

**HARVEST IS PLENTIFUL BUT THE HARVESTERS ARE A FEW  
AN EXPLORATION OF THE BELOW POTENTIAL PRODUCTION OF  
NATURAL RUBBER IN KERALA**

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Report of the study “HARVEST IS PLENTIFUL BUT THE HARVESTERS ARE A FEW: AN EXPLORATION OF THE BELOW POTENTIAL PRODUCTION OF NATURAL RUBBER IN KERALA”. The study was conducted by Prof. K J Joseph and Dr. Kiran Kumar Kakarlapudi as part of the National Research Programme on Plantation Development.

## Abstract

This study explored the factors underlying the below potential production of natural rubber in Kerala. The issue has been articulated as an outcome of the inter-play of certain unique characteristics of natural rubber a) the option of harvest postponement since the crop, if not harvested, is not lost forever and b) the farmers' option to set a reserve price which is contingent on the farm and farmer characteristics and the institutional context in which the farmers operate. It is found that 17% of the rubber holdings in Kerala are not tapping and the correlation between days tapped and production/ productivity is positive. Desisting from tapping has been attributed to lower price, labour related factors and the expectation of higher price in the future. Rain guarding, however, helps farmers tap larger number of days. The productivity of those growers depending only on hired labour is found to be lower as compared to their counterparts who depend only on family labour or both hired labour and family labour. Econometric analysis indicated that there are a number of farmer-specific and farm-specific factors that act as a dampener to tapping and productivity. Given their access to other sources of income, many of the farmers tend to have a higher reserve price, even higher than Rs 150 assured under the RPIS, which induce them to keep away from tapping. Even the RPIS seems to have been not been effective in inducing them to utilize their full capacity. In such a context, the plausible strategy shall be the direct intervention probably by the RPSs to get such holdings tapped in mutually agreeable terms. It is also of relevance to enable those growers to appropriate a larger proportion of the value of the output by moving up the rubber value chain. This will necessitate a major change in the current approach towards rubber based development by reaping the backward and forward linkages and evolving a broader innovation system in place of current narrow focus mainly on increasing productivity and production. In short run there is scope for increasing production *inter alia* by addressing labour related issues – *a la* the labour bank initiative of Rubber Board and propagating rain guarding, *a la* the recent MRF-Rubber Board initiative. In this process much could be gained by further strengthening the RPS and inducing them to take over absentee holdings and holdings where rubber a secondary activity. To the extent that large majority of the farmers would have tapped even without RPIS, it is of relevance to explore the possibilities of making use of the current budget allocation for RPIS by the state government towards evolving rubber based development within a broader perspective. This will *inter alia* involve more active state participation and facilitation in evolving a vibrant rubber based industrial sector by bringing together different stakeholders.

### *The context*

Among the plantation crops in India, natural rubber is one that has witnessed a remarkable growth in area, production and productivity during the last few decades. The planted area increased from 1.4 lakh hectare in 1960 to 7.5 lakh hectare in 2012. The production of natural rubber increased by six fold from 1.5 lakh tonnes in 1980 to 9.1 lakh tonnes in 2012-13 at the rate of 5.9 per cent. India witnessed the world record in productivity of 1806 kg/ha during 2010-11. Studies have attributed this remarkable performance to the relatively better institutional support provided by the Rubber Board to the small holders<sup>1</sup> who dominate the production structure in natural rubber. This support *inter alia* included a well-established system of research, development and extension activities; organizational innovations like formation of Rubber Producers' Societies, financial incentives for new planting and replanting and other plantation development related activities (Kannan and Pushpangadan, 1999; Lekshmi and George, 2003; Joseph and George, 2010; Mani and Santhakumar 2011; NRPPD 2015). Along with the institutional support, the sector was operating under the protected trading regime, which enabled to achieve the objective of import substitution.

However, the sector has been confronted with several challenges over the years. Among others, there has been a decline in the real plan expenditure of Rubber Board from Rs 103 crore in 1999-00 to Rs 90 crore in 2013-14.<sup>2</sup> The share of R&D in total plan expenditure too witnessed a reduction from 18 per cent in 2001-02 to 15 per cent in 2013-14. Likewise, the share of rubber plantation development scheme in total plan expenditure declined from 51 per cent in 2009-10 to 45 per cent in 2013-14. Added to it, with the opening up of the economy, the sector was exposed to heightened international competition<sup>3</sup>, which resulted in increased imports and that import as a proportion of output increased from. This increased international competition contributed to a downward trend in prices<sup>4</sup>. NRPPD (2016) has noted that at the prevailing market price,

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<sup>1</sup> There are over a million small holders with an average land holding size of 0.54 hectare.

<sup>2</sup>The numbers are in current prices.

<sup>3</sup> Tariffs were reduced from 70 per cent before WTO agreement to 20 per cent with MFN and non-tariff barriers were also reduced.

<sup>4</sup> Market price of RSS 4 grade of natural rubber was as high as Rs 208 per kg in 2011 which fell to Rs 114 per kg in 2015-16.

the net income of growers with an average holding size and entirely dependent on natural rubber, would be lower than those below the poverty line. Further, productivity drastically slumped by 17 per cent from 1879 kg per ha in 2006-07 to 1437 kg per ha in 2015-16, registering a negative growth rate of 3 per cent per annum. The production of natural rubber in India decreased from 9.1 lakh tonnes in 2012-13 to 6.9 lakh tonnes in 2016-17 mostly on account of the production decline in Kerala. Given the area under natural rubber with tappable age (5.86 lakh ha), the potential production as reported by the Rubber Board should have been around one million tonnes. Thus, today we are faced with a situation wherein “capacity utilization”<sup>5</sup> in natural rubber production is less than 70 per cent. In this context, the question that arises is: How do we explain the below potential production of natural rubber? This the central issue that prompted this study. The specific objectives of the study are the following

- What are the price and non-price factors (farm and farmer characteristics) that induce the growers to refrain from tapping their tappable trees? and
- What are the institutional interventions in place to incentivize the growers to tap the trees?

