

## **The Determinants of Production and Export of Natural Rubber in India**

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**Abstract:** *This study examined the factors that influence agricultural production and exports with specific reference to the natural rubber in India. Secondary data was used for this study. Ordinary Least Squares (OLS) technique was used in analyzing the relevant data. The OLS findings revealed that natural rubber production is significantly ( $p < 0.05$ ) by export of natural rubber ( $\beta = 0.05$ ), stock ( $\beta = 0.21$ ) and domestic price ( $\beta = 0.21$ ). For export of natural rubber, the OLS shows that stock of natural rubber ( $\beta = 0.29$ ), world market price ( $\beta = 15.96$ ), domestic price ( $\beta = -18.47$ ) and world population ( $\beta = 88.37$ ) significantly ( $p < 0.05$ ) influence in export of natural rubber. It is recommended that there should be value addition in respect of natural rubber being exported.*

**Key word:** *Ordinary Least Squares (OLS), Production, Export and Import.*

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### **I. Introduction**

India is the fourth largest natural rubber producing country after Thailand, Indonesia and Malaysia. India's share in the production has increased over the years and the country is now one of the largest producers of natural rubber in the world market. South Indian regions, especially Kerala, Tamil Nadu and Karnataka contribute major share of India's natural rubber production. In fact, 90 per cent of the total production comes from the state of Kerala. According to the figures recently released by the Indian Rubber Board Statistics, the consumption pattern of natural rubber exceeded the production pattern. This trend indicates clearly, how the natural rubber is an essential commodity in the present era.

India's natural rubber production fluctuated around 6-7 lakh tonnes annually which amounts Rs. 3000 crores. Around 72 per cent of the total rubber production is in the form of Ribbed Smoked Sheets (RSS), which is also imported by India, accounting for 45 percent of the total rubber imports. India has imported 213785 tonnes of natural rubber during 2011-12 and exported 27145 tonnes of natural rubber during 2011-12. Export of Natural Rubber from India rose from the low level of Rs. 0.05 crores in 1993-94 to Rs. 552.20 crores in 2010-11. In India the share of natural rubber exports in total agricultural exports was 0.46 per cent in 2010-11. Likewise the share of natural rubber exports in horticultural exports was 5.62 per cent in 2010-11. According to Economic Survey of India, the value of export earnings of natural rubber during 2011-12 stood at Rs. 441.30 crores. The share of natural rubber to value of exports of all commodities has slightly improved to 0.04 per cent in 2011-12. As per the Indian Economic Survey, there has been a significant employment opportunities in the rubber sector. In the year 2011 the rubber sector employed nearly 48.56 lakh workforce as against 10.32 lakh workforce in 1961.

### **Present Crisis in Indian Rubber**

According to Indian Rubber Board, the demand for natural rubber has been almost equally coincide with the supply of natural rubber. During 2011-12, the production of natural rubber in the country stood at 903700 tonnes, while its consumption was at 964415 tonnes (India had to import 60715 tonnes of natural rubber). For the first time, India's total imports crossed 200000 tonnes in 2011-12 at 213785 tonnes, up from 177637 tonnes in 2010-11 (Indian Rubber Board, 2012). The widening gap between supply and demand in the local market was the main reason for the sharp rise in prices and imports. The shortage of natural rubber is estimated around 75000 tonnes this year against an estimated consumption of over 10 lakh tonnes (Business Line, 2012). The net deficit of natural rubber in the country, as per Rubber Board estimates, is 75000 tonnes for the year 2012 against the total availability of 2.4 lakh tonnes and the total stocks at the end of January 2012 are 2.67 lakh tonnes against 3.34 lakh tonnes at the end of January 2011 (Hindu, 14<sup>th</sup> Feb-2012). Though growth in rubber production has been modest, huge capacity buildup is being undertaken by the tyre industry, which could increase the demand for rubber commodity in the near future. These types of crisis can directly or indirectly affects the rubber economy in India.

Experts from Association of National Rubber Producing Countries pointed out that the prices are likely to remain high internationally, as a large number of rubber trees were planted during the 1980s. Another concern among experts is the lower productivity of Indian rubber farms, largely due to the smaller size of holdings, many

farmers worried about insufficient price for the produces, market failure, labour shortage in rubber farms, and an approximately 50 per cent of the cost of production spent on labourers (Indian Rubber Board 2012).

