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A STUDY ON ARRIVALS AND PRICE BEHAVIOR & FORECASTING OF CHICKPEA IN KRISHI UPAJ MANDIS OF CHHATTISGARH PLAINS

O.P. Sonvanee[1]* and A.K. Koshta[2]

[1*]Department of Agriculture Economics, College of Agriculture, Raipur
[2]Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) 492012, India

Abstract

An attempt has been made in this study to examine the arrivals and price behavior & forecasting of chickpea in Krishi Upaj Mandis of Chhattisgarh plains. Krishi Upaj Mandi (KUM) Bhatapara, KUM Mungeli, KUM Rajnandgaon, KUM Kabirdham and KUM Bemetra were selected on the basis of maximum arrivals of chickpea. The seasonal variations in prices and arrivals of pulses and their seasonal indices was calculated by employing twelve months ratio to moving average method to achieve the behavior. ARIMA model was applied for forecasting of arrivals and prices of chickpea in selected Krishi Upaj Mandis of Chhattisgarh plains. This model also called Box-Jenkins model. The three peak arrivals of chickpea was observed, which was during the month of March (3594.18), April (6326.90) and May (2639.87). However, seasonal indices of prices of chickpea was three peak prices was noticed that is during the month August (97.04), September (186.07) and October (222.89). The finding of study was revealed that the inverse relation between arrivals and prices of chickpea has been observed. Forecasted arrivals of chickpea would be ranging from the minimum 1054.85 tonnes in October, 2018 to the maximum 5459.60 tonnes in March, 2021. Forecasted price of chickpea would be ranging from Rs./qtl 2859.08/- to Rs./qtl 3878.50/- for the months from October 2018 to April 2020. These informations were useful to strengthen their plan and policy makers arrivals to the conclusion on through forecasts of arrivals and prices in future months.

Key words: Chickpea, Seasonal Variations and forecasting of arrivals and prices of Chickpea.

Introduction

In Chhattisgarh, the total area under pulses was 8.14 lakh ha and production was 4.84 lakh metric tonnes, which rises 43 per cent in 2017-18 as compared to 2003-04. Five major pulse growing districts of Chhattisgarh are Mungeli, Bemetra, Kabirdham, Rajnandgaon and Bilaspur & have indentified in term of area and production first Bemetra and Mungeli respectively (Commissioner of Land Revenue, 2016-17). Healthy marketing system acts as an incentive for the farmers and various intermediaries to use the recourses prudently. Krishi upaj mandi is one, which aims at the elimination of the unhealthy and unscrupulous practices, reducing marketing charges and providing facilities to producers.

Krishi Upaj Mandis played a vital role in marketing of pulses in the state. The total arrival of agricultural produce to Krishi Upaj Mandis during 2016-17 was 9.41 million tones among them total arrival of pulses was 0.85 lakh tones (0.91 percent). Pulse arrivals was more in KUM, Bhatapara, KUM, Mungeli, KUM, Rajnandgaon, KUM, Kawardha and KUM, Bemetra then that of other Krishi Upaj Mandis of Chhattisgarh plains (CG Mandi Board, 2016-17). The pulses which are cultivated in these districts are gram, lathyrus, pigeonpea, blackgram, horsegram, lentil, green gram, pea and cowpea. Gram was found to be the major pulse grown by farmers so that this crop was considered for the study. The farmers are facing various problems during marketing of their produce; these are exploitation by traders, price fluctuation of produce, transportation & storage facility, transparency in pricing system, transaction taking place in market area, market organization and operation of marketing system *etc*.

Looking to above facts, a study has been undertaken with the following specific objectives.

Specific objectives of study

1. To examine pattern of arrivals and prices of chickpea in the selected krishi upaj mandi of Chhattisgarh plain.
2. To examine forecasting of arrivals and prices of

***Author for correspondence :** E-mail : omprakashsonvanee@gmail.com

chickpea in the selected krishi upaj mandi of Chhattisgarh plain.