The study is organized as follows. Section 2 briefly discusses the data, method and the approach of the study. Section 3 presents the empirical evidence on the tapping behavior and output at the farmer level using descriptive statistics followed section 4 wherein an econometric analysis of tapping behavior of farmers and their output performance is undertaken. Section 5 highlights the main findings and the policy pointers.

## **2. Data, Method and approach to the study**

This study is based on primary data collected from a representative sample of (441) of rubber growers from the 3 rubber growing regions in Kerala; Trivandrum, representing southern Kerala, Kottayam representing central Kerala and Thaliparampure representing Northern Kerala. The stratified random sample of rubber growers representing the three regions has been selected in consultation with the Committee appointed by the Rubber Board to associate with NRPPD in undertaking this study. The primary data was

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<sup>5</sup> Capacity utilization refers to the relationship between actual level of output and maximum possible output.

canvassed with the help of the field staff of the Rubber Board under the supervision of the senior officials of Rubber Board and the NRPPD study team. The survey was undertaken during the period may-September 2018. The Survey started after the crop year 2017-18 to get a comprehensive picture of one crop year. Three interim interactive sessions were organized with the field staff, the committee of Rubber Board and study team to ensure that the data has been properly collected from the field. With the support of the Committee concerned from the Rubber Board Focused Group Discussions (FGD) was organized with select growers and RPS representatives in two locations - Trivandrum and Adoor.

***The approach to the study: – Price and Non-price factors***

The below potential production of natural rubber could be seen as an outcome of farmers' behaviour in terms of refraining from tapping the trees within tappable age, which is conditioned in a sense by the specific character of natural rubber. The harvesting decision of rubber growers needs to be seen as distinctly different from all other agricultural crops. In all the other agricultural crops, both plantation crops like coffee, tea or cardamom or field crops like rice or wheat, farmers are forced to harvest the crops once it is ready for harvest. This is because the crop not harvested is lost forever. Hence the crop is unlikely to go un-harvested if the cost of harvesting is not more than the revenue from the harvest. In case of natural rubber, on the other hand, the crop ready to harvest need not be lost for ever if not harvested when it is ready to harvest. This is because the yield from rubber is not derived from its seed instead from the latex extracted from the bark of the tree and the bark tend to remain almost intact if not used. (One of the growers reported that girth of a non tapped tree increases at double the rate as compared to a tapped tree –indicating the future benefit of non tapping) Thus, unlike in other crops the natural rubber growers potentially have the option of postponing the harvest without any significant loss in the long run. Under such conditions, it is possible for the growers to have a reserve price and if the prevailing market price is below the “reserve price” the farmers are unlikely to tap the trees, instead postpone the harvesting. The reserve price however, is contingent on a number of factors and it would vary from

one grower to another depending on the farm and farmer characteristics along with the institutional context in which they operate. *Prima facie*, the reserve price of a grower with other sources of income is likely to be higher as compared to those holders for whom the natural rubber is the only source of livelihood. Further the institutional support, for example, from the Rubber Board or Rubber producers' Societies, might also influence the reserve price of a grower. Here again it is possible that farmers exercise their choice by resorting to full tapping, partial tapping or no tapping.

To the extent that only a select set of farmers do not resort to tapping the question of analytical significance is; what is the probability that a farmer adopts any of the options outlined above. In the literature, there has been a growing emphasis on the role of institutions in influencing the behavior of agents that shape economic outcomes (North 1991). The manifestations of institutional interventions could be in the form of price and non-price factors. The price factors include output prices (decline in the price of natural rubber), input prices (wages for instance) and increasing cost of cultivation (on account of rising wage cost due to labour shortage and increased priced of farm inputs). Prices are considered to act as one of the major determinants of the investment decision of the growers (Varkey and Kumar 2013). During the period of price fall, farmers having trees of tappable age could be expected not to tap them on account of prices not being able to cover their cost of production or being below their reserve price. Further, prices give an indication of the growers' ability to earn remunerative income that would induce them to continue with the cultivation of these crops. While the price of sheet rubber is on the decline for the past few years on the one hand, the sector has also witnessed an increased cost of cultivation on the other hand. A study by Joseph and Ajithkumar (2016) have observed that during the period of price fall, the income earned by tapping the trees was not remunerative for the growers on account of higher cost of cultivation. The available evidence also suggests that during the 10 years following 1998-99, average wage rate of tapping labour in Kerala recorded an annual increase of over 17 per cent. As such the cost of employing labour in the plantations has increased over the years (Viswanathan 2013).

Thus while price factors could play an important role in determining the farmers' tapping behavior<sup>6</sup>, there is the need to explore the non-price factors as well.

The non-price factors consist of farm and farmer characteristics. The holding structure in rubber plantations is dominated by small holders who account for about 93 percent of the total area under rubber cultivation in Kerala. It needs to be noted that the small holders are not a homogenous group and may differ by their farm and farmer characteristics, which could in turn induce/enable the farmers to desist from tapping. Farm characteristics such as holding size (operational and ownership holding), age of the trees and yield of the holding as well as location of the holding could be expected to have an influence on the decision of the grower to tap the trees. Relation between holding size and tapping could be construed as an empirical question as it depends on other factors like dependence on tappers, dependence on rubber for livelihood etc. If the holding is located far off without access to transport, could act as a deterrent to tapping.

