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A Study on Market Arrivals, Price Behavior and Forecasting of Paddy in Bangarpet APMC of Kolar District, Karnataka

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Abstract

This study has been undertaken in APMC, Bangarpet taluk which has highest market arrivals of paddy in Kolar District of Karnataka. The study focused on assessment of market arrivals, prices behavior and forecasting of paddy. The study is based on secondary data on market arrivals and prices of paddy collected from the Directorate of Economics and Statistics, Bengaluru and Krishimaratavahini as well as records maintained in APMC. The results of the study revealed that the extent of variability in arrivals of paddy in APMC yard of Bangarpet was shown highest during the month of December followed by May. Where as lowest arrivals were recorded during October. The prices of paddy in APMC yard were recorded highest in November and December, whereas the lowest prices were prevailed in April and May. The Box-Jenkins model is applied and it is concerned with fitting of a mixed Autoregressive Integrated Moving Average (ARIMA) to a given set of time series data. ARIMA models were used to study market fluctuations with advantage of this model lies in its ability to quantify random variations present in time series. Seasonal ARIMA were used to quantify the variation to predict the future arrivals and prices of paddy. Forecasting predicted that the increasing trend in arrivals and prices of paddy. There is no price change over the years although the variations in monthly market arrivals in the APMC, Bangarpet. Based on the findings of the study, it can be concluded that market intermediaries should adopt modern technology in rice value chain for more income. The farmers and rice millers skilled in processing and retailing can select for value addition and rice mills should concentrate on more investment in paddy processing units in Bangarpet to enhance availability, accessibility and selling branded packages of rice to neighboring towns and cities for realizing higher incomes in rice business.

Keywords : Market arrivals, Paddy, APMC, Price behaviour

In the wake of trade liberalization and globalization, the agriculture sector in India faces an uphill task of meeting global competition, reducing unemployment and enhancing income in the rural areas. This task has to be accomplished in a milieu of stagnant productivity across crops and other agricultural enterprises (Kumar *et al.,* 2005).

Inadequate market infrastructure, high marketing costs resulting in lower share of producer in the consumers rupee (Amera, 2002). The lack of market intelligence about the potential markets and the pattern of market arrivals and prices in important regional, national and international markets further add to the woes of the farmers (Fahimulla & Lokesha, 2022). Therefore, the need for proper marketing intelligence should be there in APMCs. The ongoing process of privatization and globalization has further compounded the difficulties of marketing high-value cash crops at reasonable prices (Prerona, 2022).

As per the KAPM (R&D) Act,1966, APMC's are established by Government of Karnataka.

The Department of Agricultural Marketing is supervising the activities of the Agricultural Produce Market Committees (APMC) in the State. There are 162 APMCs in the State which are implementing the provisions of the KAPM (R&D) Act, 1966 and Rules, 1968.

The main objective of the APMC is to ensure better marketing practices like correct weighment of produce of the farmers, competitive method of sale, rationalization of market charges and timely payment of sale proceeds to the farmers. Another objective is to provide basic infrastructure facilities for trade like construction of market yards/sub yards, auction platforms, roads, drainages, drinking water facilities, electricity, farmers rest houses, weigh bridges, administrative building, shops, godowns, canteen etc., in the market yards for the use of market functionaries and farmers. Every year Action Plans are prepared and developmental works are executed. Market Committee has got the power to levy and collect market fee as per the Act which will be used for development and other activities. In addition to this, financial assistance is also received from the Governments for developmental works.

ARIMA models are extensively used to study market fluctuations particularly of agricultural commodities. The main advantage of this class of models lies in its ability to quantify random variations present in many economic time series. Hence, the data on arrivals and prices of paddy in AMPC, Bangarpet were subjected to seasonal ARIMA analysis to quantify the variation and also to predict the future arrivals and prices of paddy. Thus, farmers from paddy producing belts will get an idea on deciding the crop and selling of produce to other places like non-paddy producing areas in time. Thus, it can be systematically forecasted with this model to helps the farmers for getting remunerative price and escape from the clutches of middlemen's and to avoid price fluctuation.

Price behavior is determined by the speed, magnitude and change in direction of the rate of variation in prices. From a statistical point of view, the greater the magnitude of its rate of change (up or down), the greater the speed of such change and the more changes there are in opposite directions, the more volatile the price will be (Onumah *et al*. 2022). The main functions of the prices in the economy are that, they act as allocators of resources, distributors of income and catalyst of capital formation. Instability in the prices of farm prices tends to cause inefficient allocation of resources and induce income fluctuations over time and across different categories of farmers. These result in distributional changes in cropping pattern in the economy. On the contrary, a stable price level would provide incentive to the producers to increase the production of required commodities thereby helping to achieve a balanced growth of the economy (Singh and Grover, 1993).

