ARRIVALS AND PRICES OF MAJOR PULSES IN APMC, BARSHI

by

Das Anand Vikas
(Reg. No.018/209)

MASTER OF SCIENCE (AGRICULTURE)

DEPARTMENT OF AGRICULTURAL ECONOMICS

POST GRADUATE INSTITUTE

MAHATMA PHULE KRISHI VIDYAPEETH
RAHURI-413722, DIST-AHMEDNAGAR
MAHARASHTRA, INDIA

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MAHATMA PHULE KRISHI VIDYAPEETH

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MAHARASHTRA, INDIA

2021

CANDIDATE'S DECLARATION

I hereby declare that this thesis or part
there of has not been submitted
by me or other person to any
other University or Institute
for a Degree or
Diploma

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Date: / /2021

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CERTIFICATE

This is to certify that the thesis entitled.“ **ARRIVALS AND PRICES OF MAJOR PULSES IN APMC , BARSHI** ” submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) in partial fulfilment of the requirements for the award of the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **AGRICULTURAL ECONOMICS,** embodies the result of piece of bonafide research work carried out by **Mr. DAS ANAND VIKAS** under my guidance and supervision and that no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been duly acknowledged.

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Place: MPKV, Rahuri
Date: / /2021

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The power of Gratitude. "Acknowledging the good that is already in your life is the foundation of all abundance"

Success is not possible without involvement of many minds and hands to beautify it. Emotions cannot be adequately expressed in words. My acknowledgement are many more than what I am expressing here.

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*This research manuscript, the second blossomed flower in my life is affectionately dedicated to my beloved senior **and my junior** for their excellent company during the study period.*

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Now as I carry this thesis in my hand, I carry with me memories that will enrich my nostalgia

.

Place: M.P.K.V., Rahuri.

Date: / /2021 ***(A. V. Das)***

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Abbrevations

%	:	Percentage
/	:	Per
₹	:	Rupee (s)
ACF	:	Autocorrelation Function
ADF	:	Augmented Dickey Fuller
AIC	:	Akike Information Criterion
APMC	:	Agricultural Produce Market committee
ARIMA	:	Auto Regressive Integrated Moving Average
C.V	:	Coefficient of Variation
CAGR	:	Compound Annual Growth Rate
eqn.	:	Equation
et al.	:	et alli (and other)
J	:	Journal
vol	:	Volume
etc.	:	Et cetera
Fig.	:	Figure
GoI	:	Government of India
Ha	:	Hectare
i.e.	:	That is
kg	:	Kilogram
No	:	Number (s)
PACF	:	Partial Autocorrelation Function
q	:	Quintal (s)
qty	:	Quantity
S.E. ±	:	Standard Error
Sr. No.	:	Serial Number
T	:	Tonne (s)

ABSTRACT

ARRIVALS AND PRICES OF MAJOR PULSES IN APMC, BARSHI

By

Mr. Das Anand Vikas

A candidate for the degree

of

MASTER OF SCIENCE (AGRICULTURE)

in

Agricultural Economics

2021

Research Guide : Dr. R. R. Nirgude
Department : Agricultural Economics

The market information relating to market prices and arrivals over a period of time helps the farmers to take decision about the future production pattern and sale of agricultural commodities in the market during specific period. The APMCs were established by state government for regulating the marketing of different kinds of agricultural produce.

Agriculture Produce Market Committee's help the farmer in disposing of their produce in the market smoothly by reducing the exploitation level and to promote fair trade by providing infrastructural facilities to farmers.

The present investigation was undertaken to study the arrivals and prices selected agricultural commodities in APMC, Barshi with the objectives *viz*, to study the organizational structure of APMC, Barshi, To study the trends in arrivals and prices of major pulses, To study the seasonal indices in arrivals and Prices of major pulses, To study the variability in arrivals and prices of major pulses and To forecast the prices of major pulses. The APMC, Barshi was selected purposively for the study. Four agricultural commodities *viz*, Tur (Red gram), Moong (Green gram), Udid (Black gram) and Gram (Chick pea) were selected on the basis of maximum area under crops and high volume of transaction in the APMC. The secondary data were collected from APMC, Barshi for the period of 11 years since 2008. The data were analyzed with simple statistical tools for fulfilling set objectives. Trends in arrivals and prices, seasonal indices, coefficient of variability arriving at meaningful conclusions, Correlation coefficient were estimated.

A.V. Das **Abstract contd...**

The study revealed that, organizational structure and composition was well established according to the Maharashtra Agricultural Produce Marketing (Regulation) Act 1963. The open auction method was strictly followed in the market, the overall conduct and regulations and administrative promptness was observed to be satisfactory in market.

For all major pulses the arrivals have significantly increase over the years. The similar situation was observed for prices also except for moong (green gram).

The analysis of trends in arrivals and prices of major pulses in APMC, Barshi revealed that, there was no any observation of cyclical and irregular trend in the selected market. However constant variation trend was observed in arrivals and prices of major pulses in APMC, Barshi.

There was small magnitude of deviation observed between the estimated price and average price of major pulses in APMC, Barshi.

The more variability was observed in the arrivals of Tur (Red gram), Moong (Green gram), Udid (Black gram) and Gram (Chick pea), due to fluctuations in the production and demand of the pulses.

This study suggested that the Agricultural Produce Market Committee (APMC's), Barshi should provide sufficient grading and storage facilities which will help to get higher prices to the producers. The APMC should create facility to judge the quality of commodity and organize separate auction for different types of pulses. The officials of APMC, Barshi should make sufficient arrangements for trading huge quantum of all pulses in near future. Study also suggests that the seasonality of arrivals and prices of major pulses in APMC, Barshi which help for the farmer to obtaining the better prices in the market .Tur growers should bring Tur for sell in the APMC, Barshi during the month of July to November to get better price for their produce. The Moong growers shall bring Moong for the sell in the APMC, Barshi during the month of January to June. The Udid growers should bring Udid for sell in APMC, Barshi during March to June. Gram can be brought for sell in APMC, Barshi during the month of August to January in order to get good prices for their produce.

There was positive correlation in arrivals and prices of tur (0.04) and udid (0.36), but turned out to be non-significant. Thus it indicates that along with increase in arrivals and prices have also been increased. The correlation coefficient of moong (0.24) and gram (0.46) were positive and significant.

It indicated along with significant increase in commodity arrivals and prices have also been increased significantly during the entire period.

From that study it also concluded that lagged month prices had positive impact on current month's prices of major pulses. The positive magnitude of regression coefficients of lagged month prices reveled that, if the lagged month prices increased by one rupee per quintal, the current months price led to increase minimum by ₹ 0.73/q, ₹ 0.63/q, ₹ 0.74/q and ₹ 0.54/q for tur, moong, udid and gram, respectively

The study also suggested that the farmer should have to use the information of future prices of major pulses which help the farmer to obtaining future prices. The predicted prices of all major pulses will vary with small magnitude during January 2020 to December 2021. The percentage difference between the predicted price and actual prices was small.

1. INTRODUCTION

1.1 Background information

Marketing of agricultural commodities assumes great significance from the producers as well as consumers point of view for achieving twin conflicting objectives of providing remunerative prices to farmers and at the same time ensuring supplies to consumers at reasonable price. Marketing system has to play a very crucial role. To avoid exploitation of farmers from market functionaries, regulation of marketing came up in the country. The major steps are enlisted as below,

- 1886 – Elements of regulation was introduced in the Karanja cotton market under the 'Hyderabad Residency Order' to ensure supply of pure cotton at reasonable prices to the textile mills at Manchester (U.K.).
- 1887- 'The Bearer Cotton and Grain Market Act' was enacted. Drawback of this act was that it provided no representation for the growers on the committee.
- 1917- Indian Central Cotton Committee was appointed by the Governor General in council to look into the problems of cotton marketing. As most of the cotton growers were under financial obligations of trader-cum-money lenders and were forced to sale their produce at a price much below the ruling market price. The committee recommended establishment of markets for cotton on Berar system in compact cotton tracks.
- 1927- 'Bombay Cotton Market Act' was passed which was an improvement over Berar Act of 1887 and provided representation for the growers on the committee.
- The Royal Commission on Agriculture (1928) recommended the establishment of regulated markets on the Berar pattern. It also emphasized on the application of scheme of regulation to all agricultural commodities instead of cotton alone. Due to this recommendation, numbers of states have enacted Regulated Markets Acts thereafter.
- 1930 - 'Hyderabad Agricultural Market Act' was passed modelled on the Act of 1927.
- 1932 – 'Central Province (Now A.P.) Cotton Market Act' was passed.
- 1933 – 'Madras Commercial Crops (Now T.N.) Markets Act' was enacted and first regulated market in state was established in 1936 at Tirupur (Coimbatore).
- 1935 – 'Central Provinces Agricultural Market Act' was passed which was modelled on the lines of Act of 1932.
- 1939 – 'Bombay Agricultural Produce Market Act' was enacted for all commodities including cotton and which repealed the Cotton Market Act of 1927 and as a result, all market committees set up under Act of 1927 were declared deemed to be the market committees under new Act.

- 1939 – The Mysore (Now Karnataka) Agricultural Produce Market Act was passed and first regulated market at Tiptur was established.
- 1948 – 'Patiala Agricultural Produce Markets Act, 1947' was passed.
- 1952- The Government of M.P. passed '*Madhya Bharat* Agricultural Produce Market Act', 1955 '*Sourashtra* Agricultural Produce Markets Act' was enacted by Government of *Sourashtra*. After independence, reorganization of states resulted into different laws in force simultaneously. In case of Maharashtra, three different law were in force, simultaneously *viz.*, 'The Hyderabad Agricultural Market Act, 1930' in Marathwada region, 'The Bombay Agricultural Produce Market Act, 1939' in Western region and 'The Central Provinces Agricultural Market Act, 1939' in *Vidarbha* region. To remove this ambiguous situation, Maharashtra Government modified present Acts after considering recommendations of T.G. Shirmane committee and 'Bombay Agricultural Produce Market Act, 1939' was replaced by Maharashtra Agricultural Produce Market (Regulation) Act, 1963. Under this law, Maharashtra State Agricultural Marketing Board (MSAMB) was established on 23rd March, 1984 for co-ordination and development of agricultural market system in Maharashtra.

1.2 Concept of Regulated market

"A market is said to be a regulated market when the state Government establishes a market under a specific enactment and frames rules and regulations to conduct business there in or when the State or any Public Authority comes forward to enforce regulation for the organization of market, it is termed as a "Regulated Market".

It shall be the duty of the Market Committee to implement the provisions of the Maharashtra Agricultural Produce Marketing (Regulation) Act 1963, the rules and bye-laws made there under in the market area to provide such facilities for marketing of agricultural produce there in as the Director may from time to time, direct do such other acts as may be required in relation to the superintendence, direction and control of markets or for relating marketing of agricultural produce in any place in the market area and for purpose connected with the matters aforesaid, and for that purpose may exercise such powers and perform such duties and discharge such functions as may be provided by or under this Act.

The APMC's are functioning in all districts of the state. Division wise break-up of the APMCs functioning is as follows in table no 1.1

The APMC Act provides for establishment of Market Committees in the State. These Market Committees are engaged in development of market yards for the benefit of agriculturists and the buyers. Various agricultural produce commodities are regulated under the Act.

Table 1.1 Division wise break-up of the APMCs functioning in Maharashtra

Sr. No.	Division	Main Market	Sub-Market
1.	Ratnagiri	20	41
2.	Pune	22	68
3.	Nashik	53	117
4.	Aurangabad	36	65
5.	Latur	49	80
6.	Amaravati	55	91
7.	Nagpur	50	76
8.	Kolhapur	21	60
	Total	**306**	**598**

(Source: Maharashtra State Agricultural Marketing Board, Pune Annual Report, Year 2018-19)

1.3 Aim of the Regulated Market

A regulated market is one which aims at the elimination of the unhealthy and unscrupulous practices, reducing marketing charges and providing facilities to producers and sellers in the market.

Under the provisions of the Maharashtra Agricultural Produce Market (Regulation) Act 1963, the state government gives notice of its intention to bring a particular area under regulation by notifying the market area, market yard, main assembling market and sub market yard, if any, under the principle regulated market.

Method of sale in regulated market is either by open auction or by the close tender method to ensure fair price for the produce. The sale is carried out under the supervision of an official of the market committee and signature of buyer is taken as soon as auction is over. The business hours are fixed and generally different commodities are traded at different times of the day. Bidding is open for all authorized traders and produce is given to the highest bidder. The farmer may refuse to accept the sale even at the highest bid, if he desires.

Weightment of produce is done by a licensed weight man with standard weights and a platform scale some markets may install weightbridges. Grading is generally expected prior to sale in regulated market. The scheme is in operation only in some a court of low markets due to absence of facilities such as space, funds and technical staff and grading equipment's. According to National Commission on Agriculture (XIIth Report) only 13 percent of Regulated markets are having grading facility. The regulated market should have facilities for a proper and correct dissemination of information about market prices. The various media such as loudspeakers and notice boards are used for dissemination of market information.

Unfair market charges such as *darmaday*, charity, *kharda*, *dhalta* and *muddat* were abolished while rates of other charges such as commission, brokerage, *hamali* and weighing charges are specified in regulated markets. Recently, the market charges payable by seller have

been transferred to the buyer, the seller have to pay only for the activities undertaken prior to marketing of produce *i.e.* for transportation, octroi, *hamali etc.*

Prompt payment is obligatory on the buyer in regulated market scheme without any deductions of any *muddat.* In regulated markets, all the market functionaries are licensed from a market committee after paying a license fees. These licensed traders should maintain proper records and accounts as per the laws of market committee. Any violation of rules by any one may lead to cancellation or suspension of the license or to the filing of *challans* in a court of law.

Day to day supervision is done by the officials of market committee *i.e.* the secretary, auction clerks *etc.* The nominated and elected members take the administrative decisions. The market committee companies of representatives of all sections *viz.*, traders, co-operative marketing societies, commercial banks, government officials with the majority of farmers. In regulated market, mechanism for settlement of dispute is provided by the dispute settlement sub-committee. Regulated market aims elimination of malpractices to protect producer-sellers from formerly prevailing malpractices. A sale slips containing details about produce sold is supplied to farmers and a copy of sale slip is supplied to market committee for purpose of checking.

The regulated market should provide amenities such as link roads, spacious market yard, rest houses, *etc.* for smooth and efficiency marketing and to attract the producer-sellers to sale their produce in the regulated markets,

Like any other enterprise or organization, the wholesale agricultural produce markets are also established to achieve some objectives and perform certain functions and therefore, these markets must be managed efficiently. The objectives includes, maximum price for the producer for his produce, minimum price for buyer to get exactly same goods as desired by him, with maximum of ease in minimum time, with maximum comfort and affordable cost and providing sufficient returns to the market functionaries to gainfully remain in the business.

The main objectives of the regulated markets are to provide maximum price for seller and at the same time, for exactly same good, minimum price for buyer, contradiction exists and to reconcile this contradiction Agricultural Produce Market Committee has to play a crucial role by increasing level of competition in the market *i.e.* healthy competition and also by eliminating monopoly either of buyer and seller.

The responsibility of managing the markets came to rest with the market committee and the secretary is being entrusted with the job of running day to day operations of the market. However, the management is considered only a subsidiary duty and main job of committee is to enforce the provisions of Agricultural Produce Market Acts.

1.4 Importance of the study

India is the largest producer (25% of global production), consumer (27% of world consumption) and importer (14% global import) of pulses in the world (Sing *et. al.*, 2015). Pulses account for around 20 per cent of the area under food grains and contribute around 7-10 per cent of the total food grains production in the country. Though pulses are grown in both *Kharif* and *Rabi* seasons, *Rabi* pulses contribute more than 60 per cent of the total production. Gram is the most dominant pulse having a share of around 40 per cent in the total production followed by Tur (Red Gram) 15 to 20 per cent and Udid (Black Gram), Matki (Moth Bean) and Moong (Green Gram) around 8-10 per cent each.