Farmer characteristics include access to other means of livelihood, extent of dependence on hired labour and membership in Rubber Producers' Societies (RPSs). In the context of decline in the price of natural rubber, the decision to desist from tapping rubber trees by the farmers could be dependent on other means of livelihood. For instance, if rubber tapping is not the primary or the only source of income for the household, it is possible that the household may not resort to tapping during the years of low price. The farmer does not forego income completely as he/she can tap in the later years when the prices become favorable. On the other hand, those farmers who do not depend hired labor and rubber is the sole source of livelihood will be having a lower reserve might undertake tapping irrespective of the prevailing market price. Further, in the light of increased labour shortage in natural rubber, farmer characteristics such as dependency on hired labour could be an important factor in inducing farmers to refrain from tapping the trees. It is also possible that to retain the labour, the growers may be induced to tap the trees.

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<sup>6</sup> During the course of discussion in the workshop, it was pointed out by the Rubber Board officials that given the low price of natural rubber and increased cost of cultivation, growers follow an inconsistent tapping method. However, while deliberating on the possibility of price subsidy to incentivize the farmers to tap the trees, it was noted that the price may not be the sole reason for below potential production since non-traditional area in rubber is expanding particularly in states such as Tripura.

In the context of unprecedented price crash in the natural rubber sector, to ensure remunerative prices to the growers, Government of Kerala had launched the Rubber Production Incentive Scheme in 2015. This scheme constitutes a price stabilization fund of Rs 300 crore. As per this scheme, the subsidy amount provided to the grower would be the difference between the market support price of Rs 150 and daily reference price of RSS 4 rubber published by the Rubber Board. This subsidy is directed to the growers through the RPSs. The effect of this government policy could be expected to have a positive effect on inducing the growers who are members of RPSs to tap the trees. NRPPD (2015) study has noted that only a small proportion of farmers are actively involved in RPSs. But the introduction of RPIS would have induced the farmers to join the RPS with view to avail the incentive offered by the Government.

### **3. Production and Tapping practices: A descriptive analysis**

The central issue addressed by this study- the observed less than potential production of natural rubber in Kerala - could be empirically explored by analyzing the number of days tapped by the rubber growers having rubber trees of tappable age (above 6years)during the reporting period. Analysis based on the number of tapping days however, could be influenced by the tapping practice adopted by the growers. This is especially because, based on scientific evidence that low frequency tapping enhances productivity, the Rubber Board has been advocating the growers to adopt low frequency tapping. In such a context, definite conclusion cannot be drawn based purely on number of tapping days. Since it has been observed that only 4 out of 441of the sample adopt 7d (tapping once in a week) the plausible impact of low frequency tapping could be minimal. Also the numbernon-rainy days per year varies across regions.Another approach to analyse the problem could be by examining the recorded productivity (output per hectare) by the growers during the reporting period. In what follows we shall analyse both the tapping days reported as well as the observed productivity across the three study regions.

## Production Pattern

Though the total number of sample growers is 441 all of them put together are found to having 921 plots. Since we have collected information regarding production across different plots owned by the growers, the pattern of production is analyzed plot-wise. Out of the 921 plots 22.5 per cent where in Trivandrum, 49.3 per cent in Kottayam and 28.1 per cent in Thaliparampu. With a view to analyse trend in production, we have divided the plots into three categories. –Poor performers, Medium performers and High performers. Poor performers are those plots wherein the observed productivity is less than 25 percent of the maximum recorded. Medium performers are those whose productivity in between 25 to 50 percent of maximum recorded and high performers are those with productivity higher than 50 per cent of the maximum recorded (see Table 1).

Table 1: Distribution of sample households across yield categories

	Trivandrum	Kottayam	Thaliparampu	Total
Poor yield	78	311	74	463
	37.5	68.5	28.57	50.27
Medium yield	108	90	164	362
	51.92	19.82	63.32	39.31
High yield	22	53	21	96
	10.58	11.67	8.11	10.42
Total	208	454	259	921
	100	100	100	100

Source: field survey (2018)

From table 1, it is evident that for the state as a whole a little over 50% of the plots came under the poor yield category and only 10% being in the high yield category. There is however, significant inter-regional variation. With 68.5 per cent, Kottayam recorded highest incidence of poor performers followed by Trivandrum (37.5 per cent) and Thaliparampu(28.6 per cent). It is interesting to note that Kottayam also recorded the highest incidence of high performers followed by Trivandrum and Thaliparampu. When it comes to medium performers Kottayam recorded the lowest and Thaliparampu being the highest. In general it is evident that almost 50 per cent of the plots came under the category of poor performers, which explains the marked gap between the actual production and potential production of the natural rubber in Kerala. Further, it is also

evident that the production behavior of farmers in Kottayam, the heartland of rubber production is presumably most instrumental in the observed performance of natural rubber.

The key question is how to account for the observed behavior of the farmers? Analytically, both price and non-price factors could be at work. However, in the current context we are not considering the price factor because the government of Kerala has introduced the rubber production incentive scheme wherein a minimum price of Rs 150/Kg is assured for all the growers. Hence, the focus of our analysis will be on non-price factors – the farmer-specific and farm specific factors along with the institutional arrangements that incentivize the farmers to harvest the rubber trees by dealing with the tapping behavior.