Regular price fluctuations *viz.,* 'day-to-day' or 'normal volatility' is both typical and requisite for competitive market functioning. The essence of the price system is that when a commodity becomes scarce its price rises, thus inducing a fall in consumption and signaling more investment in the production of that commodity (Sangeeta, 2004). However, the efficiency of the price system begins to break down when price movements become increasingly uncertain and precipitous and ultimately reaches the point of redundancy when prices undergo 'extreme volatility' or 'crisis'. With above explanation, volatility may seem a rather obvious concept, but a precise definition of Volatility is elusive and its measurement is prone to much subjectivity. In mainstream economic theory, however, volatility connotes two principle concepts: variability and uncertainty, the former describing overall movements while the latter referring to unpredictable movement (Kainth and Mehra, 1988). Against this backdrop, the present study was undertaken to gain insights into the behaviour of market arrivals and price pattern of paddy in APMC, Bangarpet, Kolar district.

METHODOLOGY

The study examines market arrivals and price pattern of paddy in Bangarpet. The period of reference is from 2002-03 to 2012-13, the sample area was purposely selected because the highest arrivals of paddy were reported in APMC Bangarpet among the APMC's in

Kolar district. Further, the area under paddy is continuously decreasing in Kolar district.

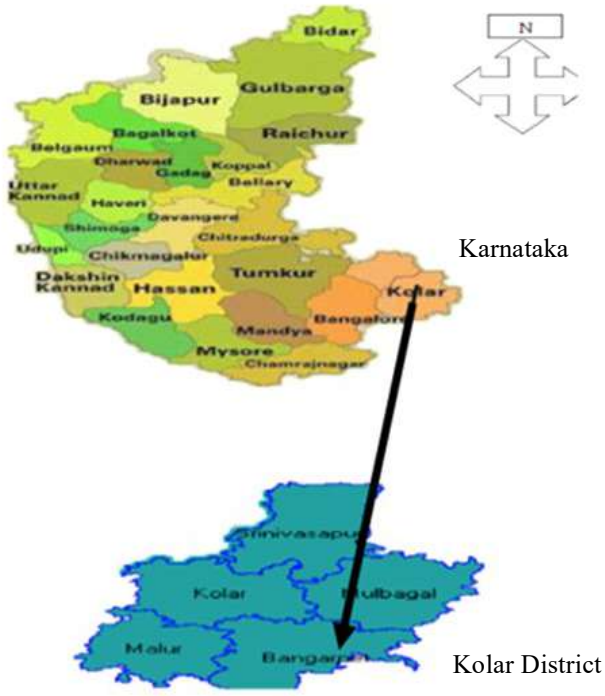

Fig. 1 : Map of Bangarpet APMC, Kolar district under study

Data on paddy arrivals and price is analysed for APMC, Bangarpet. The secondary data was collected from Directorate of Economics and Statistics and Daily prices reported at APMC are available from Krishimaratavahini, Directorate of Marketing and Inspection (DMI), Government of India (GoI) (http://agmarknet.gov.in) as well as records maintained by APMC. From this market-level price series, monthly averages of the daily modal price are calculated.

Seasonal Indices

Seasonal indices were used to detect the fluctuations and seasonality in paddy prices. Seasonal indices measure how much the average for a particular period tends to be above or below the expected value (Navadkar *et al.* 2002). Seasonal variation is a component of a time series, which is defined as the repetitive and predictable movement around the trend line in one year. To measured the seasonal variation in monthly arrivals and prices of paddy in APMC. Seasonal indices were calculated employing twelve-month ratio to moving average method. All the components comprising the time series were considered as multiplicative form (Mitrannovar and Gummagolmath, 1998).

The Seasonal Indices were Calculated by Adopting Following Steps :

1. Generate series of twelve months moving average.
2. Generate series of twelve months moving average: a series of twelve months moving average is generated by dividing twelve months moving average.
3. Generate a series of centered 12 months moving averages. This step involves taking averages of pairs of two subsequent 12 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 averages. The percentage of moving averages represents indices of seasonal and irregular components combined. The next step involves removing the irregular components.
5. Arrange the percentages of moving averages in the form of monthly arrays. Next, the average index for each monthly is calculated.
6. These averages are to be adjusted in such a way that their sum becomes 1200. This can be done by working out of correction factor and multiplied the average for each month by this correction factor. The correction factor (K) is worked out as follows:

$$K=1200/S$$

Where K is correction factor and S is sum of averages indices for months. Multiply K with the percentage of moving averages for each month to obtain the linear indices.

