SJCC Management Research Review
Print ISSN-2249-4359
Vol - 9(1) June. 2019. Page No. 1-13

INTERNATIONAL DETERMINANTS ON INDIAN RUBBER PRICES

Dr. A. N. Vijayakumar*

Abstract

India is one of the natural rubber producing countries in the world. Prices of natural rubber depends upon many important factors including import policy, crude oil prices, rubber production, demand, vehicle sales, international rubber production and prices etc., In the era of globalisation, Indian market of natural rubber has been integrated with international markets resulting any changes in the international factors would have simultaneous impact on rubber prices. In the recent past, the price of natural rubber in India has fallen from all time high to lowest within a short period of time. In this regard, this paper focusing on global determinants such as prices of crude oil, USD/INR, rubber prices of Thailand and Malaysia evaluated their influence on Indian rubber prices. This study finds the significant influence of crude oil, USD INR and Rubber prices of Thailand than other factors on India rubber prices.

Keyword: Rubber prices, Exchange rates, crude oil, Plantation

Acknowledgement: This paper has been prepared as a part of major research project entitled – "Rubber price uncertainty and Risk management Strategies for Small Farm holders" Sponsored by ICSSR, New Delhi. Author thankfully acknowledge financial grants received from ICSSR, New Delhi

Introduction

Indian plantation sector played an important role in the socio- economic development of the country. The sector provides significant number of employment opportunities and livelihood to small and marginal farmers in rural areas. It has also helped to open up underdeveloped areas through social capital contributing for the economic growth by reducing regional imbalance. Plantation crops are export oriented and contributing for building foreign exchange reserves with rising economic integration among the different countries of the world.

**Associate Professor, Finance and Control, Indian Institute of Plantation Management, Jnana Bharathi Campus, Bengaluru 560056E-mail :v.kumariipmb@gmail.com*

Rubber is one of the important commodity in the Indian plantation sector, largely cultivated in the states of Kerala, Tamil Nadu, Karnataka, Goa and Tripura. Kerala is the largest rubber producing state contributing around 90% to India's total production. The sector consists of small farm holders, medium and corporate participants as rubber producers and processors. The small farm holders contributes to the extent of 88% to countries total production. The average productivity of small farm holders (1580kg/ hectare) is comparatively higher than corporate sector (1509 kg/hectare). India produced 774000 tonnes of Natural Rubber during 2013-14. The production was decreased to 562000 tonnes during 2015-16 however; the natural rubber production was increased to 691000 tonnes in 2016-17 (Rubber Board, India).Globally, Thailand is the leading producer of Natural Rubber followed by Indonesia, Malaysia and India. Rubber being an important raw material used in the manufacture of wide variety of products in automobile, health care, electric, household and other sectors. The demand for natural rubber as an input from industries has been increasing with the growth of economic development. The variations in prices of natural rubber at International and domestic markets moves in tandem with the influence of production, demand, crude oil prices, import and export policies, vehicle sales, exchange rates, synthetic rubber prices etc. However, the fluctuation and instability of prices of Natural Rubber posing critical issue to producers resulting in decline in the income (Selvia.V.J.Y, 2012). It also impacts negatively on the balance of payments of importing and exporting countries. India being one of the leading producers of natural rubber has been taking several steps to facilitate small farm holders of rubber with price supporting measures and schemes. This paper made an attempt to understand the influence of crude oil prices, exchange rate (USD/INR), International Rubber prices of Malaysia and Thailand on Indian rubber prices.

This paper has presented in the following sections - Section 2 reviews existing literatures on International determinants on rubber prices, Section 3 describes Methodology adopted for the study, Section 4 contains data analysis and interpretation and Section 5 presents findings and conclusions.