### **Tapping Pattern**

The observed production behavior to begin with needs to be seen with respect to the tapping behavior of the grower. From Table 2 it is evident that 17.3% of the sample growers have not tapped during the last one year despite having trees under tappable age. There is however, inter-regional variation; the extent of non-tapping is found to be highest in Kottayam 20.7% followed by Trivandrum (15.6%) and 12.6% in Thaliparamabu.

	Trivandrum	Kottayam	Thaliparambu	Total
	173	355	221	749
Tapped	84.39	79.24	87.35	82.67
Not tapped	32	93	32	157
	15.61	20.76	12.65	17.33
	205	448	253	906
Total	100	100	100	100

Source: field survey (2018)

Our inquiry into the reasons for non-tapping revealed that, un remunerative prices, labour related issues and expectations of better price in future are the prominent reasons for not tapping the trees within the tapping age (Table 3). It is also to be noted that there is no much difference across region with respect to the reasons for not tapping.

	Trivandrum	Kottayam	Thaliparambu	Total
Low Price	35.29	33.33	27.25	25.76
Labor shortage	17.65	30.3	24.75	24.24
Postpone production till price is remunerative	47.06	36.36	48	50
Total	100	99.99	100	100

Source: field survey (2018)

**Frequency of tapping:** A related factor is the observed frequency of tapping. As already noted, based on scientific evidence that low frequency tapping enhances productivity, the Rubber Board has been advocating the growers to adopt low frequency tapping. However, from table 4 it is evident that the most preferred tapping practice is D2 (64.4 percent) and D3 (20.2) percent with D1 accounting for 13.7 percent. The table further shows sharp interregional difference with Trivandrum recording 53 percent D1 and D2 showing 81 percent in Thaliparambu and 64 percent in Kottayam. In general D2 is the most popular followed by D1 and D3.

	Trivandrum	Kottayam	Thaliparambu	Total
D1	52.29	0.35	0.63	13.69
D2	47.71	64.24	81.01	64.44
D3	0	32.99	16.46	20.2
D4	0	0.69	0.63	0.5
D5	0	0.35	1.27	0.5
D7	0	1.39	0	0.67
Total	100	100	100	100

Source: field survey (2018)

### Number of days tapped

Given the tapping practices followed, our enquiry further revealed that during 2017 and 2018, the total number of tapping days was only 69. However, the number of tapping days tends to vary across the regions because of the difference in the number of rainy days as well as the adoption of rain guarding. From table 5 it is evident that Trivandrum recorded the highest number of mean tapping days (89) followed by 72 in Thaliparambu

and only 58 in Kottayam. We have noted that rain guarding could help farmers to increase the number tapping days. Our analysis of the adoption of rainguarding revealed that only 33 percent of the farmers have adopted rain guarding.

Code	Mean	Std.dev	Freq
Trivandrum	89.32	44.40	208
Kottayam	58.40	36.94	454
Thaliparambu	71.63	30.81	259
Total	69.11	39.14	921

Source: field survey (2018)

However, it is surprising Kottayam though 47 percent of the sample growers have adopted rain guarding their productivity and incidence of tapping is found to be lower. Having said this we would like to report from the Focus Group Discussion with farmers in Trivandrum, it was discerned that any initiative to facilitate rain guarding is likely to increase production. Farmers have also placed their appreciative for the recent initiative by the rubber board to provide free rain guarding with the help of MRF.

### **Primary Occupation and Tapping**

It may be of relevance to examine the association between primary occupation of the head of the household and average number of days tapped. Based on the primary and secondary occupation of the head of the household, we have divided the households into three categories. A) those households wherein primary and secondary occupation of the head of household is rubber, b) primary occupation is non-rubber whereas secondary occupation is rubber and c) head of the household's primary and occupation is non-rubber. It is evident from Table 6 that average number of days tapped is highest for those households where primary and secondary occupation is rubber. The observed lower productivity and the lower number of tapping days needs to be seen in the context of the presence of a large proportion. This has to be seen in the context wherein about 39 percent of the sample households we have studied are not where the primary occupation of the head of the household is not rubber.

	Trivandrum	Kottayam	Thaliparambu	Total
Primary and Secondary Rubber	93.54	61.90	70.56	68.54
Primary not rubber secondary rubber	80.26	48.33	66.09	61.73
both non-rubber	92.20	54.14	79.44	78.76
Total	89.32	58.41	71.64	69.11

This needs to be seen in the context of more diversified income earning opportunities available in Kerala given its higher level of economic development. This finding underlines the need for Kerala to break away from its traditional system of a primary production wherein makers of the value are rarely the takers of value (Mazzucato 2018). To facilitate such a transition, it is imperative that the policy makers think beyond the present narrow innovation system focusing mainly on production and productivity to a broader approach wherein the region is able appropriate the value that it generates.

### **Indebtedness and Tapping**

Along with the household occupational status of the growers, one of the important factors that could influence the tapping behavior is indebtedness of the grower. Table 7 shows the mean days tapped for the households who are indebted as compared to others who are not indebted. It is evident that the mean days tapped is marginally higher for those who accessed credit in the previous year. However, the different in mean days tapped between the households who accessed credit as compared to who have not is more pronounced in case of Trivandrum (87 and 94 respectively) and Kottayam (55 and 61 respectively).

