Forecasting the price of natural rubber in International rubber markets

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Abstract- *Natural rubber in international market has slower growth in demand and huge increase in supply. This leads to an imbalance in demand and supply which also has led to the decline of natural rubber price in international markets. Therefore, it has become essential to study the natural rubber price in international markets. Forecasts of natural rubber prices are useful to the farmers, policymakers and industries for planning strategy, and making decisions. To attain this objective, in this study, Auto Regressive Integrated Moving Average (ARIMA) is adopted for the forecasting the monthly price of Natural Rubber Viz. Bangkok and Kuala Lumpur. For testing stationarity, Autocorrelation function (ACF), Partial Autocorrelation function (PACF), Ljung-Box (LB) Statistic and Augmented Dickey Fuller Test (ADF) are used. For determining the best fitted model, we have employed AIC value. The residual of the fitted model is tested for Heteroscedasticity using Durbin Watson Test.*

Keywords-*AIC, ARIMA, Forecasting, Stationarity*

I. INTRODUCTION

Natural rubber is an imperative plantation commodity utilized globally in the production of a wide scope of items. Its output from the rubber tree (Hevea brasillensis) assumes a significant role in the socio-economic sphere of various developing countries. More than 20 million families belong to small holdings with two or fewer hectares are reliant to rubber plantations for their livelihood in the international rubber market. [3] The global natural rubber market is initially focused on China, India, USA, Japan and Thailand which were the main five countries that consume natural rubber in 2016 [7]. China has been ranked first in the consumption of natural rubber which consumed 4863 thousand tonnes in 2016, with a 3.9% rise from the earlier year, making up 38.63% of the international entire consumption [7]. China produced only 774 thousand tonnes of natural rubber in 2016 and the rate of percentage of growth was decreased by -2.5 percent from the preceding year [7] Due to this decreased growth, China was forced to import a large quantity of natural rubber from Indonesia, Malaysia and Thailand to fill the demand-supply gap with import reaching 4560 thousand tonnes in 2016 or 40.77% of the whole import of natural rubber in 2016 [7]. Similar to agricultural products, natural rubber was exposed to significant volatility in price. The instability of the natural rubber prices was a major risk to farmers, traders and industrialists who involved in the production and marketing of natural rubber. In circumstances to significant uncertainty, price forecasts were crucial to facilitate decision-making. Exact price forecasts were very important to have an effective assessment in between making decisions and the real production of the goods in the market [5].

Various researches are made to forecast the prices of various agriculture commodities by agricultural economists. Though, there are only few studies which concentrated on forecasting the prices of natural rubber. Mad Nasir Shamsudin and Fatimahmohd [5] employed ARIMA model for forecasting the short term prices of the natural rubber. Burger et al.[4] utilised a vector error correction (VEC) model in their research to study the relationship between the price of natural rubber and exchange rate during the Asian financial crisis in 1997. Romprasert [6] used various forecasting models, which consist of

regression analysis, exponential smoothing, Holt's linear exponential, and Box-Jenkins, to examine the futures price of the Thailand natural rubber ribbed smoked (RSS3). Khin [2] employed an autoregressive integrated moving average (ARIMA) and multivariate autoregressive moving average (MARMA) models to forecast the prices of SMR20 over the period January 1990 to December 2008. Khin and Thambiah [1] conducted a study to forecast the NR price employing simultaneous supply-demand and price model equation and the VECM model.

II. MATERIALS AND METHODS

The price of international natural rubber is forecasted based on secondary data. The time series data published by The Rubber Board, Ministry of Commerce and Industry, Government of India has been used for the study.

Based on the related literatures, Auto Regressive Integrated Moving Average (ARIMA) is one among the models employed for forecasting a time series analysis. In this process, time series variable is assumed as linear function of past values and random shocks. Generally this model is distinguished by ARIMA (p,d,q), where p,d,q specify the orders of Auto Regression (AR), Integration (I) and Moving Average (MA).

An ARMA (p, q) method is defined by equation

$$y_t = \mu + \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_p y_{t-p} + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - ..... - \theta_q \varepsilon_{t-q} \quad (1)$$

Where μ represents the drift, and ϵ_t represents the error term. Before construction of ARIMA model, checking and converting the data into stationary is the important process. For making out the stationary data, simple method is plot the data through visualization in order to identify the stationarity. Another statistical procedure is correlogram which consists of Autocorrelation, Partial Autocorrelation and LB-stat is used. For the stationarity check, Dickey Fuller Test is also used.

The best fitted ARIMA model is chosen using the smallest Akaike Information Criterion (AIC) or Schwarz Bayesian Criterion (SBC) value (Makridakis et al. 2003). The performance measure used to validate models is R^2, Adj R^2, RMSE, MAE, and MAPE.

III. RESULTS AND DISCUSSION

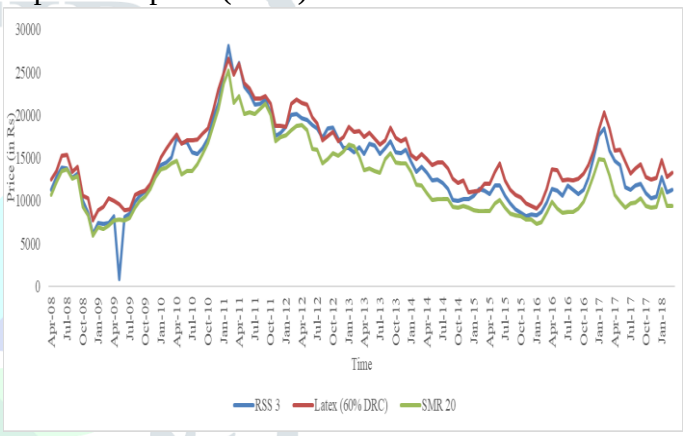
The most familiar methods are employed for checking the stationarity, they are ACF, PACF and LB stat. ACF and PACF are computed for 36 lags. Through LB –stat, the significance are tested. The disparity of LB-Stat value for zero difference and first difference is listed in the Table.I.