Table 1.2 State wise Area, production and productivity of total pulses in India (2018-19)

Sr. No.	States/UTs	Area		Production		Productivity (Kg./ha)
		('000 ha)	Per cent	('000 Tonne)	Per cent	
1	Madhya Pradesh	6600.00	22.64	6045.41	27.38	916
2	Rajasthan	5907.62	20.26	3759.38	17.03	636
3	Maharashtra	4002.23	13.73	2682.54	12.15	670
4	Karnataka	3356.66	11.51	1773.86	8.04	528
5	Uttar Pradesh	2291.00	7.86	2408.01	10.91	1051
6	Andhra Pradesh	1326.00	4.55	739.59	3.35	558
7	Tamil Nadu	850.54	2.92	551.21	2.50	648
8	Chhattisgarh	745.79	2.56	537.47	2.43	721
9	Jharkhand	742.78	2.55	735.16	3.33	990
10	Odisha	718.15	2.46	412.09	1.87	574
11	Gujarat	661.95	2.27	681.33	3.09	1029
12	Telangana	511.00	1.75	440.05	1.99	861
13	Bihar	479.37	1.64	453.46	2.05	946
14	West Bengal	462.81	1.59	368.40	1.67	796
15	Assam	150.23	0.52	113.50	0.51	756
16	Other	349.84	1.20	374.38	1.70	1070
17	**India**	**29155.97**	**100.00**	**22075.84**	**100.00**	**757**

Source: Ministry of Agriculture and Farmers Welfare, Govt. of India. (ON2357)

Madhya Pradesh, Rajasthan, Maharashtra, Karnataka and Uttar Pradesh are the top five pulses producing States. The productivity of pulses at national level was 757 kg/ha during 2018-19. Since ages, pulses have been well integrated into the farming system of our country as the farmers could produce them by using their own seeds and family labour without depending much on external inputs. With the advent of Green Revolution, which promoted rice and wheat using external inputs and modern varieties of seeds, pulses were pushed to the marginal lands. This resulted in decline in productivity and land degradation. Thus, pulses are still cultivated on the marginal and sub marginal land, predominantly under unirrigated conditions. The trend of commercialization of agriculture has further aggravated the status of pulses in the farming system.

Table 1.3 Area, production and productivity of major pulses in Maharashtra (2018-19)

Sr. No.	Crop	Maharashtra			Solapur District		
		Area ('000 ha)	Production ('000 tonne)	Productivity (kg/ha)	Area ('000 ha)	Production ('000 tonne)	Productivity (kg/ha)
1	Tur	1209.98	684.25	566	708.00	6.44	90.96
2	Mung	411.5	158.24	385	137.20	3.52	256.56
3	Udid	395.94	152.94	386	338.50	8.86	261.74
4	Gram	1292.79	986.11	763	339.50	14.63	430.93
5	Other	198.23	93.29	471	3.50	0.07	200.00
6	**Total**	**3508.44**	**2074.83**	**591**	**1526.70**	**33.52**	**219.56**

(Source: Third advance estimates of crops in respect of Maharashtra state for the year 2018-19.)

1.5 Objectives

The specific objective of the study

1. To study the organizational structure of APMC, Barshi
2. To study the trends in arrivals and prices of major pulses
3. To study the seasonal indices in arrival and prices of major pulses
4. To study the variability in arrival and prices of major pulses
5. To forecast the prices of major pulses

1.6 Hypotheses

1. H_0 = The annual arrivals and prices of major pulses in APMC, Barshi are steady.

   H_1 = There are fluctuations in annual arrivals and prices of major pulses in APMC, Barshi.

2. H_0 = The seasonal indices of arrivals and prices of major pulses are uniform.

   H_1 = The seasonal indices of arrivals and prices of major pulses are fluctuating.

3. H_0 = There are no deviations in predicted and actual prices of major pulses.

   H_1 = There are deviations in predicted and actual prices of major pulses.

1.7 Scope and limitations of the study

The present study was selected with an intension to know the infrastructural facilities available at APMC, Barshi, *viz*, trends, seasonal variation and relationship in arrival and prices of the selected agricultural commodities.

The seasonal effects means change in arrivals or prices within a year or a production period. While cyclical effect means change in arrivals or prices between years. The effects of seasonality in the arrival and prices of agricultural commodities were further intensified by the yearly variation in the production of commodities. The importance of such seasonality, trend and cycles in arrival and prices are well known and deserves proper consideration while attempting any improvement in the marketing system.

In agriculture, demands for agricultural commodities are increasing, thus the supply plays active role in determining the prices of goods. Price uncertainties arise due to seasonal, cyclical

and secular factors. To overcome these price uncertainties price forecasting plays an important role which helps the producers to plan their activities on production, processing, storage and marketing of commodities.

Agricultural commodities are produced seasonally but required for consumption throughout the year. The seasonal increase and decrease of arrivals of agricultural commodities has direct relationship with the prices. Thus, price is one of the most important determinants of profit or loss in the farm business and income of the farmers. Risk in agricultural production and price risk not only hampers the growth in agricultural sector but also that of other sectors which are dependent on agriculture.

In the present study the efforts have been made to compare the price risk through price variability in different agricultural commodities. The present study has its own limitations. The study is based on the secondary data for 11 years (2008 to 2019) collected from the office of the APMC, Barshi. There are various agricultural commodities have been notified in APMC, Barshi but only four agricultural commodities were selected for the study by considering the time and resources available with researcher. So the results obtained from the study may applicable to the similar situation in the state.

2. 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.

2.1 Organizational structure of APMC

2.2 Trends in arrival and prices of major pulses in APMC

2.3 Seasonal indices in arrival and prices of major pulses

2.4 Variability in arrival and prices of major pulses

2.5 Forecast prices of major pulses

2.1 Organizational structure of APMC

Bhatia (1990) studied the legal and administrative framework for regulation and management of Agricultural Produce Markets in India. The legal and administrative framework for regulation and management of APMC has mainly been provided in the provisions of the 24 Regulated Markets Act in vogue in different states and Union Territories of India. Though the purpose of enactment of these Acts was basically the same *i.e.* regulation of trading practices, increased market efficiency through reduction of market charges, elimination of superfluous intermediaries and protect the interest of producers, many of these Acts differs even in vital contents. This framework covers the issues like coverage of notified commodities by a particular market, market committee, its composition of constitution, election of members of committee, chairmanship of committee, functions and powers of market committee, sources of finance and Agricultural Marketing Boards of respective states**.**

Rangi (1990) carried out the study to examine the role of the Punjab Mandi Board in providing services to the farmers of the state for better marketing and its impact on rural development. The results revealed that the success of Green Revolution in Punjab lies in the successful and efficient marketing of farm produce. The regulation of markets has resulted in disappearance of various malpractices. The contribution of the *Punjab Mandi* Board was tremendous in helping the Punjab farmers which in turn contributed to the rural development of the state economy. The Board has not only provided infrastructure in the markets but also linked 97 per cent of the total villages of Punjab with link roads. The link roads have revolutionized the rural economy of the state with speedy movement of farm produce to the market places. Besides, the Board has initiated various schemes in the interest of rural/ urban population especially *Apani Mandi*, storage facilities, grading and standardization, *Vikas Bhawan*, insurance cover, *etc*. These schemes having economic and social dimensions will go a long way in the overall rural development of Punjab.

Pant and Bajroli (1998) studied the evaluation of primary regulated market in Nagpur district of Rajasthan. Irrespective of market committee, functionaries, backward and forward linkages, market power concentration, *etc.*, the market committee was issuing licenses to only traders, 'A' class brokers and retailers. There were no association existed in the mandis to safeguard the interests of the producers as it was operating to protect the traders interest.

Kambli (2005) had studied the organizational structure and marketing management of agricultural produce market committee in *Vashi*, *Navi* Mumbai. The study revealed that the organizational structure and composition of APMC, *Vashi* was in accordance with the Maharashtra Agricultural Produce Marketing (Regulation) Act, 1963. She observed that Government has made special provision for Mumbai APMC and 25 members were appointed on committee whereas for rest of Maharashtra, there were 18 members. The features of market like regulation of market charges, licensing of market functionaries and open auction sales were also observed in *Vashi*, APMC. The market committee was well equipped with storage infrastructural and ancillary facilities. The open auction method was accepted in *Vashi* market, but not being followed strictly. The market committee was well equipped with world class infrastructure, but lacks in its proper utilization. Committee has less control on trader's activities.

Bhosale (2013) studied the prices of major agricultural commodities in APMC, *Satara*. The study revealed that the APMC, *Satara* was managed by an autonomous and representative managing committee comprising of 18 members. The committee includes members which were representatives of various trading sections like farmers, commission agents, traders, Government nominees, *etc.*, with predominance of agriculturist. It was observed that out of 18 committee members eleven were from agriculturist, three from revenue divisions in Maharashtra state, one member from traders, one from *mathadi* and other two from women and economically backward class as per the nomination of state Government.

Thakare (2014) studied the arrivals and prices of selected agricultural commodities in APMC, Kolhapur with the objectives *viz*., to study the organizational structure, to study the trends in arrivals and prices of selected agricultural commodities, to study the seasonal indices in arrivals and prices of selected agricultural commodities and to study the variability in arrivals and prices of selected agricultural commodities. The APMC, Kolhapur was selected purposively for the study. Six agricultural commodities *viz.*, wheat, paddy, onion, potato, groundnut and jaggery were selected on the basis of maximum area under crop and high volume of transaction in the APMC. The secondary data were collected from APMC, Kolhapur for the period of 11 years since 2001-02. The study revealed that, organizational structure and composition was established well according to the Maharashtra Agricultural Produce Marketing (Regulation) Act 1963. The open auction method was strictly followed in the market, the overall conduct and law and administrative promptness was seen satisfactory.

Goril and Kharkwal (2016) the study was conducted to compare the structure and performance of two principal markets of fruits and vegetables in Uttarakhand (*viz.,* Haldwani and Dehradun) and to assess the marketing efficiency, price spread and farmer's share in consumer's rupee for sample commodities arriving in these markets. Basic facilities like internal roads, parking, water supply and electricity along with information notice boards, public address system, auction platform, canteen and toilet facilities were available in both markets. While mechanical grader and cold storage facilities were lacking in both the markets.

Thakare *et al*. (2016) studied the organizational structure and seasonal indices in arrivals and prices of agricultural organizational structure and composition in Kolhapur, APMC market established commodities well according to the Maharashtra Agricultural Produce Marketing (Regulation) Act 1963. The open auction method was strictly followed in the market, the overall conduct and law and administrative promptness was seen satisfactory.

This study suggested that the wheat growers should bring wheat for sell in the APMC, Kolhapur during the month of December to March. The paddy growers should bring paddy for the sell in the APMC, Kolhapur during the month of August to December. In case of the onion growers should bring onion for sell in APMC, Kolhapur during September to December. Potato cabe brought for sell in APMC, Kolhapur during the month of September to December and the groundnut during April and September to January and in case jaggery for sell in APMC, Kolhapur during August and October to December in order to get good prices for their produce.

Thus, it is clear from the above studies that the Agricultural Produce Market Committees (APMC) are the regulated markets managed by the elected body *i.e.* market committee. The maximum representation was given to farmers as per the provisions of Act. The function of the market committee is to provide various amenities and facilities to the farmers and carry out various developmental programs and also to minimize malpractices followed in the markets.

2.2 Trends in arrival and prices of major pulses in APMC

Reddy *et al.* (2012) studied price trend and integration of wholesale markets for onion in metro cities of India. The study reveals that there was high variability in the arrival of onion in the month of March and April in selected markets. Among the markets, the coefficient of variation in both arrivals and prices were found to be higher in Ahmedabad and Kolkata. The zero-order correlation matrix between two markets average wholesale prices of onion indicated the high integration among the selected markets except Ahmedabad with Mumbai market. This might be due to the movement of produce from one market area to another depending upon price prevailed in the markets. The competitive conditions prevailing in the selected markets might have influenced the movement of prices in the same direction. The magnitude of regression coefficient revealed that an increase in market arrivals by a MT in a month led to an increase in prices by ₹ 6.00/MT and ₹ 0.40/MT in Bangalore and Delhi markets, respectively. On the contrary, prices of onion decreased in Ahmedabad (₹ 6.00), Mumbai (₹ 10.00) and Kolkata (₹ 2.00) markets with increase in arrivals by one MT in a month.

Bhat *et al*. (2014), study was conducted on arrivals and prices of fruits in Narwal market of Jammu district. The average monthly arrivals and prices for the period of 2007–08 to 2010–11 were collected from Narwal market of Jammu. The analysis shows that the prices move contrary to arrivals. It has been found that the seasonal nature of fruits creates glut in the market which leads to sharp fall in prices during the post-harvest season and affects the orchardists adversely. The highest market arrivals in the Narwal mandi commensurate with the harvesting date of the produce and it was found that peak market arrival period in case of banana was from July with arrivals of 16008.33 q to October with arrivals of 27451.67 q, whereas in case of papaya, the arrivals were highest (4525.00 q) in April and in guava in the month of March (2335.00 q). It was also noticed that the major portion of the farmers' produce was sold at the lower price in the post-harvest period thereby lowering their incomes.

Syed (2014) study was undertaken in APMC, Bangarpet of Karnataka State to examine production, market arrivals, price behaviour and market linkages with paddy processing units. The primary data was collected from the 15 rice millers. Secondary data were collected on production of paddy from the KSDA. The information on market arrivals and prices were collected from the APMC. The data were analyzed using different statistical techniques involving time series analysis *viz.,* trends, seasonal indices, ARIMA, descriptive statistics and Henry Garrett's ranking technique. 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. The price of paddy was the highest during the month of November and the lowest during April. The rice millers were sourcing paddy directly from farmers of major paddy growing belts of Karnataka (93.33%). The rice was sold directly to retailers in Bangarpet town by the rice miller (86. 66%).The rice millers in Bangarpet have also sold rice in Bangalore city (80%). It was also noticed that 46.66 per cent of the rice millers have sold rice in the neighboring towns of Kolar district.

Hile *et al.* (2017) studied trends in arrivals and prices of major agril. commodities in APMC, Satara. The study revealed that, arrivals of jowar, wheat, soybean, pigeon pea and chick pea had showed fluctuations yearly during the period under 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 growers should bring jowar for sell in the APMC, Satara during the month of November to January and the wheat growers should bring wheat for the sell in the APMC, Satara during the month of March to May and in case of soybean, the growers should bring soybean for sell in APMC, Satara during December to January. Pigeon pea can be brought for sell in APMC, Satara during the month of January to March and chick pea during December to January in order to get good prices for their produce.

Sahoo and Singh (2017) studied trend and seasonality in prices and arrivals of Bengal gram. The study was conducted for the period of 2003-2016 by collecting secondary data from market in respect of Bengal gram. The major APMC markets were selected purposively on the basis of high prices and arrivals in Uttar Pradesh and Madhya Pradesh which was the major Bengal gram growing states of India. There was a positive and significant growth rate has been observed in the prices of selected APMC markets *i.e.* 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% level of significance. Both Bareilly and Shujalpur market have high seasonal indices in the month of May and June indicated the high post-harvest arrivals in the months. The low arrivals in the month of August, January, and July indicated the shortage and speculation in the pulse market. There was an inverse relationship between arrival and prices of Bengal gram in the selected markets.

Verma *et al.* (2017) studied price behaviour of soybean in selected district of Southern Rajasthan. To workout the trend, secondary data was collected from 2000 to 2014 from publish government sources. Four markets were selected from four district *viz.*, Pratapgarh, Chittorgarh, Bhilwara and Banswara. Exponential trend for annual wholesale prices was found to be best fit for all the markets. The time element alone explained 89.3% to 93.0% variations in annual wholesale prices in the selected markets. The result of compound growth rates revealed that wholesale prices of soybean recorded significant growth rates in selected markets of Southern Rajasthan. The compound growth rates ranged from 9.91% per annum in Banswara to 10.08% annum in Pratapgarh market. The extent of intra year price rise varied from 15.62% in Banswara to 17.52% in Nimbahera market. In majority of the markets, the extent of intra year price rise was ranged between 15 to 18%. The smaller magnitude of coefficient of variations (4.57% to 5.61%) indicated that there was greater consistency and smaller variability in the monthly prices of soybean in the selected markets of Southern Rajasthan.

Navasare *et al.* (2018) studied the behaviour of fluctuations in prices and arrivals of sorghum, tur, soybean, chickpea and bajra in Ahmednagar district. The 12 years (2005-06 to 2016-17) time series data from all four APMC of Ahmednagar district was collected. The analysis of compound growth rate reveals that the growth rates of arrival and prices of overall period was positive and significant. In APMC, Ahmednagar the highest per annum growth rates were noticed in the soybean (161.82%) and lowest growth rate were noticed in the bajra (32.24%). In Karjat, APMC the highest growth rates were noticed for sorghum (0.46%) and lowest growth rate were noticed in the bajra (-32.71%) per year, respectively. The prices of sorghum, tur, soybean, chickpea and bajra increased significantly during the period under study. The inverse relationship between arrivals and prices was noticed for sorghum, tur, soybean, chickpea and bajra which indicated that the increase in arrivals lowered the prices of these commodities.

Devi *et al.* (2019) studied price and arrivals pattern and market integration of major pulse crops (gram and tur) in Gujarat state. The study has indicated that the inter-year price analysis shows upward trend of annual price indices and there was a significant increase in the price of gram and tur in all the selected markets with positive and statistically significant compound growth rate during the study period. The intra year price analysis revealed that the general pattern of seasonal variations in prices were found with increased the prices in off season and decreased in main season all most in all the selected markets in both the crops. The pattern of arrivals shows that the quantity of arrival was more in off season in the selected markets. This may be due to that the stockiest released their stocks with the commencement of new season. The results of market integration exposed that there was positive and significant correlation for each market pairs that means the wholesale prices of gram and tur were integrated in all the selected markets. Thus, it can be inferred from the above results that the prices increased in one market, it leads to increase the prices in other markets.