	Trivandrum	Kottayam	Thaliparambu	Total
Not indebted	155	225	78	458
%	74.52	49.56	30.12	49.73
Indebted	53	229	181	463
%	25.48	50.44	69.88	50.27
Total	208	454	259	921
	100	100	100	100
Mean Tapping days				
Not indebted	87.44	55.54	69.11	68.65
Indebted	94.81	61.23	72.73	69.57
Total	89.32	58.41	71.64	69.11

Source: field survey (2018)

### **Tapping and productivity**

It goes without saying that the tapping and productivity are positively correlated with estimated correlation coefficient being 0.45. To explore this relationship further, we have divided the sample growers into two categories, a) reporting tapping days less than the sample average and b) those reporting tapping days more than sample average. Table 8 reports tapping behavior across different productivity performance discussed above across different regions. For the whole sample, it is evident that those growers recording lower than average tapping days are found to be poor performers. In general those recording less than average number of tapping days present a poor productivity performance as compared those reporting higher than average. There is however an interesting inter-regional variation wherein Kottayam presents a distinctly different picture as compared to other two districts. It is observed that despite being in the less than average tapping performance about 40 percent of them are able to be high performers. This probably explains the lower estimated value of the estimated correlation coefficient.

Table 8: Proportion of growers with different practices and yield categories				
	Low Yield	Medium Yield	High Yield	Total
Total				
Tapping days below average	61.22	27.44	21.33	42.8
Tapping days above average	38.78	72.56	78.67	57.2
Total	100	100	100	100
Trivandrum				
Tapping days below average	30.51	12.12	0	17.05
Tapping days above average	69.49	87.88	100	82.95
Total	100	100	100	100
Kottayam				
Tapping days below average	69.01	35.8	39.47	58.45
Tapping days above average	30.99	64.2	60.53	41.55
Total	100	100	100	100
Thaliparambu				
Tapping days below average	60	33.11	5.26	37.89
Tapping days above average	40	66.89	94.74	62.11
Total	100	100	100	100

Source: field survey (2018)

Exploring further we analyzed the recorded average productivity of three categories of labour deployment in tapping; a) only family labour b) only hired labour and c) both hired and family labour. To begin with it may be noted that while 37% reported only family labor 49% reported only hired labour where as those using both are found to be only 13% (see Table 9).

Table 9: Labour practices and tapping practices (in %)			
	Tapping days below average	Tapping days above average	Total
Only Self	39.81	60.19	100
	36.84	37.57	37.28
Only hired	40.36	59.64	100
	49.56	49.41	49.47
Both	41.33	58.67	100
	13.6	13.02	13.25
Total	40.28	59.72	100
	100	100	100
Trivandrum			
Only Self	15.38	84.62	100
	17.39	18.49	18.31
Only hired	16.82	83.18	100
	78.26	74.79	75.35
Both	11.11	88.89	100
	4.35	6.72	6.34
Total	16.2	83.8	100
	100	100	100
Kottayam			
Only Self	47.73	52.27	100
	30.43	46	36.97
Only hired	65.87	34.13	100
	60.14	43	52.94
Both	54.17	45.83	100
	9.42	11	10.08
Total	57.98	42.02	100
	100	100	100
Thaliparambu			
Only Self	39.18	60.82	100
	56.72	49.58	52.15
Only hired	25.53	74.47	100
	17.91	29.41	25.27
Both	40.48	59.52	100
	25.37	21.01	22.58
Total	36.02	63.98	100
	100	100	100

Source: field survey (2018)

The use of hired labour is found to be the highest in Trivandrum (75%) followed by Thaliparambu (52) and Kottayam (25). It is observed that the average productivity is found to be the lowest (1155Kg) for those using only hired labour while those using only family labour and both family labour and hired labour reported much productivity 1320Kgs and 1343Kgs respectively (see Table 10).

Table 10: Average Productivity Across different Tapping and Labour Practices (in kg)				
	Only self	Only hired	Both	Total
Tapping days below average	1097.8	744.2	1097.1	922.5
Tapping days above average	1467.7	1433.5	1516.5	1457.1
Total	1320.5	1155.3	1343.1	1241.8
Trivandrum				
Tapping days below average	1161.6	876.4	1094.2	935.5
Tapping days above average	1224.9	1582.7	1348.2	1500.8
Total	1215.1	1463.9	1319.9	1409.2
Kottayam				
Tapping days below average	977.1	687.7	762.4	782.8
Tapping days above average	1402.5	1135.8	814.9	1223.2
Total	1199.5	840.7	786.4	967.9
Thaliparambu				
Tapping days below average	1224.5	936.7	1353.2	1205.6
Tapping days above average	1609.1	1419.8	1879.	1610.1
Total	1458.4	1296.5	1666.2	1464.4

Source: field survey (2018)

Further, it is also evident that the average productivity is higher irrespective of whether the grower belongs to more than average or less than average tapping intensity. Coming to interregional variation, it is interesting to note that in Trivandrum, where the usage of hired labour is the highest, recorded highest average productivity as compared to those

use using own labour and both categories of labour. But, it is also evident that in Trivandrum when it comes to the farmers with tapping days less than the average, the recorded productivity is the lowest for who are using only hired labour. The table also highlights two contrasting pictures with respect to Kottayam and Thaliparambu. While those with own labour recorded highest productivity in Kottayam, the productivity was highest for those used both hired and own labour in Trivandrum and Thaliparambu. To the extent that dependence on hired labour adversely affects productivity, any efforts towards improving the quality hired labour as well as their availability is likely to provide rich dividends.

### **Institutional Interventions, Tapping and productivity**

There are institutional interventions at the instance of the central/state government and implemented through the rubber board that are expected to have its bearing on tapping and productivity. The intervention by the rubber board towards skill up gradation through training, market interventions and research and extension activities could have their bearing on productivity and tapping. However, for the present study we shall focus only on rubber board's initiative towards establishing rubber producer societies (RPS) and the production incentive scheme initiated by the state government and implemented through the rubber board.