Review of Literature

The scholastic evidences on determinants of rubber prices were reviewed at National and International source. Accordingly, the prices of rubber in International market has an impact on domestic market. Prices of rubber influenced by internal and external factors such as crude oil prices, exchange rates, climatic conditions, international rubber prices, demand and supply and government policies.Khin.A.A, Mohamed.Z2012 studied on rubber industry in Malaysia using Granger causality test to analyse the relationship between the selectedvariables. It is observed that rubber prices follow the trend of crude oil prices and it is determinant of natural rubber industry.Lekshmi.S, et.al (1996) using linear regression model analysed the relationship between price and explanatory variable. The interrelationship between price and explanatory variables showed positive relationship between price and demand, increase in consumption led to an increase in price of natural rubber.Raju. K.V (2016) in his study analysed instability of natural rubber prices in India. The results of Co-efficient of variation found that instability was very high during the period of study i.e. 2000- 2014. The study also found that economic condition in the developed and developing countries, fall in crude oil prices, decline in the prices of synthetic rubber and depreciation in currencies of natural rubber exporting countries are the major reasons for the decline in prices of rubber in the rubber producing countries. International rubber prices, fall in the crude oil prices and consequent decline in the prices of synthetic rubber are the major reasons for the fall in the natural rubber prices at domestic markets.Chawananon.C (2014) studied on factors affecting natural rubber market in Thailand focusing econometric model of demand and supply of natural rubber in Thailand market and also to understand the relationship between natural rubber demand, supply and its determinants. The study finds negative relationship of rubber prices with the quantity demanded however, there is positive relationship between the quantity supplied. The study used variables such as GDP per capita of India, China, Japan, and US, Vehicle sales in US, annual rainfall and prices of rice. It is also found that car sales in US affect the demand for rubber in Thailand.Purcell.D.T (1993) in his study focussed on factors affecting long run supply of natural rubber in Sarawak. The study used Granger causality test to determine the relationship and found bidirectional causality. The results of granger causality test indicated that production has high causal effect whereas there is medium level causal

effect on price and area.Khin.A.A et.al (2017) finds the impact of exchange rate volatility on Malaysian natural rubber prices. The results indicated that RSS4 natural rubber prices granger causes SMR 20 prices. Determinants of price volatility of natural rubber in Malaysia by Sadali.N (2013) used multiple regression analysis to understand the impact of independent variables of crude oil, export-import on rubber prices as dependant variable. International crude oil prices has impact on natural rubber prices (MdLudin.N.H, et.al., 2016) and on GDP in both long run and short run (Murshidi.M.H and Aralas.S ,2017). Burger.K, Smit.H and Vogelvang.B (2002) studied on exchange rates and natural rubber prices on the effect of Asian crisis. It is observed that synthetic rubber prices do not lead to natural rubber prices however; natural rubber prices are affected by Asian prices.

The above scholastic evidences finds determinants of rubber prices as prices of crude oil, currency exchange rates, International rubber prices, synthetic rubber prices, import – export of rubber, production ,demand, rainfall, inflation and GDP etc. The studies used multiple regression analysis and granger causality test to understand impact and causal relationship of variables. However, there is dearth of scholastic evidences in understanding impact of International factors on Indian Rubber prices. This study, therefore, has been conceptualised to fulfil the gap in the existing literature and domain of knowledge.

Objective

The objective of study is to identify and review the impact of selected International factors on Indian rubber prices.

Methodology

The study with empirical research used secondary data from published sources. It has identified crude oil prices, currency exchange rates (USD/INR), rubber prices of Thailand and Malaysia as independent variables and rubber prices of India as dependant variable. The statistical method of Multiple Regression analysis has been used through E-views software package to understand the impact of independent variables on Indian rubber prices as dependant variable.

The study converted variables into log values for testing stationarity as it was not becoming stationary under differentiation method. This study usingAugmented Dickey - Fuller test for the log variables converted into stationary at the first difference. The study also used Breusch – Godfrey serial Correlation LM test, Heteroskedasticity-Breusch- Pagan – Godfrey test and Normality test using Jarque – Bera Probability method.

Augmented Dickey - Fuller test: Stationarity test

Augmented Dickey Fuller (ADF) test uses the following regression equation: (1)

$$\Delta y_t = a + \alpha y_{t-1} + \sum_{i=1}^{k} b_i \Delta y_{t-i} + \varepsilon_t \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad (1)$$

$$\Delta y_t = a + \beta t + \alpha y_{t=1} + \sum_{i=1}^{k} b_i \, \Delta y_{t-i} + \varepsilon_t \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad (2)$$

The test for unit root in y_t where Δy_{t-i} is the lagged difference to accommodate serial correlation in the errors, ε_t. $k$is the appropriate lag length.

