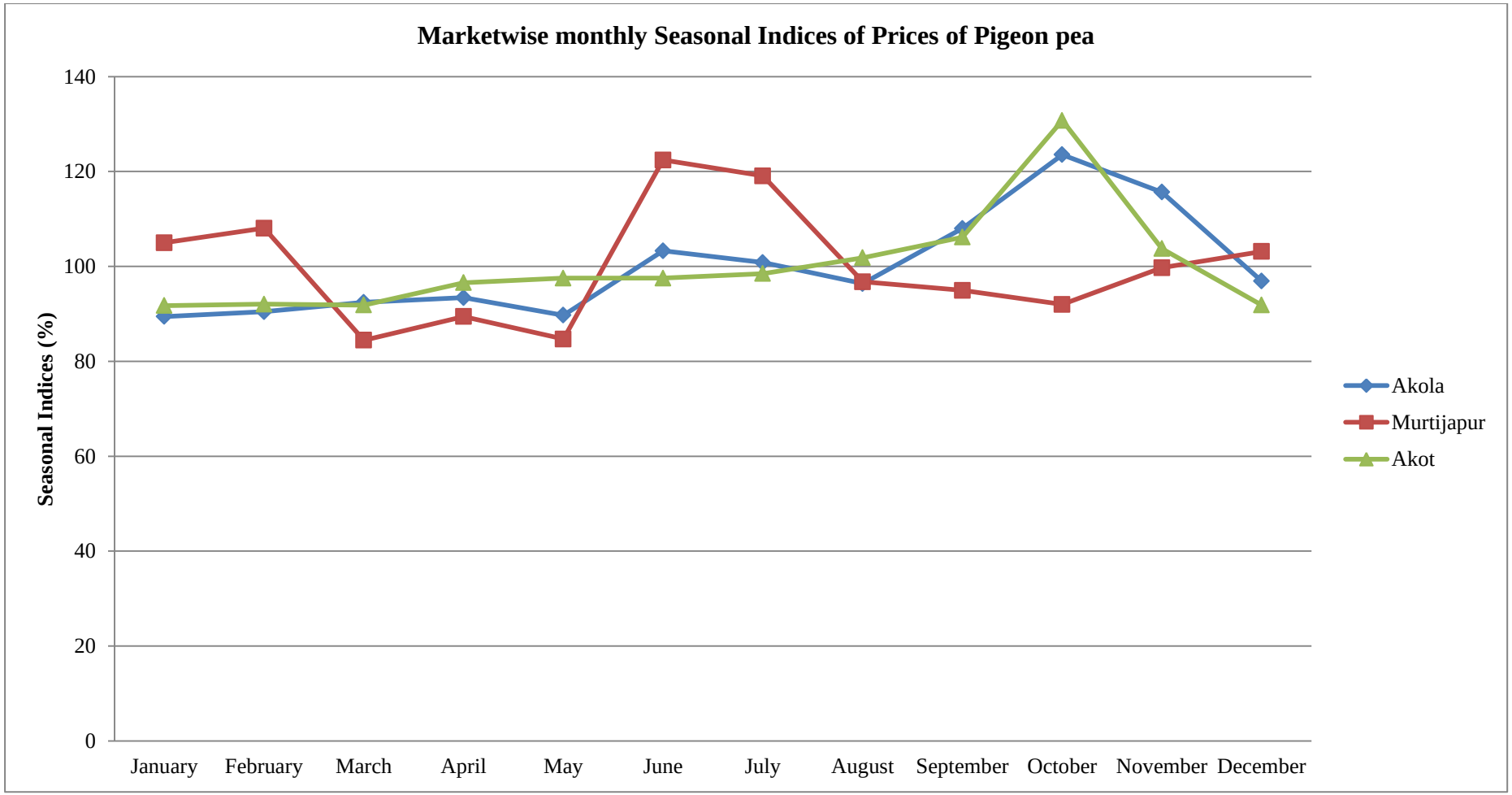

Fig. 4.4 Monthly seasonal indices of prices of Pigeon pea 2019-20

It was observed that in positive correlation between prices and arrival in Akola (0.75) and Akot (0.57) markets. However, these correlation coefficients were statistically significant at one percent level of significance. However, in Murtijapur market, (0.42) the correlation between arrival and prices was indicated statistically positive. This positive and significant Correlation coefficient was attributed to the off-season supplies of Pigeon pea, which fetched higher prices.

Table 4.14 Monthly Correlation between arrivals and prices Pigeon pea 2019-20

Market	Correlation coefficients
Akola	-0.482
Murtijapur	0.302
Akot	-0.521

The degree of relationship between monthly market arrivals and prices of Pigeon pea was studied by computing correlation analysis, and given in Table 4.14. Results indicated the negative correlation between prices and arrivals in Akola and Akot market. However, these Correlation coefficients were statistically non significant. Whereas, in Murtijapur Market, the correlation between arrivals and prices was positive and statistically non-significant. This negative and non-significant Correlation coefficient could be attributed to the off-season supplies of Pigeon pea, which fetch lower prices.