Materials and Methods

Arrivals and Price Analysis

$Yt = T \times C \times S \times I$

Where,

Yt= Original value at time

T = Element of trend

C = Element of cyclical

S = Variation of Seasonal

I = Irregular fluctuation

Estimation of seasonal indices of monthly data

To measure the seasonal variations value in prices and arrivals, seasonal indices have been calculated employing twelve months ratio to moving average method. The seasonal indices were calculated by adopting the following steps

1. Firstly generate a series of twelve months moving totals
2. Generate a series of twelve months moving averages: A series of twelve months moving averages was generated by dividing twelve months moving totals by twelve.
3. Generate a series of centered twelve months moving averages. This step involves taking averages of pairs of two subsequent twelve months moving averages and entering between each pair. There are no corresponding moving averages for the first six and last six months.
4. Express each original value as a percentage of corresponding centered moving average. The percentage of moving average represents indices of seasonal and irregular components combined.
5. Arrange the percentages of moving averages in the form of monthly arrays.
6. Next, the average index for each month has been calculated.

Arrivals and Price Forecasting Analysis

ARIMA model was applied for forecasting of arrivals and prices of chickpea in selected Krishi Upaj Mandis of Chhattisgarh plains. This model also called Box-Jenkins model. This model includes autoregressive terms, moving average terms, and differencing operations. ARIMA model is an extrapolation method for forecasting and like any other such method, it requires only the historical time series data on the variables under forecasting. It is robust to handle any data pattern.

Forecasting of arrivals and prices of major pulses in Chhattisgarh plains in required four steps. In the first step includes the identification of model through coding under which p, d, q indicates non-seasonality and P, D, Q reform to seasonality. The steps II has estimated the parameters of model. When the step III made diagnostic checking with respect to reliability of model and in last steps IV made forecasting of arrivals and prices of major pulses, which is presented on follows:

Model Identification

A seasonal ARIMA $(p,d,q)\times(P,D,Q)_{12}$ model were identified by finding the initial values for the orders of non-seasonal parameters p and q and seasonal parameters P and Q with 12^{th} lag intervals. They were obtained by looking for significant spikes in autocorrelation and partial autocorrelation functions.

Estimation of parameters

At the identification stage one or more models are tentatively chosen that seem to provide statistically adequate representations of the available data. Then we attempt to obtain precise estimates of parameters of the model by least squares as advocated by Box and Jenkins. Standard computer packages like R program.

Diagnostic checking

In this step, model must be checked for adequacy by considering the properties of the residuals whether the residual from an ARIMA model must has the normal distribution and should be random. An overall check of model adequacy is provided by the Ljung-Box Q statistic. The test statistic Q is

$$Q_m = n(n+2)\sum_{k=1}^{m}\frac{rk^2(e)}{n-k}$$

Which follows a chi-square distribution with (m-r) degrees of freedom

Where,

$r_k(e)$ = the residual autocorrelation at lag k

n = the number of residuals

m = the number of time lags includes in the test.

r = p+q

If the p-value associated with the Q statistic is small (p-value <), the model is considered inadequate. The analyst should considered a new or modified model and continue the analysis until a satisfactory model has been determined.

After satisfying the adequacy of the fitted model, it

can be used for forecasting based on the model.

Evaluating forecast accuracy

The best model is obtained with following diagnostics based on Least Mean Absolute Percentage Error (MAPE), Mean Absolute Square Error (MASE) value and highest Root Mean Squared Error (RMSE) value.

Table 1: Seasonal indices of arrivals and prices of chick pea in selected KUM of Chhattisgarh plains (2003-04 to 2017-18)

Month	Arrival	Price	Month	Arrival	Price
Jan	-1121.35	-231.21	July	-1057.77	-1.29
Fab	-1793.48	-203.34	Aug	-1575.75	97.04
Mar	3594.18	-150.04	Sep	-1930.08	186.07
Apr	6326.90	-9.37	Oct	-2126.78	222.89
May	2639.87	100.99	Nov	-2063.76	79.71
Jun	679.46	-35.95	Dec	-1571.40	-55.49

Table 2: Identification of models by selected parameters of arrivals and prices of chickpea

Type	Model	RMSE	MASE	MAPE
Arrivals	(2,1,1) (0,1,0)	2161.24	0.78	70.24
Prices	(4,0,1) (2,0,1)	454.20	0.98	8.32