It can be concluded from the above studies that, researches have collected a sizable time series data to analyze the behaviour of arrivals and prices of most of the agricultural commodities among the different markets in the country. The collected data were analyzed using different statistical techniques involving time series analysis *viz.*, trend analysis, seasonal indices, compound growth rates, integration analysis, *etc.*

2.3 Seasonal indices in arrival and prices of major pulses

Asmatoddin *et al*. (2009) studied arrivals and prices behaviour in APMC market Parbhani during the year 2004-05 to determine price index fluctuations for important pulse crops. The data on monthly arrivals and prices for nine years (1996-97 to 2004-05) were collected and analyzed. The result revealed that, the peak arrivals of green gram were in the month of October and the highest price index recorded was in the month of March. The price index touched to the lowest 83 per cent and to the peak value of 105. Pigeon pea, the arrival index was the highest in the month of January whereas, the price index was highest in the month of September, the price index varies in the range of 93 to 107 per cent.

Kakade *et al*. (2013) studied the seasonal variation, cyclic variation and trends in arrivals and prices of selected pulses in all APMC'S of Akola district *i.e.,* Akola, Akot, Balapur and Telhara for the period of 20 years *i.e.* 1987 to 2006.The monthly seasonal indices for selected pulses arrivals were higher immediately after harvest in all the study markets, the price indices of selected crops were lower during peak arrival months and vice versa. Cyclic fluctuations were found to be more pronounced than seasonal fluctuation in prices. This showed that when maximum production is there, prices decreased and increased during the pre-harvest month. Coefficient of variation of real prices was found to be highest.

Patel and Patel (2013) studied comparative analysis of performance of cumin and fennel marketing system in market at APMC, Unjha. The 10 years' time series data ending 2011-12 on price and arrivals of cumin and fennel were collected from the APMC of Unjha. A trend and cyclic trend component were obtained for agricultural products cumin and fennel. A significant relationship between arrivals and prices was studies for both the agricultural products. Regression Analysis was done for forecasting future values of arrival and their relationship on prices in the agricultural commodities cumin and fennel at APMC. The seasonal indices of arrivals indicated the heavy arrivals of cumin during April-June in APMC. Whereas in case of fennel, heavy arrivals were noticed during July to September. The impact of market arrivals on prices has been found to be negative. In the light of such finding if fluctuations in market arrivals are regulated through market extension, the risk of fluctuations in price would be minimized. The forecasted value of arrivals indicated the higher arrivals in the coming years.

Mahalle *et al.* (2014) results reveal that both market arrivals and prices of chickpea have 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 deciphering stability in the marketing system. Johansen market integration methodology concluded that out of four markets, two were co-integrated. Error correction mechanism established the fact that chickpea markets came to price equilibrium in long run.

More and Katkade (2014) study was carried out to know the arrivals and prices fluctuation in oilseed crops over time in Marathwada region. Oilseed sector occupies an important place in Indian economy but oilseed crops are cultivated in high risky regions where there are uncertainties on production level, leads to wider fluctuation in arrivals of these crops in the markets which ultimately contribute to price instability. Soybean and safflower, which are important oilseed crops of the region, were selected for the study. Monthly time series data for sixteen major markets from eight districts of Marathwada region were collected and analyzed for the period of twenty years from 1991-92 to 2009-10. Mean, coefficient of variation and seasonal indices (Ratio to moving average method) were worked out. They concluded that, arrivals and prices of oilseed crops *i.e.* soybean and safflower in all selected markets of Marathwada region were seasonal. Peak arrivals of soybean and safflower were observed during October to December and March to May, respectively. The price index of soybean and safflower was highest in the month of December and June with modest coefficient of variation of 29 per cent and 19 per cent, respectively. Maximum arrivals and price of soybean were observed in Latur market. Whereas maximum arrival of safflower was observed in Latur market but maximum prices prevailed in Aurangabad market.

Patil and Bhurke (2014) studied economic analysis of arrivals and prices of pulses in Maharashtra state of India. Study depicted that pulses (red gram, green gram and black gram) were the important commodities in Agricultural Produce Market Committees (APMC) Akola. Arrivals of Red gram in APMC market start rising from December with arrivals of new crop and the lowest arrivals (10.12) were observed in the pre-harvest month, *i.e.* November. As regards price indices it shows declining trend from July to October and increasing trend from October to July. Highest arrivals of black gram were reported in the month of September (317.45). With regard to prices of black gram there were lots of variations. There were two peaks observed in terms of prices, *i.e.* January (143.55) and July (121.12). Seasonal indices of green gram show maximum arrivals in the month of September (399.01). While maximum prices were obtained in the month of pre-harvest period, *i.e.,* March (101.77) to July (125.41) and minimum prices were obtained in the post-harvest period. Study concluded that, as arrivals increased, prices decreased and vice versa. To overcome this constraint private sector and public-sector organizations need to take initiative by developing lucrative, win –win model of price discovery mechanism for sustainable development in rural income levels.

Naidu (2014) studied the behaviour of market arrivals and prices of cotton in Andhra Pradesh. The level of market arrivals was low during the month of September and high during the month of November while prices were low during November and high in September. Cyclical indices of arrivals and prices were nearer to one, but a well-defined cycle could not be discerned. The correlation coefficient between monthly arrivals and prices were significant, except during 2010–11. The forecasted highest and lowest prices were observed in September and October respectively while arrivals were highest and lowest November and in September 2013, respectively.

Kumawat and Singh (2015) studied trends in arrivals and prices of Moth bean in Rajastan. They revealed that when major portion of the produce was received in the market, the prices were at the lowest. There was a significant negative correlation between prices and arrivals of Moth bean in Nagaur and Jodhpur. However, there was negative but non-significant correlation in Merta and Jaipur markets. However, in Nokha market, the correlation between arrivals and prices was positive but non-significant. Trend analysis of arrivals of moth bean in Nagaur, Merta, Jodhpur and Jaipur markets showed decreasing trend (non-significant) except Jodhpur market where it was significant. However, the trend values of arrivals in Nokha market showed positive but non-significant trend over the years. During the peak period, the prices of moth bean are depressed. Therefore, government should enhance efforts in procurement of moth bean at MSP in the peak period. Farmers should also avail marketing loans to withhold their produce for some time so that they can get remunerative price during mid and lean period. Credit facilities should also be given to farmers under *Gramin Bhandaran Yojana* to have scientific storage facilities at village level.

Sharma and Meera (2016) study has undertaken by collecting monthly wholesale prices of wheat in Sriganganagar district of Rajasthan. This study was based on the secondary data on arrival and prices of wheat in APMC, Sriganganagar, Sadulsahar, Guarana, Apgar, Vijayanagar, Suratgarh, Gajsinghpur, Karanpur and Raisinghnagar for the period of 10 years (2005 - 2014). In the analysis all the selected markets showed positive trend in prices. The seasonal price index provides a measure of the month to month variation in wheat prices. Price of wheat was found to be highest during off season and lowest during harvest season. Since wheat is a *rabi* crop, the arrivals were high during March to May. The higher seasonal indices of prices were observed during December to February during which the arrivals were found to be low.

Benke *et al.* (2016) studid price behaviour of green gram in Akola district. The data on arrivals and prices of green gram for the period of 20 years(1987 to 2006) were used. They concluded that compound growth rate of production and arrival were found to be positively associated in period I (1987-96) of study and negatively associated in period II (1997-2006) of study for APMC, Akola. 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 showed that when maximum production was there, prices decreased and increased during the pre-harvest month. The C.V. was seen lowest for green gram crop.

The above studied reveals that during the post-harvest periods for most of the agricultural commodities, the arrivals were more resulting into glut situation and thereby decrease in prices. Also, with very few exceptions there was negative relationship between arrivals and prices was noticed in the markets. The fluctuations on prices was the main reason for lower income to the farmers and most of the researchers have suggested remedies like storage for some duration and availing credit facilities to farmers.

2.4 Variability in arrival and prices of major pulses

Jadhav *et al*. (2011) study was based on the secondary data on arrival and prices of soybean in A.P.M.C., Achalpur, Amravati, Morshi and Daryapur for the period of 10 years (1999-00 to 2008-09). Amongst all selected markets, arrival and price index was observed to increasing compared to the base year. In all selected markets, monthly seasonal index of soybean was found to be the highest immediately after harvest. Whereas price index of soybean was found to be lower during peak arrival months and vice versa.

Mishra and Kumar (2012) studied the price behaviour of major vegetables in hill region of Nepal. The study is based on secondary data on wholesale monthly/weekly arrivals and prices for the period of 2000-01 to 2009-10. The seasonality in wholesale price was analyzed using multiplicative model; the Fourier analysis was used to analyze cyclical variation in wholesale prices and Autoregressive model to study the relationship between market arrival and price of

vegetables in market of hill region of Nepal. It was found that during the post-harvest period, the wholesale price ruled very low while during the lean period, the prices were quite high which was due to seasonal and perishable nature of the vegetables. The entire vegetables registered the positive and increasing trend and periodicities of 2 to 3 years in the wholesale price of vegetables. The effect of lagged price on current wholesale price was positively significant and high in magnitude and significant negative response was observed for the relationship between wholesale price and market arrival for all the vegetables in the market of hill region. Therefore, improved market information system is a need of efficient vegetable markets in Nepal in order to enable farmers to make proper production and marketing decisions. Further, Government is required to create market infrastructure facilities like warehousing, processing, transportation, etc. for reducing the variation in prices of vegetables in the market of hill region of Nepal.

Bhosale (2013) analyzed prices of major agricultural commodities in APMC, Satara. The arrivals of jowar, wheat, soybean, Pigeon pea and chick pea had showed annual fluctuations during the period under study (2000-01 to 2011-12). The prices of all commodities were found to be increased over entire period. He suggested optimum time to sell the produce in market as jowar (November to January); wheat (Marchto May); soybean (December to January); pigeon pea (January to March) and the chick pea during December to January in order to get good prices for their produce.

Bandke and Chandrakant (2014) studied trends in arrivals and prices of major pulses in Marathwada region. Their study was useful to formulate economic policies beneficial for consumers, producers, traders and government and to identify some direction about the degree of competitiveness in markets for pulses. It helps the farmers to adopt suitable marketing strategies to maximize their net returns. The analytical tools used were seasonal indices, coefficient of variation, standard deviation, trend, mean, compound growth rate and linear growth rate. The pulses were sold immediate after harvest showing more arrivals in post-harvest months. Aurangabad and Jalna markets were 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 were analyzed. The negative sign indicates the inverse relationship between the arrivals and prices, when the market arrival increases the prices decreases and vice-versa.

Sharma and Burark (2015) investigated the price behaviour of maize and market concentration in Nimbahera market of Rajasthan. Monthly wholesale prices of maize in major markets of Rajasthan were collected for a period of 12 years (2002 to 2013). The seasonal price index provides a measure of the month to month variation in maize prices. Price of maize was found to be highest during off season and lowest during harvest season. Since maize is a *Kharif* crop, the arrivals were high during October to January. The higher seasonal indices of prices were observed during April to August during which the arrivals were found to be low. The Lorenz ratio was less than 0.5 in Nimbahera market which indicates that the moderate market competitiveness in markets as the arrivals were concentrated among few large traders.

Navadkar *et al.* (2016) made an attempt to study the arrivals and prices of black gram in Barshi tahsil of Solapur district. The time series data on monthly arrivals and prices of black gram were collected from the purposively selected APMC, Barshi for the years from 2001-02 to 2011-12 in order to compute the trends, growth rates and relationship between arrivals and prices. The arrivals of black gram in the post-harvest period were the maximum and during the lean period were the least. Whereas, in the case of prices, opposite trend was observed. At the Barshi market, the prices of black gram increased rapidly over the period of 11 years ending 2011- 12 and at a faster rate.

Virkar *et al.* (2017) studied inter-year and intra-year variation in price behaviour of wheat in Nagpur district. Secondary data on arrival and prices of wheat for the period of 20 years *i.e.* from 1991-92 to 2010- 11 were used. The data were collected from Umrer, Kalmana, Saoner, Kalmeshwar and Katol APMCs of Nagpur district. The results indicated that in Nagpur district APMC, Kalmana had the highest arrival of wheat *i.e.* 24611.33 qtls over 20 years period. In the selected APMCs in Nagpur district highest arrival were found in month of March, April and May *i.e.* post harvesting period and lowest in October, November and January due to lean period. The Inter-year arrival index analysis revealed highest index (1894.98 %) for APMC, Umrer in 2010- 11.

Kolageri and Banakar (2018) analysed the growth trend and instability in arrivals and modal prices of the commodity in Karnataka. The growth rate in arrivals and prices of selected commodities in APMCs of Karnataka was calculated for the period of fifteen years. The coefficient of variation and nature of instability in arrivals and modal price were examined. The samples commodities were selected based on the highest arrivals of particular commodity to the market yard. For the study thirteen different commodities in thirteen different markets of Karnataka were selected. All the commodities showed significant and positive growth rate with low variability and instability. In the arrivals the variability and instability were high and majority of the commodity's showed significant and positive growth rate excluding few which had negative and significant growth rate. The instability and variation were high in arrivals compared to price of the selected commodities.

Chaudhary *et al*. (2019) studied the trends, relationship, as well as seasonal fluctuations in arrivals and prices of selected vegetables in Baijnath regulated market of Kangra district in Himachal Pradesh for the year 2010-11 to 2015-16. They stated that the rate of increase in the monthly arrivals was highest for cauliflower whereas the monthly prices were highest for ladyfinger. The prices of vegetables move contrary to arrivals *i.e.* prices increased with decreasing arrivals in the market hence negatively correlated. The average monthly variability in arrivals and prices was found to be maximum for cucumber and ladyfinger, respectively. The study of seasonal fluctuations in arrivals and prices showed that arrivals of most of the vegetables were higher in the peak season and lower in the lean season. The correlation

coefficient calculated from different market prices of vegetables showed that study market was highly integrated with Kangra market for most of the vegetables.

It was evident from the above studies that the prices and arrivals of agricultural commodities have increased considerably over the years; also the variation in arrivals was quite low as compared to the variation in prices. The higher magnitudes of variation in market prices leads to uncertainty and distress sell of farm produce. A proper and effective price signal dissemination mechanism was advised by researchers to safeguard the interest of farmers.

2.5 Forecast prices of major pulses

Saima and Raza (2012) designed study to find out suitable forecasting method among the two forecasting methods namely trend analysis and double exponential smoothing. Measures of accuracy (MAPE, MAD and MSD) were used as the model selection criteria that could best describe the trend of prices of major pulses such as gram, mash, masoor and mung during 1975-76 and 2009-10. Double exponential smoothing method was found to be pertinent for price estimation of major pulses in Pakistan because of smaller values of accuracy measures. Six-year's forecasts of prices of gram, mash, masoor and mung in Pakistan in 2010-11 were ₹ 31.80, ₹ 84.09, ₹ 72.06, and ₹ 47.69 per kg, respectively along with 95% prediction intervals. The results showed that if the present growth rates remain the same then prices of these pulses in Pakistan would be ₹ 37.64, ₹ 120.26, ₹ 89.55 and ₹ 55.03 per kg, respectively in 2015- 16. An increasing trend in the estimated prices would turn down the demand of these pulses and consequently poor class of the economy who do not have enough resources to buy expensive livestock-based protein-rich food will be badly affected.

Niaz *et al.* (2013) studied modeling and forecasting time series data of lentil, pulse production in Bangladesh. The Box Jenkins ARIMA methodology has been used for forecasting. The diagnostic checking has shown that ARIMA (0, 1, 9) was appropriate. The forecasts from 2011-12 to 2015-16 were calculated based on the selected model. These forecasts would be helpful for the policy makers to foresee ahead of time the future requirements of grain storage import and/or export and adopt appropriate measures in this regard.

Chaudhari and Tingre (2014) studied the forecast of green gram prices for Maharashtra by using the time series data of monthly average prices for the period from January, 2001 to September, 2012 of Akola market. To forecast the green gram prices ARIMA models introduced by Box and Jenkins (1970) were used. To test the reliability of model R2, Mean Absolute Percentage Error (MAPE), and Bayesian Information Criterion (BIC) were used. Model parameters were estimated using the Statistical Package for Social Sciences (SPSS). Among the different models lowest BIC value worked out to 1989 for ARIMA (0, 1, and 0) which was the best fitted model. Based on model results the estimated green gram prices for Maharashtra would increase from ₹ 4646 per quintal during October 2012 to ₹ 4729 per quintal during February, 2013.

Dhakre and Bhattacharya (2014) conducted a study on price behavior of potato in Agra market. The information on prices of potato in Agra market was collected for the period January, 2004 to December, 2012. Potato wholesale prices of Agra market were analyzed by using univariate ARIMA (2, 1, and 1) model. Seasonal indices calculated showed that generally the price was low from November to January and it starts picking up from February and reaches the maximum in November. Based on the Shwartz Bayesian Criterion (SBC) and Akaike Information Criterion (AIC), the estimated best model was ARIMA (2, 1, and 1). Short term forecasts based on this model were close to the observed values. The accuracy measures like MAPE and MSE were considered as the best models to forecast monthly prices. Among all the models, ARIMA (2, 1, and 1) model was best with least Mean Average Percentage Error (MAPE) and Mean Square Error (MSE) value for Agra 20.57, 102.22, respectively.