In this study, we used SARIMA (Seasonal ARIMA or Seasonal Autoregressive Integrated Moving Average) model to forecast monthly paddy arrivals

and price series by applying Box-Jenkins approach. SARIMA model is useful in situations when the time series data exhibit seasonality-periodic fluctuations that recur with about the same intensity each year.

The seasonal ARIMA model incorporates both non-seasonal and seasonal factors in a multiplicative model. One shorthand notation for the model is:

$$\text{ARIMA}\ (p, d, q) \times (P, D, Q)\ S$$

Where, p = non-seasonal AR order, d = non-seasonal differencing, q = non-seasonal MA order, P = seasonal AR order, D = seasonal differencing, Q = seasonal MA order and S = time span of repeating seasonal pattern (in a monthly data, s = 12).

The Box-Jenkins model is concerned with fitting of a mixed Autoregressive Integrated Moving Average (ARIMA) to a given set of time series data. The main objective in fitting ARIMA model is to explain the behaviour of paddy arrivals and prices in APMC yard, Bangarpet.

The Box-Jenkins (BJ) methodology consists of four iterative steps:

Step 1 : Identification

Step 2 : Estimation.

Step 3 : Diagnostic checking

Step 4 : Forecasting

Identification of the Model : The tentative models were first identified based on the Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) values for the different series Y_t for the selected market. The computed values of ACF and PACF for lags upto 24 for all the selected market were tested.

Estimation of Parameter

After identifying the model tentatively, the next step is the parameters of the best model are estimated using least square technique by an iterative process. Then residuals for the best model are obtained by back forecasting. Residual analysis is carried out to check adequacy of the model.

Diagnostic Checking

Residual analysis was carried out to check the adequacy of the models. The residual of ACF and PACF were obtained from the tentatively identified model. The adequacy of the model is judged based on the estimates of parameters.

Forecasting of Prices of Paddy in APMC Yard of Bangarpet

Identification of the Model

The tentative models were first identified based on the Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) values for the different series Y_t for the selected market. Then compute the values of ACF and PACF for lags upto 24 for the selected market.

Estimation of Parameter

After identifying the model tentatively, the next step is the parameters of the best model are estimated using least square technique by an iterative process and then residuals for the best model is obtained by back forecasting. Residual analysis is carried out to check adequacy of the model. ACF and PACF plots of residual series up to 24 lags.

Diagnostic Checking

Residual analysis was carried out to check the adequacy of the models. The residual of ACF and PACF were obtained from the tentatively identified model. The adequacy of the model is judged based on the values of estimates of parameters.

Results and Discussion

In order to study the arrivals pattern of paddy and its impact on price, seasonal indices were computed adopting 12 months moving averages. The extent of seasonal variations in arrivals and prices of paddy in APMC its clearly understood from the seasonal indices are presented in Table 1. It revealed that the major portion of the arrivals increased during the period of December and May shown in Fig. 1. This can be attribute to higher production of paddy from Tungabhadra command area and Cauvery

The Mysore Journal of Agricultural Sciences

TABLE 1

Seasonal indices of monthly arrivals and prices of paddy (2002-2012-13)

Months	Arrivals (Qtls)	Prices (Rs/Qtls)
Jan	107.82	102.45
Feb	89.54	100.46
Mar	69.79	99.78
Apr	91.49	96.81
May	139.78	98.76
Jun	114.30	99.45
July	103.45	98.14
Aug	77.53	97.68
Sept	74.96	97.94
Oct	54.94	102.09
Nov	102.69	103.48
Dec	173.65	102.91

command area and arrives to the APMC, Bangarpet due to higher demand at local level for business activities. The arrivals of the paddy noticed below average level during the period of March and October. The findings of the present study were similar to that of Singh and Grover, D. K., 1993.

The demand for paddy in the Bangarpet of Kolar district is increasing because of increase in population and shifting in the consumption pattern of consumers from other cereals foods towards rice, example there was a shift in the consumptions from Ragi to Rice. Thus, the cost of production and inflation are the reasons for increase in prices of paddy. The findings of the present study were similar to that of Shivaraya and Hugar, L. B., 2002 and from Fig. 2. Trend analysis of paddy prices increased during November,