Table 3: Estimation of parameters of identified model for arrivals and price of chick pea in Chhattisgarh plains

Type	Model	Term	Coefficient	SE
Arrivals		AR1	0.74	0.07
	$(2,1,1)(0,1,0)_{12}$	AR2	-0.21	0.08
		MA1	-1.00	0.03
		AR1	1.40	0.14
		AR2	-0.35	0.16
		AR3	-0.33	0.12
		AR4	0.27	0.07
Prices	$(4,0,1)(2,0,1)_{12}$	MA1	-0.60	0.14
		Seasonal AR1	-0.13	0.25
		Seasonal AR2	-0.32	0.10
		Seasonal MA1	0.33	0.28

Scale-dependent errors

Mean absolute error: MAE = mean ($|e_i|$).

Root mean squared error: RMSE = $\sqrt{mean(e_i^2)}$

Where, $e_i = y_i - \hat{y}, y_i$ denote the ith observation and denote a forecast of y_i. When comparing forecast methods on a single data set, the MAE is popular as it is easy to understand and compute.

Percentage errors

The percentage error is given by $p_i = (e_i / y_{\downarrow} i) \times 100$. Percentage errors have the advantage of being scale-independent, and so are frequently used to compare forecast performance between different data sets. The most commonly used measure is:

Mean absolute percentage error: MAPE = mean ($|p_i|$).

Results and Discussion

Seasonal indices of arrivals and price of chickpea in the selected Krishi Upaj Mandi of Chhattisgarh plains

The patterns of variations in arrivals within a year as revealed by the seasonal indices were computed for each month. The final estimates were stabilized monthly seasonal indices *i.e;* shown in Table 1 and Fig. 1 & 2. It indicates that there were three peak arrivals was found in month of March (3594.18), April (6326.90) and May (2639.87) while the lowest arrivals were observed found in month of September (-1930.08), October (-2126.78) and November (-2063.76). However, seasonal indices of prices of chickpea. It indicates that there were three peak prices was found in month August (97.04),

Table 4: Predicated arrivals and prices of chick pea in selected Krishi Upaj Mandi of Chhattisgarh plains (2018-19 to 2020-21).

Month/Year	2018-2019		2019-20		2020-21	
	Arrival (tonnes)	Price(Rs/qtl)	Arrival (tonnes)	Price(Rs/qtl)	Arrival (tonnes)	Price(Rs/qtl)
April	3129.69	2976.68	3297.58	3453.48	3402.50	3878.50
May	3857.53	3002.27	3962.46	3575.85	4067.38	3840.22
June	3869.86	3063.58	3974.80	3682.23	4079.72	3793.58
July	3565.14	3051.17	3670.07	3660.08	3774.99	3788.42
August	3215.57	3459.96	3320.49	3437.92	3425.41	3675.28
September	1592.97	3060.45	1697.90	3431.94	1802.82	3792.36
October	1054.85	2859.08	1159.77	3603.00	1264.69	3822.15
November	1961.11	2871.66	2066.03	3666.87	2170.96	3797.71
December	1747.07	3248.91	1852.00	3690.85	1956.92	3661.80
January	1434.55	3744.16	1852.00	3763.34	1644.39	3481.72
February	2046.43	3679.96	1539.47	3731.21	2256.27	3495.21
March	5249.75	3729.21	2151.35	3811.78	5459.60	3457.38

September (186.07) and October (222.89) while the lowest prices indices were observed was found in month of January (-231.21), February (-203.34) and March (-150.04).

Seasonal movement on arrivals of chickpea indicates that season start from March and peak arrival was observed during the month of April and the lowest arrival was seen in the month of October. While the highest arrivals and lowest prices were seen in the month of October and January.