Vishwajith *et al*. (2014) Attempt has been made to analyses and forecast the production scenario of pulses in major pulses growing states of India. Autoregressive Integrated Moving Average (ARIMA) methodology has been used to model and forecast the behaviour of pulses production with and without inclusion of the above factors of production. In most of the cases, inclusion of the factors of production in the model outperformed the simple ARIMA modelling. To take care of conditional variances, use of Generalized Autoregressive Conditional Heteroscedastic (GARCH) models were found in literature; the method has also been used in this study. From the forecasted value it was clear that among the Indian states, Madhya Pradesh has to play a major role in augmenting pulses production in India with its estimated share of 3661 thousand tons out of all India production of 14360 thousand tons in 2015. Comparative analysis reveals that uniform superiority of neither the ARIMA model nor the GARCH could be established in modeling and forecasting the production behavior of pulses in India.

Jalikatti *et al.* (2014) forecasted the prices of onion at Bijapur district of northern Karnataka. The study was carried out in Bijapur market where arrivals of onion were found to be more in Northern Karnataka. The time series data on monthly price of onion required for the study was collected from the registers maintained in the Bijapur APMC Market from year 1996-97 to 2010-11. The ARIMA model forecasted prices revealed that there was sudden increase in the prices during 1998, 1999, 2010 and 2011. The year-wise alternate decrease in production and adequate storage facilities might be the reasons for such sudden increase in the price. The forecasted price values showed an increasing trend in the next coming years. Hence, farmers' needs to plan the production process in such a way that a good price for the produce can be expected. ARIMA model is an extrapolation method that requires only historical time series data on the variable under study. The Box-Jenkins approach primarily makes use of three types of filters, namely, the autoregressive, the integration and the moving average. The Box-Jenkins model provides a verified approach for identifying and filtering most appropriate variations for the series being analyzed, for diagnosing the accuracy and the reliability of the models that have been estimated and lastly, for forecasting the policy.

Jalikatti and Patil (2015) forecasted the prices of onion at Hubli market of northern Karnataka, as the arrivals of onion were found to be maximum in this market. The time series data on monthly price of onion required for the study was collected from the registers maintained in the APMC, Hubli from year 1996-97 to 2010-11. The ARIMA model forecasted prices revealed an increase in the prices of onion in the future years and also demand for onion. Hence, farmers need to plan the production process in such a way that good price for the produce could be expected. ARIMA model was an extrapolation method that requires only historical time series data on the variable under study.

Shukla and Jharkharia (2015), investigated the applicability of ARIMA models in wholesale vegetable market models were built, taking sales data of one perishable vegetable from Ahmedabad wholesales market in India. It was found that these models can be applied to forecast the demand with Mean Absolute Percentage Error (MAPE) in the range of 20 per cent. This error was acceptable in fresh produce market where the demand and prices are highly unstable. The model was successfully validated using sales data of another vegetable from the same market. This model can facilitate the farmers and wholesalers in effective decision making. ARIMA model was applied due to its superior behavior over other models in the same class to forecast the demand of a fresh produce on a daily basis. The data was collected from Ahmedabad wholesales market over a period of twenty-five months (1-Jan-07 to 31-Jan-2010) to build the models. The model was identified using twenty-four months of onion sales data. The left one-month data was used to forecast the sales and to calculate the accuracy of the model. It was observed that the model was able to forecast the demand with an accuracy of Mean Absolute Percentage Error (MAPE) of 19.39 per cent. In order to validate the model, data was collected for potato sales in the same market and the model was applied. Result shows that the proposed model was able to forecast the daily demand with approximately the same accuracy.

Sohyun *et al*. (2015) predicted the 12-month wholesale price of onion and cabbage by using price and inflow data of the Garak agricultural wholesale market from January, 2004 to March, 2014, and the yearly production data from Department of Statistics, Korea. The HW 38 smoothing, ARIMA, VAR, X-12 ARIMA, and ARDL models were chosen for the analysis and their prediction power were compared. The HW smoothing, ARIMA and VAR models predicts the out-of-sample wholesale prices to range between 650 and 800 won. In the X-12 model, the wholesale prices were predicted to exceed 1000 won. For cabbage, the HW Smoothing, ARIMA, and VAR models predict the cabbage wholesale price to range between 450 and 490 won. The X-12 ARIMA model predicts the highest price to amount to 558 won. The ARDL model suggests that it was in September when the highest price is 780 won.

Nagabhushana *et al*. (2016) studied a model that helps in effective distribution of vegetable yield demand. Prediction model was developed using regression analysis to find out

the future yield so that the farmer can plan the distribution of his produce. Second phase of the study was aimed at reducing transportation using cost integer programming from distributors to retailers while meeting the demand at the same time. The developed model can predict the future yield value which would be closer to the actual yield value. Future demand can also determined which would be closer to the actual demand. Based on the yield generated and demand comparison, decision could be incorporated in the distribution of vegetables by the farmer to different regions. If the demand was more than yield, tapping of other sources was done. If the demand was lesser, the part of the yield could be sent to other towns and cities where demand has not been met. Food waste problem can be tackled at the source itself by using this model. Wastage can be reduced considerably which was one of the final benefits that would contribute to the societal welfare and development. The integer programming model done for optimizing the cost of distribution provides a feasible solution to the distributors and retailers and satisfying the demand at the same time. Thus, total cost could be minimized without affecting the efficiency of distribution. Distributors and retailers can optimize their distribution effectively while minimizing the transportation cost as much as possible without affecting the demand.

Darekar *et al*. (2016) forecasted the prices of onion at Kolhapur market of Western Maharashtra, as being a primary market, the arrivals of onion were found to be maximum in this market. The time series data on monthly price of onion required for the study was collected from the registers maintained in the Kolhapur APMC from year 2004 to 2013. The ARIMA model forecasted prices revealed an increase in the prices of onion in the future years and also demand for onion. Hence, farmers need to plan the production process in such a way that good price for the produce could be expected. ARIMA model was an extrapolation method that requires only historical time series data on the variable under study. The Box Jenkins model provides a verified approach for identifying and filtering most appropriate variations for the series being analyzed, for diagnosing the accuracy and the reliability of the models that have been estimated and lastly, for forecasting the price.

Darekar and Reddy (2017) studied price forecasting of pulses: case of Pigeon pea. The present study has been undertaken with an objective to forecast the future prices of the pigeon pea to help the farmers to take appropriate acreage, selling and storage decisions. The present study aimed to forecast the pigeon pea prices by using the time series data of monthly average prices for the period of January 2006 to December 2016 to predict harvest prices during 2017-18 in major pigeon pea producing states like Maharashtra, Uttar Pradesh, Rajasthan, Madhya Pradesh and Gujrat. The study used ARIMA models for price forecast. To test the reliability of model MAPE, AIC, and BIC Criterion were used. The model was validated for the year 2016-17. Model parameters were estimated using the R programming software. The forecast shows that market prices of pigeon pea, would be ruling in the range of ₹.4,300 - 7,600 per quintal during November to January, 2017-18.

3. METHODOLOGY

This chapter includes the materials and methods used for the present study and socio-economic characteristics of the study area. It deals with the source of data, type of data utilized, selection of period and statistical tools used for data analysis to achieve the objectives of the study.

A) Methodology

The present study was based on the data of arrivals and prices of selected agricultural commodities in APMC, Barshi.

3.1 Selection of market

The study was based on arrival and prices of major pulses in APMC, Barshi, so that APMC, Barshi was selected purposively.

3.2 Selection of the commodities

Major pulses *viz.* Tur (Red Gram), Moong (Green gram), Udid (Black Gram) and Gram (Chick Pea) based on maximum arrivals in the selected APMC were selected for present study.

3.3 Source of data

The data required for the investigation was collected from office records of APMC, Barshi, Annual reports of APMC, District statistical abstract and handbook of basic statistics of Maharashtra, *etc.* were utilized.

3.4 Method of data collection

The month wise data in respect of arrival and prices of selected major pulses was collected from the records maintained by APMC, Barshi. Based on the availability, the last 11 years data starting from 2008 to 2019 was collected.

3.5 Infrastructural facilities

Information regarding market infrastructural facilities like as storage, display board of market charges, commodity wise prices, market fees *etc.* was collected from APMC, Barshi.

3.6 Analysis of data

3.6.1 The organizational structure of APMC, Barshi

This information was collected from APMC, Barshi by personal interview with officials of APMC, Barshi and from the available records/ reports. Market committees recorded the monthly arrivals and average price of major pulses and the same was used for the study.

3.6.2 Trends in arrivals and prices

The time series data pertaining to monthly arrivals and prices of major pulses was collected from APMC, Barshi. The compound growth rates of arrivals and prices of major pulse commodities was worked out by using an exponential form of equation as below,

$$\mathbf{Y = ab^t}$$

Where,

Y = Monthly arrivals/prices

a = Constant

b = Trend coefficient

t = Time period

Annual compound growth rate (CGR) in percentage was calculated as,

$$\mathbf{CGR\ (\%) = (Antilog\ of\ b\text{-}1) \times 100}$$

3.6.3 Seasonal indices in arrivals and prices

Seasonal indices are those periodic movements in business activity which occur regularly every year and have their origin in the year itself. Since such variations repeats during a period of twelve months that can be predicted fairly accurately. To obtain a statistical description of a pattern of seasonal variation it will be desirable to first free the data from the effects of trend, cycles and irregular variations. Once these other components have been eliminated, seasonal index can be calculated in index form as a measure of seasonal variation. Seasonal index for each month was calculated. Thus specific seasonal index refers to the seasonal changes during a particular year. Seasonal indices were given as percentage of their average.

The seasonal indices of arrivals and prices of selected agricultural commodities were worked out by using simple average method.

$$\mathbf{SI = \frac{Monthly\ arrival\ /prices}{Average\ of\ arrival\ /prices} X 100}$$

3.6.4. Variability in arrivals and prices

Degree of instability in arrivals and prices of selected crops during selected period was calculated by using coefficient of variation. Co-efficient of variation in arrivals and prices were computed for all the selected commodities between years. The variability in arrivals and prices of selected agricultural commodities in APMC, Barshi was studied by calculating the coefficient of variation (CV %) for study period, by using the following formula,

$$CV\ \% = \frac{SD}{mean} \times 100$$

Where,

$$\mathbf{CV\ (\%) = Coefficient\ of\ Variation}$$

$$\textbf{SD} = \sqrt{\sum (Xi - X)^2)/N}$$

$$\textbf{Mean} = \sum \frac{Xi}{N} \qquad (i = 1, 2, 3, \ldots\ldots N)$$

X i's = i^{th} month arrivals/prices of selected commodities.

N = Number of years

3.6.5 Correlation between arrivals and prices

For achieving one of the objective of the study *i.e.* to study the relationship between market arrivals and prices, the method of correlation was used. The correlation for the arrival and prices of selected agricultural commodities were calculated. The correlation is the measure of degree of relationship amongst two series *i.e.* Arrival and Price. The formula used for calculating the Pearson's coefficient of correlation (r_{xy}) is as follow.

$$r_{xy} = \frac{COV\ (x, y)}{\sigma x\ \sigma y}$$

Where,

x=Arrival mean

y = Prices mean

r = Correlation coefficient

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

$\sigma y =$ Standard deviation of y

σx= S.D. of x

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

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

Where,

r = correlation coefficient,
n = number of observations
K = number of parameters

3.6.6 Forecasting the future values of major Pulses-

For quantifying and forecasting the future prices for a given set of data ARIMA model was used. The outline of the model is as below.

3.6.6.1 Auto Regressive Integrated Moving Average (ARIMA) model (Box-Jenkins models)

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

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

3.6.6.2 Stationarity and non-stationarity

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

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

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

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

$f(X_1, X_2 \ldots . X_n) = f_1(x_1), f_2(x_2), \ldots, f_n(x_n)$

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

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

$$Y_t = \Delta X_t$$
$$= X_t - X_{t-1}$$
$$= X_t - BX_t$$
$$= (1-B) X_t \qquad \ldots\ldots\ldots (1)$$

Where,

B = Backward shift operator

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

$BBix_t = x_t\text{-}1$ i= 1, 2, . . .

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

$$y_t = \Delta (AX_t) \quad \ldots\ldots\ldots (2)$$
$$= \Delta (X_t - X_{t-1})$$
$$= (X_t - X_{t-1}) - (X_{t-1} - X_{t-2})$$
$$= X_t - 2X_{t-1} + X_{t-2}$$
$$= X_t - 2BX_t + B^2X_t$$
$$= (1 - 2B + B^2) X_t$$
$$= (1 - B)^2 X_t$$

In general, if it takes a d^{th} order difference to achieve stationarity, it is written as,

d^{th} order difference $= (1-B)^d X_t$ …… (3)

The general ARIMA (o, d, o) model is

$(1 - B)^2 X_t = e_t$ …… (4)

Where e_t is error term distributed normally with

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

Cov (ei, ej) = θfor all t ($i \neq j$)

In order to test the stationarity, auto-correlation functions (ACF) of difference series (Yt) up to 36 lags should be computed. If the ACF for first and higher differences (after 2-3 lags) drop abruptly to zero then it indicates the series is stationary.

3.6.6.3 Stationary time series model

(a) Auto regressive process (p, o, o)

If the observation Yt depends on previous observation and error term et is called auto regressive process (AR process)

$$Y_t = \mu + \emptyset_t Y_{t-1} + \emptyset_2 Y_{t-2} + \emptyset_p Y_{t-p} + e$$
$$= \emptyset_p (B)(Y_{t-\mu}) + e_t \quad \ldots\ldots\ldots (5)$$

Note the term μ in equation (3.5) is not quite the same as the "Mean" of the Y series. Rather, the development is as follows.

$$(Y_t - \mu) = \emptyset p (Y_t - \mu) + e_t$$
$$= \varphi_1(Y_{t-1} - \mu) + \varphi_2 (Y_{t-2} - \mu) + \ldots . \varphi_p(Y_{t-p} - \mu) + e_t \ldots\ldots (12.6)$$
$$= \varphi_1(Y_{t-1} - \varphi 1\mu) + \varphi_2 (Y_{t-2} - \varphi 2\mu) + \ldots . \varphi_p(Y_{t-p} - \varphi\mu) + e_t$$
$$Y_t = (\mu - \varphi_1\mu \ldots\ldots\ldots\ldots \varphi\mu) + \varphi_1 Y_{t-1} + \ldots\ldots\ldots + \varphi_p Y_{t-p} + e_t)$$
$$\mu_1 + \varphi_1 Y_{t-1} + \ldots\ldots\ldots + \varphi_p Y_{t-p} + e_t$$

And the values of auto regressive coefficient restricted to lie between -1 and +1.

(b) Moving average process (o, o, q)

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

$$Y_t = \mu + e_t - \theta_1 e_{(t-1)} - \theta_2 e_{(t-2)} - \ldots . \theta_q e_{(t-q)} \quad (7)$$

Where,

Ti = i^{th} moving average parameter

i = 1, 2, ...q

q = Order moving average

The values of the coefficient are restricted to lie between -1 to +1.

(c) Mixtures: ARIMA process

If the non-stationarity is added to a mixed ARIMA process, then the general ARIMA (p, d, q) is implied. Here the word integrated is confusing to many and refers to the differencing of the data series.

$$(1-B)\, d\, (1-\varphi_p B_p)\, Y_t = u = (1-\varphi_p B_q)\, e_t \qquad \ldots\ldots\ldots(8)$$

(d) Seasonality and ARIMA models

Some time series exhibit perceptible periodic pattern for instance price and arrivals of agricultural commodities usually have a seasonal pattern process then the general.

The ARIMA notation can be extended readily to handle seasonal aspects and the general shorthand rotation is ARIMA

(P.D.Q.)

(non-seasonal part of the model) (Seasonal part of the model)

s = number of periods per season

The mixture of AR and MA seasonal model is

$$\varnothing_p\,(B)\,\Delta d\,\varnothing_p(B_s)\,\Delta D\,x_t = \theta_q\,(B)\,.\,(H)Q\,(Bs)\,e_t \qquad \ldots\ldots\ldots\,(9)$$

If $Y_t = \Delta d\,\Delta d\,x_t$ - the model becomes an integrated model.

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

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

(1) Identification of models

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

Before estimating the parameter p and q of the model, the data are not examined to decide about the model which best explains the data. This is done by examining the sample ACF (Autocorrelation function) and PACF (Partial Autocorrelation function) of differenced series Y_t.