The null and alternate hypotheses are as under:

H_0: $\alpha = 0$.

H_1: $\alpha < 0$.

The series shall be non - stationery, if there is a presence of unit root due to not rejecting the null hypothesis. In case of equation (1), the series shall be mean stationery process, if the null hypothesis is rejected whereas; for equation (2) the series shall be trend stationery process. The series is called differenced stationery process if Δ *Yt*is stationary. Yt is called as integrated of first order I(1) if Δ*Yt*is stationary and *Yt* is not.

Multiple regression analysis

This analysis used to explain the relationship between one dependant variable and two or more independent variables. Multiple regression estimates the ß's in the equation.

$$y_{j=\beta_0} + \beta_1 \; x_{1\,j} + \beta_2 x_{2\,j} + \cdots + \beta_p x_{pj} + \varepsilon_j \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad (3)$$

Here, X variables indicate independent variables and Y is the dependant variable. The subscript j represents the observation. The β's are the unknown regression coefficients. Their estimates are represented by b's. Each ß represents the original unknown (population)

parameter, while b is an estimate of this ß. The ej is the error (residual) of observation j. This study formulated equation as under -

Indian Rubber Price= Crude oil Price+ Currency Exchange rate (USD/INR) + Rubber prices of Thailand+ Rubber prices of Malaysia

IRP=COP+ USD/INR+ RPT +RPM

Serial Correlation LM test

Breusch- Godfrey Serial Correlation LM Test is an auto correlation test used when there are errors in the regression model. Residuals are used from the regression model and a test statistic is derived. The null hypothesis of this test is that there is no serial correlation in the residuals up to the specified order. Test statistic is computed by an auxiliary regression as follows. The estimated regression;

$$y_t = X_t \beta + \epsilon_t \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad (5)$$

Where, ϵ indicates errors.

In Breusch- Godfrey Serial Correlation LM Test is **the observed R squared statistic. LM statistic is computed as the number of observations.** This LM statistic is computed as thenumber of observations, times the (uncentered)$R^2$from the test regression.**In certain conditions the LM test statistic is asymptotically distributed as** $Xn^2(p)$

Heteroskedasticity Test

This study used Breusch - Pagan- Godfrey to understand the nature of deviations of the concerned return series. If the variance is time dependant and changes from one period to another then it is known as Heteroscedastic. The Breusch - Pagan - Godfrey test as a Lagrange Multiplier test of null hypothesis of no heteroscedasticity against heteroscedasticity of the form:

$$\boldsymbol{\sigma}^2_{t=\ \boldsymbol{\sigma}^2}\ h(z_t'\alpha) \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad (6)$$

Where, Z^t indicates as a vector independent variable. Generally, this vector contains regressors from the original least square regression which is not necessary. It is tested by completing an auxiliary regression of the squared residual of the original equation on (1-Z^t)

SJCC Management Research Review
Print ISSN-2249-4359
Vol - 9(1) June. 2019. Page No. 1-13

Normality test –

Using Normality test, study determined if the data is well modelled by normal distribution and also to compute how likely it is for a random variable underlying the data set to be normally distributed. Jarque Bera test is used as a tool for testing normality. If the residuals are normally distributed then histogram is a bell shaped and the Jarque Bera statistic is not significant. *Jarque Bera* test statistic measures the difference of the skewness and kurtosis of the series with those from the normal distribution. The statistic is computed as:

$$Jarque\ Bera = \frac{N}{6}\left(S^2 + \frac{(K-3)^2}{4}\right) \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad \longrightarrow \quad (7)$$

Empirical results

The study focussing on objective valuated influence of International determinants on Indian rubber prices. The study considered factors such as prices of Crude oil, currency exchange rates (USD/INR) and Rubber prices of Thailand and Malaysia as independent variables. The study used Augmented Dickey - Fuller test for converting each variable in to stationary.