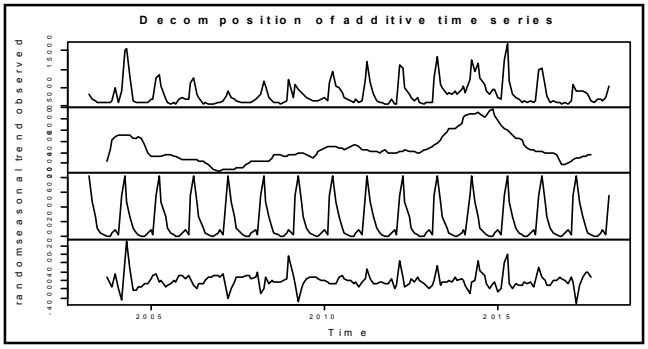

Fig. 1: Seasonal arrivals indices of chickpea in selected Krishi Upaj Mandi of Chhattisgarh plains

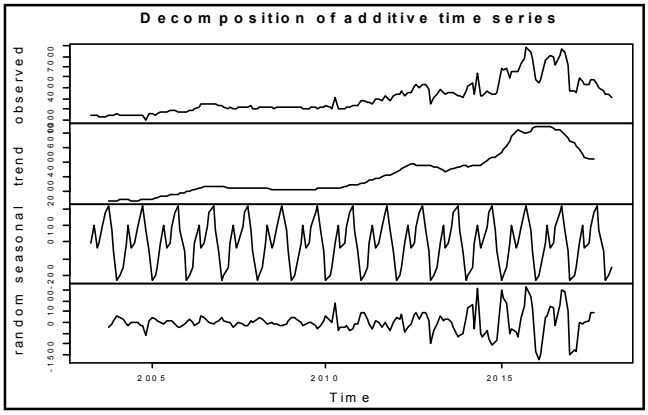

Fig. 2: Seasonal price indices of chickpea in selected Krishi Upaj Mandi of Chhattisgarh plains

Forecasting of arrivals and price of chickpea in the selected Krishi Upaj Mandi of Chhattisgarh plains

Forecasting of arrivals and prices of major pulses in Chhattisgarh plains in required four steps. In the first step includes the identification of model through coding under which p, d, q indicates non-seasonality and P, D, Q reform to seasonality. The steps II has estimated the parameters of model. When the step III made diagnostic checking with respect to reliability of model and in last steps IV made forecasting of arrivals and prices of major pulses, which is presented on follows:

Identification of the Model

ARIMA model was estimated after transforming the arrivals and price data of chickpea into stationary series. The Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) values are graphically presented in Fig. 3 and 4. Based on p, d, q values many models were tested. A seasonal ARIMA (p, d, q) × (P, D, Q)$_{12}$ model were identified by finding the initial values for the orders of non-seasonal parameters p and q and seasonal parameters P and Q with 12th lag intervals.

They were obtained by looking for significant spikes in autocorrelation and partial autocorrelation functions.

At the identification stage, one or more models were tentatively chosen which seem to provide statistically adequate representations of the available data. Finally, the ARIMA (2, 1, 1) (0, 1, 0)$_{12}$ and ARIMA (4, 0, 1) (2, 0, 1)$_{12}$ were selected as the most suitable models to forecasts of chickpea arrivals as well as prices based on Least Mean Absolute Percentage Error (MAPE), Mean