The sample auto correlations for k time lags can be found and denoted by r_k as follows.

$$\hat{P}k\,(Y_t) = r_k\,(Y_t) \qquad \ldots\ldots\ldots\,(10)$$

$$= C_k\,(Y_t)/\,C_0\,(Y_t)$$

$$C_k\,(Y_t) = 1/n\ S\,(Y_t - Y)\,(Y_{t+k} - Y)$$

$k = 0, 1, 2, \ldots .n$

$t = 1, 2, \ldots n\text{-}k$

$Y_t = 1/n \sum Y_t$

n = Length of time period

Both ACF and PACF are used as the aid in the identification of appropriate models. There are several ways of determining the order type of process, but still there was no exact procedure for identifying the model.

(2) Estimation of parameters

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

$$S(\theta, Ø) = S\, e_t^2\, (\theta, Ø) \qquad \ldots\ldots\ldots (11)$$

Where,

$$t = 1, 2, 3, \ldots n$$

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

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

Interactive method: Choose a preliminary estimate and let a computer programmed refine the estimate interactively.

The latter method is used in our analysis for estimating the parameters.

(3) Diagnostic checking

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

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

One of the procedures for diagnostic checking mentioned by Box-Jenkins is called over fitting i.e. using more parameters than necessary. But the main difficulty in the correct identification is not getting enough clues from the ACF because of inappropriate level of differencing. The residuals of ACF and PACF considered random when all their ACF were within the limits.

$$\pm 1.96\sqrt{1/(n-12)} \qquad \ldots\ldots\ldots (12)$$

We also used Box and Pierce 'Q' statistic for whether the auto correlations for these residuals are significantly different from zero. It can be computed as follows.

$$Q = n \sum_{K}^{m} rk^2 \qquad \ldots\ldots\ldots (13)$$

Where,

m = Maximum lag considered
n = N – D
N = Total number of observations
rk = ACF for lag k
D = Differencing

And Q is distributed approximately as a Chi-square statistic with (m-p-q) degree of freedom.

The minimum Akike Information Coefficient (AIC) criteria is used to determine both the differencing order (d, D) required to attain stationarity and the appropriate number of AR and MA parameters, it can be computed as follows.

$$\mathbf{AIC\ (p+q) = N \ln \sigma^2 + 2\ (p + q)} \qquad \textbf{…… (14)}$$

Where,

$\boldsymbol{\sigma}^2$ = Estimated MSE
N = Number of observations
(p+q) = Number of parameters to be estimated.

This diagnostic checking helps us to identify the differences in the model, so that the model could be subjected to modification, if need be.

(4) Forecasting

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

$$(1-ØB)\ (1-φB)s\ Y_t = (1-θB)\ (1-(H)sB)\ e_t \quad \ldots\ldots\ (15)$$

This was computed for upto 36 months (m) ahead. The above model (15) gives the forecasting equation is

$$Y_t = ØY_t\text{-}1 + φY_{t-12} - ØφY_{t-13} + e_t - θe_{t-1} - (H)\ e_{t-12} + θ(H)\ e_{t-13} \ldots\ldots\ (16)$$

Given data upto time 't' the optional forecast of Y (also called Ex-Ante forecast) model at the t is the conditional expectation of Y_{t+1}.

It follows, in particular, that

$$e_t = Y_t - Y_{t-1} \qquad \ldots\ldots\ (17)$$

The errors et in model (17) are in fact that forecast errors for unit lead time. That for an optimal forecast these 'one step ahead' forecast errors ought to form an uncorrelated series is otherwise obvious. Suppose, if these forecast errors were auto correlated, then it could be possible to forecast the next forecast error in which case it could not be optimal.

The required expectations are easily found because

$$E\ (Y_{t+m}) = Y_t\ (m),\ E\ (e_{t+m}) = 0 \qquad \ldots\ldots\ (18)$$

Where,

m = 1, 2, 3 …….n
$E\ (Y_{t-m}) = Y_{t-m}\ E\ (e_{t-m}) = a_{t-m} = Y_{t-m} - Y_{t-m-1}$
Where, m = 0, 1, 2, ...n …… (19)

For instance, to determine the three month ahead (1-3) forecast for series Y_t (use equation 16).

$$Y_{t+1} = Y_{t+3}$$

$$= ØY_{t+2} + φY_{t-9} - ØφY_{t-10} + e_{t+13} - θe_{t-2} - (H)\ e_{t-9} + θ(H)\ e_{t-10}$$

taking conditional expectations at time t,

$Y_t(1) = Y_t(3)$

$= ØY_t(2) + φy_{t-9} - ØφY_{t-10} + 0 - θ(0) - (H)(Y_{t-9} - Y_{t-10}) + θ(H)(Y_{t-10} - Y_{t-11})$

Because, $E(e_{t+1}) = 0$, $E(e_{t-1}) = Y_{t-1} - Y^{\wedge}{}_{t-1} = e_{t-1}$

i.e. $Y_t(3) = 0\ Y_t(2)$.

The forecast $Y_t(2)$ can obtained in a similar way in terms of $Y_t(1)$ from $E(Y_{t+2})$. Similarly $Y_t(1)$ can be obtained from $E(Y_{t+1})$. In practice it is very easy to compute the forecast $Y_t(1)$, $Y_t(2)$, $Y_t(3)$ *etc.* recursively using the forecast function (18).

$E(Y_{t+1}) = E(0Y_{t+1}-1 + Q_{t+1}-0\ e_{t+1}-1) - θe_{t+1}-1 - (H)\ e_{t+1}-12 + θ(H)\ e_{t+1}-13$ and using 18 and 19.

However, using these methods, Ex-post forecasts can also be calculated for comparing with the value actually realized

3.7 SOCIO ECONOMIC CHARACTERISTICS OF THE STUDY AREA

3.7.1 Introduction

Solapur district is situated on the south east fringe of the Maharashtra state. It is located and lying on the ridge in the Bhima and Sina basins and almost the whole of its drained by either Bhima River or its tributaries. The Solapur municipal council was the first municipal council of India. The location of Solapur district was previously part of Ahmednagar, Pune and Satara districts. It became the sub-district of Ahmednagar in 1838, with including Mohal, Barshi, Karamala, Madha, Indi, Hippargi and Muddebihal sub division. These sub-division were reformed with join Solapur, Barshi, Mohal, Madha and Karamala in 1871 and two divisions were included from Satara district like that Pandharpur, Sangola and also Malshiras was attached in 1875.

In 1956, Solapur was included in Mumbai state, and it became a full fledge district of Maharashtra state in 1960. According to census 2011, the district has 11 tahsils, 13 town and 1154 villages. The district has an area of 14844.6 sq. km. It lies in the center of a large plain 1800 feet above sea level. The headquarter is situated in Solapur city of the district. Solapur, next to Mumbai is one of the major textile centers in the western Maharashtra. It is geographically located on the border line of Andhra Pradesh and Karnataka. It is connected with the major industrial towns and business centers in India, through the well- developed railway network. Recently air service in the form of 'Vayudoot' has been started in Solapur, which has also given boast to its industrialization. Solapur is well known for the textile products. However, it the jacquard chaddar and Terry Towels manufactured on a large scale in the power looms industry; Solapur is famous for exporting Jacquard chaddar and Terry towels in the international market. The products like Bed-sheets, *Dhotis, Irkal* Saress, plain cloth, *khadi* cloth and wall hanging are being manufactured in the handloom industry. Therefore, both power looms and handloom industries are the major provider of employment, next to agriculture in Solapur district. Solapur district has a rich historical background, and it has its own cultural and socioeconomic structure.

3.7.2 Location

Solapur district is situated on the south-east fringes the state of Maharashtra. It lies between latitude 17.10° to 18.32° north and longitude 75° to 77° on the border of Maharashtra

The district is situated entirely in the Bhima, Nira, Sina and Man river basin which is a part of Deccan plateau. The area is demarcated by Bhalaghat range on the east and Shambhu Mahadeo Range in the west, Osmanabad district to the north, Bijapur district of Karnataka state to the south east and east, Sangli district to the south and east, Satara district to the west and Pune district to the north west.

3.7.3 Area

Karmala is the longest (1609.70 sq.km) and north solapur is the smallest (746.30 sq.km) tahsil in the district. Solapur constitutes 4.84 percent area of the Maharashtra and ranks 4^{th} in the area among districts of Maharashtra. The east west length of the district is about 200 km and north south width is about 150 km.

3.7.4 Boundries

On the northern side Solapur district is bounded by Ahmednagar and Osmanabad district, on the east by Osmanabad and Gulbarga (Karnataka State) districts, on the south by Sangli and Bijapur (Karnataka) and west by the Satara and Pune district. The district is situated on the south east fringe of Maharashtra and its lies entirely in the Bhima and Sina basins.

3.7.5 Rainfall

Rainfall is a main factor which influence Agriculture sector. Solapur district is under drought prone area, because the average annual rainfall of the district is less than 700mm annually. Most of the rainfall to the district is available from south west monsoon during June to September. This accounts 74 percent of the total annual rainfall. The rainfall varies from tahsil to tahsil. The Akkalkot tahsil receives highest annual average rainfall (751.27 mm) whereas the lowest average rainfall was noticed in Malshiras tahsil (530.14 mm). The district is divided into five rainfall zones such as very high rainfall (more than 700 mm), moderate rainfall (600 to 650 mm), low rainfall (500 to 600 mm) and very low rainfall (below 550 mm). Relatively high rainfall occurs in the Akkalkot, North and South Solapur Tahsils. While, high rainfall was observed in Madha, Barshi and Pandharpur tahsils, moderate rainfall is in Mohal and Karmala tahsils however low rainfall in Mangal wedha tahsil and very low rainfall in Malshiras and Sangola tehsils.

3.7.6 Temperature

Solapur district which fall under tropical area experiences moderate to high temperature throughout the year. The highest limit of Maximum temperature recorded at Solapur was 45.6°C on 12th May 1939 and lowest limit of minimum was 4°C on 7th January 1945. Generally, temperature of the district is moderate and the hot months are March April and May. The highest temperature is experienced in May and lowest is in December. Mean daily maximum temperature in the month of May is about 39.9°C and mean daily minimum temperature in the month of December is about 14.8°C.

3.7.7 Drainage

Bhima is the main river in the district. The Nira and Man are its chief right bank tributaries, while the Sina is the main left bank tributary. The flow of Bhima and Sina is south eastern directional while Nira flows east and the Man to north east.

3.7.8 Soil

A. Deep Soil-

Characteristics

- Soil depth is more than 90 cms.
- Water availability period exceeding 130 days.
- 25% area of the district having deep soils (tahsils: Akkalkot, north and south Solapur)
- Area – 3,72,000 ha

Medium deep soil-

Characteristics-

- Soil depth is between 22.5 to 90 cms.
- Water availability period exceeding between 100-130 days.
- 45% area of the district having medium deep soils (Tahsils: Mohol, Barshi, Pandharpur, Madha and Mangalwedha).
- Area-6,69,600 ha

C. Shallow Soil-

Characteristics

- Soil depth is less than 22.5 cms.
- Water availability period less than 100 days.
- 30% area of the district having shallow soils (Tahsils: Malsiras, Karmala and Sangola)
- Area-4,46,400 ha.

3.7.9 Land utilization pattern of Solapur district

Land is a crucial input in the process of agricultural production. Its availability and proper use is an essential condition for the development of agriculture. The detail information of land use pattern in the district is shown in the following Table 3.1.

The total geographical area of Solapur district was 14,87,800 ha during 2018-19. While the per cent share of area under forest, barren and uncultivable land, land under non-agril. Uses, cultivable waste land, permanent pasture, area under miscellaneous trees & groves, current and other fallow were 2.37, 6.44, 1.15, 2.61, 4.11, 0.48, 11.09 and 8.79 per cent, respectively. Thus, excluding all above categories, the net sown area in Solapur district was accounted to 9,36,700 ha (62.96%). Including the area sown more than once (1,054,600 ha), the gross cropped area was estimated to be 1,10,41,300 ha with cropping intensity of 111 per cent. Rainfed weather conditions and uneven distribution of rains might be responsible for lower cropping intensity of the district.

Table 3.1 Land utilization pattern of Solapur district (2018-19) (Estimated)

Sr. No.	Particular	Area (00' ha)	Per cent
1.	Total geographical area	14878	100.00
2.	Forest	353	2.37
3.	Barren & uncultivable land	958	6.44
4.	Land under non-agril. uses	171	1.15
5.	Cultivable waste land	389	2.61
6.	Permanent pasture	611	4.11
7.	Area under miscellaneous trees & groves	71	0.48
8.	Current fallow	1650	11.09
9.	Other fallow	1308	8.79
10.	Net area sown	9367	62.96
11.	Area sown more than once	1046	7.03
12.	Gross cropped area	10413	69.98
13.	Cropping intensity		111

(Source: NARP and DSAO, Solapur report.)

3.7.10 Cropping pattern of Solapur district

Cropping pattern of a district represents the general preferences and choice of farmers regarding different crops and also, the resource availability could also be judged by observing the same. The cropping pattern of Solapur district is depicted in Table 3.2.

Table 3.2 Cropping utilization pattern of Solapur district (2018-19)

Sr. No.	Crop	Area (00' ha)	Production (00' Tonnes)	Productivity (Kg /ha)
A	***Kharif***			
1	Rice	19.24	1.73	89.87
2	Jowar	36.88	18.19	493.30
3	Bajra	237.93	32.03	134.64
4	Maize	216.23	201.85	933.47
5	Other cereals	5.08	1.47	290.00
6	Tur	353.16	40.50	114.68
7	Moong	116.14	28.32	243.84
8	Udid	237.17	63.50	267.74
9	Other pulses	3.50	0.71	203.00
10	Groundnut	28.90	12.80	442.88
11	Sesame	0.45	0.06	125.00
12	Niger seed	1.02	0.11	112.50
13	Sunflower	25.24	5.59	221.32
14	Soybean	350.37	115.69	330.19
15	Other oilseed	32.49	9.75	300.00
16	Sugarcane	1900.18	140936.35	74.17
17	Cotton (Lint)	1.63	0.88	91.40
	Sub- total (A)	**3565.61**		
B	***Rabi***			
1	Jowar	5138.10	1825.00	355.20
2	Wheat	643.00	569.00	884.20
3	Maize	382.90	544.00	1422.00
4	Other cereals	0.30	0.05	180.00
5	Gram	506.90	281.00	554.00
6	Safflower	11.39	3.00	268.00
7	Linseed	0.05	0.02	387.30
8	Sesame	4.08	0.50	117.00
9	Sunflower	136.10	23.00	166.30
10	Other oilseeds	0.10	0.02	140.00
	Sub-total (B)	**6822.92**		

Sr. No.	Crop	Area (00' ha)	Production (00' Tonnes)	Productivity (Kg /ha)
C	**Summer**			
1	Maize	18.30	15.20	830.00
2	Other cereals	0.10	0.10	900.00
3	Groundnut	6.60	7.50	1135.00
	Sub-total (C)	**25.00**		
	Total	**10413.53**	**144737.92**	

(Source: NARP and DSAO, Solapur report.)
Note : Productivity of Sugarcane in Tonnes, Production of cotton in"00"bales of 170 kg each

The table reveals that the numbers of crops grown in *kharif* season were more but the area under *rabi* crops was high (6,82,292 ha) as compare to *kharif* (3,56,561 ha). Thus, it could be concluded that cropping pattern of Solapur district was dominated by *rabi* crops. Further, among the *rabi* crops area under *rabi* Jowar (513810 ha) was estimated to be maximum. Sugarcane was the next important crops in the district having contributed to 1,90,018 ha area, followed by wheat (64,300ha), gram (50,690ha) and maize (38,290ha) in *rabi* season and tur (35,316ha) and soybean (35,037ha) in *kharif*.

4. RESULT AND DISCUSSION

This chapter is devoted to express the results obtained from the present study. The discussion regarding organizational structure and marketing management, performance of market committee, activities under taken and achievements made so far are briefly discussed in this chapter, the organizational and management constraints faced by market committee, intermediaries are also discussed in this chapter.

4.1 Organizational structure of APMC, Barshi.

The Agricultural Produce Market Committee, Barshi was constituted on 7th November, 1949. The notified area of market committee is whole Barshi tahsil. The main market yard is in Barshi city and sub-market of APMC, Barshi is in Vairag.

4.1.1 Number of intermediaries in APMC, Barshi

Table indicates the total numbers of license holders working in the APMC.

Table 4.1 Total license holders working in APMC, Barshi (2019-20)

Sr.No.	License type	Number
1	*Hamal*	180
2	Weightment	128
3	Commission agent	409
4	Traders	426
5	Processor	21
6	Others	75

4.1.2 Infrastructural facilities and amenities in APMC, Barshi

Various infrastructural facilities and amenities are provided by APMC, Barshi for its effective functioning. The APMC, Barshi is spread over an area of 29.44 ha.