4.3 Market Integration:

Market integration is the relationship among the spatially separated markets. APMC's difference in the extent of integration and therefore, there variation in their degree of efficiency. The extent by which price of a commodity move together over a period of time in different markets located at varied distances from each other was an indicator of market integration for the commodity.

4.3.1 The market integration studied by Pearson Correlation

Table 4.15 Market integration prices of Pigeon pea

Market	Murtijapur	Akola	Akot
Murtijapur	1	0.958**	0.932**
Akola		1	0.943**
Akot			1

**Significant at the 1per cent level of significance.

The relationship between two or more APMC's, which were spatially integrated indicated by APMC integration. Spatial integration was one of the most important indicators of effective function of APMC. According to the results of the Pearson's correlation analysis of the prices of the Pigeon pea in the Akola, Murtijapur and Akot markets, there were very high degree of association of prices between these markets, with (Murtijapur and Akola), (Murtijapur and Akot) and (Akola and Akot) each having a Correlation coefficient of 0.958, 0.932 and 0.943, respectively. The association was highly significant at the 1 per cent level of significance. Due to their proximity, the Murtijapur, Akola, and Akot market place have high degree of connectivity with one another. As a result, the price signal spread readily between market place.

Ganga Devi *et.al.* (2019) reported the similar which explained the results of market integration exposed that there was positive and significant correlation was found for each market that means the wholesale prices of gram and Pigeon pea was integrated in all the selected markets. Bannor *et.al* (2016) also found positive influence of growth rate on market integration. The co-integration tests results indicate that, Tonk and Alwar: Tonk and Dausa: Bharatpur and Alwar and Sriganganagar and Dausa were integrated in the long run at lag one i.e., there was long run relationship between these two markets, hence the prices of the markets pair move together in a period.

4.3.2 Descriptive Statistics of price data of Pigeon pea*:*

Descriptive Statistics portray the basic elements and features of the data under study. It provides concise summary about the variables taken into consideration and the observation that was recorded. It also serves as the basis of virtual analysis of quantitative data, when used with simple graphical analysis.

Table 4.16 Descriptive statistics of price data of Pigeon pea markets

Market	Mean	SD	N
Akola	3357.20	1714.75	20
Murtijapur	3152.60	1547.38	20
Akot	3428.10	1664.09	20

Descriptive statistics of price data of Pigeon pea markets presented in Table 4.16. The results revealed that maximum mean price per quintal was registered in Akot market with Rs.3428.10 per quintal, Akola market Rs. 3357.20 per quintal and Murtijapur market recorded mean price of Rs. 3152.60 per quintal during the study period. Highest Standard deviation in Akola market was 1714.75, followed by Akot 1664.09 and Murtijapur market was 1547.38.

CHAPTER-V

SUMMARY AND CONCLUSIONS

CHAPTER-V

SUMMARY AND CONCLUSIONS

Trends in arrival and prices of Pigeon pea in Akola district in Maharashtra, this topic was selected with view to study and examine arrival and prices of major crops in market, trends and relationship between arrival and prices of different markets and market integration between all markets. The study will be beneficial for formulation of economic policies and action to be taken on results of study. It is also useful for producers, traders, consumers and research workers along with Government. The verification of trends, fluctuations and relation between market arrival and prices and empirical study was carried out in Akola district in respected APMC markets with the certain objectives stated below.

OBJECTIVES

5.1 Trends in arrival and prices of Pigeon pea

5.2 The peak and slack period in arrival and prices of Pigeon

5.3 The market integration of Pigeon pea market in Akola District

Akola district of Vidarbha region in Maharashtra was purposefully selected. The Pigeon pea was selected among all other pulses. The data was collected on the market arrivals and prices of major crops from selected APMC's from the published and unpublished annual reports and maintained records of respective APMC's. The required data was collected for the period from 2000-01 to 2019-20.

Collected data was analyzed with the help of simple statistical tool such as Mean, Frequency, Percentage, etc. The functional analysis such as Trends, Seasonal indices, Correlation coefficient, Standard deviation, Compound Growth Rate, Coefficient of variation, etc. were computed by well-known analytical procedure. The results of the statistical analysis of the selected crops in selected markets are summarized as follows.

5.1 Trend in Arrival and Prices of Pigeon pea

The time series data on annually arrivals and prices of Pigeon pea covering the time period of twenty years 2000-01 to 2019-20 was collected from Akola, Murtijapur

and Akot APMC's. Trend in arrivals and prices of Pigeon pea was evaluated by using linear and exponential function and the compound growth rate was worked out.