### **RPS Membership, Tapping behaviour and Productivity**

Considering the rubber board's organizational innovation by way of facilitating the establishment of rubber producer societies and high hopes on their potential for invigorating the rubber sector, it is only natural to expect that the membership in RPS would have its impact on tapping and productivity. However, the aggregate picture that we get is not very encouraging. For the sample as a whole the productivity of members is not higher but lower than the non-members. Having said this, it needs to be highlighted that those members having higher than average tapping days have recorded the highest productivity higher than all other categories. What is striking is the inter-regional difference. Surprisingly enough RPS members in Kottayam is found to have much lower

productivity as compared to non-members. However, when it comes to Trivandrum and Thaliparambuwe get a highly encouraging picture wherein members' productivity is much higher than the non-members.

To obtain further insight into the influence of RPS, we probed the issue further. From Table 11 it is evident that productivity vary significantly across ordinary members, active members and office bearers. The productivity of an active member (1399 kg) is found to be significantly higher than an ordinary member (1117 kg) and the office bearer (1160 kg). Inter-regional variation in the observed role of RPS engagement is equally interesting. In Trivandrum, about 98 percent of the sample growers are ordinary members. When it comes Kottayam in contrast to the general trend, officer bearers record significantly higher productivity (1165) as compared to the ordinary members (849) and office bearers (712) (Table 12).

Table 11: Average productivity and RPS membership (in kg)			
	Tapping days below average	Tapping days above average	Total
RPS Member	831.9	1390.2	1143.0
Non-Member	982.8	1355.9	1238.5
Total	845.0	1385.3	1154.3
Trivandrum			
RPS Member	1006.2	1491.5	1409.9
Non-Member	523.3	1365.1	1210.5
Total	861.3	1456.4	1353.8
Kottayam			
RPS Member	680.6	1152.0	879.6
Non-Member	1422.6	1928.6	1591.3
Total	687.8	1157.2	885.6
Thaliparambu			
RPS Member	1226.4	1603.5	1463.6
Non-Member	1174.2	1309.0	1247.1
Total	460.4	506.4	483.9
Total	1216.1	1560.5	1427.7

Source: field survey (2018)

Finally in case of Thaliparambu, in sync with the general trend, the productivity recorded by the active members is found to be higher than that of their counter parts-ordinary members and office bearers. In general it appears that any efforts towards further activating RPS to attract growers to RPS as well as induce them to be more active would significantly contribute towards increase in productivity.

Table 12: Average Productivity Differences Extent of RPS membership (in ha)				
	Only member	Active member	Office bearer	Total
Tapping days below average	797.6	1123.5	1110.4	835.3
Tapping days above average	1389.3	1490.1	1203.6	1390.0
Total	1117.5	1398.5	1160.3	1145.4
Trivandrum				
Tapping days below average	1103.1	.	.	1103.1
Tapping days above average	1471.9	2837.5	323.6	1489.0
Total	1413.0	2837.5	323.6	1429.9
Kottayam				
Tapping days below average	613.4	930.5	1099.4	671.1
Tapping days above average	1194.0	553.3	1240.1	1152.0
Total	849.2	712.1	1165.8	874.1
Thaliparambu				
Tapping days below average	1216.1	1344.1	1320.0	1230.0
Tapping days above average	1570.1	1692.1	1488.9	1598.9
Total	1418.1	1628.0	1455.1	1460.6

Source: field survey (2018)

### **RPIS and Tapping Behavior**

RPIS was initiated in a context wherein the price of NR was around Rs 90 inter-alia because of unbridled imports of NR apparently with a view to help building a vibrant rubber industry in the country.

Table 13: RPIS subsidy and tapping patterns				
	Trivandrum	Kottayam	Thaliparambu	Total
Yes	185	425	218	828
	96.86	99.3	98.2	98.45
No	6	3	4	13
	3.14	0.7	1.8	1.55
Total	191	428	222	841
	100	100	100	100
Tapped without RPIS				
	Trivandrum	Kottayam	Thaliparambu	Total
Yes	158	333	187	678
	75.96	73.35	72.2	73.62
NO	50	121	72	243
	24.04	26.65	27.8	26.38
Total	208	454	259	921
	100	100	100	100
Reasons for tapping without RPIS				
	Trivandrum	Kottayam	Thaliparambu	Total
Price not remunerative	140	113	71	324
	83.33	38.05	48.3	52.94
Not timely	15	5	4	24
	8.93	1.68	2.72	3.92
Others	13	179	72	264
	7.74	60.27	48.98	43.14
Total	168	297	147	612
	100	100	100	100

Source: field survey (2018)

From **Table 13** it is evident that over 98 percent of the sample growers availed RPIS subsidy which was implemented through the RPS. This seems to have had two effects. While the farmers in general received an assured price of Rs 150 per kg, RPS in the state got a lease of life. Thanks to the introduction of RPIS, many of the dormant RPSs got invigorated and large number of hitherto non-members became the members of RPS. As we have already seen many of the current members have joined RPS only with a view to avail the RPIS subsidy and seems to have not got actively engaged with RPS, which would have been mutually beneficial.

However, though all most all the sample growers who availed RPIS subsidy, 73.6 percent of the growers reported that they would have tapped the rubber trees even without the RPIS (Table 13). In response to our question on the reason for continuing without RPIS, 52 percent have reported that the price obtained through RPIS is not sufficient. Whereas 43 percent responded that they would have continued because they have no other source of income to survive. During the last three years, the government of Kerala has spent about Rs 1000 crores in RPIS. In the light of the feedback received from the field it may be highly relevant explore the social marginal product a rupee spent on RPIS vis a vis initiating targeted measures to facilitate building up of a broader innovation system which in turn enable the makers of the value to be the takers of value as well inter alia by reaping the linkages.