APMC, Barshi has provided various infrastructural facilities which can be grouped as trading, ancillary, administrative, farmers and common facilities. Various facilities which comes under these five groups are as under

1	Trading	Common auction hall and Open auction platform
2	Ancillary	Storage godowns; Cold storages; Weighing equipments; Material handling system
3	Administrative	Banks; Post offices; Police Station; Security Posts
4	Farmers	Rest House; Dormitory Accommodation; Agril. Input Shops
5	Common	Tea Shops; Bathrooms, Toilets; Drinking Water Parking Facilities; Garbage Disposal & Drainage; Hospitals

4.1.3 Conduct of auction

The open auction method of sale is expected in APMC, Barshi. Under this auction system of sale, the information regarding the shop of commission agent from which the auction will commence is displayed on notice board. The produce is sold in the presence of sellers and traders. The buyers examine the produce for its quality, grade *etc.* The commission agent under supervision of market officials normally conduct the entire process of bidding. The highest bidder is entitled to purchase the produce, provided the cultivator – seller also accept the rate offered in the bid. The farmer may reject or postpone the sale if he is not satisfied with the bid price.

After the completion of deals, every buyer is required to sign an agreement to buy the goods at the price agreed upon, the copies of trade slips are to be submitted to the Market Committee as well as to license Mapadi for weighment.

4.1.4 Time of auction

The market time to carry out trade transactions and holidays have been declared by market committee as per the law of 1963, section 44 (2)

4.1.5 Method of payment

The prompt payment to the producer seller on the same day of transaction is an important feature of regulated market. According the rules and by laws, the payment of the agriculture produce to the seller should be made with appropriate deductions within 24 hours. However, in some cases, the payment made delayed due to late payment by buyers to the commission agents.

4.1.6 Dissemination of market information

The market information regarding prices and arrivals of agricultural commodities and their trends are very much important for farmers to take appropriate decisions about sell of their produce. The market committee supplies daily, weekly, fortnightly and monthly statistical information to various concerned offices of the central and state governments. Recently the computer system is introduced in the market. Previously the records regarding prices, daily arrivals were kept in written form and the most of the records are misplaced and destroyed. The market committee also displays information on the notice board in market yard, publishes pamphlets and broachers and other materials periodically for disseminating useful information regarding market regulations and activities of the market committee to all market functionaries.

4.2 Board of directors of APMC, Barshi

The Board of directors constitutes the organizational structure of APMC, Barshi. This board of directors has an Executive Body that consists of the committees of elected members headed by the Chairman. The Chairman and the Vice-Chairman are the supervising authorities of market committee and are assisted by the heads of sub committees.

The secretary of the market committee acts as the administrative head and looks after the day to day working of committee and responsible for implementing the plans and the policies and

gives feedback on them to board of directors through the chairman. The board of directors also has an administrative staff which comprises of staff appointed for official work and functioning of the market. The staff on this body was appointed as per the 'staffing pattern' given by Maharashtra State Agricultural Marketing Board (MSAMB), Pune.

The tree diagram of organizational structure and administrative hierarchy existing in APMC, Barshi is depicted in Fig.1

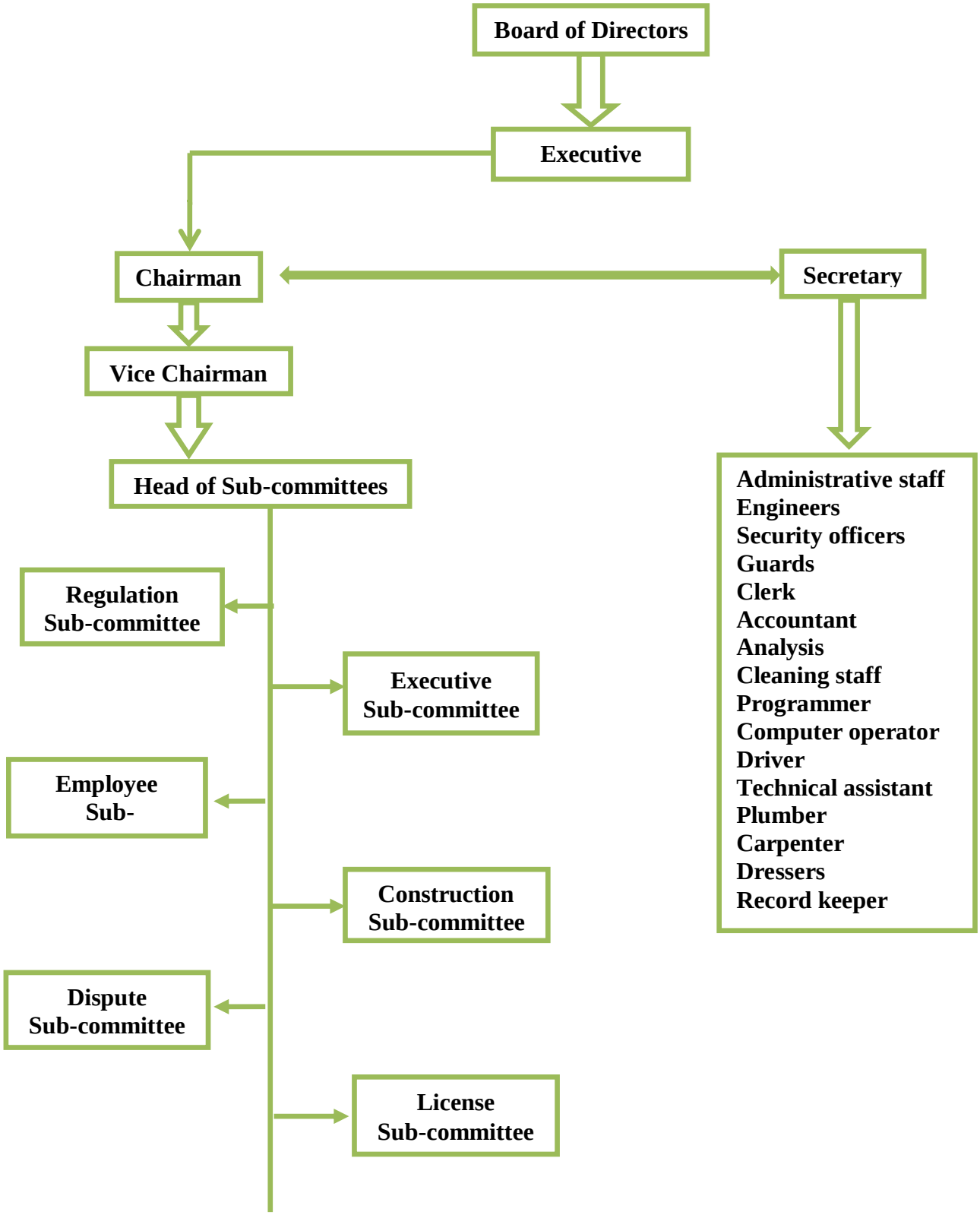

Fig.1 Organizational structure of APMC, Barshi.

4.2.1 Composition of market committee and its management

APMC, Barshi was being managed by an autonomous and representative managing committee comprising of 19 members. The committee includes members which were representatives of various sections like farmers, commission agents, traders, governments' nominees etc., with predominance of agriculturist. The representatives should be of age above 21 years. The present composition and constitution of APMC, Barshi is given in the Table 4.2.

Table 4.2 Present composition and constitution of APMC, Barshi

Sr. No.	Representative group	Number of members
1	Agriculturist	15
2.	District deputy registrar	1
3.	Traders	1
4.	Mapadi, Mathadi and others	1
5.	Secretary of APMC	1
	Total	**19**

4.2.2 Terms of office and election of Chairman and Vice-chairman

Average term of office of APMC, Barshi was found to be of five years, which was never dissolved before its completion. The Chairman was elected every five years and is the head of the organization while operational matters were handled by the secretary. The current committee is chaired by Mr. Ranvir Rajendra Raut and the current secretary is Mr. Jagdale Tukaram Ambadas

4.2.3 Provision of sub-committees and their role in management.

The newly framed market committee has taken the responsibility of management of market committee. For effective management various sub- committees have been formed and by officials. The name of the sub-committees itself implies its functions. The various sub- committees undertaking various activities and their role in management is described below

Table 4.3 Sub-committees and their role in management of APMC, Barshi

Sr.No.	Name of the subcommittee	Role in management
1.	Executive sub-committee	Carry out day to day functions & supervision
2.	Regulation sub-committee	Supervision of the marketing functions as per the code and conduct suggested in Act of 1963.
3.	Construction sub-committee	Constructions of buildings in market yard
4.	Employees sub-committee	Involved in welfare of the employees of market committee
5.	Dispute sub-committee	Resolves disputes arising in market during trade.
6.	Grading & Sampling sub-committee	Though grading is not done in the APMC, Barshi, the role of this committee was confined to only dissemination of knowledge about grading and sampling to farmers. Most of the farmers grade their produce by themselves before arriving in the market yards.

4.2.4 Administration

The constitution of APMC, Barshi was as per the provision in Maharashtra Agricultural Produce Marketing (Regulation) Act, 1963 13 (IA).

As per the provision in the above act, the Market committee should call the meeting once in a month and there will not be a gap of more than 60 days in two consecutive meetings. The funds for election were reserved which are about 5 per cent of annual income. In the absence of Chairman or Vice-Chairman, the responsibility can be taken up by any member chosen by rest of the committee members

The market committee deserves following rights information by laws.

1. Inspection and preservation of samples of commodity.
2. Standardization of types of commodities and prevention of adulteration.
3. Promotion of graded and AGMARK graded commodities.
4. Method of sale and weighing equipment's.
5. Space utilization and formation of laws, acts regarding market yards.
6. Laws regarding eligibility and duties to be performed by the various market intermediaries

4.3 Arrivals and prices of major pules in APMC, Barshi

The data for 11 years (2008-2019) for major pulses viz.; Tur (Red gram), Moong (Green gram), udid (Black gram) and gram (Chick pea) was collected and analyzed for the present study. The annual monthly arrivals and prices of major pulses is presented in Table 4.4.

Table 4.4 Monthly average arrivals and prices of major pulses in AMPC, Barshi (2008-2019)

Month	Tur (Red gram)		Moong (Green gram)		Udid (Black gram)		Gram (Chick pea)	
	Arrivals (q)	Prices (₹/q)	Arrivals (q)	Prices (₹/q)	Arrivals (q)	Prices (₹/q)	Arrivals (q)	Prices (₹/q)
January	16499.67	4246.42	43.08	4451.00	309.08	3452.08	738.00	3182.50
February	9299.08	4183.58	22.08	4445.33	218.83	3621.42	2688.83	3253.08
March	2348.17	4068.67	23.75	4338.25	30.00	3333.92	3242.17	3187.67
April	1620.67	4262.50	12.75	4629.17	39.50	3815.58	2538.83	3289.58
May	1164.08	4239.58	29.33	4856.17	49.33	4399.25	1690.42	3518.17
June	1036.00	4139.08	88.50	4690.92	233.42	4538.25	1295.58	3324.25
July	825.75	4250.92	68.08	4353.25	281.25	3985.75	948.75	3437.92
August	573.50	4514.17	239.58	4577.00	938.08	4339.00	692.25	3489.83
September	429.17	4136.33	826.58	4750.17	6151.83	4679.25	548.58	3381.08
October	320.67	4020.42	563.42	4755.25	5137.25	4521.25	1111.58	3433.50
November	475.42	4024.33	179.42	4803.67	1589.00	4586.83	858.58	3415.08
December	5261.42	4491.42	138.92	4683.17	998.25	4157.33	1073.58	3292.58

The table revealed that, the average arrivals of Tur was maximum during January (16499.67 q) and after word it shown decline trend upto November (475.42 q) while, again increased in December (5261.42 q). On the contrary, the average prices of tur were consistently

above ₹ 4000/-. In case of moong, the average arrivals were fluctuating during the months while average prices were constant. A significant movement in the average arrivals of udid and gram was observed in the table with considerably constant average prices for both crops.

4.4 Compound annual growth rates of arrival and prices of major pulses in APMC, Barshi

The compound annual growth rates (CAGR) of annual arrivals and prices of major pulses *viz.*; Tur (Red gram), Moong (Green gram), udid (Black gram) and gram (Chick pea) for a period of 2008-2019 were estimated by fitting exponential type of equation and the results have been presented in Table 4.5.

Table 4.5 Compound annual growth rates of arrival and prices in APMC, Barshi (2008-19) (Per cent)

Sr. No.	Crops	Arrivals	Prices
1	Tur (Red gram)	17.34*	4.72*
2	Moong (Green gram)	38.17***	4.07
3	Udid (Black gram)	21.30*	7.32**
4	Gram (Chick pea)	38.17***	8.90***

(*, ** and *** indicates significance at 5, 10 and 1 per cent, respectively)

Above table states that, for all major pulses the arrivals have significantly increase over the years. The similar growth was observed in case of prices except moong (green gram).

The arrivals of moong and gram have been increased by 38.17 per cent annualy, while for tur and udid has been increased by 17.34 and 21.30 per cent, respectively. In case of prices, 4.72, 7.32 and 8.90 per cent of significant increase was noticed for tur, udid and gram, respectively. While in case of moong the annual increase of 4.07 per cent has turned out to be non- significant.

Thus, it could be concluded that there was growth in both the arrivals and prices of selected pulses in APMC, Barshi. Therefore, the alternate hypothesis **"There are fluctuations in annual arrivals and prices of major pulses in APMC, Barshi." has been proved and accepted.**

4.5 Seasonal indices of arrivals and prices of major pulses in APMC, Barshi

Seasonal indices are those periodic movements in business activity which occur regularly every year and have their origin in the year itself. Since such variations repeats during a period of twelve months that can be predicted fairly accurately. The estimated seasonal indices of arrivals and prices of Tur (Red gram), Moong (Green gram), udid (Black gram) and gram (Chick pea) are depicted in Table 4.6.

Tur

It was revealed from the table 4.6 that maximum indices of Tur arrival were found in the month of September (182.58%) and minimum in the month of March (26.56%). Whereas, price indices were maximum the month of December (127.08%) and fluctuated with very negligible

difference during the rests of the months. The harvesting period of Tur is generally December to January, which coincides with higher magnitude of arrival indices (135.34%) in December, but interestingly the price indices were also high as seen earlier. Whereas, during the post-harvest period the indices of arrivals were decreasing upto March and price indices were also decreasing.

Table 4.6 Seasonal Indices of arrivals and prices of major pulses in APMC, Barshi

(Per cent)

Month	Tur (Red gram)		Moong (Green gram)		Udid (Black gram)		Gram (Chick pea)	
	Arrivals	Prices	Arrivals	Prices	Arrivals	Prices	Arrivals	Prices
January	99.80	92.45	68.99	93.03	89.66	89.43	44.11	91.63
February	78.86	97.74	83.00	92.30	83.00	92.30	130.92	93.44
March	26.56	96.53	32.10	95.82	32.10	95.82	132.37	100.23
April	75.24	100.66	82.30	96.12	82.39	96.12	115.29	99.01
May	118.36	99.42	65.39	106.15	65.39	106.15	96.97	104.50
June	125.62	95.29	111.13	105.24	111.13	105.24	104.14	97.46
July	61.94	98.08	70.20	94.04	70.20	94.04	97.51	101.51
August	42.11	106.84	44.45	100.56	44.45	100.56	88.89	103.16
September	182.58	96.85	216.78	106.48	216.78	106.48	72.31	100.03
October	175.10	94.82	202.86	100.57	202.86	100.57	126.69	100.13
November	78.49	94.24	96.27	104.96	96.27	104.67	95.71	101.43
December	135.34	127.08	105.86	108.34	105.86	108.34	95.09	107.49

Moong

It is revealed from the table that maximum indices of moong arrival was found in the month of September (216.78) and minimum price index was noticed in the month of August (44.45).The seasonal indices regarding price revealed that the indices for price was fluctuate in very small scale. The highest indices of Moong price was highest in the month of December (108.34) and lowest indices was in the month of February (92.30).The harvesting period of moong is generally August to December. Due to harvesting period there were increase in indices arrival in these month of September and also indices for prices increased simultaneously in the month.

Udid

The highest seasonal indices of Udid arrivals were observed during the month of September (183.97) followed by October (165.72) and lowest during the month of February (48.32). In case of prices, maximum price indices were noticed in the month of December (107.47) and it was minimum in the month of January (89.43).The harvesting period of Moong is generally in the month of October so there was more arrival and prices in this month. The seasonal indices of both the arrivals and prices of the moong crop is lowest because there is low demand of moong in that season.

Gram

The highest seasonal indices of Gram arrivals were observed during the month of March (132.37) followed by February (130.92) .The indices of gram arrivals was highest from the month

of February to April because harvesting period of gram is from the month of January to march. The lowest indices of gram arrival was in the month of January (44.11). In case of prices, maximum price indices were noticed in the month of December (107.49) and it was minimum in the month of January (91.63).

Based on the above discussion, the null hypotheses of uniform arrivals and prices was rejected and alternate hypotheses **"The seasonal indices of arrivals and prices of major pulses are fluctuating" has been accepted.**

4.6 Cyclical and irregular trends in prices of major pulses in APMC, Barshi

The cycles are the oscillatory movements of the time series with a variable period and amplitude. According to Schumpeter (1939), these cycles are classified as Kondratiet cycles (period < 60 years), Juglar cycles (period < 10 years) and Kitchin cycles (period < 3.3 years). Eleven years seasonalised and detrended data was analyzed to estimate the hidden periodicity along with amplitude in the cycles of major pulses in APMC, Barshi. The estimated coefficients for selected major pulses in APMC, Barshi are presented in Table 4.7 and illustrated graphically in Fig 6 to 9.