Even though the rubber industries in India met lot of difficulties, it has a great future. To set right the problems which are occurred in rubber industry, the planners, educationalists, engineers, agriculturists, economists, scientists and politicians of the country jointly should pay attention on development of rubber economy. Further to achieve the sustainable development in rubber economy, much efforts has to be focused on different angles, such as productivity of land and labour, quality of products, value addition, quantity and price determination, export performance, modern technical adoption, efficient marketing system etc.

### **Objectives**

The specific objectives of the study as follows:

1. To examine various determinants of production on Natural Rubber in India and
2. To examine various determinants of Exports on Natural Rubber in India

## **II. Review of Literature**

Regarding to the rainfall which has a positive significance effect on the yield of cocoa crop, this research find its significance to the previous finding where Akintola (1983), studying the effects of agro climatic factors on some selected crops in Ibadan. Following his correlation and regression analysis, the responsiveness of each crop yield to specific agro climatic variables (rainfall, temperature, sunshine and humidity) was determined. Based on his findings, it was known that rainfall has statistically significant effect on yields of rice, cowpea, yam, cocoa and rubber crops. Ngeno (1990) carried out a study on determinants of export and one of his findings was that export is positively related to output level since higher production leads to increased volume of exports. Studies in Ghana and India by Fosu (1992) and Sharma (2001) respectively have showed that real exchange rate has a significant negative relationship with export. However a good producer price matching with export price has a positive significance on the export. Ball *et.al* (1966) also argued that at relatively high level of domestic demand, ceterus paribus, the quantity of resources devoted to export is lower. So, at lower domestic demand the surplus production leads to increased export volume. He further said that higher level of production is the main cause of export expansion since surplus output can be exhausted in international markets. Tijani *et.al* (1999) employed co-integration and error correction model to estimate export supply function in Nigeria using time series data that span more than three quarters of the 20<sup>th</sup> century. The results indicate that weather effect is stationary while producer price and hectare planted to cocoa have a long run equilibrium relationship with cocoa export. . Musila (2004) analyses the impact of the common market for Eastern and Southern Africa on Kenya export, and finds that export is associated with high volume exported and not higher price for the product. A huge domestic demand impede an increase of the export related by ADB (2005), which reported a negative association between exports and growth rate of domestic demand in the Southeast Asian countries. Thus a variation in domestic demand pressure will affect the supply-side or availability for exports.

Grafoute Amoro and Yao Shan (2012) examined the factors that influence agricultural exports with specific reference to Cocoa and rubber. Secondary data was used for this study. Ordinary Least Squares (OLS) method was used in analyzing the relevant data. The OLS findings revealed that rubber export is influenced significantly ( $p < 0.05$ ) by domestic rubber production ( $\beta= 68124.857$ ), producer price ( $\beta= 10741.503$ ), exchange rate ( $\beta= -17078.957$ ), domestic consumption ( $\beta= -27094.147$ ) and interest rate ( $\beta= 14991.565$ ). For cocoa, the OLS shows that cocoa output ( $\beta=0.847$ ), domestic consumption ( $\beta=-0.850$ ) and rainfall ( $\beta=44.074$ ) significantly ( $p < 0.05$ ) influence cocoa export. It is recommended that there should be value addition in respect of the cocoa being exported.

## **III. Methodology**

The secondary data has been used for the study purpose. The pertaining to different aspects in natural rubber such as export quantity, import, stock, domestic price, rainfall, production, world market price, domestic price and world population were collected for 20 years from 1991-92 to 2010-11 and the collected data are used to analyze the influence on the quantity of production and export of natural rubber in India. Ordinary Least Square (OLS) method was used to determine variables affecting production and export of natural rubber in India. The various publications and reports such as Hand Book of Statistics on the Indian Economy, Economic Survey, RBI Bulletin, International Study Group, Kerala Rubber Board Statistical News, Annual Reports of Indian Rubber Board, Agricultural Statistics at a Glance, Food and Agricultural Organization of the United Nations etc., have been referred for collection of data.