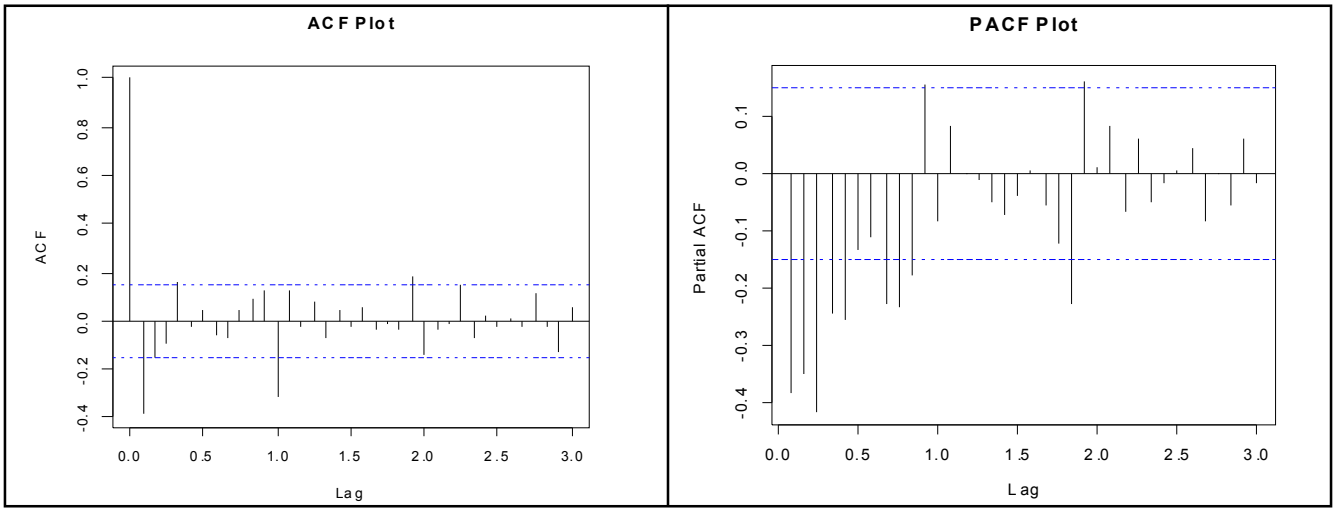

Fig. 3: Expressed Auto-Correlation Function (ACF) and Partial Auto-Correlation Function (PACF) plot of arrivals data of chickpea in selected Krishi Upaj Mandi of Chhattisgarh plains

Absolute Square Error (MASE) value and highest Root Mean Squared Error (RMSE) value that are presented in Table 2.

Estimation of parameters

The parameters of best fitted model of arrivals and prices were presented in Table 3. The non-seasonal specification of Autocorrelation (AR), differencing, and Moving Average (MA), and then the seasonal specification of seasonal AR, seasonal differencing, seasonal MA, and period or span for the seasonality.

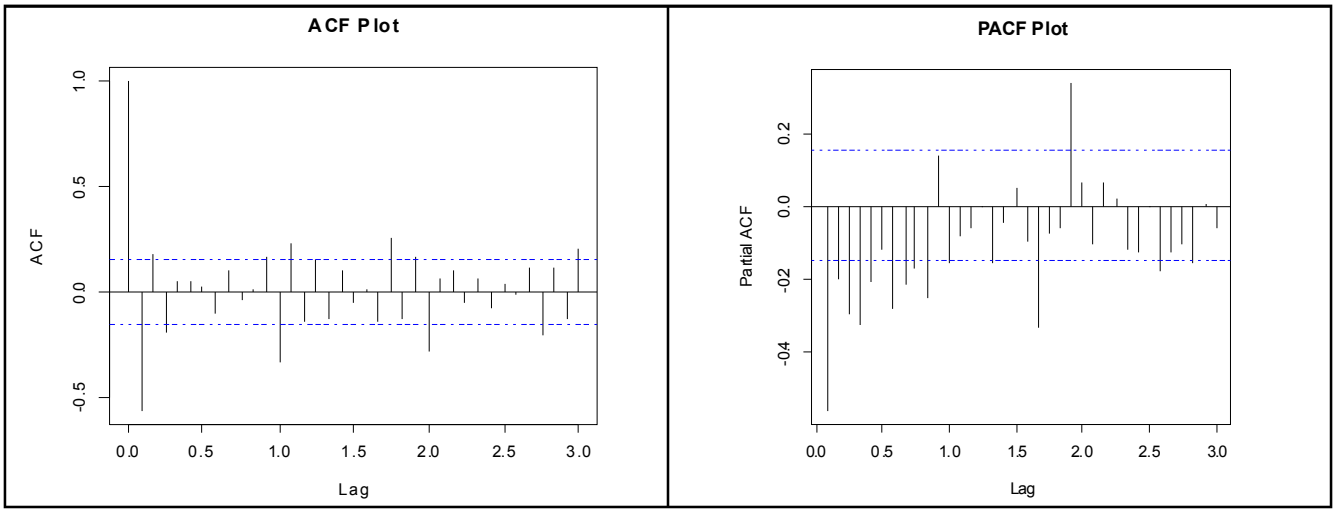

Fig. 4: Expressed Auto-Correlation Function (ACF) and Partial Auto-Correlation Function (PACF) plot of price data of chickpea in selected Krishi Upaj Mandi of Chhattisgarh plains