Table 4.7 Cyclical and irregular trends in prices of major pulses in APMC, Barshi

Year	Tur		Moong		Udid		Gram	
	Cyclical	Irregular	Cyclical	Irregular	Cyclical	Irregular	Cyclical	Irregular
2009	0.9933	1.1343	1.0732	1.0569	1.0237	1.0325	1.0137	1.0186
2010	0.987	1.0121	1.0218	0.9904	0.9956	0.9948	0.9939	1.001
2011	0.9089	0.9192	0.9786	0.9393	0.9844	0.9543	0.9868	0.9671
2012	0.8884	1.0044	0.9815	1.0233	1.012	1.0112	1.0219	0.9895
2013	0.9181	1.021	0.9513	1.0734	0.9755	1.1004	0.9814	1.1213
2014	1.1163	0.8283	0.9983	0.8297	0.9966	0.8326	0.9991	0.8333
2015	1.2979	1.1455	1.0541	1.0867	1.021	1.0643	1.0088	1.055
2016	1.2472	1.1886	1.0365	1.1467	1.0152	1.1295	1.0091	1.1193
2017	0.9961	0.7756	0.9548	0.8123	0.9747	0.8334	0.9886	0.843
2018	0.8145	0.9003	0.9327	0.9652	0.9624	1.0029	0.9686	1.0353
2019	0.8355	1.1224	1.0113	1.1098	1.0375	1.0697	1.0363	1.0323

From the table and figures, it was revealed that there was no particular trend was observed in major pulses *viz.*; Tur (Red gram), Moong (Green gram), udid (Black gram) and gram (Chick pea) in APMC, Barshi.

4.7 Average and estimated prices of major pulses in APMC, Barshi

The Average and estimated prices of major pulses in APMC, Barshi were estimated for eleven years from 2008 to 2019 and presented in Table 4.8.

Tur

There was slight deviation observed during the study period. Highest deviation of average price from the estimated prices was observed in the year 2016 and lowest deviation was observed in the year of 2010.

Moong

It was revealed from the table that highest deviation of average price from the estimated price was in the year 2014 and minimum deviation was in the year of 2010. The deviation between average price and estimated price has fluctuated in lower magnitude.

Table 4.8 Average and estimated prices of major pulses in APMC, Barshi (₹/q)

Year	Tur		Moong		Udid		Gram	
	Avg. Price	Y_{est}	Avg. Price	Y_{est}	Avg. Price	Y_{est}	Avg. Price	Y_{est}
2008	2735	3202	2444	3817	2267	2712	2242	2042
2009	3815	3386	3776	3962	3151	2968	2204	2280
2010	3566	3570	4160	4106	3457	3224	1971	2518
2011	3137	3754	3930	4250	2629	3479	2324	2756
2012	3515	3938	4686	4395	3112	3735	3675	2994
2013	3865	4123	5843	4539	3089	3991	3091	3232
2014	3982	4307	6513	4683	4575	4247	2601	3469
2015	6677	4491	5356	4828	7127	4503	3866	3707
2016	6931	4675	5391	4972	7716	4759	5963	3945
2017	3754	4860	4142	5116	4321	5015	5029	4183
2018	3699	5044	3865	5261	3196	5271	3404	4421
2019	4903	5228	5228	5405	4791	5527	3836	4658

Udid

The small deviation of average price from the estimated price was observed during the study period but there was more deviation observed in the year 2015 and 2016. The highest deviation of average price from the estimated price was observed in the year 2016 and least deviation was observed in the year 2010.

Gram

It was revealed from the table that highest deviation was observed in the year 2016 and lowest deviation was observed in the year 2008.There was slight fluctuation was observed between average and estimated price but more fluctuation was observed in year 2016 and 2017.

It could be concluded from the above discussion that, the average prices of selected pulses have moved closely with the estimated constant prices with some few exception wherein some peaks and fall have been observed.

4.8 Inter year variability in Arrivals of Major pulses in APMC, Barshi.

The inter year variability in arrivals of major pulses in APMC, Barshi were estimated for eleven years from 2008 to 2019 and presented in Table 4.9.

Tur

The information depicted in table revealed that variability of Tur was maximum in the year 2015 (199.64 %) and the minimum in the year 2011 (121.75). There is slight variability in the arrivals of Tur in APMC, Barshi. During the year 2008-2019 the coefficient of variation

ranges between the 199.64 to 121.75. So it can be cleared from that there was no wide variation between the arrivals of Tur in APMC, Barshi.

Moong

It was clear from the table that the variation in arrivals of moong has ranges between 132.51 and 245.08 per cent during 2015 and 2011, respectively.

Table 4.9 Inter year variability in Arrivals of major pulses in APMC, Barshi.

Year	Tur		Moong		Udid		Gram	
	Average(q)	CV (%)	Average(q)	CV (%)	Average(q)	CV (%)	Average(q)	CV (%)
2008	500.92	196.14	236.00	146.27	427.50	106.82	27.00	113.90
2009	513.50	124.49	238.00	167.71	594.33	107.08	16.33	32.64
2010	4030.33	195.58	831.75	162.93	921.00	86.41	17.75	87.97
2011	3815.33	121.75	1311.17	245.08	1232.42	87.89	67.08	259.35
2012	3644.17	149.80	1617.83	207.30	1042.00	69.49	158.33	211.44
2013	2099.75	155.89	385.08	159.99	1329.25	102.09	163.50	163.35
2014	4399.75	145.83	507.58	176.63	2739.58	61.90	129.25	152.36
2015	4479.67	199.64	190.00	132.51	2246.50	89.11	94.17	169.73
2016	2553.58	163.55	3646.67	226.76	1647.00	109.24	608.17	181.03
2017	10212.50	153.69	2690.75	140.30	2485.50	104.94	550.08	122.97
2018	1833.42	134.90	2667.83	166.25	1609.17	65.49	216.83	110.49
2019	1770.67	167.76	1653.17	154.61	1152.92	94.98	187.00	134.68

Udid

The information depicted in table revealed that variability of Udid was maximum in the year 2016 (109.24%) and the minimum in the year 2014 (61.90%).There is slight variability in the arrivals of Udid in APMC, Barshi. That means there was moderate variation in the arrivals.

Gram

From the above table it was clear that the variation ranged between 32.64 (2009) to 259.35 (2011). It means that there was wide fluctuation in arrivals of gram in market. As gram is a *rabi* crop, its production entirely depends on weather conditions which were drastic in the study area. Therefore, the arrivals of gram have been observed to be varying during the study period.

To sum up, there was moderate variation in arrivals of tur, moong and udid but higher in case of gram.

4.9 Inter year variability in prices of major pulses in APMC, Barshi.

The inter year variability in prices of major pulses in APMC, Barshi were estimated for eleven years from 2008 to 2019 and presented in table 4.10

Tur

The information depicted in table revealed that variability of price of tur was maximum in the year 2011 (25.71 %) and the minimum in the year 2019(4.54 %). There was no wide variation between the arrivals of Tur in APMC, Barshi Market, as it is the dominant pulse crop in Maharashtra and has continuous and higher demand throughout the year.

Udid

The information depicted in table revealed that price variability of Udid was maximum in the year 2016 (22.58%) and minimum in the year 2010 (2.63%). Similar to moong the variation in prices of udid were low. This may be due to steady demand and supply of the pulses in the market.

Table 4.10 Inter year variability in Prices of Major pulses in APMC, Barshi.

Year	Tur		Moong		Udid		Gram	
	Average(q)	CV (%)	Average(q)	CV (%)	Average(q)	CV (%)	Average(q)	CV (%)
2008	2735.00	8.91	2266.75	29.50	2241.67	12.31	2443.75	13.38
2009	3814.75	17.56	3150.92	28.88	2204.42	5.43	3775.92	14.66
2010	3566.25	14.83	3457.08	23.59	1970.67	2.63	4160.42	18.71
2011	3136.58	25.71	2628.92	16.97	2323.75	8.49	3930.08	12.96
2012	3514.50	9.35	3111.75	15.05	3675.42	14.82	4685.83	11.61
2013	3864.83	5.17	3089.25	17.86	3091.08	8.24	5842.67	11.76
2014	3982.25	9.75	4574.75	18.76	2600.83	5.63	6513.25	10.71
2015	6677.25	19.42	7127.25	25.63	3866.25	9.71	5355.67	17.17
2016	6930.75	18.95	7715.58	27.47	5962.75	22.58	5391.42	16.29
2017	3754.17	12.23	4320.83	19.75	5029.17	19.24	4141.67	7.17
2018	3698.50	10.67	3196.08	26.33	3403.50	10.03	3864.67	14.29
2019	4902.58	4.54	4790.75	22.76	3835.75	5.66	5228.00	13.63

Gram

It could be concluded from the above table that there the variation in gram prices ranges between 7.17 to 18.71 per cent in the year 2017 and 2010, respectively. It means that there was low fluctuation in prices of gram in market.

4.10 Intra year variability in arrivals of major pulses in APMC, Barshi

The Intra year variability in arrivals of major pulses in APMC, Barshi were estimated over twelve year from 2008 to 2019 and presented in table 4.11

Tur

In the APMC, Barshi the intra year variation in arrivals of tur have been ranged between 59.93 to 123.37 per cent in December and June, respectively. As the minimum variation was in December, which is the harvesting month for tur and steady arrivals were noticed in the market. The magnitude of variation have increased thereafter upto March, which might be due to prices of tur in the market.

Moong

The market arrival of moong revealed that variability remained high (above 100 per cent) except in the month of October and November during the entire study period. The information depicted in table revealed that the variability was maximum in the month of February (162.01 per cent) and minimum in the month of November (91.34 per cent). Thus, the arrivals of moong were steady during the post-harvest period and fluctuated thereafter.

Udid

In case of udid the variability remained below 100 per cent in all months except January, October and December. The maximum variability was observed in the month of October (132.72 per cent) and minimum variability is observed in the month of June (60.56 per cent). Interestingly, the arrivals of udid have been widely fluctuating during the harvesting season and settled in the months of sowing

Table 4.11 Intra year variability in Arrivals of major pulses in APMC, Barshi (2008-2019)

Months	Tur		Moong		Udid		Gram	
	Average(q)	CV (%)	Average(q)	CV (%)	Average(q)	CV (%)	Average(q)	CV (%)
January	16499.67	85.44	309.08	118.98	738.00	128.08	43.08	147.61
February	9299.08	104.78	218.83	162.01	2688.83	56.03	22.08	170.20
March	2348.17	105.67	30.00	151.78	3242.17	81.80	23.75	200.92
April	1620.67	75.65	39.50	106.63	2538.83	65.21	12.75	122.70
May	1164.08	75.80	49.33	146.87	1690.42	74.50	29.33	114.97
June	1036.00	123.37	233.42	162.16	1295.58	60.56	88.50	157.33
July	825.75	113.20	281.25	139.05	948.75	80.86	68.08	124.40
August	573.50	85.65	938.08	145.97	692.25	81.81	239.58	149.29
September	429.17	83.11	6151.83	131.36	548.58	86.90	826.58	134.30
October	320.67	80.22	5137.25	98.82	1111.58	132.72	563.42	91.25
November	475.42	104.34	1589.00	91.34	858.58	82.05	179.42	114.75
December	5261.42	59.93	998.25	148.63	1073.58	126.60	138.92	164.96

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Gram

The estimates of variation for gram showed that the variability ranged from 91.25 per cent to 200.92 per cent. The intra year variability was always greater than 100 per cent except in the month of October. The maximum variability was observed in the month of March (200.92 per cent) and minimum in the month of October (91.25 per cent). The arrivals of gram were widely fluctuating during the harvesting period but have been steady prior to the same. As the demand for gram is high and furthers rises during the festive season, might be responsible for the same.

To sum up, the variation in selected pulses like tur, moong, udid and gram has mostly been coincided with their harvesting period and fluctuated more or less accordingly. The variation in arrivals of gram were highest amongst the other selected pulses

4.11 Intra year variability in prices of major pulses in APMC, Barshi

The Intra year variability in Prices of major pulses in APMC, Barshi were estimated over twelve year from 2008 to 2019 and presented in Table 4.12.

Tur

The information depicted in table revealed that intra year variability in prices of tur in APMC, Barshi has fluctuated in very low magnitude. The variability for all the months was observed to be below 100 per cent. The maximum variability was observed in the month of June (38.33 per cent) and minimum in the month of March (31.11 per cent).

Moong

In case of moong, it showed minimum variability in prices in APMC, Barshi. The maximum variability was observed in the month of May (60.75 per cent) and minimum in the month of September (37.24 per cent).

Table 4.12 Intra year variability in Prices of major pulses in APMC, Barshi

Months	Tur		Moong		Udid		Gram	
	Average(q)	CV (%)	Average(q)	CV (%)	Average(q)	CV (%)	Average(q)	CV (%)
January	4246.42	35.45	3452.08	39.64	3182.50	40.05	4451.00	33.23
February	4183.58	31.55	3621.42	53.17	3253.08	31.01	4445.33	26.51
March	4068.67	31.11	3333.92	36.25	3187.67	26.52	4338.25	26.44
April	4262.50	35.50	3815.58	58.90	3289.58	37.95	4629.17	29.81
May	4239.58	36.47	4399.25	60.75	3518.17	41.16	4856.17	29.96
June	4139.08	38.33	4538.25	59.70	3324.25	41.17	4690.92	26.08
July	4250.92	34.06	3985.75	41.87	3437.92	41.19	4353.25	20.33
August	4514.17	28.29	4339.00	38.42	3489.83	38.06	4577.00	25.34
September	4136.33	35.88	4679.25	37.24	3381.08	37.53	4750.17	25.65
October	4020.42	37.23	4521.25	45.63	3433.50	48.65	4755.25	27.52
November	4024.33	36.43	4586.83	43.83	3415.08	45.81	4803.67	29.49
December	4491.42	37.54	4157.33	44.00	3292.58	40.59	4683.17	27.73

Udid

There was slight fluctuation in intra year variability of prices in APMC, Barshi. The variability was always below 100 per cent throughout the year. The maximum variability was observed in the month of October (48.65 per cent) and minimum in the month of February (31.01 per cent).

Gram

The information depicted in table revealed that intra year variability in prices of gram in APMC, Barshi has fluctuated with a very small magnitude. The variability in all the months of was below 100 per cent. The maximum variability was observed in the month of January (33.23 per cent) and minimum in the month of July (20.33percent). This may be due to constant demand for gram in the state.

4.12 Correlation Between arrivals and prices of major pulses in APMC, Barshi

To study the relationship between market arrivals and prices, the method of correlation was used. The correlation is the measure of degree of relationship amongst two series i.e. Arrival and Price.

Table 4.13 Correlation Between arrivals and prices of major pulses in APMC, Barshi

Sr. No	Crop	Correlation
1	Tur	0.04
2	Moong	0.24*
3	Udid	0.36
4	Gram	0.46***

Note: *, ** and *** Significant at 10, 5 and 1 per cent level, respectively

There was positive correlation in arrivals and prices of tur (0.04) and udid (0.36), but turned out to be non-significant. The reason may be continuous demand for particular commodity in the locality. Thus it indicates that along with increase in arrivals and prices have also been increased.

The correlation coefficient of moong (0.24) and gram (0.46) were positive and significant.It indicated that, there was high degree of positive correlation amongst the arrival and prices of these pulses and indicated that along with significant increase in commodity arrivals and prices have also been increased significantly during the entire period under study.

4.13 Price function of major pulses in APMC, Barshi

Analysis of prices, market arrivals and previous month price over time serves as an important item for formulating a sound agricultural policy, fluctuations in market arrivals largely contributes to the price instability of the produce. In order to derive appropriate ways and means for reducing price fluctuations of agricultural commodities, there is need to have thorough understanding of price over time and space. It has been noticed that when major portions of the produce reaches to the market during the peak season, the prices are generally low, which depresses the farmer's moral as well as income to a greater extent, proper planning in disposing off the produce by the farmer can considerably increase their income without incurring much additional cost.

To ascertain the response of prices to a given change in arrivals and previous months price of all major pulses in APMC, Barshi a simple linear regression equation was used as bellow,

$$\mathbf{Y_i = a + b_1X_1 + b_2X_2 + u_t}$$

Where,

Y_i = Prices of pigeonpea (₹/q)
X_1 = Market arrivals of pigeonpea (q)
X_2 = Previous months price of pigeonpea (₹/q)
a = Intercept
b_i's = Regression coefficients

The estimated response of prices to the change in arrivals and previous month price in major pulses is depicted in Table 5.4.