Sl. No.	Variable (log)	At the level		At first difference	
		T - statistic	P - value	T - statistic	P - value
1.	Crude oil (COP)	-2.670641	0.0812	-9.396357	0.0000
2.	Currency Exchange rates (USD/INR)	-0.415933	0.9026	-12.07983	0.0000
3.	Rubber Thailand (TRP)	-2.360027	0.1547	-9.586878	0.0000
4.	Rubber Malaysia (MRP)	-4.083085	0.0013	-14.41852	0.0000
5.	Rubber India (IRP)	-2.276231	0.1809	-9.906811	0.0000

The above table no.1 depicts the outcome of ADF test. At the level p value for Crude o:ilis 0.0812 which is more than 0.05 further, at first difference the p-value was 0.00 indicating stationarity. In case of USD / INR rates the p value at the level was 0.9026 indicating non stationarity and at the first difference p value is stationary. The p value of prices of rubber in Thailand at the level is not stationary as the p value is more than 0.05 (0.1547). Rubber prices of Malaysia at the level are stationary. The prices of rubber in

India being the dependent variable have the p value more than 0.05 (0.1809) which indicated that null hypothesis has a unit root however, the same variable at the first difference converted in to stationary.

Table No.2: Regression output

Dependent Variable: LRUB_IN				
Method: Least Squares				
Sample: 2003M04 2018M03				
Included observations: 180				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-1.138983	0.183586	-6.204093	0.0000
LC_OIL	0.103493	0.027872	**3.713142**	**0.0003**
LRUB_ML	-0.005237	0.013784	**-0.379926**	**0.7045**
LRUB_TL	0.874546	0.031107	**28.11409**	**0.0000**
LUSDINR	0.362949	0.038383	**9.456010**	**0.0000**
R-squared	**0.957038**	Mean dependent var		5.380995
Adjusted R-squared	0.956056	S.D. dependent var		0.399840
S.E. of regression	0.083818	Akaike info criterion		-2.092961
Sum squared resid	1.229446	Schwarz criterion		-2.004268
Log likelihood	193.3665	Hannan-Quinn criter.		-2.057000
F-statistic	**974.5929**	Durbin-Watson stat		0.473778
Prob(F-statistic)	**0.000000**			

Model fit-Theabove table no.2 indicates value of R squared as 0.957 and it indicates 95.7% of the variability in Indian rubber prices (dependant variable) has been expressed by the selectedinternational factors(Independent variables). The remaining 4.3% variation in Indian rubber prices are explained by residuals or other variables besides the International factors used in this study.

Individual significance of variables – The influence of independent variables such Crude oil, USD/INR, Rubber price of Thailand and Malaysia on Indian rubber prices (dependant factor) are analysed using t-statistic. The t-statistic of Crude oil is 3.713142, USD/INR is 9.456010, Rubber price of Thailand is 28.11409and Rubber prices of Malaysia is 0.379926. The p- value of Crude oil,USD/INR and Rubber price of Thailand are 0.0003, 0.0000,and 0.0000 respectively. However, the p value of rubber price of Malaysiais 0.7045 i.e. more than 0.05 hence, it is not significant. In total, three out of four independent variables i.e., Crude oil, USD/INR, Rubber price of Thailand are significant in the model.

Joint Significance of independent variables: In addition to the above, the regression model should also have a joint significance of independent variables on dependent variable. The table no.2 also indicates F-statistics value to understand joint significance of International factors on Indian rubber prices. Accordingly, the F-statistics with a corresponding P-value is less than 5%. The study, therefore, based on computed statistics found that selected international factors jointly express the variability on Indian rubber prices.

Serial or Auto Correlation LM Test

The study checked existence of autocorrelation in the variables and the table no.3 shows statistical outcome of Breusch- Godfrey Serial Correlation LM Test.

Null Hypothesis (H0) – Residuals are not serially/auto correlated

Alternate Hypothesis (H1)- Residuals are serially/auto correlated

Table No. 3:Breusch- Godfrey Serial Correlation LM Test

F-statistic	5.584320	Prob. F(60,115)	0.0000
Obs*R squared	134.0061	Prob. Chi-Square(60)	**0.0000**

This study finds that, observed R-square and corresponding P- value is less than 5%. Hence, the study rejects null hypothesis and accepts that, residuals are serially/auto correlated.

Heteroskedasticity

The study used Breusch-Pagan-Godfrey test to check Heteroskedasticity of the model.