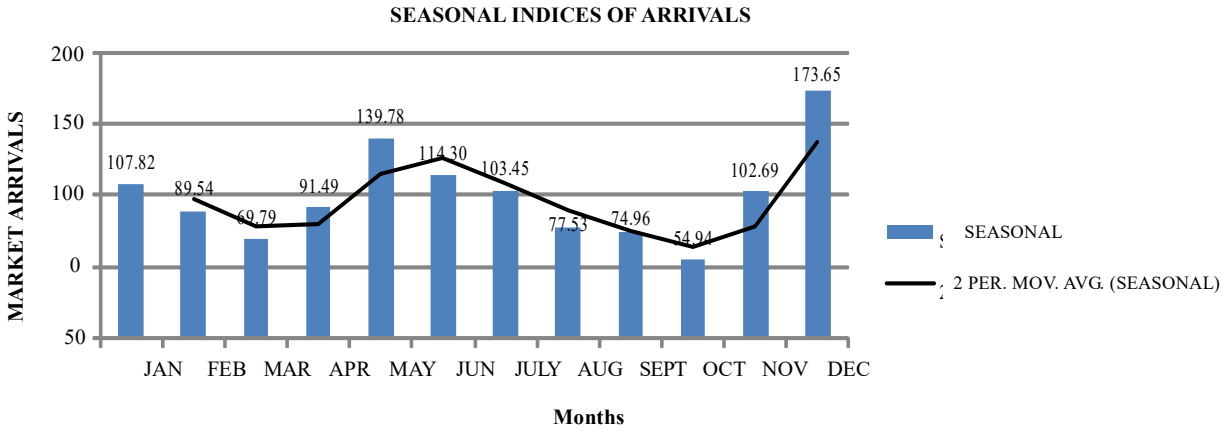

Fig. 1 : Trend analysis of paddy arrivals (Seasonal indicies)

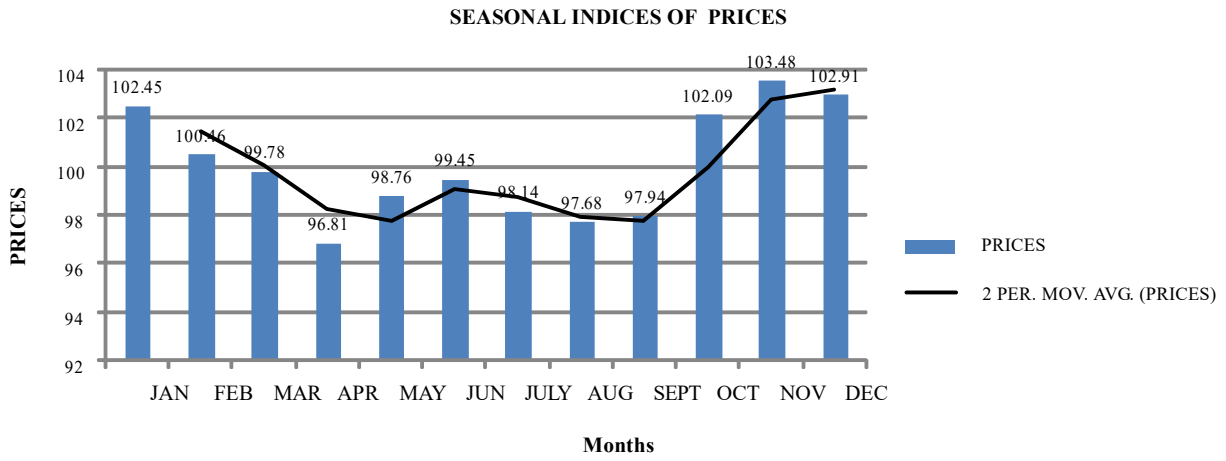

Fig. 2 : Trend analysis of paddy prices (Seasonal indicies)

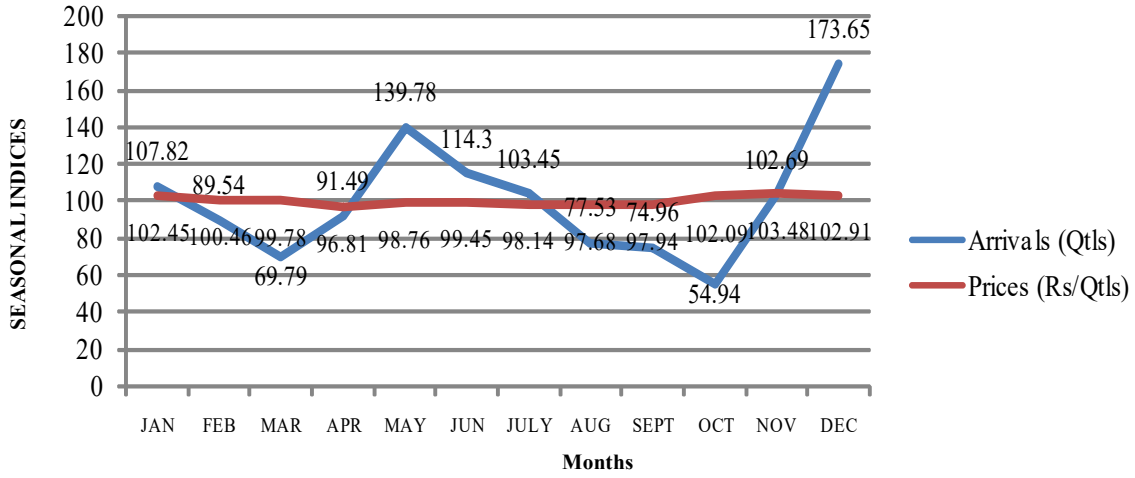

Fig. 3 : Trend pattern Plots of the Monthly Average arrivals and Price of Paddy at APMC