Table 4.14 Price function of major pulses in APMC, Barshi

Sr. No.	Crop	Price function	R^2
1	Tur	Y= 1939.32 - 0.2232 X_1 + 0.7390** X_2	0.32
2	Moong	Y = 1802.49 - 0.2830 X_1 +0.6396**X_2	0.39
3	Udid	Y = 1571.90 - 0.3008 X_1 + 0.7445** X_2	0.38
4	Gram	Y = 1232.53 + 0.2623 X_1 + 0.5406** X_2	0.42

* indicates significance level at 5 per cent level

The regression coefficient of arrivals was negative and non-significant for Tur (Red gram), Moong (Green gram), Udid (Black gram) in APMC, Barshi. It clearly indicated that as

arrivals in study area increases, the prices declined. But regression coefficient of arrivals of Gram (Chick pea) was positive and non-significant in APMC, Barshi. The lagged month prices of major pulses were positive and significant for all the pulses under study. It indicates that the lagged month prices had positive impact on current month's prices of major pulses. The positive magnitude of regression coefficients of lagged month prices reveled that, if the lagged month prices increased by one rupee per quintal, the current months price led to increase minimum by ₹ 0.73/q, ₹0.63/q, ₹ 0.74/q and ₹ 0.54/q for tur, moong, udid and gram, respectively.

4.14 ADF test values and best fitted ARIMA models for the major pulses in APMC, Barshi

The price of major pulses fluctuates over season due to the variations in production, market arrivals and storage. Thus modeling and forecasting the monthly price behavior over the years is of much practical importance. Forecasting involves making estimates of the future values using past and current information. Auto Regressive Integrated Moving Average (ARIMA) model, introduced by Box and Jenkins (1970), was frequently used for discovering the pattern and prediction of future values of the time series data. The forecasting models are often written in short hand as ARIMA (p, d, q) where, 'p' describes the 'AR' part,'d' describes the 'I' part and 'q' describes the 'MA' part. ARIMA model was used in this study, which required a sufficiently large data set and involved four steps. *Viz;* identification, estimation, diagnostic checking and forecasting. Model parameters were estimated using statistical packages for social sciences (SPSS) software and to fit the ARIMA models. In this section region wise forecasting of major pulses is discussed in details. Before analyzing any time series data, testing for stationarity is pre-requisite. The stationarity in time series data of all major pulses was tested by applying Augmented Dickey-Fuller (ADF) test. The ADF test is to test for the unit root in a time series. The results of the crop wise ADF tests are depicted in Table

Table 4.15 ADF test values and best fitted ARIMA models for the major pulses in APMC, Barshi

Sr. No.	Particulars	Tur	Moong	Udid	Gram
1	ADF values at level	0.5337	0.4916	0.5588	0.4726
2	ADF values at I^{st} difference	0.02371	0.01	0.01	0.03405
3	Best fit ARIMA model	(1,1,4)	(0,1,2)	(3,1,0)	(2,1,2)

The ADF values at level *i.e.* for original series were 0.5337, 0.4916, 0.5588 and 0.4726 for tur, moong, udid and gram, respectively. The values were more than the p value at 1% level *i.e.* 0.05, which means that the original series of selected pulses were not stationary and will not generate proper results for forecasting future prices. Therefore, difference for each of the series

were taken and the values obtained were 0.02371, 0.01, 0.01 and 0.03405 for tur, moong, udid and gram, respectively. Thus now all the series were stationary.

For forecasting the future prices of selected pulses in APMC, Barshi ARIMA model was used. For major pulses the was best fit ARIMA models were (1,1,4); (0,1,2); (3,1,0) and (2,1,2) for tur, moong, udid and gram, respectively. That means, 1, 0, 3 and 2nd order auto-regressive; stationary at 1st difference and moving average of 4, 2, 0 and 2 degree were used for tur, moong, udid and gram, respectively.

4.15 Forecasting future prices of major pulses in APMC, Barshi

The above stated ARIMA model the future prices for 24 months for tur, moong, udid and gram have been predicted and depicted in following Table 4.16, 4.17, 4.18 and 4.19, respectively. Also, these predicted prices have been tested against the actual values prevailed in the market for 10 months *i.e.* from January, 2020 to October, 2020.

Predicted and actual prices of Tur (Red gram)

From that table 4.16 it could be seen that the predicted value of Tur (Red gram) have ranged between ₹ 3710.98/q to ₹ 4576.97/q. These predicted prices have been tested with the actual prices of Tur from January, 2020 to October, 2020 and revealed difference of 1.71 to 11.78 per cent. That means the predictions with ARIMA were in acceptable range.

Table 4.16 Predicted and actual prices of Tur

Month	Predicted Price (₹ /q)	Actual Price (₹ /q)	Per cent difference
Jan, 20	4576.97	4500	1.71
Feb, 20	4389.79	4500	-2.45
Mar, 20	4176.14	4650	-10.19
Apr, 20	4009.16	4500	-10.91
May, 20	3897.40	4750	-17.95
Jun, 20	3823.40	4850	-21.17
Jul, 20	3775.23	5000	-24.5
Aug, 20	3744.73	3350	11.78
Sep, 20	3726.31	5000	-25.47
Oct, 20	3716.14	5000	-25.68
Nov, 20	3711.63		
Dec, 20	3710.98		

Predicted and actual prices of Moong (Green gram)

From that table 4.17 it could be seen that the predicted value of moong (Green gram) have ranged between ₹ 5862.47/q. to ₹ 6176.58/q. Then the predicted price was compare with

the actual price and by which difference obtained ranging from 2.87 to 21.96 per cent. That means the predictions with ARIMA were in acceptable range.

Table 4.17 Predicted and actual prices of Moong (Green gram)

Month	Predicted Price (₹ /q)	Actual Price (₹ /q)	Per cent difference
Jan, 20	5862.47	6300	-6.94
Feb, 20	5913.95	6700	-11.73
Mar, 20	5940.22	5100	16.47
Apr, 20	5966.48	5800	2.87
May, 20	5992.74	5550	7.98
Jun, 20	6019.00	6500	-7.4
Jul, 20	6045.27	6500	-7
Aug, 20	6071.53	5000	21.43
Sep, 20	6097.79	5000	21.96
Oct, 20	6124.05	6400	-4.31
Nov, 20	6150.31		
Dec, 20	6176.58		

Predicted and actual prices of Udid (Black gram)

From that table 4.18 it could be seen that percentage difference between actual price and predicted price was ranges between 1.1 to 25.83 percent. The predicted value of Udid (Black gram) have ranged between ₹ 5850.79/q. to ₹ 6500.11/q. Comparing the actual price to the predicted price it could be seen that ARIMA model was in the acceptable range.

Table 4.18 Predicted and actual prices of Udid

Month	Predicted Price (₹ /q)	Actual Price (₹ /q)	Per cent difference
Jan, 20	6139.06	5100	20.37
Feb, 20	5850.79	5200	12.52
Mar, 20	6237.53	5000	24.75
Apr, 20	6157.12	6000	2.62
May, 20	6286.01	6300	-0.22
Jun, 20	6212.79	6000	3.55
Jul, 20	6291.42	6500	-3.21
Aug, 20	6291.37	5000	25.83
Sep, 20	6354.77	5500	15.54
Oct, 20	6369.34	6300	1.1
Nov, 20	6472.01		
Dec, 20	6500.11		

Predicted and actual prices of Gram (Chick pea)

From that table 4.19 it could be seen that the predicted value of Gram (Chick pea) have ranged between ₹ 3660.2/q to ₹ 3741.75/q. These predicted prices have been tested with the actual prices of gram from January, 2020 to October, 2020 and revealed difference of 0.2 to 6.76. That means the predictions with ARIMA were in acceptable range.

Table 4.19 Predicted and actual prices of Gram (Chick pea)

Month	Predicted Price (₹ /q)	Actual Price (₹ /q)	Per cent difference
Jan, 20	3660.2	3750	-2.39
Feb, 20	3667.43	3650	0.48
Mar, 20	3629.95	3400	6.76
Apr, 20	3682.42	3700	-0.48
May, 20	3691.16	3600	2.53
Jun, 20	3670.7	3800	-3.4
Jul, 20	3707.52	3700	0.2
Aug, 20	3717.03	3700	0.46
Sep, 20	3707.48	4000	-7.31
Oct, 20	3734.41	4500	-17.01
Nov, 20	3744.3		
Dec, 20	3741.75		

On the basis of above tables of actual and predicted prices, the null hypotheses of constant predicted prices was rejected and alternative hypotheses **"There are deviations in predicted and actual prices of major pulses" was accepted.**

5. SUMMARY AND CONCLUSION

The price of agricultural commodities assumes great significance from producer's as well as consumer's point of view. It is said that prices are mirror of economy of the country. The regulated markets plays an important role for efficient marketing of agricultural produce in the country. The functioning of any institution is depends on the organizational structure and the powers allotted to them. The purpose of the present study is to examine the functioning of Agricultural Produce Market Committee, Barshi and behaviour of fluctuations in arrivals and prices of major pulses commodities *viz.,* Tur, Moong, Udid and Gram traded in APMC, Barshi.

The specific objectives of the study were

1. To study the organizational structure of APMC, Barshi
2. To study the trends in arrivals and prices of major pulses
3. To study the seasonal indices in arrival and prices of major pulses
4. To study the variability in arrival and prices of major pulses
5. To forecast the prices of major pulses

The present study was based on the data regarding arrivals and prices of major pulses in APMC, Barshi. The data pertain for a period of 11 years *i.e.* from 2008 to 2019. The secondary data pertaining prices and arrivals of Tur, Moong, Udid and Gram were collected information from selected Agriculture Produce Market Committee's (APMC), Barshi. For analyzing the data various simple statistical tools *viz*, averages, percentages, percentage change were employed. The compound growth rates of arrivals and prices of selected agricultural commodities was worked out by for assessing the trend in arrivals and prices of agricultural commodities. Seasonal indices were worked out using simple average method. To judge variability in arrivals and prices coefficient of variation in arrivals and prices were estimated.

The important findings of the present study are summarized below.

Organizational structure

The Board of directors constitutes the organizational structure of APMC, Barshi. This board of directors has an Executive Body that consists of the committees of elected members which is headed by the Chairman. The Chairman and the Vice-Chairman are the supervising authorities of market committee and are assisted by the heads of sub committees. Shri. Ranveer R. Raut is existing Chairman APMC, Barshi. Average term of office of APMC, Barshi was found to be five years which was not yet dissolved before its term.

The constitution of APMC, Barshi is as per the provision in Maharashtra Agricultural Produce Marketing (Regulation) Act, 1963 13(IA). As per the provision in the above act, the

Market committee should call the meeting one in a month and there will not be a gap of more than 60 days in two consecutive meetings.

Trends in arrivals and prices of major pulses

The average arrivals of Tur were maximum during January (16499.67 q) and started decline upto November (475.42 q) while, again increased in December (5261.42 q). On the contrary, the average prices of tur were consistently above ₹ 4000/-. In case of moong, the average arrivals were fluctuating during the months while average prices were constant. A significant movement in the average arrivals of udid and gram was observed in the table with considerably constant average prices for both crops.

It was revealed that, for all major pulses the arrivals have significantly increase over the years. The similar situation was observed for prices also, except for moong (green gram).The arrivals of moong and gram have been increased by 38.17 per cent annually, while for tur and udid have been increased by 17.34 and 21.30 per cent, respectively. In case of prices, 4.72, 7.32 and 8.90 per cent of significant increase was noticed for tur, udid and gram, respectively. While in case of moong the annual increase of 4.07 per cent has turned out to be non-significant.

It was revealed that maximum indices of Tur arrival were found in the month of September (182.58%) and minimum in the month of March (26.56%). Whereas, price indices were maximum the month of December (127.08%) and fluctuated with very negligible difference during the rests of the months.

It was concluded that maximum indices of moong arrival was found in the month of September (216.78) and minimum in the month of August (44.45). The highest indices of Moong price was in the month of December (108.34) and lowest in the month of February (92.30).

Seasonal Indices of arrivals and prices of major pulses in APMC, Barshi

The highest seasonal indices of Udid arrivals were observed during the month of September (183.97) followed by October (165.72) and lowest during the month of February (48.32). In case of prices, maximum price indices were noticed in the month of December (107.47) and it was minimum in the month of January (89.43).

The highest seasonal indices of gram arrivals were observed during the month of March (132.37) followed by February (130.92). In case of prices, maximum price indices were noticed in the month of December (107.49) and it was minimum in the month of January (91.63).

It was revealed that there was no trend observed in major pulses in APMC, Barshi.

Average and estimated prices of major pulses in APMC, Barshi

Highest deviation of average price from the estimated prices was observed in the year 2016 and lowest deviation was observed in the year of 2010 for tur.

It was revealed that highest deviation of average price of moong from the estimated price was in the year 2014 and minimum deviation was in the year of 2010.

The small deviation of average price from the estimated price was observed during the study period but there was more deviation observed in the year 2015 and 2016 in case of udid.

It was revealed that highest deviation was observed in the year 2016 and lowest in the year 2008 for gram.

Correlation Between arrivals and prices of major pulses in APMC, Barshi

There was positive correlation in arrivals and prices of tur (0.04) and udid (0.36), but turned out to be non-significant. The correlation coefficient of moong (0.24) and gram (0.46) were positive and significant. It indicated that, there was high degree of positive correlation amongst the arrival and prices of these pulses and indicated that along with significant increase in commodity arrivals and prices have also been increased significantly during the entire period under study.

Price function of major pulses in APMC, Barshi

The regression coefficient of arrivals was negative and non-significant for Tur (Red gram), Moong (Green gram), Udid (Black gram) in APMC, Barshi. But regression coefficient of arrivals of Gram (Chick pea) was positive and non-significant in APMC, Barshi. The lagged month prices of major pulses were positive and significant for all the pulses under study.

ADF test values and best fitted ARIMA models for the major pulses in APMC, Barshi

The ADF values at level i.e. for original series were 0.5337, 0.4916, 0.5588 and 0.4726 for tur, moong, udid and gram, respectively. The values were more than the p value at 1% level i.e. 0.05, which means that the original series of selected pulses were not stationary. Therefore, difference for each of the series were taken and the values obtained were 0.02371, 0.01, 0.01 and 0.03405 for tur, moong, udid and gram, respectively. Thus now all the series were stationary.

Forecasting future prices of major pulses in APMC, Barshi

For forecasting the future prices of selected pulses in APMC, Barshi ARIMA model was used. For major pulses the best fit ARIMA models were (1,1,4); (0,1,2); (3,1,0) and (2,1,2) for tur, moong, udid and gram, respectively.

The predicted value of tur have ranged between ₹ 3710.98/q to ₹ 4576.97/q. These predicted prices have been tested with the actual prices of tur from January, 2020 to October, 2020 and revealed difference of 1.71 to 11.78 per cent. That means the predictions with ARIMA were in acceptable range.

The predicted value of moong has ranged between ₹ 5862.47/q. to ₹ 6491.73/q. Then the predicted price was compare with the actual price and by which difference obtained ranging from 2.87 to 21.96 per cent. That means the predictions with ARIMA were in acceptable range.

The percentage difference between actual price and predicted price was ranges between 1.1 to 25.83 percent. The predicted value of udid has ranged between ₹ 5850.79/q. to ₹ 6820.15/q. Comparing the actual price to the predicted price it could be seen that ARIMA model was in the acceptable range.

The predicted value of gram has ranged between ₹ 3660.2/q to ₹ 3867.62/q. These predicted prices have been tested with the actual prices of gram from January, 2020 to October, 2020 and revealed difference of 0.2 to 6.76. That means the predictions with ARIMA were in acceptable range.

5.2 Conclusions

1. More variability was observed in the indices of arrivals of all major pulses particularly from the month of September to November.
2. There was slight fluctuation in cyclical trends of prices of Moong, Udid and Gram as compared to Tur. The irregular trends of prices of pulses had shown wide fluctuation in the inter-year analysis.
3. There was no variation observed in seasonal indices of prices but greater fluctuation in arrival was observed in all pulses in APMC, Barshi.
4. Seasonal indices for arrival observed more in the month from August to November for Tur, Moong and Udid but for gram crop it was observed more in the month of February to April and October.
5. The magnitude of intra-year and inter-year variability of prices of selected pulses were low as compared to variability in arrival in APMC, Barshi.
6. There was a small difference between the average and estimated prices of major pulses in APMC, Barshi.
7. The correlation between arrivals and prices of Tur and Udid were positive and non-significant while in case of Moong and Gram it was positive and significant.
8. The average Predicted price of Tur, Moong, Udid and gram for Jan-2020 were ₹ 3842.20/q, ₹ 6188.66/q, ₹ 6449.12/q and ₹ 3755.29/q respectively.
9. Month wise maximum difference in percentage of predicted price to the actual price was 25.83 % and minimum difference was 0.40 %.

5.3 Suggestions

The foregoing summery of the results enabled to draw the following specific conclusions

1. The chairman and secretary of APMC may be empowered for the effective control over the market functionaries. Necessary grading and storage facilities be provided to help producers to get higher prices.
2. Farmers may sale Tur, Moong and Udid during the months of January to July and Gram during May to September so as to get better prices.
3. Farmers should be motivated to store in warehouses and take the benefits of these receipts to avail loans to meet their current needs.

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