Null Hypothesis (H0) - Variance of residuals are not heteroskedastic

Alternate Hypothesis (H1) - Variance of residuals are homoscedastic

Table No. 4:Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.393170	Prob. F(4,175)	0.0524
Obs*R-squared	9.335523	Prob. Chi-Square(4)	**0.0532**
Scaled explained SS	9.057970	Prob. Chi-Square(4)	0.0597

The table no. 4 shows statistical results of Breusch-Pagan-Godfrey test. Accordingly, the P-Value (5.32%) of observed R square is more than 5%. The study based on P value cannot reject null hypothesis and concludes that, variance of residuals are notheteroscedastic. This outcome is desirable for a good regression model.

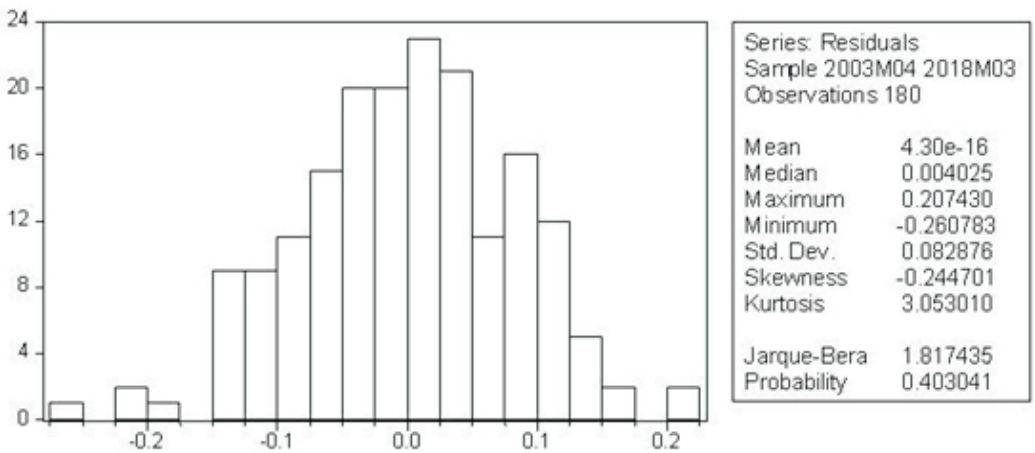
Test of Normality:

The study checked test of Normality using JarqueBeraTest. Accordingly, the hypothesis are-

Null Hypothesis (Ho):Residuals are normally distributed

Alternate Hypothesis (H1): Residuals arenotnormally distributed

Figure 1: Results of Normality test



Another important criteria in the regression analysis is to test the normality of regression model. The study used Jarque Beratest of Normality and finds test value as 1.817435 with corresponding p value as 0.403041.Here, the p value is more than 0.05, the study therefore, cannot reject null hypothesis and it can be concluded that population residual (u) are normally distributed.

Table No. 5: Summary of Regression Model

Sl.No	Criteria	Statistical value	Remarks
1.	Model fit	Observed R square-0.957038(95.70%)	More than 60% best fit
2.	Individual significance of variables	T statistics- 3 out of 4 variables are significant	Desirable
3.	Joint Significance of independent variables	F statistic- with p-value less than 0.05 showing influence of all independent on dependant variables	Desirable
4.	Test of Serial Correlation	Breusch- Godfrey Serial Correlation LM Test - Observed R square with p value less than 0.05	Auto Correlated-not desirable
5.	Test of Hetroscedasticity	Breusch-Pagan-Godfrey test results with the p value of 5.32%.	Homoscedastic - Desirable
6.	Test of Normality	Jarque- Bera test with p-value - 0.00, residuals with bell shaped curve	Acceptable

Table no. 5 depicts the output of the regression model used in the study. The observed R square is 95.70% i.e., more than 60% hence, the developed regression model is best fit. Individual significance of independent variables 3 out of 4 are significant, showing that majority of variables are significant, therefore, it is desirable. The test also shows the combined significance of independent variables such as USD/INR, Crude oil prices, rubber prices of Thailand and Malaysia significantly influenceson Indian rubber prices with the value of f- statistic in the study. Hence it is desirable to accept the model. Breusch-Pagan-Godfrey test results shown the residuals are homoscedastic, hence it is desirable. The test of Normality reveals that residuals are normally distributed. In total, amongst the six criteria of the good regression model developed in the study satisfying five criteria which are desirable and satisfactory. The model developed, therefore can be used to estimate the rubber prices of India considering selected independent variables in the study, which is statistically significant and accepted.