Trend in arrival of Pigeon pea:

The data of Pigeon pea from 2000-01 to 2019-20 was collected from Akola, Murtijapur, and Akot APMC's.

Marketwise trends of arrivals of Pigeon pea (2000-01 to 2019-20)

The trends analysis of annual arrivals of Pigeon pea in Akola, Murtijapur and Akot markets was depicted trends values of arrivals in Akola (9396.33), Murtijapur (4575.39) and Akot (4608.67) market was found significant trend.

Marketwise compound growth rate of arrivals of Pigeon pea (2000-01 to 2019-20)

Compound growth rate was calculated by exponential linear function with respect to Pigeon pea arrivals for selected APMC's during period i.e. (2000-01 to 2019-20) Akola, Murtijapur and Akot APMC showed positive growth rate which was significant at 5 per cent level of significance. In case of Akot APMC the growth rate was found highest 4.83 per cent among selected APMC's.

Trend in Prices of Pigeon pea (2000-01 to 2019-20)

Marketwise trends of Prices of Pigeon pea (2000-01 to 2019-20)

The data of Pigeon pea from 2000-01 to 2019-20 was collected from Akola, Murtijapur, and Akot APMC's and analyzed for the current study. The trends of prices of Pigeon pea determined by using linear function. The study that revealed the values of prices in Akola (237.72), Murtijapur (208.72) and Akot (239.42) market showed increasing trend and significant at 5 per cent level.

Marketwise compound growth rate of prices of Pigeon pea (2000-01 to 2019-20)

APMC's showed positive growth rate in the study period, which was significant at 5 per cent level of significance. Akot APMC was highest growth rate of 4.82 per cent among selected APMC's followed by Akola and Murtijapur.

5.2 Seasonal indices of arrival and prices of Pigeon pea

Marketwise yearly seasonal indices of arrivals of Pigeon pea 2000-01 to 2019-20

Among the selected markets the highest arrivals were in the year 2018–2019 (286.79 per cent) in Akot APMC market followed by Murtijapur APMC market (269.16 per cent), whereas the lean period of arrival in the year 2013 – 2014 (15.52 per cent) in Akot APMC market were observed among the selected markets.

Mean, Standard Deviation, and Coefficient of variation of arrivals of Pigeon pea (2000-01 to 2019-20)

It was observed that, mean arrivals of Pigeon pea during study period was high in Akola market 178849.45 quintals, whereas Murtijapur and Akot APMC's showed the arrivals as 65715.10 and 81239.60 quintals, respectively.

The Standard deviation was highest in the Akot market (70103.80), followed by Akola market (69475.99) and the lowest in the Murtijapur market (38614.12). The value Coefficient of variation of arrivals for Pigeon pea during the study period were observed 38.84 per cent, 58.75 per cent and 86.29 per cent Akola, Murtijapur and Akot, respectively. The maximum Coefficient variation observed in Akot market because Standard deviation observed in Akot APMC highest comparatively Akola and Murtijapur market.

Marketwise monthly seasonal indices of arrivals of Pigeon pea (2019-20)

Among the selected markets the highest arrivals were in the month of February (396.80 per cent) in Akola market followed by Akot market (282.81 per cent) and Murtijapur market showed highest in the month of June (248.43 per cent) followed by October (200.11 per cent), whereas the lowest arrivals in the month of November (4.37 per cent) in Akot APMC market

Mean, Standard Deviation, and Coefficient of Variation of arrivals of Pigeon pea (2019-20)

It was observed that mean arrivals of Pigeon pea during period was high in Murtijapur market 37613.16 quintals. Followed by Akola market 15342.58 quintals and lowest in the Akot market 6787.58 quintals. The Standard deviation was highest in the Murtijapur market (24913.80), followed by Akola market (17889.77) and lowest in the Akot market (5963.93). The Coefficient of variation of in arrivals of

Pigeon pea, during the study period was observed as 116.6 per cent, 66.28 per cent and 87.86 per cent in Akola, Murtijapur and Akot markets, respectively

Seasonal indices of prices of Pigeon pea (2000-01 to 2019-20)

Marketwise yearly seasonal indices of prices (2000-01 to 2019-20)

The highest indices of prices of Pigeon pea were registered in the year 2015-16 (241.13 per cent) in Murtijapur market, followed in 2015-16 (239.78 per cent) in Akola market. The lowest indices of arrivals were registered in the year 2001-02 (29.72 per cent) in Akot market.

Mean, Standard Deviation, and Coefficient of variation prices of Pigeon pea (2000-01 to 2019-20)

It was observed that, Mean of Pigeon pea during study period was highest in Akot market 3428.10 Rs per quintal, whereas Akola and Murtijapur APMC's showed prices as Rs 3357.20 and Rs 3152.60 per quintal, respectively. The results of Standard deviation showed that highest Standard deviation was recorded in Akola (1714.75) and Akot (1664.20) while lowest Standard deviation was recorded in Murtijapur (1547.38) APMC.