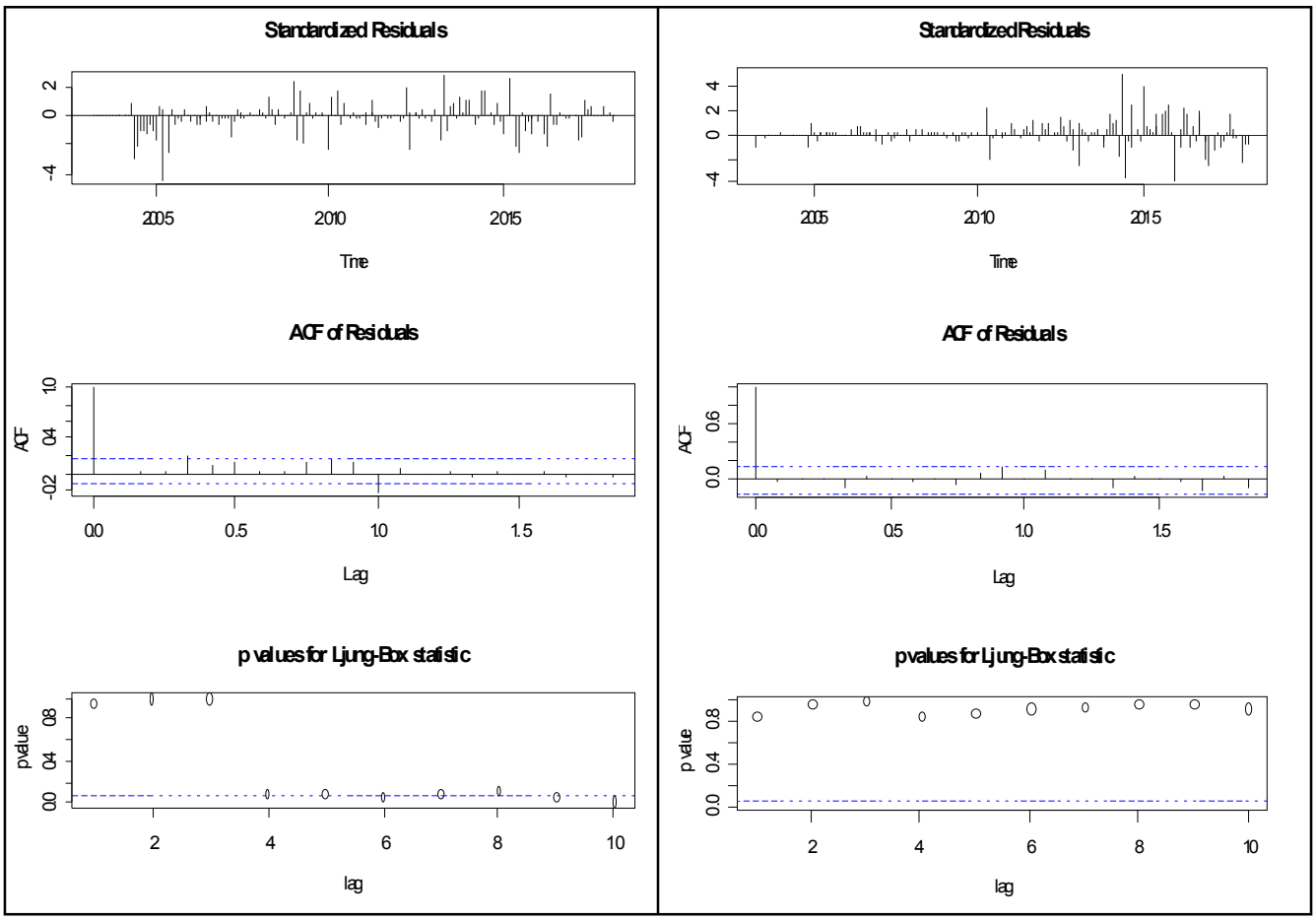

Fig. 5: Diagnostic checking for arrivals data

Fig. 6: Diagnostic checking for price data

Diagnostic Checking

The time series plot of the standardized residuals mostly indicates that there was no trend in the residuals, no outliers, and in general, no changing variance across the time (Fig. 5 and 6). The ACF of the residuals shows non significant autocorrelations that is a good result. The bottom plot gives p-values for the Ljung-Box-Pierce statistics for each lag up to 36 months. These statistics consider the accumulated residual autocorrelation from lag 1 up to and including the lag on the horizontal axis. The dashed blue line was at .05, largely p-values were above it. That was a good result. Diagnostic checking for arrivals and prices are graphically presented in the Fig. 5 and 6.