Table I. Comparison of LB-stat values

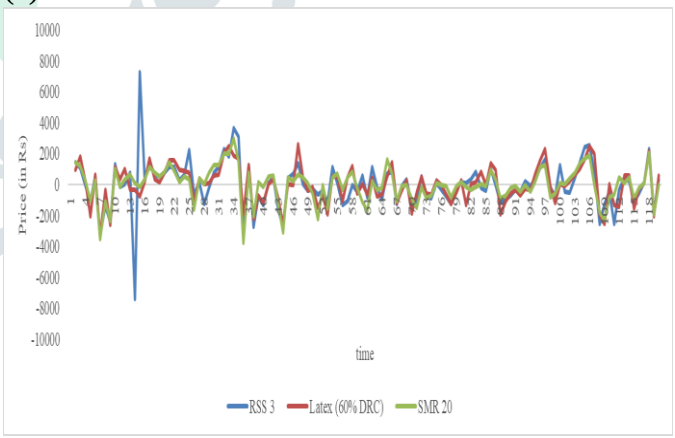
Segments	Zero Difference	First Difference
SMR 20	1018.8	**45.382**
Latex (60% DRC)	963.3	**38.42**
RSS 3	914.02	**24.99**

The stationary data is bold faced

Figure1. shows graphical representation of zero difference and First difference data. The x-axis specifies the time (in monthly) and y-axis depicts the price (in Rs).



(a) Zero difference



(b) First Difference

Figure.1: Graphical Representation of Price of Zero Difference and First Difference

This graphical representation clearly shows the zero difference data the variance is not constant (i.e., the fluctuation of data is not in constant form) but in the first difference data the variance of the data is constant.

Another trendy method for finding stationary is Unit root test (i.e. Augmented Dickey Fuller Test). The comparison of τ-values

for zero difference and first difference is listed in the table.II.

Table.II. Comparison of Unit Root Test

	Zero Difference		First Difference	
	t-Statistic	Prob	t-Statistic	Prob
SMR 20	-1.59	0.4862	**-6.16**	**0**
Latex(60%drc)	-2.61	0.097	**-7.72**	**0**
RSS 3	-1.76	0.3999	**-6.57**	**0**

For 1% level the table value is -2.60, 5% level the value is -1.95 and 10% level the value is -1.61. Here the calculated values are greater than the table value for the first differenced data. This shows that the acceptance of alternate hypothesis all the data are stationary in the First Difference. The first difference the τ-values values are significant compare to zero difference. This shows that the first difference became stationary.

Based on the AIC value the best fitted model is chosen for the forecasting process. For SMR 20 the best fitted model is chosen as ARIMA (3,1,3). For Latex 60% DRC the ARIMA (3,1,4) is selected as best fitted model. Similarly, for the RSS 3 the ARIMA (4,1,3) is selected as best fitted model.

Table.III. Comparison of Performance Measure

	AIC	(p,d,q)	R^2	Adj R^2	SC	HQC	RMSE	MAE	MAPE
SMR 20	16.82028	(3,1,3)	0.938085	0.934590	16.99499	16.89127	916.18	683.22	4.12
Latex (60% DRC)	16.91388	(3,1,4)	0.929649	0.925073	17.11043	16.99375	1042.29	1005.051	5.11
RSS 3	17.48037	(4,1,3)	0.901793	0.895405	17.67693	17.56024	706.152	617.83	3.24

Table.III is the comparison of the performance measure such as R^2, Adj R^2, AIC, SC, HQC, RMSE, MAE and MAPE. The R^2 values for the best fitted model are higher.

Based on the best suited ARIMA model the forecasting of price is carried out during April 2018 to March 2019. Comparison table is shown in Table.IV. This helps the farmers and industrialists for the decision making process.

Table.IV. Comparison of forecasting value for price and SD

Month	RSS 3		Latex (60% DRC)		SMR 20	
	Price	SD	Price	SD	Price	SD
Apr-2018	11130	978	12763	1002	15105	1011
May-2018	14429	1027	13622	1253	14142	562
Jun-2018	14092	827	15748	313	15834	613
Jul-2018	13825	951	15112	642	15224	1501
Aug-2018	14466	998	15838	482	15197	1124
Sep-2018	13745	1098	15858	472	14142	1101
Oct-2018	14254	1043	14508	401	15162	1006
Nov-2018	14199	840	15500	447	15271	847
Dec-2018	13839	1260	16399	559	15253	718
Jan-2019	14562	1140	14925	674	15290	634
Feb-2019	13960	646	14944	824	15308	822
Mar-2019	14386	808	16507	825	15326	910

CONCLUSION

Forecasting the price of International Natural Rubber is crucial for the industrialist for decision making process and farmers for investment in farming process. In this study, the ARIMA (p,d,q) is used for the forecasting the price of International natural rubber. For employing ARIMA model the initial process is to check whether the data is stationary or not. For this testing procedure the Auto correlation, Partial Auto correlation, LB-stat and unit root test is employed. Three types of natural rubber

are considered for this research. First is RSS 3, second is Latex (60% DRC) and third one is SMR 20. For all the three segments first differenced data became stationary. By using this first difference data the ARIMA model is constructed. The best model is chosen based on the performance measure. The best fitted ARIMA models for RSS 3, Latex 60% DRC and SMR 20 are ARIMA(4,1,3), ARIMA(3,1,4), and ARIMA(3,1,3). After making out the most suitable model, the forecasting process is conducted for the period of April 2018 to March 2019.

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