**Ordinary Least Squares (OLS) Method**

In order to identify the factors affecting production and export of natural rubber in India, the Ordinary Least Squares (OLS) technique was done, by using the following equations.

A dynamic equation of production of natural rubber can be derived as:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \mu$$

Where,

- Y = Quantity Production of Natural Rubber (tonnes)
- X<sub>1</sub> = Export Quantity of Natural Rubber (tonnes)
- X<sub>2</sub> = Import Quantity of Natural Rubber (tonnes)
- X<sub>3</sub> = Stock of Natural Rubber (tonnes)
- X<sub>4</sub> = Average Annual Domestic Market Price of Natural Rubber (in Rupees)
- X<sub>5</sub> = Average Annual Rainfall (mm / year) Southern Peninsular India (SPI)

μ = error term

b<sub>1</sub>, b<sub>2</sub>, .....b<sub>5</sub> = Regression Coefficients

a = Intercept (Constant)

The desired export equation of natural rubber can be postulated as:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \mu$$

Where,

- Y = Export Quantity of Natural Rubber (tonnes)
- X<sub>1</sub> = Quantity of Production of Natural Rubber (tonnes)
- X<sub>2</sub> = Stock of Natural Rubber (tonnes)
- X<sub>3</sub> = Average Annual World Market Price of Natural Rubber (in Rupees)
- X<sub>4</sub> = Average Annual Domestic Market Price of Natural Rubber (in Rupees)
- X<sub>5</sub> = World Population

μ = error term

b<sub>1</sub>, b<sub>2</sub>, .....b<sub>5</sub> = Regression Coefficient

a = Intercept (Constant)

**Results of Ordinary Least Square Technique on Factors Influencing the Production and Export of Natural Rubber in India**

The factors influencing the production and export of natural rubber are analyzed. The data pertaining to different aspects that influence the production and export were collected for 20 years from 1991-92 to 2010-11. The Ordinary Least Square (OLS) method was employed for the analysis. The model is fitted and the R<sup>2</sup> value and F Table value are used to fit the model to analyze the parameters under study.

**Results of OLS Technique on Factors Influencing the Production of Natural Rubber**

The Ordinary Least Square (OLS) Method was used for determining the association and contribution of various factors for the production of the natural rubber in India and presented in Table 1. The data pertaining to different aspects such as export quantity, Import, Stock, domestic price and rainfall were collected for 20 years from 1991-92 to 2010-11 and the collected data is used to analyze the influence on the quantity of rubber production. Even though rubber is a perennial crop, still various factors such as rainfall, price etc., can influence the quantity of rubber extracted. Hence the variables such as the quantity(X<sub>1</sub>), Import(X<sub>2</sub>), Stock(X<sub>3</sub>), Domestic price(X<sub>4</sub>), and rainfall(X<sub>5</sub>), were used for analysis.

The analytical table indicates the results of 'F' value were significant at one per cent level of probability. Since the 'F' value was significant, the prediction equation was fitted for production of natural rubber in India. The R<sup>2</sup> value was 0.87 which revealed that 87.30 per cent of variation in the production was explained by the five variables were selected for the study. The OLS model for the production of natural rubber in India is as follows,

$$\hat{Y}_1 = 10.27*** + 0.05***X_1 - 0.01^{NS} X_2 + 0.21*** X_3 + 0.21**X_4 - 0.24^{NS} X_5 + e_i$$

**Table 1**  
**Results of OLS on Factors Influencing the Production of Natural Rubber in India**

	Coefficients	Standard Error	t Stat	P-value
Intercept	10.27***	1.32	7.80	0.0000
Export	0.05***	0.02	2.98	0.0100
Import	-0.01 <sup>NS</sup>	0.06	-0.13	0.9011
Stock	0.21***	0.07	2.86	0.0126
Domestic Price	0.21**	0.09	2.28	0.0392
Rainfall	-0.24 <sup>NS</sup>	0.18	-1.32	0.2092

R<sup>2</sup> Value 0.873

Adjusted R<sup>2</sup> 0.8276

F Value 19.24

\*\*\* Significant at 1 per cent level, \*\* Significant at 10 per cent level and NS Non Significant.