#### **4. Determinants of Tapping: Econometric Analysis**

The analysis using descriptive statistics undertaken in the previous section has thrown up some interesting insights on the issue at hand. In this section, we shall undertake an econometric analysis to get further insights. In the model, that we estimate, the dependent variable is productivity (measured in terms of log of yield). The independent variables, drawing from the analytical framework and descriptive analytics presented in the previous section, include a number of farmer-specific, farm-specific and institutional factors. The farmer specific factors include age, gender, education, prime occupation, access to remittance and income of the sample households. When it comes to farm specific characteristics, we consider size of holdings, proportion of the rubber area, number of plots owned, age of the trees, and the outstanding debt. The institutional factors take into account the influence of engagement with RPS, role of RPIS and labour market conditions. The estimated model may be stated as follows:

$$Y_i = \alpha + \beta X_i + \mu_i$$

Where,  $Y_i$  is log of yield and  $X_i$  represents a vector of farm, farmer and other institutional variables.

Table 14 presents the results of the estimated model.

To begin with, it is observed that while age and gender of the household has no significant bearing on days tapped and productivity, education of the head of the household has a negative impact in both models. This tends to suggest that growers with higher levels of education, plausibly with access to other sources of income, tend to postpone tapping, as their reserve price is higher than the going market price. Here it may be noted that the major reason reported for not tapping the rubber is the expectation of higher price in future. Further, it is evident that growers with higher levels of income have a negative impact, whereas household head with agriculture as the prime occupation tends to positively influence tapping and productivity. The reserve price of those with agriculture as the prime source of income might be lower and they find the price assured at present with RPIS is remunerative. It is important to note that NRI presence and access to remittance income tends to have a negative effect on both tapping and productivity calling for an appropriate institutional arrangement to facilitate tapping of holdings owned by such individuals. Finally, the estimated coefficient also suggests that the impact of access to other source of income is negative. On the whole, based on the farmer specific characteristics it may be inferred that the farmers access to other source of income which is an inevitable consequence of the development process of the regional economy, farmers tend to have a reservation price which is higher than what is being currently offered by the market. Here the direct intervention by the board or RPS to get these holdings may be explored. Alternatively, there is room for exploring ways and means by which the growers are enabled to capture a larger proportion of the value that they create such that they are induced to tap the rubber and engagement with rubber cultivation further contributes towards development rather than deprivation. This in turn calls for a much broader approach to rubber based development by reaping linkages that are not being reaped today *inter alia* on account of the narrow institutional perspective towards rubber based development (Joseph et al 2018).

When it comes to farm specific characteristics it is observed that while the proportion of area under rubber and the age of the trees have a positive effect, the farmers having more number of plots tends to record lower number of tapping days and productivity. Further, it is also evident that the farmers with higher level of indebtedness also tend to have

higher productivity presumably because of their cash flow requirement to repay the outstanding loans.

Table 14: Determinants of Yield: OLS Estimates

VARIABLES	(2) Dependent Variable: lnyield
Age of head of HH	9.90e-05 (0.00188)
Gender of head of HH (Male=0; Female=1)	0.0778 (0.0809)
Education (number of years of schooling)	-0.0348* (0.0190)
Primary Occupation (Non- agriculture=0; Agriculture=1)	0.113** (0.0460)
Income of head of HH	0.0698 (0.0484)
Average age of the family members	-0.00143 (0.00183)
NRIpresence	-0.138* (0.0778)
Other income (No=0; Yes, 1)	-0.00189** (0.000735)
Area under rubber (log acres)	0.901*** (0.103)
_Multiples plots owned (Yes=0, No=1)	-0.0659* (0.0317)
Age of the tree dummy (0=7-14 years; 1=14 to 25 and 3= 25 years plus Base: young) Medium	0.0729* (0.0423)
High	0.122** (0.0482)
Labour dummy; 0=family labour; 1=Hired, 2=both; Base=Family) Hired	-0.1433** (0.0455)
Both Own and hired	-0.0514 (0.0590)
RPIS Beneficiary (No=1 and Yes=1)	0.0720

	(0.0634)
RPS engagement activie ( <i>Ordinary Member -01; active member - 1; office bearer -2; base ordinary member</i> )	0.0778*
	(0.0574)
RPS engagement Office bearer	0.0216
	(0.0732)
Plot distance (in km)	0.117***
	(0.0382)
Credit accessed (No=0; Yes=1)	-0.128***
	(0.0387)
Constant	4.103***
	(0.217)
Observations	415
R-squared	0.105

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Finally, when it comes to institutional context, it is evident that higher dependence on hired labour tends to adversely affect productivity and tapping days indicating the bearing of labour shortage and poor quality of tapping labour. Hence, any interventions like the labour bank that the Rubber Board has initiated will provide rich returns. In sync with what we have seen in the previous section, productivity and tapping days tends to be higher with respect to those growers who are actively engaged in RPS as compared to those who are mere members. This finding highlights the relevance of strengthening the RPS as an organization towards addressing the issue of less than potential production. With respect to RPIS the estimated coefficient highlights its positive role in inducing farmers to harvest and achieve higher productivity. Having said this, it may be recalled from our discussion in the previous section that over 70 percent of the farmers reported that they would have harvested the trees even without RPIS. Hence, it might be of relevance to weigh the social marginal returns for the money spend on RPIS *vis-a-vis* other measures to enable the “makers of value to take a larger proportion of the value that they make” through a broader approach to rubber based development.