December & January and the main reasons of high prices during the month of November and December was due to the fact that paddy processing units will procure paddy in large quantities during the *kharif* arrivals in the market yards. Thus, the paddy processing units will purchase stocks enough for six months and are stored at warehouses. The reasons for low prices prevailing during the months of April may be due to less purchase by the rice millers after adjusting the previous successions purchased and existing stocks. The varration in market arrivals, there is no price change over the years and the same shown in Fig. 3.

Forecasting of Market Arrivals of Paddy in APMC

Identification of Model : An examination of ACF and PACF values revealed the presence of seasonality in the data. However, the series were found to be stationary, since the coefficient dropped to zero before the first or second lag. Each individual coefficient of ACF and PACF were tested for their significance using 't' test. From the Table 2, based on ACF and PACF plots, two models are identified *viz*., ARIMA (3,1,1) and ARIMA $(1,0,1)_{12}$. Further, the examination of Q Statistic and Akaike Information Coefficient, ARIMA (3,1,1) $(1,0,1)_{12}$ model has been identified as

TABLE 2

Tentative identified models for paddy arrivals in APMC Yard Bangarpet

Parameter	Estimate	Standard Error	t Value	ApproxPr> |t|	Lag
MU	47.50742	96.51156	0.49	0.6235	0
MA1,1	0.64330	0.26087	2.47	0.0152	1
MA2,1	0.66420	0.12884	5.16	<.0001	12
AR1,1	0.28079	0.28663	0.98	0.3294	1
AR2,1	-0.31248	0.11802	-2.65	0.0093	2
AR3,1	-0.22556	0.12186	-1.85	0.0668	3
AR4,1	-0.18328	0.15650	-1.17	0.2440	12

Constant Estimate 65.03223; Variance Estimate 86668254; Std Error Estimate 9309.579; AIC 2519.527; SBC 2538.981; Number of Residuals 119

The Mysore Journal of Agricultural Sciences

model which explain the behaviour of paddy arrivals in APMC Yard, Bangarpet.

Diagnostic Checking

Residual analysis was carried out to check the adequacy of the models. The residual of ACF and PACF were obtained from the tentatively identified model. The adequacy of the model is judged based on the estimates of parameters. Thus, these tests suggest model ARIMA (3,1,1) $(1,0,1)_{12}$ is adequate in capturing the behaviour of paddy arrivals in APMC, Bangarpet. The estimates of parameters, SE and t-statistic of the ARIMA (3,1,1) $(1,0,1)_{12}$ model is shown in Table 3 and Table 4.

The model is written with its significant parameters as,

$Y_{t} = C + (\theta+1)Y_{t-1} - \theta Y_{t-2}$

$Y_{t} = 47.5074 - 0.71921 Y_{t-1} - 0.28079 Y_{t-2}$

This model has the least value of AIC 2519.527 and SBC 2538.981, which is significant. It may be noted from the forecasted figures that paddy arrivals at initial period would be seen about 6148 quintals which later increase to 32823.67 at 156 months period.

Forecasting of Prices of Paddy in APMC

Identification of Model : An examination of ACF and PACF values revealed the presence of seasonality in the data. However, the series were found to be stationary, since the coefficient dropped to zero before the first or second lag. Each individual coefficient of ACF and PACF were tested for their significance using 't' test. Based on ACF AND PACF plots, two models are identified, *viz*., ARIMA (1,1,1) $(2,0,1)_{12}$. Further, the examination of Q Statistic and Akaike Information Coefficient, ARIMA (1,1,1) $(2,0,1)_{12}$ model has been identified as model which explain the behaviour of paddy prices in APMC yard of Bangarpet.