The regression model contributes to the development of following equation-

$$\textit{Indian Rubber Price} = -1.138983 + 0.103493\ (\textit{Crude oil}) - 0.005237\ (\textit{Rubber Prices Malaysia}) + 0.874546\ (\textit{Rubber Prices Thailand}) + 0.362949\ (\textit{USD INR})$$

Indian rubber price being a dependent variable is influenced with selected independent variables as identified in the study. The variations in prices of crude oil are directly influencing change in Indian rubber prices. As per the above regression model, one unit increase in crude oil showing the variation to the extent of 10.34% increase in the prices of Indian rubber. The crude oil is an important source of raw material in the production of synthetic rubber, being one of the components in the production of rubber products. Hence, any change in crude oil prices is directly contributing to the change in Indian rubber prices. It is, therefore, any fluctuations in crude oil can be used to understand the impact on Indian rubber prices.

Findings and Conclusion

The study finds International determinants as independent factors such as USD/INR, Crude oil prices, Rubber prices of Thailand and Malaysia to understand their impact on Indian Rubber prices. Accordingly, the statistical tool of Multiple Regression revealed that Rubber prices of Malaysia do not have an impact on Indian rubber prices. However, other independent variables namely- Crude oil prices, USD/INR,Rubber prices of Thailand has a positive impact on Rubber Prices of India.

Acknowledgement:This paper has been prepared as a part of major research project entitled – "Rubber price uncertainty and Risk management Strategies for Small Farm holders " Sponsored by ICSSR, New Delhi. Author thankfully acknowledges financial grants received from ICSSR, New Delhi.

References

1. Burger.K, Smit.H and Vogelvang.B (2002) Exchange Rates and Natural Rubber Prices, the Effect of the Asian Crisis. Xth EAAE Congress. Exploring Diversity in the European Agri-Food System, Zaragoza (Spain), 28-31.

2. Chawananon.C (2014) Factors affecting the Thai Natural rubber market Equilibrium: demand and supply response analysis using two stage least squares approach. California Polytechnic State University.

3. Khin.A.A, Mohamed.Z and Hameed.A.A.A (2013) The Impact of the Changes of the World Crude Oil Prices on the Natural Rubber Industry in Malaysia. *World Applied Science Journal*, 28(7), 993-1000.

4. Khin.A.A, Chau.H.W, Yean.L.U.,Keong.C.O and LehBin.L.R (2017) Examining between Exchange Rate Volatility and Natural Rubber Prices: Engle-Granger Causality Test. *International Journal of Economics and Financial Issues,* 7(6), 33-40.

5. Lekshmi. S, Mohanakumar.S, and George. K.T. (1996) The trend and pattern of natural rubber price in India: An exploratory analysis. *Indian Journal of Natural Rubber Research,* 9(2), 82-92.

6. MdLudin.N.H, Applanaidu.S.D and Abdullah (2016) An Econometric Analysis of Natural Rubber Market In Malaysia. *International Journal of Environmental & Agriculture Research (IJOEAR),* 2 (6), 25-33.

7. Murshidi.M.H and Aralas.S (2017), The impact of price shocks of crude oil, palm oil and natural rubber towards the Gross Domestic Product of Malaysia. *Proceedings of International Conference on Economics 2017 (ICE 2017)*.

8. Purcell.D.T (1993) The factors affecting the long run supply of Rubber from Sarawak, East Malaysia- An Historical and Econometric Analysis, Department of Agriculture.

9. Raju. K.V (2016) Instability in Natural Rubber Prices in India: An Empirical Analysis. *IOSR Journal of Economics and Finance (IOSR-JEF),* 7 (3), 24-28.

10. Sadali.H.N (2013). Determinant of Volatility Natural Rubber Price. SSRN Electronic Journal. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2276767.

11. Selvia.V.J.Y (2012) A study on the impact of LPG on Natural Rubber and rubber-based industries in Kanyakumari district. ManonmaniamSundaranar University.

12. Index Mundi, https://www.indexmundi.com/
13. Rubber Board, India. http://www.rubberboard.org.in/public
14. Reserve Bank of India, https://rbi.org.in/