The results reveal that the variables such as Export, Stock and Domestic Price had positive and significant association with the production of natural rubber at one per cent level of significance. The results of OLS analysis showed that the quantity of natural rubber export is positively influenced the quantity production of natural rubber, i.e., increasing the production will lead to increase the quantity exports. The price will have direct effect on the quantity of natural rubber production and hence the present study also proves that the domestic price has positive and significant impact on the production of natural rubber in India.

The stock of the rubber has also had positive influence with the production of natural rubber which was an unusual phenomenon and which may be due to the expectation of rise in the prices. The natural rubber tree is becoming a perennial crop, it is not completely depend on rainfall for its cultivation. Therefore from the table is inferred that the rainfall has negatively influenced the production of Indian natural rubber. Even though the Import of natural rubber is not significant, it has negative relation with the production of natural rubber. The negative sign implies that the import increases due to the lowering of the domestic production of natural rubber.

### Results of OLS Technique on Factors Influencing the Export of Natural Rubber

The OLS Result for factors influencing Export of natural rubber in India is presented in the Table 2. The results reveal that the coefficient of multiple determinations (R<sup>2</sup>) indicated that, higher proportion of variation was 0.9312 which indicated that 93.12 per cent variables in the dependent variable (Quantity Export) was explained by the independent variables (Production, Stock, World Market Price, Domestic Price and World Population) included in the model. Similarly, the adjusted R<sup>2</sup> also indicated the higher proportion of variation in the dependent variable by taking care of degrees of freedom. The OLS model on the export is as follows,

$$\hat{Y}_1 = -442033^{***} - 0.03^{NS} X_1 - 0.29 X_2 + 15.96 X_3 - 18.47^{**} X_4 + 88.37^{***} X_5 + e_t$$

**Table 2**  
**Results of OLS on Factors Influencing the Export of Natural Rubber in India**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	-442033***	117414	-3.76	0.0021
Production	-0.03 <sup>NS</sup>	0.07	-0.36	0.7213
Stock	-0.29***	0.06	-4.82	0.0003
World Market Price	15.96**	6.73	2.37	0.0326
Domestic Price	-18.47**	7.31	-2.52	0.0243
World Population	88.37***	26.91	3.28	0.0054

R<sup>2</sup> Value 0.9312

Adjusted R<sup>2</sup> 0.9066

F Value 37.90

\*\*\* Significant at 1 per cent level, \*\* Significant at 10 per cent level and NS Non Significant.

Among the five independent variables, except production all other variables such as stock, world market price, domestic price and world population are statistically significant at one per cent level. The stock of the natural rubber in India is negatively related to total export quantity i.e., increasing the stock of natural rubber will lead to lowering the export quantity and vice versa.

It obvious that as the world market price increases to capture the price advantage, the exporters will export more quantity of natural rubber. Hence, the increases of world market price influenced the rubber export in positive direction. The coefficient of the domestic price has negative sign in the result of OLS which implies that the domestic price declines than that of world average price, then the quantity export increases to get more profit from the international market than trading in the domestic market at lower price.

The world population has positively influenced export quantity of natural rubber. Increases of world population positively influenced with quantity exported as the hike in aggregate demand on produces of automotive industries around world. Therefore, the world population and overall increasing demand on an automotive produces positively influences the export quantity of natural rubber.

### IV. Conclusion

In the production of natural rubber, the variables such as export quantity, stock and domestic price had positive and significant association with the production of natural rubber. Even though the Import of natural

rubber is not significant, it has negative relation with the production of natural rubber. The OLS model reveals that in the export of natural rubber, among the five independent variables, except production all other variables such as stock, world market price, domestic price and world population are found to be influencing the export of natural rubber significantly.

### **Suggestions**

The production of natural rubber in India is positively influenced by indigenous rubber prices. Therefore, the study suggests that the Government may increase the procurement price for natural rubber at an appropriate and reasonable rate. The export of natural rubber in India is negatively influenced with the quantity stock. Therefore, it is suggested and recommended that, in order to increase the Indian export, the stock of natural rubber should not be maintained over reasonable and prescribed level.

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