TABLE 3

Auto correlations for residuals of ARIMA (3,1,1) $(1,0,1)_{12}$ for paddy arrivals

Autocorrelation Check of Residuals									
To Lag	Chi-Square	DF	Pr>ChiSq	Auto correlations					
6	0.00	0	0.00	0.003	-0.018	0.032	-0.020	-0.057	0.107
12	9.50	6	0.1472	0.099	-0.077	-0.156	-0.072	0.106	-0.010
18	12.70	12	0.3909	-0.031	-0.029	-0.096	-0.055	-0.015	0.093
24	20.61	18	0.2997	0.145	-0.145	0.048	0.082	0.007	-0.053

TABLE 4

The estimates of parameters of the model (3,1,1) $(1,0,1)_{12}$ for paddy arrivals

Correlations of Parameter Estimates							
Parameter	MU	MA1,1	MA2,1	AR1,1	AR2,1	AR3,1	AR4,1
MU	1.000	0.160	0.196	0.155	0.082	0.027	0.075
MA1,1	0.160	1.000	-0.040	0.944	0.582	0.566	-0.055
MA2,1	0.196	-0.040	1.000	-0.023	-0.001	-0.087	0.711
AR1,1	0.155	0.944	-0.023	1.000	0.486	0.513	-0.068
AR2,1	0.082	0.582	-0.001	0.486	1.000	0.374	0.038
AR3,1	0.027	0.566	-0.087	0.513	0.374	1.000	0.026
AR4,1	0.075	-0.055	0.711	-0.068	0.038	0.026	1.000

Diagnostic Checking

From the Table 5 and Table 6, residual analysis was carried out to check the adequacy of the models. The residual of ACF and PACF were obtained from the tentatively identified model. The adequacy of the model is judged based on the values of estimates of parameters. Thus, these tests suggest model ARIMA $(1,1,1)\ (2,0,1)_{12}$ is adequate in capturing the behaviour of paddy prices in market yard of Bangarpet.

The estimates of parameters, SE and t-statistic of the ARIMA $(1,1,1)\ (2,0,1)_{12}$ model.

The model is written with its significant parameters as,

$$Y_t = C + (\theta + 1)Y_{t-1} - \theta Y_{t-2}$$

$$Y_t = 0.36741 + 1.87278\ Y_{t-1} - 0.87278\ Y_{t-2}$$

This model has the least value of AIC 1284.711 and SBC 1301.385, which is significant. It may be noted from the forecasted figures that paddy prices at initial period would be seen about Rs.546.00, which later increase to Rs.1810.442 at 56 months period.

From the Table 7, Paddy prices forecasting where both actual and predicted prices are coinciding. Price forecasting of paddy are represented in the Fig. 7 upto 156 months. It indicates that future prices are increasing beyond 133 to 156 months. Thus, it is projected that the paddy prices will increase in next two years.

TABLE 5

Tentatively identified models for paddy prices in APMC yard of Bangarpet

Conditional Least Squares Estimation					
Parameter	Estimate	Standard Error	t Value	ApproxPr> |t|	Lag
MU	0.36741	0.52834	0.70	0.4882	0
MA1,1	1.00000	0.04511	22.17	<.0001	1
MA2,1	0.86624	0.08994	9.63	<.0001	12
AR1,1	0.87278	0.07476	11.67	<.0001	1
AR2,1	0.09197	0.13375	0.69	0.4931	12
AR3,1	-0.08316	0.12588	-0.66	0.5102	24

Constant Estimate 0.045972; Variance Estimate 2721.409; Std Error Estimate 52.16712; AIC 1284.711; SBC 1301.385; Number of Residuals 119

TABLE 6

Auto correlations for residuals of ARIMA $(1,1,1)\ (2,0,1)_{12}$ for paddy prices

Auto correlation Check of Residuals									
To Lag	Chi-Square	DF	Pr>ChiSq	Auto correlations					
6	8.63	1	0.0033	-0.122	-0.001	-0.039	-0.008	0.221	-0.060
12	9.11	7	0.2449	0.035	0.016	0.013	0.032	-0.030	-0.011
18	11.06	13	0.6060	0.016	-0.024	-0.035	-0.016	-0.106	-0.016
24	14.06	19	0.7805	-0.013	-0.066	0.016	-0.101	0.071	-0.012

TABLE 7

The estimates of parameters of the model (1,1,1) (2,0,1) $_{12}$ for paddy prices

Correlations of Parameter Estimates						
Parameter	MU	MA1,1	MA2,1	AR1,1	AR2,1	AR3,1
MU	1.000	-0.953	-0.037	-0.671	-0.081	-0.069
MA1,1	-0.953	1.000	-0.028	0.731	0.055	0.055
MA2,1	-0.037	-0.028	1.000	0.010	0.681	0.591
AR1,1	-0.671	0.731	0.010	1.000	0.007	0.099
AR2,1	-0.081	0.055	0.681	0.007	1.000	0.351
AR3,1	-0.069	0.055	0.591	0.099	0.351	1.000

ARIMA model was employed to estimate suitable time series model. The output from the Table 8, tells us that the model that best fits our original data is ARIMA (3,1,1) and (1,1,1) for paddy arrivals and prices and the same percent was depicted in Fig. 4 and Fig. 5. ARIMA models are typically expressed like 'ARIMA (p,d,q)', with the three terms p, d and q defined as follows: p means the number of preceding ('lagged') Y values that have to be added / subtracted to Y in the model, so as to make better predictions based on local periods of growth / decline in our data. This captures the 'autoregressive' nature of ARIMA. Whereas d represents the number of times that the data have to be 'differenced' to produce a stationary signal (*i.e.*, a signal that has a constant mean over time). This captures the 'integrated' nature of ARIMA.