The Coefficient of variation in prices of Pigeon pea, during study period was observed that 51.07 per cent, 49.08 per cent and 48.54 per cent for Akola, Murtijapur and Akot, respectively. The maximum variability observed in Akola market..

Market variation monthly seasonal indices of prices of Pigeon pea (2019-20)

Among the selected markets the highest prices were in the month of October (130.76 per cent) in Akot market followed by Akola market (123.55 per cent) and Murtijapur market showed highest in the month of June (122.43 per cent) followed by July (119.07 per cent), whereas the lowest prices in the month of March (84.44 per cent) in Murtijapur APMC market.

Mean, Standard deviation, and Coefficient of Variation of prices of Pigeon pea (2019-20)

Akot market recorded highest Mean for prices (Rs. 5204.06) followed by Akola market (Rs. 5058.50) and lowest Mean indicated in Murtijapur market (Rs. 3691). The results of Standard deviation showed that highest Standard deviation was recorded in Akot market (562.82), while lowest Standard deviation in Murtijapur market (451.76) followed by Akot market (562.82).

The Coefficient variation for prices of Pigeon pea, during study period was observed as 12.23 per cent, 10.90 per cent and 10.81 per cent Murtijapur, Akola and Akot, respectively.

Correlation between arrival and prices of Pigeon pea 2000-01 to 2019-20

The degree of relationship between yearly market arrival and prices of Pigeon pea was studied by computing Pearson's coefficient of correlation analysis. It was observed that in positive correlation between prices and arrival in Akola (0.75) and Akot (0.57) markets. However, these correlation coefficients were statistically significant at one percent level of significance. However, in Murtijapur market, (0.42) the correlation between arrival and prices was indicated statistically positive. This positive and significant Correlation coefficient was attributed to the off-season supplies of Pigeon pea, which fetched higher prices.

Monthly Correlation between arrival and prices Pigeon pea 2019-20

The degree of relationship between monthly market arrival and prices of Pigeon pea was studied by computing correlation analysis. Results indicated the negative correlation between prices and arrivals in Akola and Akot market. However, these Correlation coefficients were statistically non significant. Whereas, in Murtijapur Market, the correlation between arrivals and prices was positive and statistically non-significant. This negative and non-significant Correlation coefficient could be attributed to the off-season supplies of Pigeon pea, which fetched lower prices.

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The relationship between two or more APMC's, which were spatially integrated indicated by APMC integration. Spatial integration was one of the most

important indicators of effective function of APMC. According to the results of the Pearson's correlation analysis of the prices of the Pigeon pea in the Akola, Murtijapur and Akot markets, there were very high degree of association of prices between these markets, with (Murtijapur and Akola), (Murtijapur and Akot) and (Akola and Akot) each having a Correlation coefficient of 0.958, 0.932 and 0.943, respectively. The association was highly significant at the 1 per cent level of significance. Due to their proximity, the Murtijapur, Akola, and Akot market place have high degree of connectivity with one another. As a result, the price signal spread readily between market place.

Descriptive Statistics of price data of Pigeon pea 2000-01 to 2019-20

The results revealed that maximum mean price per quintal was registered in Akot market with Rs.3428.10 per quintal, Akola market Rs. 3357.20 per quintal and Murtijapur market recorded mean price of Rs. 3152.60 per quintal during the study period. Highest Standard deviation in Akola market was 1714.75, followed by Akot 1664.09 and Murtijapur market was 1547.38.

CONCLUSION:

The following conclusions the analysis and the results of the present study were drawn:

1. Annual growth rate of arrival of Pigeon pea in Akola, Murtijapur and Akot markets were recorded positive and significant.
2. The Akola, Murtijapur and Akot markets showed the positive and significant growth rate of Pigeon pea prices.
3. The correlation between annual arrival and prices of Pigeon pea between Akola and Akot market showed the positive and statistically significant at 1 per cent level.
4. The correlation between monthly arrival and prices of Pigeon pea, in Murtijapur market showed the Positive, whereas the Akola and Akot observed the negative results.
5. Pearson's correlation analysis of the prices of the Pigeon pea in the Akola, Murtijapur and Akot markets were observed very high degree of association of prices between markets i.e., Murtijapur and Akola (0.958), Murtijapur and Akot (0.932) and Akola and Akot (0.943).

POLICY IMPLICATION:

1. Farmer may sale Pigeon pea during the months of September to November respectively so as to get better prices.
2. Proper marketing system is to be developed for pigeon pea
3. The researchers and policy makers have to pay more attention to develop location specific cultural practice to increase and sustain pigeon pea production and yield in the nation
4. Smooth and hassle – free transportations should ensure for better inter – district – state market integration.

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