## **5. Concluding observations and implication of policy**

The study explored an issue of immense relevance of policy; how to account for the below potential production of natural rubber in Kerala in a context of growing imports and declining prices? It has been articulated that the issue at hand could be an outcome of the unique characteristic of the crop which in turn leave room for postponing the harvesting and reserve price set by the farmers which is contingent on the farm, farmer and institutional factors context in which they operate. In exploring the issue, we have undertaken a primary survey in association with the Rubber Board and the study made use of both descriptive statistics and econometric tools to draw inferences. It is observed that 17% of the rubber holdings in Kerala are not found tapping and there was a high positive correlation between taping and recorded productivity. The main reasons as put forward by the farmers for not tapping include, lower price, labour related factors and expectation of higher price in the future, which gave credence to the argument that very often than not farmers have reserve price below which they may not harvest. Such a behavior is especially probable in rubber because unlike in all other crops, the crop not harvested is not lost forever. There is evidence to show that rain guarding helps farmers to tap larger number of days. It also observed that the productivity and tapping days of those growers depending only on hired labour is found be lower compared to their counterparts who depend only on family labour or both hired labour and family labour. The analysis using descriptive statistics also point towards the positive role of RPS and RPIS in inducing farmers to tap the rubber trees and achieving higher productivity. The inference that we could draw from the descriptive statistics appears to be that, notwithstanding the higher reserve price for many growers which induce them to refrain from tapping, there is scope for increasing productivity through facilitating rain guarding, by addressing labour market related issues and facilitating more active involvement of rubber growers in the RPSs.

The econometric analysis reinforced the findings that we have arrived at using descriptive statistics. The estimated econometric model revealed that there are a number of farmer-specific factors that stand in the way of increasing the number of tapping days and productivity. On account of their access to other sources of income, many of the farmers

tend to have higher reserve price, which induce them to keep away from tapping which in turn explains less than potential production in Kerala. Even the RPIS seems to have been not effective in inducing them to utilize their full capacity, as their reserve price is higher than Rs 150 assured under the RPIS. In such a context, the plausible strategy shall be to explore the possibility of getting these holdings tapped by the RPSs on mutually agreed terms. Further, it is also of relevance to enable those growers to appropriate a larger proportion of the value of the output in the rubber value chain. This will necessitate a major change in the current approach towards rubber based development by reaping the backward and forward linkage and evolving a broader innovation system instead on the one that focus mainly on increasing productivity and production. This could ensure higher returns from rubber cultivation such that involvement with rubber cultivation contributes to the farmers income and regional development at large and not deprivation. In the immediate short run there appears to be scope for increasing production *inter alia* by addressing labour related issues – *a la* the labour bank initiative of Rubber Board and propagating rain guarding, *a la* the recent MRF-Rubber Board initiative. In this process much could be gained by further strengthening the RPSs. To the extent that large majority of the farmers would have tapped even without RPIS, it is of relevance to explore the possibilities of making use of the current budget allocation by the state government for RPIS towards evolving a rubber based development with a broader perspective for enabling the makers of value to be the takers of value. This will *inter alia* involve more active state participation and facilitation in evolving vibrant rubber based industrial sector by bringing together different stakeholders.

Table A1: Summary profile of the field					
		Trivandrum	Kottayam	Thaliparambu	Total
	Sample size	102	200	121	443
	Ratio of rubber income	0.34	0.59	0.58	0.53
	other crops	0.02	0.12	0.16	0.11
	other family members	0.21	0.22	0.23	0.22
	land with patta	0.37	1.42	1.70	1.26
	area under NR	0.99	1.28	1.20	1.19
	Ratio of NR in total	0.92	0.81	0.69	0.80
	proportion of cut trees	24.61	32.53	32.24	30.54
Reasons for cutting the tress	Price fall	0	2.33	0	1.31
	Construction	2.44	0	0	0.44
	Conversion other drops	4.88	6.2	8.47	6.55
	to keep idle	4.88	0	5.08	2.18
	replanting	87.8	91.47	86.44	89.52
	Proportion plans to replant	11.24	16.5	35.14	20.27
	Proportion multiple plots	66.32	78.62	80	76.34
type of plot	new planted	17.59	4.62	44.1	18.83
	replanted	82.41	95.38	55.9	81.17
	mean age	14.2	14.6	17.2	15.3
	RPDS subsidy received	32.31	33.96	48.63	37.87
type of plot	undulating	59.26	41.58	91.6	60.75
	plain	17.46	42.12	2.94	24.53
	steep hill	23.28	16.3	5.46	14.72
Location of plot	within premises of the growers household	25.41	58.41	53.36	48.82
	Proportion tapped	84.39	79.24	87.35	82.67
	Mean days tapped	89.32	58.41	71.64	69.11
	Avg yield per ha	1253.94	818.87	1351.83	1068.63
	Used smoke facility	56.57	54.03	68.95	59.09
Ownership of smoke house	own	68.57	94.76	88.29	85.84
	hired	31.43	5.24	8.56	12.94
	through RPS	0	0	3.15	1.22
	Membership in RPS	71.36	99.34	83.67	88.67
	mean year RPS membership joined	2014	2003	2004	2005
Engagement in RPS	Only member	96.55	83.78	75.93	83.98
	Active member	2.07	5.41	21.3	9.07
	Office bearer	1.38	10.81	2.78	6.96

	Proportion of RPIS beneficiaries	88.94	93.61	84.17	89.9
	Continued without RPIS	75.96	73.35	72.2	73.62

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