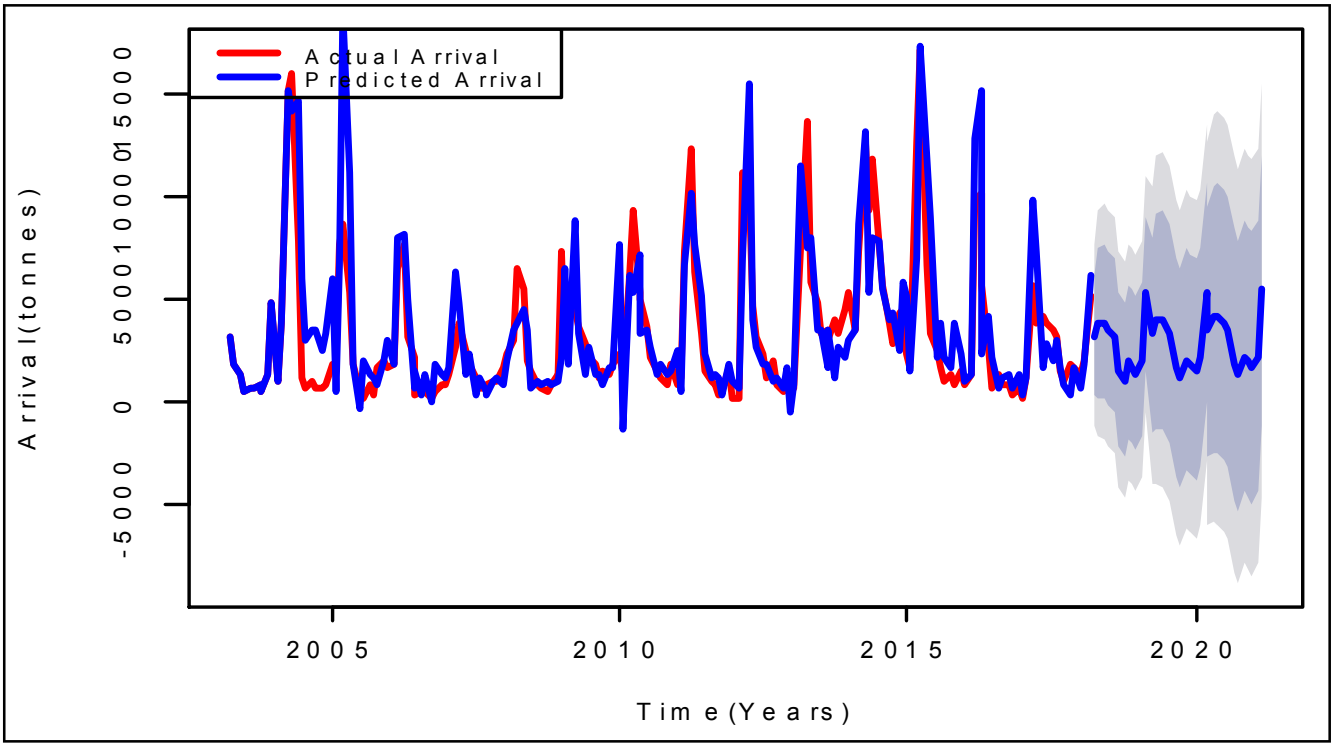

Fig. 7: Actual and predicted arrivals of chick pea in Chhattisgarh plains

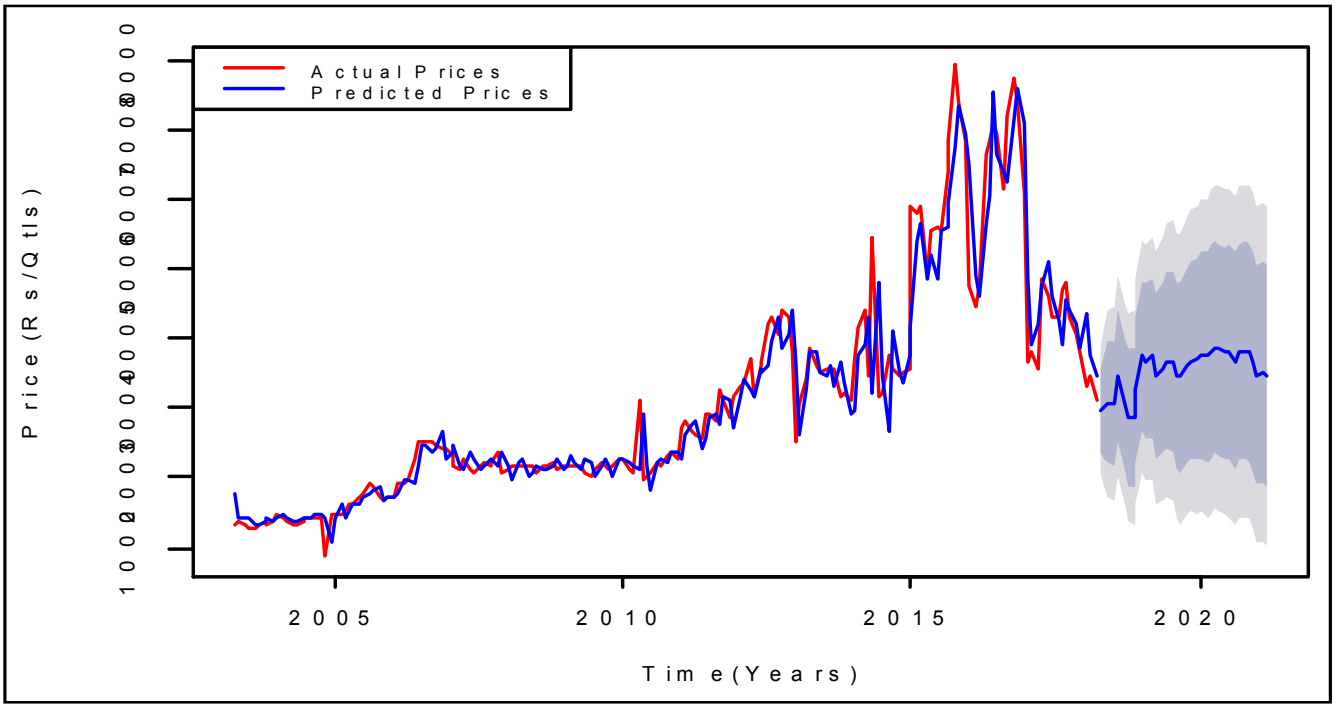

Fig. 8: Actual and predicted price of chick pea in Chhattisgarh plains

Forecasting

After identification of the model and its adequate checking then model used to forecast the arrivals and prices of chickpea in the coming periods. Hence, we used the identified ARIMA model to forecast the arrivals and prices of chickpea in the Chhattisgarh plains for the period of April 2018 to March 2021 and the results of forecasted arrivals and prices are presented in Table 4 and illustrated in Fig. 7 and 8.

As can be seen from the graph that the actual and forecasted arrivals and prices of chickpea in the selected market were more or less closer. The study was found that forecasts the arrivals of chickpea would be ranging from the minimum 1054.85 tonnes in October, 2018 to the maximum 5459.60 tonnes in March, 2021.

As can also be seen from the graph that the actual and forecasted prices of chick pea in the selected market were more or less closer. Forecasted price of chickpea would be ranging from Rs./qtl 2859.08/- to Rs./qtl 3878.50/- for the months from October 2018 to April 2020.

Conclusion

The study was reported that the maximum price is near to minimum arrivals month. It is noticed that the inversely relationship between price and arrivals of chickpea in selected market of Chhattisgarh plains The study reported that pattern of arrivals and prices were directly supported in decision making to the farmers and various intermediaries.

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