TABLE 8

Forecasted values of paddy monthly arrivals and prices (2015-16)

Months	Arrivals	Forecasts	Prices	Forecast
April	48374	41147.84	1206	1168.447
May	68393	56771.69	1222	1212.295
June	68534	67061.64	1228	1230.608
July	38308	55814.07	1294	1232.247
Aug	38308	32496.5	1294	1285.736
Sept	31649	46094.35	1342	1307.720
Oct	26667	39621.13	1375	1349.360
Nov	44954	39244.14	1443	1385.258
Dec	67794	67219.03	1488	1446.439
Jan	24266	52376.63	1462	1480.029
Feb	6312	27401.39	1480	1458.431
March	18688	17943.55	1457	1479.303

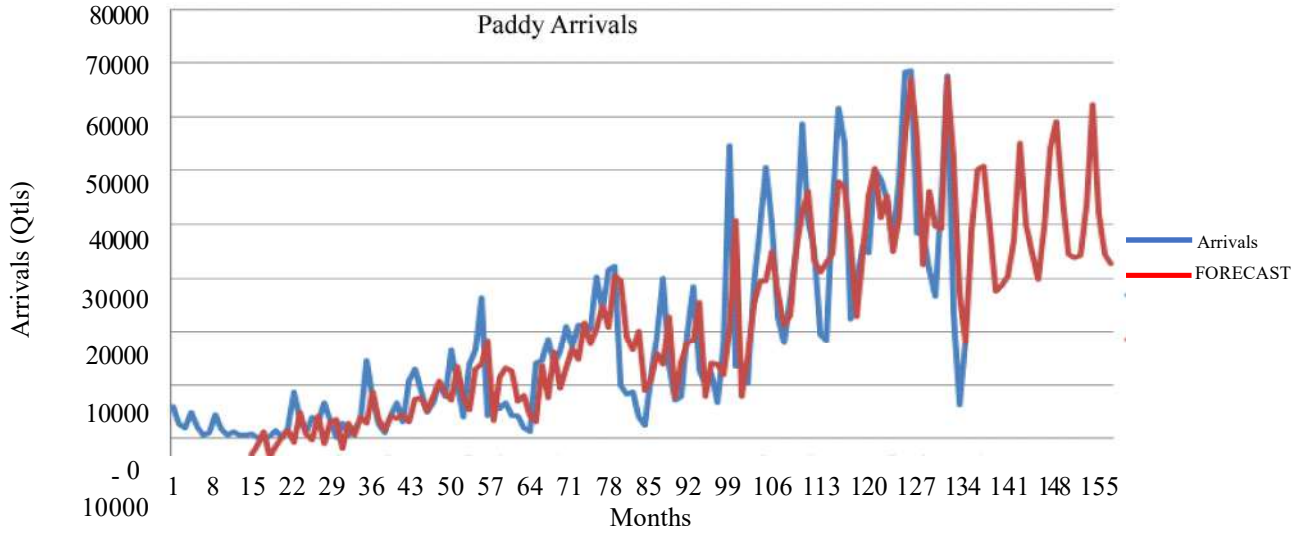

Fig. 4 : Paddy monthly arrivals forecast sine waves and runby using ARIMA (3,1,1) (1,0,1)$_{12}$

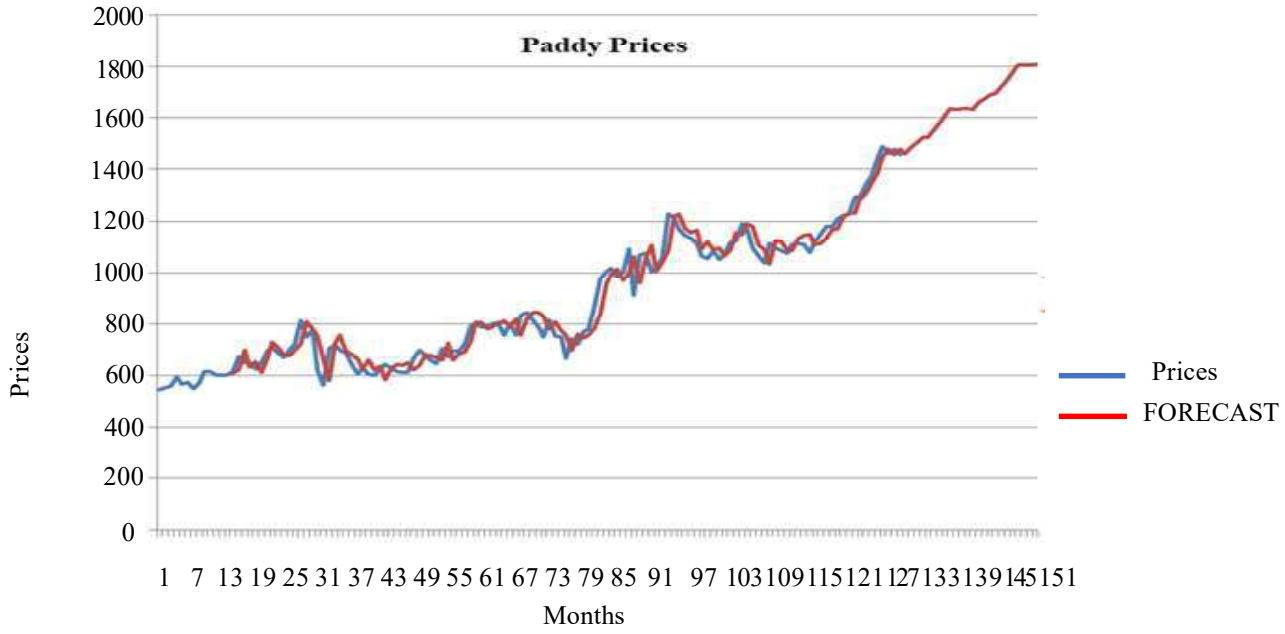

Fig. 5 : Paddy Monthly Prices Forecast sine waves and runby using ARIMA (1,1,1) $(2,0,1)_{12}$

If d = 0, this means that our data does not tend to go up/down in the long term (*i.e.*, the model is already 'stationary'). If p is 1, then it means that the data is going up / down linearly. If p is 2, then it means that the data is going up / down exponentially. Then q represents the number of preceding / lagged values for the error term that are added/subtracted to Y. This captures the 'moving average' part of ARIMA.

The ARIMA model has been followed by Madhusudan, R. and Manasa, 2010, Market dynamics and price forecasting of sunflower and pigeonpea in south Karnataka.

Best model fitted are as follows.

Paddy Arrivals APMC, Bangarpet : The output tells us that the model that best fits our original data is ARIMA (3,1,1)

- 3 tells us that we need to consider the Y value at 3 lags from a given time point t.
- 1 tells us that the time series is not stationary, so we need to take a first-order difference.
- 1 tells us that this model considers the error term from 1 preceding / lagged values.

Paddy Prices APMC, Bangarpet : The output tells us that the model that best fits our original data is ARIMA (1,1,1)

- 1 tells us that we need to consider the Y value at 1lags from a given time point t.
- 1 tells us that the time series is not stationary, so we need to take a first-order difference.
- 1 tells us that this model considers the error term from 1 preceding / lagged values.

Thus, the present study indicatesthat analysis of prices and market arrivals over a period is important for formulating a sound agricultural price policy. This study investigates the degree of fluctuations in the arrivals and prices of paddy but also a need in increase in the quantity of market arrivals. For that there is a need to have a perfect understanding and responsiveness of market arrivals to price movements over a period of time.The nature of supply and demand for paddy generally results in instability of prices. Navadkar, *et. al,* 2002, also reported the same findings in arrivals and prices of vegetables in Gultekadi regulated market.

On the other hand, stable price level of the paddy provides incentives to the producers and rice millers

to increase the production and processing of paddy and its byproducts. The study examined that the monthly arrivals of paddy in APMC yard were recorded highest during the month of December followed by May. Whereas lowest arrivals were observed during the month of October. The prices of paddy in APMC yard have shown highest prices during the months of November and December, whereas the lowest prices were prevailed during the months of April and May. The results of the study have confirmed that with the variations in market arrivals there is no price change over the years in the APMC. Lavleen, *et. al.,* 2005, has also reported the similar findings using econometrics analysis of tomato arrivals and prices in Punjab. Based on the findings of the study, it can be concluded that market functionaries should adopt modern technology in rice value chain for more income, Bharathi *et. al.,* 2022, are also reported the same in production and marketing of tamarind in Kolar district. The farmers and rice millers skilled in processing and retailing can select ideas on startups in value addition, and rice mills should concentrate more on investments in upgrading with modern technologies and facilities in paddy processing units in Bangarpet to enhance availability, accessibility and selling branded packages of rice to realize higher income in the rice business.

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